Technical Memorandum

To:	Outcross Agri Services (Tony Dean)
From:	Adrian Leader
Date:	13 May 2024
Pg/Attach.:	13 plus attachments
Job ref:	1-201354_05_18a_NRLX_Soils

Northern Rivers Livestock Exchange (NRLX): Environmental Monitoring Report – Soil (March 2024)

AWC commenced routine environmental monitoring at the NRLX in March 2021 which includes extraction of groundwater samples from monitoring bores, collection of water samples from the storage/irrigation ponds, wet weather overflow and soil samples from the irrigation zone. This report documents soil monitoring. Table 1 provides details of the environmental protection license (EP License) and project.

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Table 1 Site and project details

NRLX	
Site Identification	Lot 1 DP 1240949 Dargaville Drive, Casino NSW 2470
Current reporting period	March 2024
EP License	3878 (17 April 2023)
Attachments	Attachment 1 Historic surface soil sampling results Attachment 2 Historic depth profiling soil sampling results Attachment 3. Phosphorus sustainability calculation Attachment4. Site Plan and Sampling Locations Attachment5. Laboratory results sheets (EAL)

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Summary

The following is a summary of the results of the monitoring undertaken:

- Composite surface layer samples within both irrigation areas are within the preferred pH range of 6-7.5
- Exchangeable Sodium Percentage (ESP) measures are acceptable in the surface layers; however the depth samples show values indicative of sodic soils which may affect soil structure and infiltration capacity
- Effective Cation Exchange Capacity (ECEC) values are not expected to provide a 'severe' restriction to plant growth though have a moderate limitation to plant growth
- The majority of depth profiles shows a substantial decreases in TP concentration when compared to previous results
- TN concentrations within the composite surface soils samples increased in both irrigation zones when compared to previous results

Soil Monitoring Methods

Sampling was undertaken by AWC in accordance with the EP Licence (EPL 3878), and the *NRLX Effluent Monitoring and Assessment Plan* (AWC, 2017) and are in accordance with the EPA approved guidelines *Use of Effluent by Irrigation* (DEC 2004). Table 2 provides details of the effluent sampling. EAL performed all analysis.

Table 2 Soil monitoring details

Soil Monitoring sampling details – NRLX	
Sample date	27/03/2024
Sampled by	Will Dale (AWC)
Location	Refer site plan attached
Sample collection methods	A composite sample comprising 40 individual core samples taken from the surface (0-10cm) of each irrigation area is formed for analysis. AWC collected and formed the composite sample for analysis by EAL. Additionally, depth analysis comprising five composite samples, each formed from five point samples for four depth ranges in each of the two irrigation zones. Core samples are collected in the field using a hand auger or shovel/spade with the composite formation undertaken by EAL (NATA accredited laboratory). Samples are collected in zip lock plastic bags, numbered and coded and stored cool (ice) in an esky before delivery to EAL for analysis.
Sample analytes	Refer results tables below and laboratory results sheets attached
Sample frequency	Annual soil sampling (various frequency on analytes)

Soil Monitoring Results

There are two irrigation zones known as Eastern Zone (EZ) and Northern Zone (NZ). Current sampling results are provided alongside historic sampling results in Attachment 1 (surface) and Attachment 2 (depth profile). Laboratory results sheets are attached.

pH

A pH range of 6-7.5 maximizes the availability of nutrients for plant use (DEC 2004). There has been some fluctuation of values over time which may show natural spatial variation in the soil profiles or an influence of effluent irrigation and management. Figure 1 shows the pH results in the historical context, for both surface and depth profile analysis.

Composite surface layer samples from both the EZ and NZ irrigation area are within the preferred pH range of 6-7.5. Although depth analysis of soil depths (0-20cm and 20-40cm) within the EZ were within the preferred range, the 40-70 cm and 70-100 cm depth profiles (5.61 and 5.32) were below pH of 6. Results for pH for of all depth analysis in the NZ were out of the preferred pH range of 6-7.5. Depth analysis of soil depths (0-20 cm and 20-40 cm) recorded pH values of (7.9 and 8.28 pH) which are above pH of 7.5 while analysis of soil depths (40-70 cm and 70-100 cm) recorded pH values of (5.45 and 5.33) which are below pH of 6.

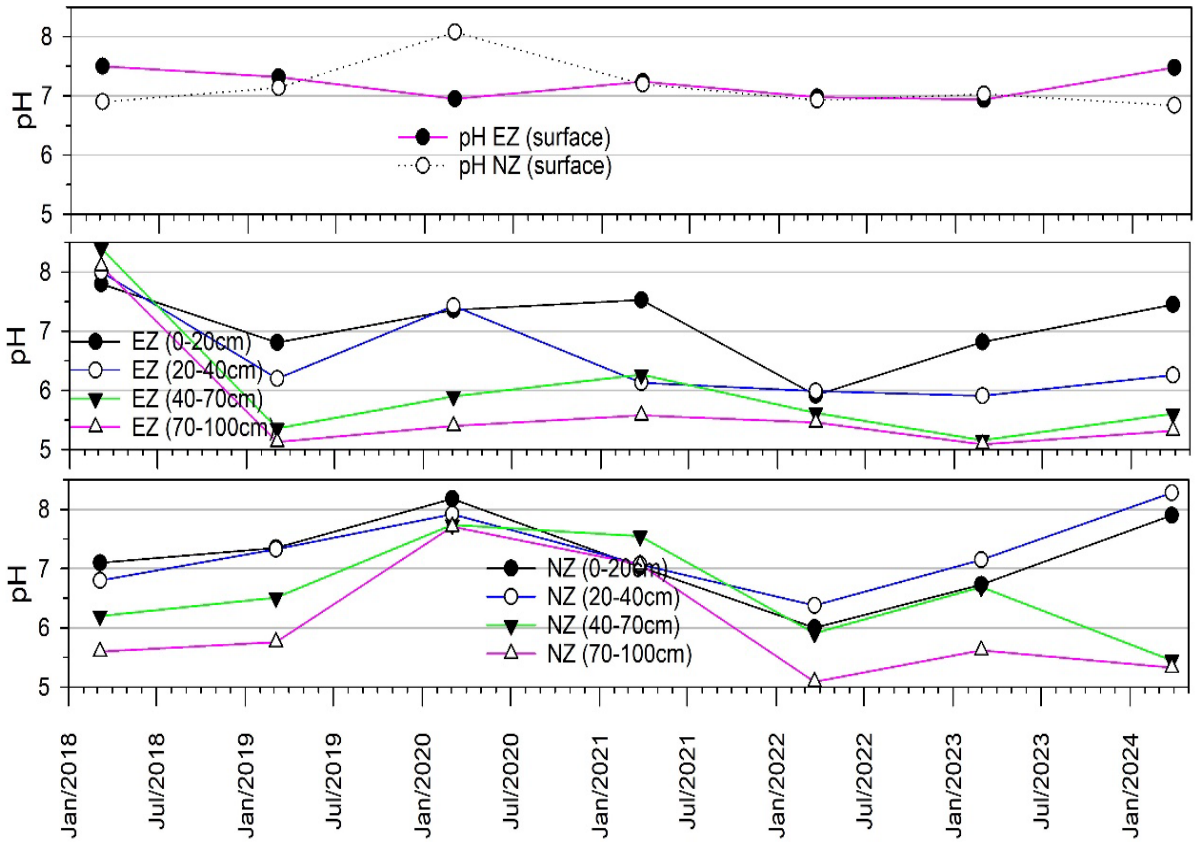


Figure 1 Historic pH results

Exchangeable Sodium Percentage (ESP)

ESP is a percentage expression that refers to the amount of exchangeable sodium cations in relation to other soil cations as a measure of soil sodicity. Dispersive soils or poor soil structure may be associated with sodicity with exchangeable sodium acting as a mechanism for weakening soil aggregate bonds, resulting in a poor soil structure. Decreased water infiltration and plant root movement result, as well as an increased erosion risk. Soils with an ESP of >5% are at risk of showing the adverse structural impacts associated with sodicity (DEC, 2004) or soil salinity issues. The soil samples were subjected to analysis of ESP. Figure 2 shows the historic results graphically.

Key findings of the results are:

- Surface soils in the EZ and NZ show similar ESP values with recorded values of 3.1% and 2.6% respectively
    - Values are within the preferred level of <5%
    - Both irrigation areas recorded a slight increase in ESP values compared to the previous reporting period (2.1% and 2.3% respectively)
    - These results show the surface soils are not affected by salinity or sodicity

- The depth analysis of the two irrigation zones shows the following:
    - EZ has a range of ESP values of 2.1-17.4%
    - NZ has a range of ESP values of 3.2-19.1%
    - Apart from surface (0-20 cm) value at EZ (2.1%) and surface values (0-20 cm and 20-40 cm) (3.2% and 4.0 %) at NZ, all other recorded values within both irrigation zones exceed the preferred maximum value of 5%, and the 1.5% preferred maximum value provided by EAL (refer results sheets)
    - Results for depth layers show ESP values in EZ vary but show an increasing trend since the previous monitoring period
    - NZ shows ESP values in the shallower layers between 0-40cm have decreased whereas ESP values in the deeper soil layers have increased since the last reporting period

The ESP of the top soils (0-40cm) with EZ may be improved by:

- Deep ripping
  Incorporation of organic matter to the topsoil (e.g. composted cow manure, or green manure crops)

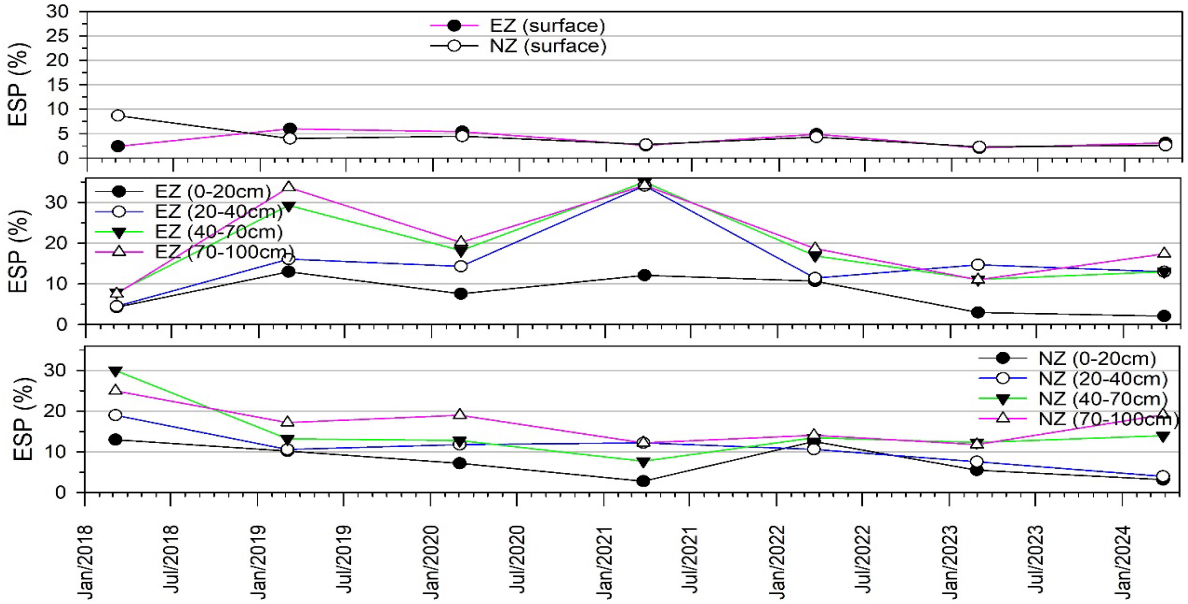


Figure 2 Historic Exchangeable Sodium Percentage (ESP) results

Cation Exchange Capacity

As a general guide, Effective Cation Exchange Capacity (ECEC) values >15 $cmol_+$/kg provide nil or slight limitation, 3-15 $cmol_+$/kg are a moderate limitation and <3 $cmol_+$/kg provides a severe limitation (DEC, 2004). Graphed historic ECEC results are shown in Figure 3.

Key findings of the results are:

- ECEC values from the surface soils of EZ and NZ (7.8 $cmol_+$/kg and 10 $cmol_+$/kg) provides a 'moderate limitation' to plant growth
    - The temporal trend at EZ surface soils shows that ECEC values have decreased over the last seven years of analysis, from a high of 14 $cmol_+$/kg in 2014 to 7.8 $cmol_+$/kg in the current period
    - Results at NZ surface soils continue to show temporal variation with values ranging from 9.2 $cmol_+$/kg (2023) to 15.3 $cmol_+$/kg (2020)
    - There has been a slight increase in the recorded ECEC value at NZ during the current reporting period (10 $cmol_+$/kg) compared to the previous (9.2 $cmol_+$/kg)
- The depth profiles show variability spatially and with depth within both irrigation areas
- NZ depth layer sampling recorded ECEC values that increased from the previous reporting period. Both 0-20 cm (16.13 $cmol_+$/kg) and 2-40 cm (18.9 $cmol_+$/kg) recoded values >15 $cmol_+$/kg which provid nil or slight limitation to plant growth
- EZ recorded ECEC values that decreased from the previous reporting period
- All current ECEC values are >3 $cmol_+$/kg value, hence no soils have a classification of 'severe' limitation to plant growth

The results show the topsoil, the growing medium for the irrigated crops, have ECEC values that do not result in a severe limitation to plant growth with the upper portion of NZ 0-40 recoding values >15 $cmol_+$/kg which provided nil or slight limitation to plant growth. Organic matter content can improve soils through increasing ECEC values which could be adjusted with the incorporation of a green

manure crop or addition of organic matter to the soil profile. This could be undertaken annually to improve the soil and mitigate against adverse impacts associated with effluent irrigation.

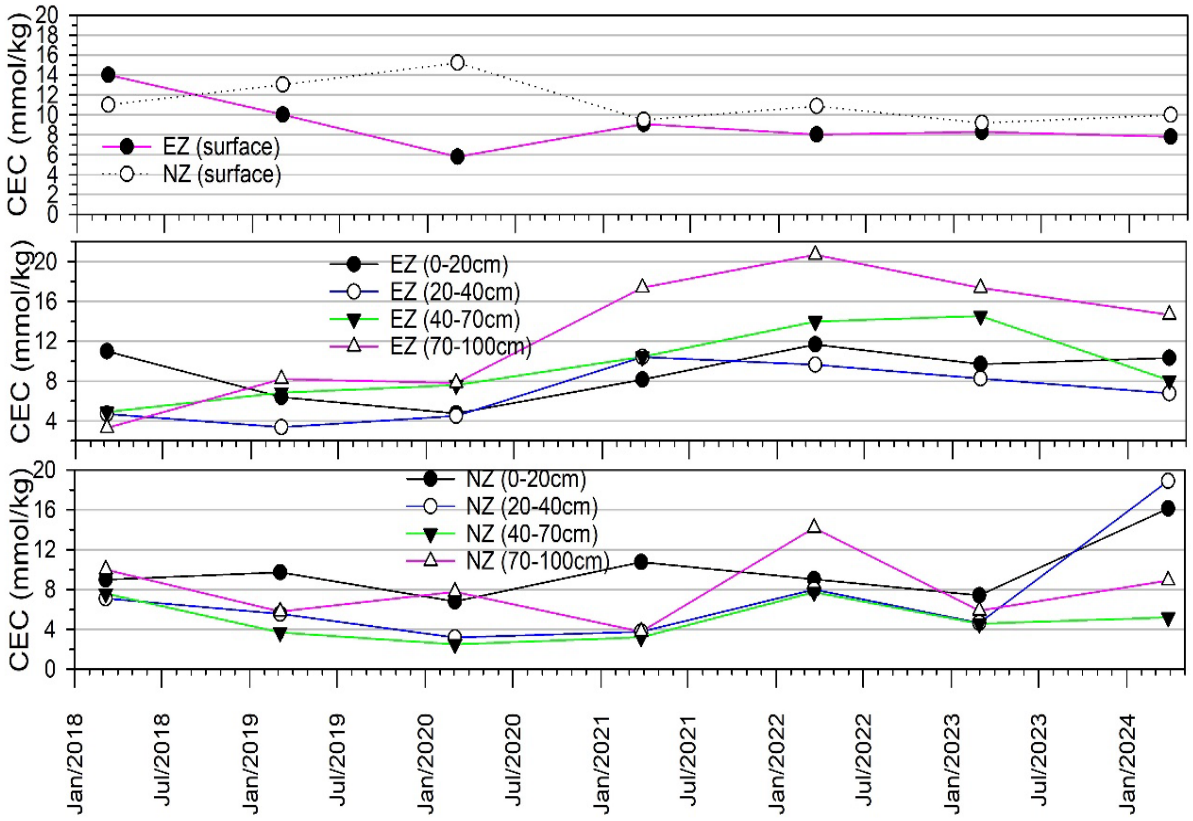


Figure 3 Historic Cation Exchange Capacity (CEC) results

Nutrients

The primary nutrients associated with eutrophication of water courses are Nitrogen and Phosphorus. Total Nitrogen is made up of several fractions including Nitrate which is highly mobile and is easily leached to the downstream aquatic environments. Dissolved or soluble Phosphorus is the portion of the Phosphorous compound that is readily available for uptake by plants and algae. The results for the current monitoring period show a variance in concentrations of Total Phosphorus (TP) and Total Nitrogen (TN) in the soil profiles within the two irrigation zones (refer Figure 4 and Figure 5). Results are provided in Attachment 1 (surface) and Attachment 2 (depth profile). A brief discussion is provided below:

Nitrate

- Results showed that Nitrate in the depth profiles at both EZ and NZ are similar to the previous reporting period with respective results ranging from 0.8-2.4 mg/kg and 0.8-2.7 mg/kg respectively.
- Composite surface samples within both irrigation areas recorded lower concentration of Nitrate compared to the previous reporting period.

Total Nitrogen

- TN concentrations within the composite surface soils samples increased in both irrigation zones
- Depth sampling shows both NZ and EZ remain relatively consistent with previous sampling (refer Figure 4)

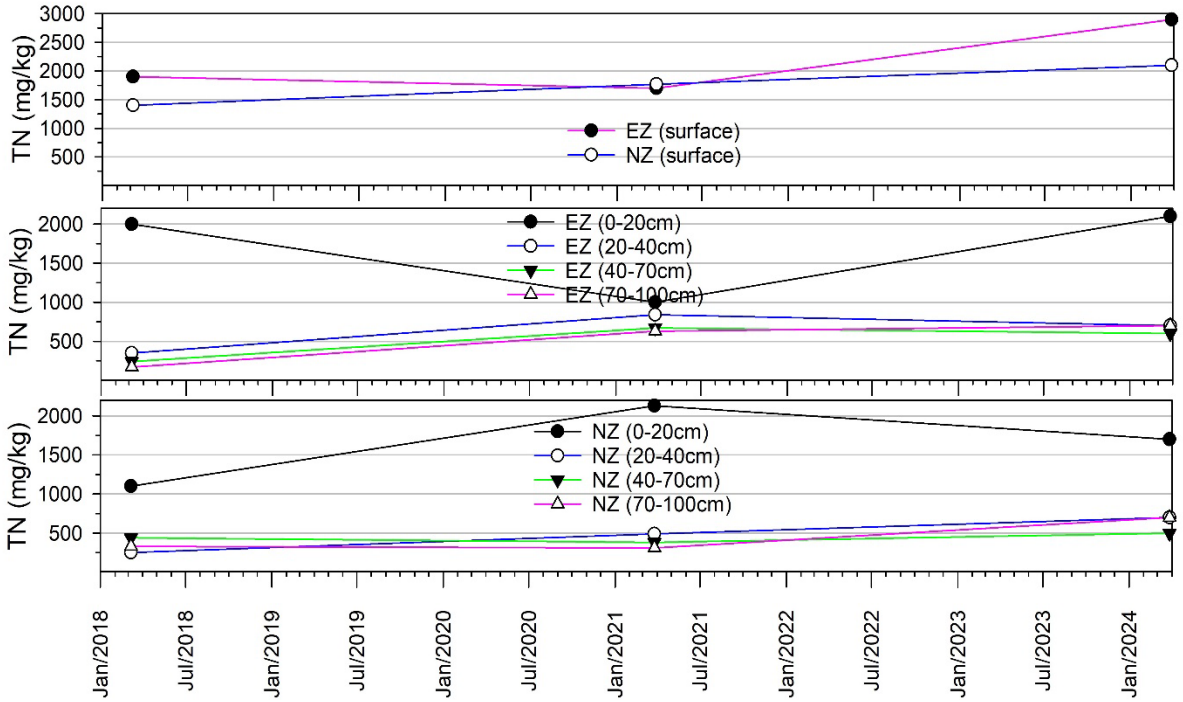


Figure 4 Historic TN results

Phosphorus

- Results showed that Reactive Phosphorus concentrations in the depth profiles at both EZ and NZ decreases at depths i.e. from surface to 100 cm with respective results ranging from 10-93 mg/kg and 29-122mg/kg
- Composite surface samples show lower concentrations of Reactive Phosphorus at EZ (71 mg/kg) compared to the previous reporting period while concentrations within the NZ (174 mg/kg) recorded higher concentrations when compared to the previous reporting period
- All samples except NZ surface composite and NZ (20-40) shows a substantial decreases in TP concentration
- NZ continues to record higher TP concentrations than EZ (refer Figure 5)

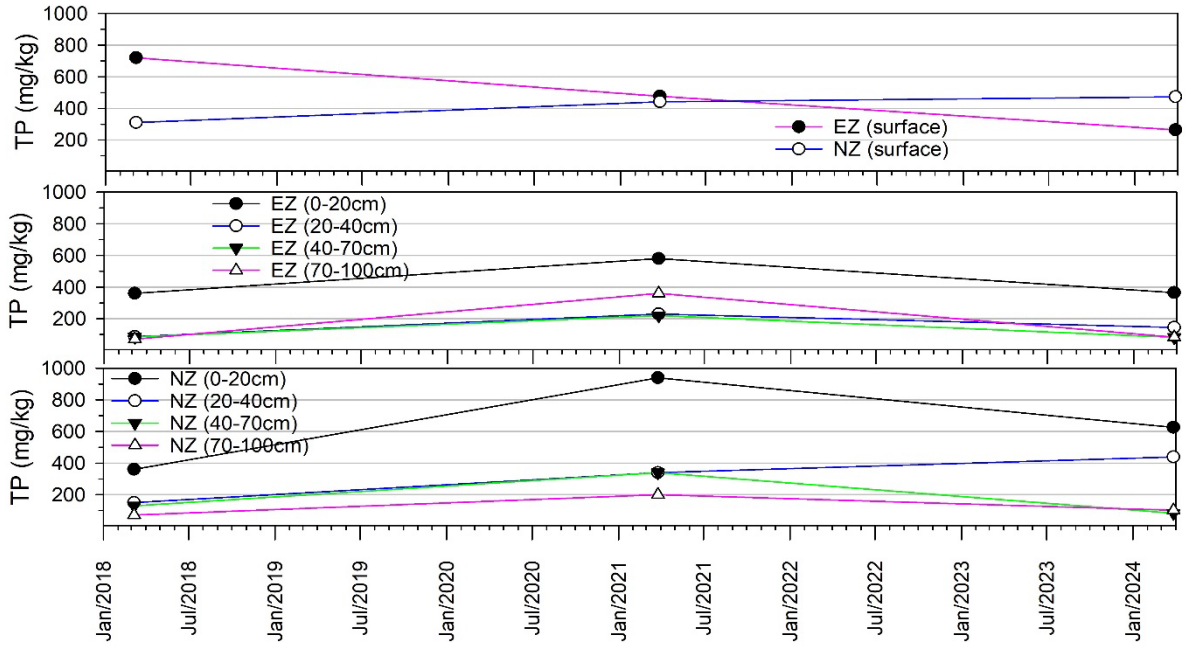


Figure 5 Historic TP results

Phosphorus Sorption Capacity

Most soils have the capacity to immobilise Phosphorus (P) by adsorption to the soil particles however this capacity is limited based on soil properties and can vary within a soil profile. When a soils P sorption capacity is reached (i.e., the soil can no longer adsorb P) P in irrigated effluent can leach through the soil and enter groundwater reserves and express in surface water bodies downstream potentially contributing to eutrophication.

P sorption capacity is tested every three years at the NRLX irrigation areas with the previous sampling undertaken in March 2021 by AWC. The results are provided in the attached laboratory sheets, these values were divided based on the soil layer depths as required by the EPL.

The current results are compared with historic values and displayed in Figure 6. Over the period P sorption capacity has decreased substantially in surface soil composite samples within both irrigation zones. Sample results within EZ increased at all depth profiles apart from (70-100cm) while all depth samples within NZ decreased apart from 70-100cm.

MEDLI modelling that was undertaken for the Effluent Irrigation Management Plan (AWC, 2021) suggested there was 138 years remaining until the P sorption capacity was exhausted. Similarly, a phosphorus sustainability calculation was undertaken using the methods in DEC (2004) which suggests more P is removed from the irrigation area by the cropping management than is being applied in the effluent (refer Attachment 3). Further monitoring of P sorption as required by the EP licence will provide further understanding of the effects of cropping over the long term on the soil profile.

Note: The P sorption capacity results from the 2018 monitoring effort were provided to AWC by RVC. There is no indication in the data that the values had been divided to provide a value consistent with the soil layer depths; P sorp values can be reported based on a 1 metre depth soil profile. It is understood requests for clarification by RVC of the previous consultants have been unsuccessful.

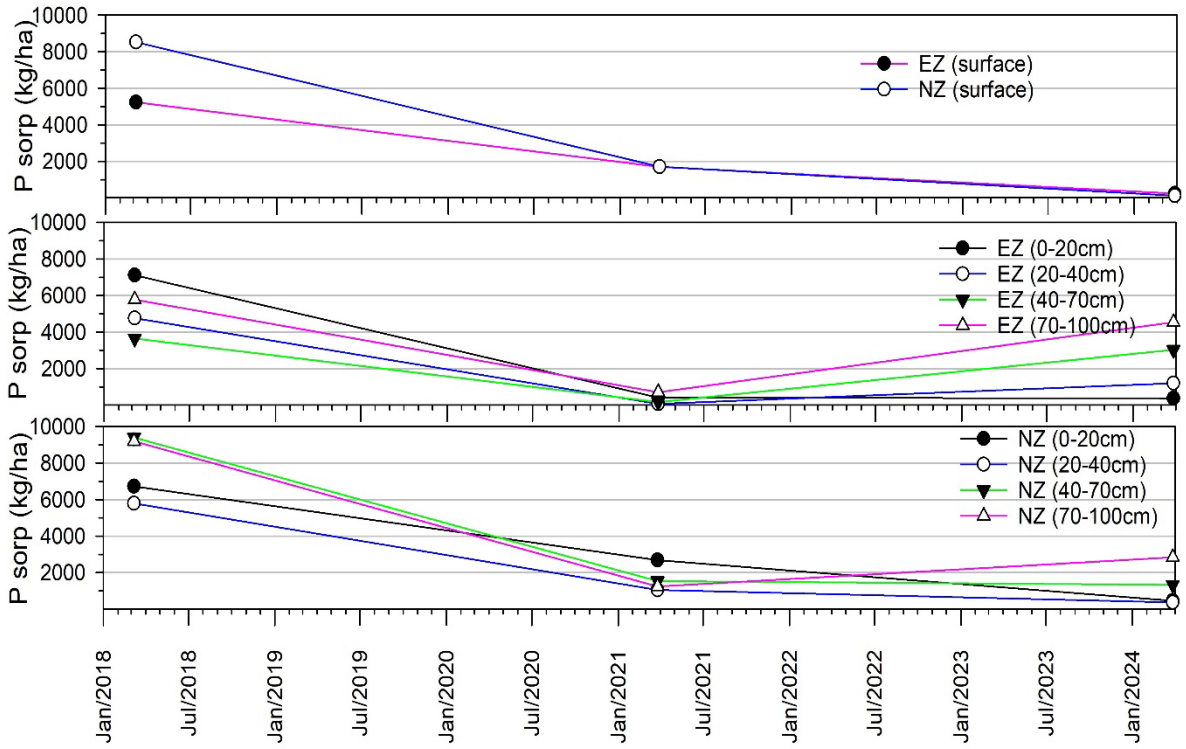


Figure 6 Historic Phosphorus Sorption Capacity results

Conclusion

The results of the soil analysis program show the irrigation of effluent is impacting the soil of the irrigation zone however this can be managed sustainably. The cropping and deep ripping improve nutrient removal and soil texture and infiltration. Incorporation of organic matter into the surface layers will further improve infiltration, water holding capacity and cation exchange.

The primary concern is the ESP values suggesting sodic soils and poor soil structure at depths within both irrigation areas.

The following is recommended to improve the soil function of the irrigation fields:

- Continue cropping the irrigation areas
- Continue deep ripping the irrigation areas
- Incorporate organic matter into the surface layers (e.g. composted cow manure or green manure crops)
- Remove organic matter from the sedimentation ponds of the effluent treatment system more frequently to reduce the solids (and P) entering the effluent pond system, and further to the irrigation area

References

AWC (2021) *Northern Rivers Livestock Exchange – Effluent Irrigation Management Plan* (Document No. 1-201335_01C, March 2021). A report prepared for Richmond Valley Council.

Department of Environment and Conservation (NSW) (DEC) (2004). *Environmental Guidelines: Use of effluent by irrigation*. DEC Sydney.

Attachment 1 Historic surface soil sampling results (shaded = current results)

Irrigation Zone ID	Date Sampled	Sampler	Layer	Electrical Conductivity	Nitrate (as N)	pH	Exchangeable Sodium Percentage	Phosphorus (dissolved reactive - Colwell)	Cation Exchange Capacity	*Total Nitrogen	*Total Phosphorus	*Phosphorus Sorption Capacity	**Heavy metals
			Depth	(dS/m)	(mg/kg)		(%)	(mg/kg)	(mmol/kg)	(mg/kg)	(mg/kg)	(kg/ha)	(mg/kg)
Monitoring Frequency				Yearly	Yearly	Yearly	Yearly	Yearly	Yearly	Every 3 years	Every 3 years	Every 3 years	Special Frequency 2
EAST	7/03/2018	EES	0 - 10 cm	0.075	7.9	7.5	2.4	183	14	1900	720	5240	NR
	5/03/2019	EES	0 - 10 cm	0.003	64.4	7.32	6	172	10.02	NR	NR	NR	NR
	3/03/2020	EES	0-10 cm	0.00044	2.3	6.95	5.4	59	5.79	NR	NR	NR	NR
	26/03/2021	AWC (AL)	0-10 cm	0.067	2.9	7.24	2.6	133	9.08	1700	480	1698	NR
	21/03/2022	AWC (AL)	0-10 cm	0.075	3.6	6.98	4.9	189	8.02	NR	NR	NR	NR
	28/02/2023	AWC (AL)	0-10 cm	0.068	4.1	6.94	2.1	104	8.3	NR	NR	NR	NR
	27/03/2024	AWC (WD)	0 -10 cm	0.086	3.6	7.48	3.1	71	7.8	2900	264	237	NR
NORTH	7/03/2018	EES	0 - 10 cm	0.09	5	6.9	8.7	256	11	1400	310	8529	NR
	5/03/2019	EES	0 - 10 cm	0.003	26.8	7.14	4	238	13.03	NR	NR	NR	NR
	3/03/2020	EES	0- 10 cm	0.00155	4.5	8.08	4.5	225	15.23	NR	NR	NR	NR
	26/03/2021	AWC (AL)	0-10 cm	0.068	3.7	7.20	2.8	133	9.5	1800	440	1708	NR
	21/03/2022	AWC (AL)	0- 10 cm	0.115	7.5	6.93	4.3	97	10.88	NR	NR	NR	NR
	28/02/2023	AWC (AL)	0-10 cm	0.091	5.3	7.03	2.3	132	9.2	NR	NR	NR	NR
	27/03/2023	AWC (WD)	0-10 cm	0.085	3.2	6.84	2.6	174	10	2100	473	177	NR

Notes:
NR = Not Required
ND = Not Detected
Values shown in red were originally reported as less than (<) that value

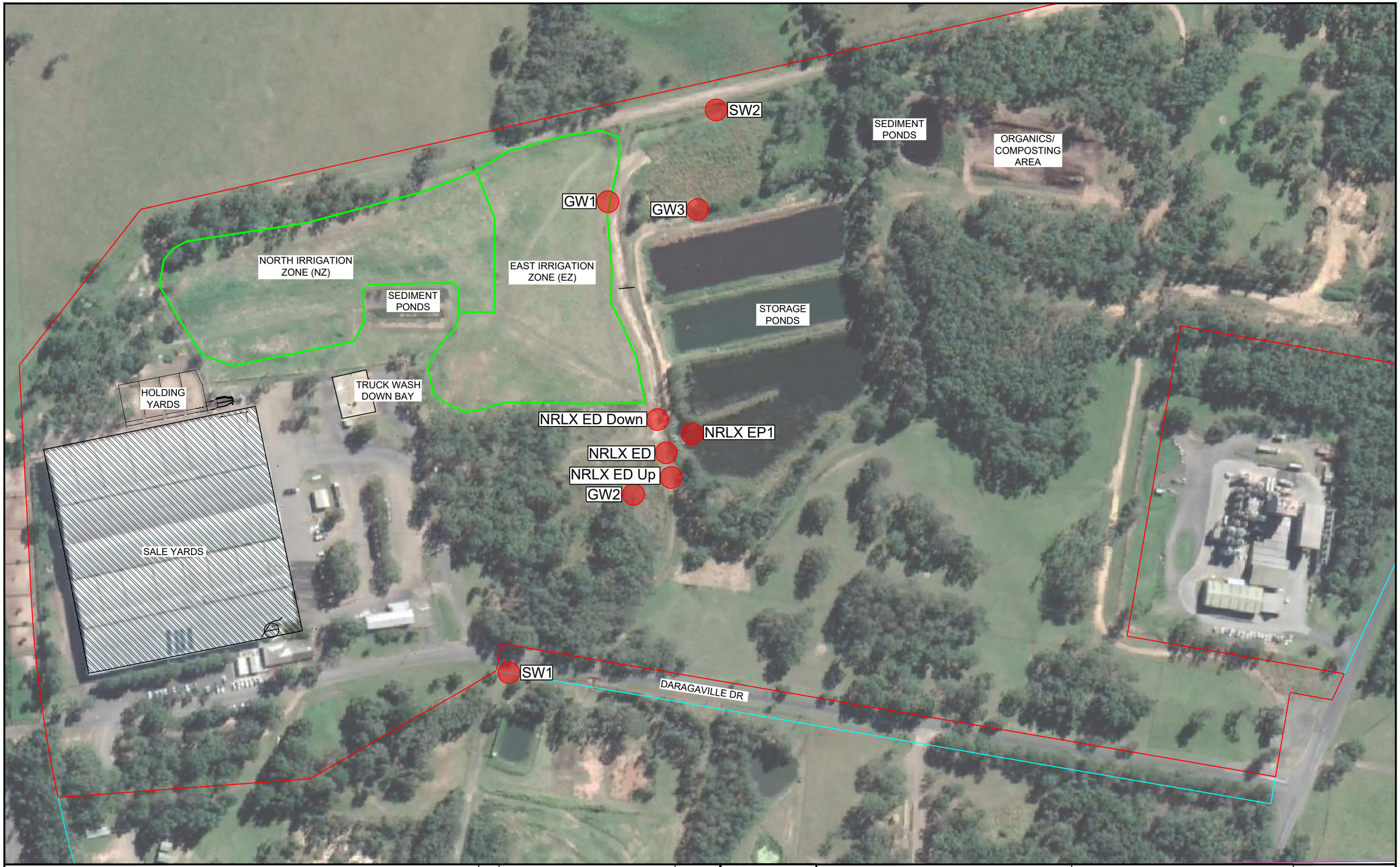
Attachment 2 Historic depth profiling soil sampling results (continue over leaf)

Irrigation Zone ID	Date Sampled	Sampler	Layer	Electrical Conductivity	Nitrate (as N)	pH	Exchangeable Sodium Percentage	Phosphorus (dissolved reactive - Colwell)	Cation Exchange Capacity	*Total Nitrogen	*Total Phosphorus	*Phosphorus Sorption Capacity	**Heavy metals
ID	**Sampled**		**Depth**	**(dS/m)**	**(mg/kg)**		**(%)**	**(mg/kg)**	**(mmol/kg)**	**(mg/kg)**	**(mg/kg)**	**(kg/ha)**	**(mg/L)**
Monitoring Frequency				**Yearly**	**Yearly**	**Yearly**	**Yearly**	**Yearly**	**Yearly**	**Every 3 years**	**Every 3 years**	**Every 3 years**	**SF2**
2018													
EAST	7/03/2018	EES	0 - 20 cm	0.11	<5	7.8	4.3	197	11	2000	360	7111	NR
			20 - 40 cm	0.055	<5	8	4.5	81.5	4.7	350	87	4761	NR
			40 - 70 cm	0.069	<5	8.4	7.9	57.9	4.9	240	85	3650	NR
			70 - 100 cm	0.077	<5	8.1	7.6	52.4	3.3	170	71	5774	NR
NORTH	7/03/2018	EES	0 - 20 cm	0.11	<5	7.1	13	208	9	1100	360	6723	NR
			20 - 40 cm	0.11	<5	6.8	19	44	7.1	250	150	5792	NR
			40 - 70 cm	0.14	<5	6.2	30	20.6	7.6	440	130	9405	NR
			70 - 100 cm	0.31	<5	5.6	25	15.5	10	330	72	9200	NR
2019													
EAST	5/03/2019	EES	0 - 20 cm	0.001	1.9	6.81	13	60	6.39	NR	NR	NR	NR
			20 - 40 cm	0.0005	0.6	6.2	16.1	20	3.37	NR	NR	NR	NR
			40 - 70 cm	0.001	0.5	5.36	29.3	6	6.85	NR	NR	NR	NR
			70 - 100 cm	0.002	0.8	5.13	33.7	4	8.2	NR	NR	NR	NR
NORTH	5/03/2019	EES	0 - 20 cm	0.002	9.2	7.35	10.2	200	9.73	NR	NR	NR	NR
			20 - 40 cm	0.001	3.7	7.33	10.6	81	5.56	NR	NR	NR	NR

Irrigation Zone ID	Date Sampled	Sampler	Layer	Electrical Conductivity	Nitrate (as N)	pH	Exchangeable Sodium Percentage	Phosphorus (dissolved reactive - Colwell)	Cation Exchange Capacity	*Total Nitrogen	*Total Phosphorus	*Phosphorus Sorption Capacity	**Heavy metals
ID	Sampled		Depth	(dS/m)	(mg/kg)		(%)	(mg/kg)	(mmol/kg)	(mg/kg)	(mg/kg)	(kg/ha)	(mg/L)
Monitoring Frequency				Yearly	Yearly	Yearly	Yearly	Yearly	Yearly	Every 3 years	Every 3 years	Every 3 years	SF2
			40 - 70 cm	0.0008	1.9	6.51	13.2	56	3.69	NR	NR	NR	NR
			70 - 100 cm	0.004	1	5.76	17.2	77	5.8	NR	NR	NR	NR
2020													
EAST	3/03/2020	EES	0 - 20 cm	0.0006	1.6	7.36	7.6	27	4.76	NR	NR	NR	NR
			20 - 40 cm	0.00077	0.9	7.43	14.3	13	4.51	NR	NR	NR	NR
			40 - 70 cm	0.00085	0.7	5.9	18.2	6.2	7.59	NR	NR	NR	NR
			70 - 100 cm	0.00132	0.7	5.4	20.2	3.6	7.81	NR	NR	NR	NR
NORTH	3/03/2020	EES	0 - 20 cm	0.00126	1	8.18	7.2	162	6.8	NR	NR	NR	NR
			20 - 40 cm	0.00125	0.7	7.92	11.8	66	3.19	NR	NR	NR	NR
			40 - 70 cm	0.00083	0.7	7.74	12.8	54	2.5	NR	NR	NR	NR
			70 - 100 cm	0.00263	0.6	7.71	19	22	7.77	NR	NR	NR	NR
2021													
EAST	26/03/2021	AWC (AL)	0 - 20 cm	0.147	0.5	7.53	12.1	60	8.15	1000	580	401	NR
			20 - 40 cm	0.425	1	6.13	34.1	35	10.42	840	230	64	NR
			40 - 70 cm	0.379	1	6.27	35	52	10.44	670	220	160	NR
			70 - 100 cm	0.556	1	5.58	34.2	25	17.38	630	360	701	NR
NORTH	26/03/2021	AWC (AL)	0 - 20 cm	0.076	1.6	7.03	2.8	369	10.76	2130	940	2685	NR
			20 - 40 cm	0.056	1	7.52	6.6	166	3.56	490	340	1049	NR
			40 - 70 cm	0.059	1	7.55	7.7	148	3.21	380	340	1534	NR
			70 - 100 cm	0.083	1	7.07	12.2	105	3.77	310	200	1237	NR
2022													
EAST	21/03/2022	AWC (AL)	0 - 20 cm	0.068	1.4	5.92	10.7	19	11.68	NR	NR	NR	NR
			20 - 40 cm	0.055	1.6	5.99	11.4	45	9.65	NR	NR	NR	NR
			40 - 70 cm	0.150	1.9	5.62	16.9	20	13.98	NR	NR	NR	NR
			70 - 100 cm	0.175	1.4	5.46	18.7	51	20.69	NR	NR	NR	NR
NORTH	21/03/2022	AWC (AL)	0 - 20 cm	0.103	3.5	6.00	12.6	83	9.03	NR	NR	NR	NR
			20 - 40 cm	0.092	3.1	6.38	10.6	79	8.01	NR	NR	NR	NR
			40 - 70 cm	0.126	1.6	5.91	13.5	49	7.73	NR	NR	NR	NR
			70 - 100 cm	0.253	1.3	5.09	14.1	64	14.19	NR	NR	NR	NR
2023													
EAST	28/02/2023	AWC (AL)	0 - 20 cm	0.080	4.0	6.82	3.0	131	9.70	NR	NR	NR	NR
			20 - 40 cm	0.112	1.6	5.91	14.7	33	8.26	NR	NR	NR	NR
			40 - 70 cm	0.175	0.8	5.16	11.1	14	14.53	NR	NR	NR	NR
			70 - 100 cm	0.221	1.5	5.09	11.0	5	17.36	NR	NR	NR	NR
NORTH	28/02/2023	AWC (AL)	0 - 20 cm	0.211	4.8	6.73	5.5	108	7.41	NR	NR	NR	NR
			20 - 40 cm	0.082	2.2	7.15	7.6	56	4.65	NR	NR	NR	NR
			40 - 70 cm	0.102	0.9	6.69	12.3	22	4.58	NR	NR	NR	NR
			70 - 100 cm	0.105	0.6	5.62	11.8	15	5.88	NR	NR	NR	NR
2024													
EAST	27/03/2024	AWC (WD)	0 - 20 cm	0.097	2.4	7.45	2.1	93	10.33	2100	365	371	NR
			20 - 40 cm	0.073	1.5	6.26	13.0	30	6.77	700	145	1194	NR
			40 - 70 cm	0.100	0.8	5.61	13.0	16	8.08	600	82	3023	NR
			70 - 100 cm	0.267	0.8	5.32	17.4	10	14.66	700	83	4539	NR
NORTH	27/03/2024	AWC (WD)	0 - 20 cm	0.167	2.7	7.90	3.2	122	16.13	1700	626	459	NR
			20 - 40 cm	0.225	0.8	8.28	4.0	84	18.90	700	439	371	NR
			40 - 70 cm	0.143	0.8	5.45	14.0	29	5.20	500	83	1331	NR
			70 - 100 cm	0.299	0.8	5.33	19.1	29	8.90	700	102	2839	NR

Attachment 3. Phosphorus sustainability calculation

Phosphorus sustainability calculation (as per DEC (2004), pg 46)			
DEC (2004) example	**NZ**	**EZ**	
Assumptions:			
350	182	136	P sorp capacity (mg/kg)
117	61	45	P Sort (critical) (mg/kg)
1	0.2	0.2	Soil depth (m)
1300	1300	1300	Soil density (kg / m^3)
40	1.545	1.545	Land area for irrigation (Ha)
400000	15450	15450	m^2
8	4.2	4.2	TP in applied effluent (mg/L)
365			Volume effluent (ML/yr)
365000000	6588250	6588250	L
Calculations:			
60667	244	183	Total P Adsorbed before leaching (kg)
2920.00	27.67	27.67	TP in applied effluent (kg)
25	45	45	P removed by crop kg/ ha/yr
1000	69.525	69.525	Total
31.6	**-5.8**	**-4.4**	**Site irrigation period**
Conversions:			
Volume of effluent		P removed by crop	
36.1	KL/day		forage sorghum
36100	L/day	15	average grain yield (t/ha DM)
13176500	L/yr	0.3%	%P
6588250	half share	0.045	t/ha
		45	kg/ha
Convert kg/ha to mg/kg			
NZ	EZ		
2369	1773	kg/ha	
0.2369	0.1773	= kg/m^3 (/10,000)	
236900	177300	= mg/m^3 (*1,000,000)	
182	136	= mg/kg (/soil density)	



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CLIENT:

Richmond Valley Council

NRLX

REV.	ISSUE / AMENDMENTS	DATE
A	FIGURE ONLY	05/05/2021

Survey: Newton Denny Chapelle (2017)
Aerial imagery: Google Earth (2021)

DESIGNED JM
DRAWN JM
CHECKED MB

PROJECT
NRLX
ENVIRONMENTAL MONITORING

DRAWING
FIGURE 1-2
MONITORING LOCATIONS

SCALE 1:2500 at A3
0m 50m 100m

DRAWING CREATED 10/12/2020

DWG No. 1-201335_NRLX_EnvMon_01

CAD FILE No. 1-201335_NRLX_EIMP

REV. A

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AGRICULTURAL SOIL ANALYSIS REPORT

2 samples supplied by Australian Wetlands Consulting Pty Ltd on 28/03/2024. Lab Job No.R2397

Analysis requested by Jesse Munro. Your Job: RVC Landfill EZ 0-10 & NZ 0-10

8 George Street BANGALOW NSW 2479

			Sample 1	Sample 2	*Heavy Soil*	*Medium Soil*	*Light Soil*	*Sandy Soil*
		Sample ID:	**EZ**	**NZ**				
		Crop:	**N/G**	**N/G**				
		Client:	**AWC**	**AWC**	*Clay*	*Clay Loam*	*Loam*	*Loamy Sand*
	Parameter	**Method reference**	**R2397/1**	**R2397/2**	**Indicative guidelines - refer to Notes 6 and 8**			
	Soluble Calcium (mg/kg)		813	942	*1150*	*750*	*375*	*175*
	Soluble Magnesium (mg/kg)	**Inhouse S10 - Morgan 1	192	252	*160*	*105*	*60*	*25*
	Soluble Potassium (mg/kg)		235	264	*113*	*75*	*60*	*50*
	Soluble Phosphorus (mg/kg)		9.1	12	*15*	*12*	*10*	*5.0*
	Phosphorus (mg/kg P)	**Rayment & Lyons 2011 - 9E2 (Bray 1)	39	66	*45 note 5*	*30 note 5*	*24 note 5*	*20 note 5*
		**Rayment & Lyons 2011 - 9B2 (Colwell)	71	174	*80*	*50*	*45*	*35*
		**Inhouse S3A (Bray 2)	68	150	*90 note 5*	*60 note 5*	*48 note 5*	*40 note 5*
	Nitrate Nitrogen (mg/kg N)		3.6	3.2	*15*	*13*	*10*	*10*
	Ammonium Nitrogen (mg/kg N)	**Inhouse S37 (KCl)	2.4	3.9	*20*	*18*	*15*	*12*
	Sulfur (mg/kg S)		9.0	6.7	*10.0*	*8.0*	*8.0*	*7.0*
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	7.48	6.84	*6.5*	*6.5*	*6.3*	*6.3*
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.086	0.085	*0.200*	*0.150*	*0.120*	*0.100*
	Estimated Organic Matter (% OM)	**Calculation: Total Carbon x 1.75	3.3	4.8	*> 5.5*	*>4 .5*	*> 3.5*	*> 2.5*
	Exchangeable Calcium (cmol+/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	5.0	6.5	*15.6*	*10.8*	*5.0*	*1.9*
	Exchangeable Calcium (kg/ha)		2,253	2,932	*7000*	*4816*	*2240*	*840*
	Exchangeable Calcium (mg/kg)		1,006	1,309	*3125*	*2150*	*1000*	*375*
	Exchangeable Magnesium (cmol+/kg)		1.8	2.5	*2.4*	*1.7*	*1.2*	*0.60*
	Exchangeable Magnesium (kg/ha)		487	670	*650*	*448*	*325*	*168*
	Exchangeable Magnesium (mg/kg)		218	299	*290*	*200*	*145*	*75*
	Exchangeable Potassium (cmol+/kg)		0.77	0.90	*0.60*	*0.50*	*0.40*	*0.30*
	Exchangeable Potassium (kg/ha)		675	791	*526*	*426*	*336*	*224*
	Exchangeable Potassium (mg/kg)		301	353	*235*	*190*	*150*	*100*
	Exchangeable Sodium (cmol+/kg)		0.24	0.27	*0.3*	*0.26*	*0.22*	*0.11*
	Exchangeable Sodium (kg/ha)		125	139	*155*	*134*	*113*	*57*
	Exchangeable Sodium (mg/kg)		56	62	*69*	*60*	*51*	*25*
	Exchangeable Aluminium (cmol+/kg)	**Inhouse S37 (KCl)	<0.01	0.01	*0.6*	*0.5*	*0.4*	*0.2*
	Exchangeable Aluminium (kg/ha)		1.6	2.9	*121*	*101*	*73*	*30*
	Exchangeable Aluminium (mg/kg)		<1	1.3	*54*	*45*	*32*	*14*
	Exchangeable Hydrogen (cmol+/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	<0.01	<0.01	*0.6*	*0.5*	*0.4*	*0.2*
	Exchangeable Hydrogen (kg/ha)		<1	<1	*13*	*11*	*8*	*3*
	Exchangeable Hydrogen (mg/kg)		<1	<1	*6*	*5*	*4*	*2*
	Effective Cation Exchange Capacity (ECEC) (cmol+/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg)	7.8	10	*20.1*	*14.3*	*7.8*	*3.3*
	Calcium (%)	**Base Saturation Calculations - Cation cmol+/kg / ECEC x 100	64	64	*77.6*	*75.7*	*65.6*	*57.4*
	Magnesium (%)		23	24	*11.9*	*11.9*	*15.7*	*18.1*
	Potassium (%)		9.8	8.9	*3.0*	*3.5*	*5.2*	*9.1*
	Sodium - ESP (%)		3.1	2.6	*1.5*	*1.8*	*2.9*	*3.3*
	Aluminium (%)		0.10	0.14	*6.0*	*7.1*	*10.5*	*12.1*
	Hydrogen (%)		0.00	0.00				
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol+/kg)	2.8	2.7	*6.5*	*6.4*	*4.2*	*3.2*

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AGRICULTURAL SOIL ANALYSIS REPORT

2 samples supplied by Australian Wetlands Consulting Pty Ltd on 28/03/2024. Lab Job No.R2397

Analysis requested by Jesse Munro. Your Job: RVC Landfill EZ 0-10 & NZ 0-10

8 George Street BANGALOW NSW 2479

			Sample 1	Sample 2	*Heavy Soil*	*Medium Soil*	*Light Soil*	*Sandy Soil*
		Sample ID:	**EZ**	**NZ**				
		Crop:	**N/G**	**N/G**				
		Client:	**AWC**	**AWC**	*Clay*	*Clay Loam*	*Loam*	*Loamy Sand*
	Parameter	**Method reference**	**R2397/1**	**R2397/2**	**Indicative guidelines - refer to Notes 6 and 8**			
	Zinc (mg/kg)	Rayment & Lyons 2011 - 12A1 (DTPA)	2.0	7.8	*6.0*	*5.0*	*4.0*	*3.0*
	Manganese (mg/kg)		7.6	16	*25*	*22*	*18*	*15*
	Iron (mg/kg)		121	303	*25*	*22*	*18*	*15*
	Copper (mg/kg)		0.40	0.87	*2.4*	*2.0*	*1.6*	*1.2*
	Boron (mg/kg)	**Rayment & Lyons 2011 - 12C2 (Hot $CaCl_2$)	0.45	0.84	*2.0*	*1.7*	*1.4*	*1.0*
	Silicon (mg/kg Si)	**Inhouse S11 (Hot CaCl2)	26	50	*50*	*45*	*40*	*35*
	Total Carbon (%)	Inhouse S4a (LECO Trumac Analyser)	1.9	2.7	*> 3.1*	*> 2.6*	*> 2.0*	*> 1.4*
	Total Nitrogen (%)		0.29	0.21	*> 0.30*	*> 0.25*	*> 0.20*	*> 0.15*
	Carbon/Nitrogen Ratio	**Calculation: Total Carbon/Total Nitrogen	6.4	13	*10–12*	*10–12*	*10–12*	*10–12*
	Basic Texture	**Inhouse S65	Loam	Loam	..	..	..	..
	Basic Colour		Brownish	Brownish	..	..	..	..
	Chloride Estimate (equiv. mg/kg)	**Calculation: Electrical Conductivity x 640	55	54	..	..	..	..
	Total Phosphorus (mg/kg)	Rayment & Lyons 2011 - 17C1 Aqua Regia	264	473	*400–1500 P*			

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwood.
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. National Environmental Protection (Assessment of Site Contamination) Measure 2013, Schedule B(1) - Guideline on Investigation Levels for Soil and Groundwater. Table 5-A Background Ranges.
9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
10. Conversions for 1 cmol$_c$/kg = 230 mg/kg Sodium, 390 mg/kg Potassium, 122 mg/kg Magnesium, 200 mg/kg Calcium
11. Conversions to kg/ha = mg/kg x 2.24
12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
13. ** NATA accreditation does not cover the performance of this service.
14. Analysis conducted between sample arrival date and reporting date.
15. This report is not to be reproduced except in full. Results only relate to the item tested.
16. All services undertaken by EAL are covered by the EAL Laboratory Services Terms and Conditions (refer SCU.edu.au/eal).
17. This report was issued on 5/04/2024.

Quality Checked: Kris Saville
Agricultural Co-Ordinator

NATA
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Accredited for compliance with ISO/IEC 17025 - Testing

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AGRICULTURAL SOIL ANALYSIS REPORT

48 samples supplied (Composited into 8 x Composites in EAL) by Australian Wetlands Consulting Pty Ltd on 28/03/2024. Lab Job No.R2395

Analysis requested by Jesse Munro. Your Job: RVC Landfill

8 George Street BANGALOW NSW 2479

			Sample 1	Sample 2	Sample 3	Sample 4
		Sample ID:	NZ-A 0-20	NZ-B 20-40	NZ-C 40-70	NZ-D 70-100
		Crop:	Composite	Composite	Composite	Composite
		Client:	RVC Landfill	RVC Landfill	RVC Landfill	RVC Landfill
	Parameter	Method reference	R2395/C1	R2395/C2	R2395/C3	R2395/C4
	Soluble Calcium (mg/kg)	**Inhouse S10 - Morgan 1	1947	3915	266	156
	Soluble Magnesium (mg/kg)		294	246	89	199
	Soluble Potassium (mg/kg)		328	329	160	309
	Soluble Phosphorus (mg/kg)		16	4.3	<1	<1
	Phosphorus (mg/kg P)	**Rayment & Lyons 2011 - 9E2 (Bray 1)	55	49	22	4.3
		**Rayment & Lyons 2011 - 9B2 (Colwell)	122	84	29	29
		**Inhouse S3A (Bray 2)	133	108	28	24
	Nitrate Nitrogen (mg/kg N)	**Inhouse S37 (KCl)	2.7	0.8	0.8	0.8
	Ammonium Nitrogen (mg/kg N)		4.7	2.0	3.4	2.5
	Sulfur (mg/kg S)		8.0	25	29	51
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	7.90	8.28	5.45	5.33
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.167	0.225	0.143	0.299
	Estimated Organic Matter (% OM)	**Calculation: Total Carbon x 1.75	3.6	1.3	0.5	0.9
	Exchangeable Calcium (cmol+/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	11.23	14.51	1.54	1.18
	Exchangeable Calcium (kg/ha)		5043	6514	692	531
	Exchangeable Calcium (mg/kg)		2251	2908	309	237
	Exchangeable Magnesium (cmol+/kg)		3.01	2.39	1.12	2.67
	Exchangeable Magnesium (kg/ha)		821	651	304	727
	Exchangeable Magnesium (mg/kg)		366	291	136	325
	Exchangeable Potassium (cmol+/kg)		1.37	1.23	0.74	1.69
	Exchangeable Potassium (kg/ha)		1197	1081	649	1478
	Exchangeable Potassium (mg/kg)		534	483	290	660
	Exchangeable Sodium (cmol+/kg)		0.51	0.76	0.73	1.70
	Exchangeable Sodium (kg/ha)		262	391	375	876
	Exchangeable Sodium (mg/kg)		117	174	167	391
	Exchangeable Aluminium (cmol+/kg)	**Inhouse S37 (KCl)	0.01	<0.01	0.71	1.32
	Exchangeable Aluminium (kg/ha)		2	<1	143	266
	Exchangeable Aluminium (mg/kg)		<1	<1	64	119
	Exchangeable Hydrogen (cmol+/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	<0.01	<0.01	0.36	0.33
	Exchangeable Hydrogen (kg/ha)		<1	<1	8	7
	Exchangeable Hydrogen (mg/kg)		<1	<1	4	3
	Effective Cation Exchange Capacity (ECEC) (cmol+/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg)	16.13	18.90	5.20	8.90
	Calcium (%)	**Base Saturation Calculations - Cation cmol+/kg / ECEC x 100	69.6	76.8	29.7	13.3
	Magnesium (%)		18.7	12.6	21.5	30.0
	Potassium (%)		8.5	6.5	14.3	19.0
	Sodium - ESP (%)		3.2	4.0	14.0	19.1
	Aluminium (%)		0.1	0.0	13.7	14.8
	Hydrogen (%)		0.0	0.0	6.8	3.8
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol+/kg)	3.7	6.1	1.4	0.4

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AGRICULTURAL SOIL ANALYSIS REPORT

48 samples supplied (Composited into 8 x Composites in EAL) by Australian Wetlands Consulting Pty Ltd on 28/03/2024. Lab Job No.R2395

Analysis requested by Jesse Munro. Your Job: RVC Landfill

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			Sample 1	Sample 2	Sample 3	Sample 4
		Sample ID:	NZ-A 0-20	NZ-B 20-40	NZ-C 40-70	NZ-D 70-100
		Crop:	Composite	Composite	Composite	Composite
		Client:	RVC Landfill	RVC Landfill	RVC Landfill	RVC Landfill
	Parameter	Method reference	R2395/C1	R2395/C2	R2395/C3	R2395/C4
	Zinc (mg/kg)	Rayment & Lyons 2011 - 12A1 (DTPA)	3.6	1.0	<0.5	<0.5
	Manganese (mg/kg)		14	8.2	0.4	0.1
	Iron (mg/kg)		97	97	11	9
	Copper (mg/kg)		0.5	0.3	<0.1	<0.1
	Boron (mg/kg)	**Rayment & Lyons 2011 - 12C2 (Hot $CaCl_2$)	0.45	0.16	0.16	0.26
	Silicon (mg/kg Si)	**Inhouse S11 (Hot CaCl2)	40	20	25	33
	Total Carbon (%)	Inhouse S4a (LECO Trumac Analyser)	2.04	0.73	0.31	0.52
	Total Nitrogen (%)		0.17	0.07	0.05	0.07
	Carbon/Nitrogen Ratio	**Calculation: Total Carbon/Total Nitrogen	11.8	10.7	6.6	7.8
	Basic Texture	**Inhouse S65	Clay Loam	Clay Loam	Clay Loam	Clay Loam
	Basic Colour		Brownish	Brownish	Brownish	Brownish
	Chloride Estimate (equiv. mg/kg)	**Calculation: Electrical Conductivity x 640	107	144	92	191
	Total Phosphorus (mg/kg)	Rayment & Lyons 2011 - 17C1 Aqua Regia	626	439	83	102

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwood.
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17. This report was issued on 8/04/2024.

Quality Checked: Kris Saville
Agricultural Co-Ordinator

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AGRICULTURAL SOIL ANALYSIS REPORT

48 samples supplied (Composited into 8 x Composites in EAL) by Australian Wetlands Consulting Pty Lt
Analysis requested by Jesse Munro. Your Job: RVC Landfill
8 George Street BANGALOW NSW 2479

			Sample 5	Sample 6	Sample 7	Sample 8
		Sample ID:	EZ-A 0-20	EZ-B 20-40	EZ-C 40-70	EZ-D 70-100
		Crop:	Composite	Composite	Composite	Composite
		Client:	RVC Landfill	RVC Landfill	RVC Landfill	RVC Landfill
	Parameter	Method reference	R2395/C5	R2395/C6	R2395/C7	R2395/C8
	Soluble Calcium (mg/kg)	**Inhouse S10 - Morgan 1	954	320	124	105
	Soluble Magnesium (mg/kg)		237	188	158	278
	Soluble Potassium (mg/kg)		207	185	68	204
	Soluble Phosphorus (mg/kg)		8.3	1.0	<1	<1
	Phosphorus (mg/kg P)	**Rayment & Lyons 2011 - 9E2 (Bray 1)	7.8	18	34	16
		**Rayment & Lyons 2011 - 9B2 (Colwell)	93	30	16	10
		**Inhouse S3A (Bray 2)	75	31	16	7.1
	Nitrate Nitrogen (mg/kg N)	**Inhouse S37 (KCl)	2.4	1.5	0.8	0.8
	Ammonium Nitrogen (mg/kg N)		3.7	1.6	1.4	2.7
	Sulfur (mg/kg S)		7.5	20	18	21
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	7.45	6.26	5.61	5.32
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.097	0.073	0.100	0.267
	Estimated Organic Matter (% OM)	**Calculation: Total Carbon x 1.75	4.5	1.6	0.9	1.1
	Exchangeable Calcium (cmol+/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	6.71	2.34	1.02	1.05
	Exchangeable Calcium (kg/ha)		3011	1051	459	472
	Exchangeable Calcium (mg/kg)		1344	469	205	211
	Exchangeable Magnesium (cmol+/kg)		2.55	2.33	2.23	4.55
	Exchangeable Magnesium (kg/ha)		693	634	608	1239
	Exchangeable Magnesium (mg/kg)		310	283	272	553
	Exchangeable Potassium (cmol+/kg)		0.84	0.85	0.38	1.37
	Exchangeable Potassium (kg/ha)		736	744	334	1201
	Exchangeable Potassium (mg/kg)		329	332	149	536
	Exchangeable Sodium (cmol+/kg)		0.22	0.88	1.05	2.56
	Exchangeable Sodium (kg/ha)		114	452	541	1316
	Exchangeable Sodium (mg/kg)		51	202	242	587
	Exchangeable Aluminium (cmol+/kg)	**Inhouse S37 (KCl)	0.02	0.20	2.86	4.56
	Exchangeable Aluminium (kg/ha)		3	40	577	920
	Exchangeable Aluminium (mg/kg)		1	18	258	411
	Exchangeable Hydrogen (cmol+/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	<0.01	0.17	0.52	0.56
	Exchangeable Hydrogen (kg/ha)		<1	4	12	13
	Exchangeable Hydrogen (mg/kg)		<1	2	5	6
	Effective Cation Exchange Capacity (ECEC) (cmol+/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg)	10.33	6.77	8.08	14.66
	Calcium (%)	**Base Saturation Calculations - Cation cmol+/kg / ECEC x 100	64.9	34.6	12.7	7.2
	Magnesium (%)		24.6	34.4	27.7	31.1
	Potassium (%)		8.1	12.5	4.7	9.4
	Sodium - ESP (%)		2.1	13.0	13.0	17.4
	Aluminium (%)		0.2	2.9	35.4	31.1
	Hydrogen (%)		0.0	2.5	6.5	3.8
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol+/kg)	2.6	1.0	0.5	0.2

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			Sample 5	Sample 6	Sample 7	Sample 8
		Sample ID:	EZ-A 0-20	EZ-B 20-40	EZ-C 40-70	EZ-D 70-100
		Crop:	Composite	Composite	Composite	Composite
		Client:	RVC Landfill	RVC Landfill	RVC Landfill	RVC Landfill
	Parameter	Method reference	R2395/C5	R2395/C6	R2395/C7	R2395/C8
	Zinc (mg/kg)	Rayment & Lyons 2011 - 12A1 (DTPA)	3.7	1.4	1.0	<0.5
	Manganese (mg/kg)		12	4.1	1.7	<0.1
	Iron (mg/kg)		124	62	50	9.0
	Copper (mg/kg)		0.6	0.3	0.2	<0.1
	Boron (mg/kg)	**Rayment & Lyons 2011 - 12C2 (Hot $CaCl_2$)	0.30	0.32	0.25	0.37
	Silicon (mg/kg Si)	**Inhouse S11 (Hot CaCl2)	33	25	36	46
	Total Carbon (%)	Inhouse S4a (LECO Trumac Analyser)	2.57	0.89	0.49	0.64
	Total Nitrogen (%)		0.21	0.07	0.06	0.07
	Carbon/Nitrogen Ratio	**Calculation: Total Carbon/Total Nitrogen	12.3	12.0	8.7	8.7
	Basic Texture	**Inhouse S65	Clay Loam	Clay Loam	Clay Loam	Clay
	Basic Colour		Brownish	Brownish	Brownish	Brownish
	Chloride Estimate (equiv. mg/kg)	**Calculation: Electrical Conductivity x 640	62	47	64	171
	Total Phosphorus (mg/kg)	Rayment & Lyons 2011 - 17C1 Aqua Regia	365	145	82	83

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwood.
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. National Environmental Protection (Assessment of Site Contamination) Measure 2013, Schedule B(1) - Guideline on Investigation Levels for Soil and Groundwater. Table 5-A Background Ranges.
9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
10. Conversions for 1 $cmol_+/kg$ = 230 mg/kg Sodium, 390 mg/kg Potassium, 122 mg/kg Magnesium, 200 mg/kg Calcium
11. Conversions to kg/ha = mg/kg x 2.24
12. The chloride calculation of Cl mg/L = EC x 640 is considered an estimate, and most likely an over-estimate
13. ** NATA accreditation does not cover the performance of this service.
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17. This report was issued on 8/04/2024.

Quality Checked: Kris Saville
Agricultural Co-Ordinator

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AGRICULTURAL SOIL ANALYSIS REPORT

48 samples supplied (Composited into 8 x Composites in EAL) by Australian Wetlands Consulting Pty L

Analysis requested by Jesse Munro. Your Job: RVC Landfill

8 George Street BANGALOW NSW 2479

			Heavy Soil	Medium Soil	Light Soil	Sandy Soil
		Sample ID:				
		Crop:				
		Client:	Clay	Clay Loam	Loam	Loamy Sand
	Parameter	Method reference	Indicative guidelines - refer to Notes 6 and 8			
	Soluble Calcium (mg/kg)	**Inhouse S10 - Morgan 1	1150	750	375	175
	Soluble Magnesium (mg/kg)		160	105	60	25
	Soluble Potassium (mg/kg)		113	75	60	50
	Soluble Phosphorus (mg/kg)		15	12	10	5.0
	Phosphorus (mg/kg P)	**Rayment & Lyons 2011 - 9E2 (Bray 1)	45 note 5	30 note 5	24 note 5	20 note 5
		**Rayment & Lyons 2011 - 9B2 (Colwell)	80	50	45	35
		**Inhouse S3A (Bray 2)	90 note 5	60 note 5	48 note 5	40 note 5
	Nitrate Nitrogen (mg/kg N)	**Inhouse S37 (KCl)	15	13	10	10
	Ammonium Nitrogen (mg/kg N)		20	18	15	12
	Sulfur (mg/kg S)		10.0	8.0	8.0	7.0
	pH	Rayment & Lyons 2011 - 4A1 (1:5 Water)	6.5	6.5	6.3	6.3
	Electrical Conductivity (dS/m)	Rayment & Lyons 2011 - 3A1 (1:5 Water)	0.200	0.150	0.120	0.100
	Estimated Organic Matter (% OM)	**Calculation: Total Carbon x 1.75	> 5.5	>4 .5	> 3.5	> 2.5
	Exchangeable Calcium (cmol+/kg)	Rayment & Lyons 2011 - 15D3 (Ammonium Acetate)	15.6	10.8	5.0	1.9
	Exchangeable Calcium (kg/ha)		7000	4816	2240	840
	Exchangeable Calcium (mg/kg)		3125	2150	1000	375
	Exchangeable Magnesium (cmol+/kg)		2.4	1.7	1.2	0.60
	Exchangeable Magnesium (kg/ha)		650	448	325	168
	Exchangeable Magnesium (mg/kg)		290	200	145	75
	Exchangeable Potassium (cmol+/kg)		0.60	0.50	0.40	0.30
	Exchangeable Potassium (kg/ha)		526	426	336	224
	Exchangeable Potassium (mg/kg)		235	190	150	100
	Exchangeable Sodium (cmol+/kg)		0.3	0.26	0.22	0.11
	Exchangeable Sodium (kg/ha)		155	134	113	57
	Exchangeable Sodium (mg/kg)		69	60	51	25
	Exchangeable Aluminium (cmol+/kg)	**Inhouse S37 (KCl)	0.6	0.5	0.4	0.2
	Exchangeable Aluminium (kg/ha)		121	101	73	30
	Exchangeable Aluminium (mg/kg)		54	45	32	14
	Exchangeable Hydrogen (cmol+/kg)	**Rayment & Lyons 2011 - 15G1 (Acidity Titration)	0.6	0.5	0.4	0.2
	Exchangeable Hydrogen (kg/ha)		13	11	8	3
	Exchangeable Hydrogen (mg/kg)		6	5	4	2
	Effective Cation Exchange Capacity (ECEC) (cmol+/kg)	**Calculation: Sum of Ca,Mg,K,Na,Al,H (cmol+/kg)	20.1	14.3	7.8	3.3
	Calcium (%)	**Base Saturation Calculations - Cation cmol+/kg / ECEC x 100	77.6	75.7	65.6	57.4
	Magnesium (%)		11.9	11.9	15.7	18.1
	Potassium (%)		3.0	3.5	5.2	9.1
	Sodium - ESP (%)		1.5	1.8	2.9	3.3
	Aluminium (%)		6.0	7.1	10.5	12.1
	Hydrogen (%)					
	Calcium/Magnesium Ratio	**Calculation: Calcium / Magnesium (cmol+/kg)	6.5	6.4	4.2	3.2

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AGRICULTURAL SOIL ANALYSIS REPORT

48 samples supplied (Composited into 8 x Composites in EAL) by Australian Wetlands Consulting Pty L

Analysis requested by Jesse Munro. Your Job: RVC Landfill

8 George Street BANGALOW NSW 2479

			Heavy Soil	Medium Soil	Light Soil	Sandy Soil
		Sample ID:				
		Crop:				
		Client:	Clay	Clay Loam	Loam	Loamy Sand
	Parameter	Method reference	Indicative guidelines - refer to Notes 6 and 8			
	Zinc (mg/kg)	Rayment & Lyons 2011 - 12A1 (DTPA)	6.0	5.0	4.0	3.0
	Manganese (mg/kg)		25	22	18	15
	Iron (mg/kg)		25	22	18	15
	Copper (mg/kg)		2.4	2.0	1.6	1.2
	Boron (mg/kg)	**Rayment & Lyons 2011 - 12C2 (Hot $CaCl_2$)	2.0	1.7	1.4	1.0
	Silicon (mg/kg Si)	**Inhouse S11 (Hot CaCl2)	50	45	40	35
	Total Carbon (%)	Inhouse S4a (LECO Trumac Analyser)	> 3.1	> 2.6	> 2.0	> 1.4
	Total Nitrogen (%)		> 0.30	> 0.25	> 0.20	> 0.15
	Carbon/Nitrogen Ratio	**Calculation: Total Carbon/Total Nitrogen	10–12	10–12	10–12	10–12
	Basic Texture	**Inhouse S65	..	..	..	..
	Basic Colour		..	..	..	..
	Chloride Estimate (equiv. mg/kg)	**Calculation: Electrical Conductivity x 640	..	..	..	..
	Total Phosphorus (mg/kg)	Rayment & Lyons 2011 - 17C1 Aqua Regia	400–1500 P			

Notes:

1. All results presented as a 40°C oven dried weight. Soil sieved and lightly crushed to < 2 mm.
2. Methods from Rayment and Lyons, 2011. *Soil Chemical Methods - Australasia.* CSIRO Publishing: Collingwood.
3. Soluble Salts included in Exchangeable Cations - NO PRE-WASH (unless requested).
4. 'Morgan 1 Extract' adapted from 'Science in Agriculture', 'Non-Toxic Farming' and LaMotte Soil Handbook.
5. Guidelines for phosphorus have been reduced for Australian soils.
6. Indicative guidelines are based on 'Albrecht' and 'Reams' concepts.
7. Total Acid Extractable Nutrients indicate a store of nutrients.
8. National Environmental Protection (Assessment of Site Contamination) Measure 2013, Schedule B(1) - Guideline on Investigation Levels for Soil and Groundwater. Table 5-A Background Ranges.
9. Information relating to testing colour codes is available on sheet 2 - 'Understanding your agricultural soil results'.
10. Conversions for 1 $cmol_+/kg$ = 230 mg/kg Sodium, 390 mg/kg Potassium, 122 mg/kg Magnesium, 200 mg/kg Calcium
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Quality Checked: Kris Saville
Agricultural Co-Ordinator

PHOSPHORUS SORPTION CAPACITY

40(8) samples supplied by Australian Wetlands Consulting Pty Ltd on 28/03/2024 - Lab Job No. R2395

Analysis requested by Jesse Munro. - **Customer Reference: RVC Landfill**

8 George Street BANGALOW NSW 2479

	SAMPLE 1 NZ A 0-20	SAMPLE 2 NZ B 20-40	SAMPLE 3 NZ C 40-70	SAMPLE 4 NZ D 70-100	SAMPLE 5 EZ A 0-20	SAMPLE 6 EZ B 20-40	SAMPLE 7 EZ C 40-70	SAMPLE 8 EZ D 70-100
Job No.	*R2395/C1*	*R2395/C2*	*R2395/C3*	*R2395/C4*	*R2395/C5*	*R2395/C6*	*R2395/C7*	*R2395/C8*
Native NaOH Phosphorus (mg/kg P)	304	235	35.6	12.7	195	34.8	12.4	0.36
Residual phosphorus remaining in solution from the initial phosphate phosphorus								
Initial Phosphorus concentration (ppm P)	**30.69**	**30.69**	**30.69**	**30.69**	**30.69**	**30.69**	**30.69**	**30.69**
72 hour - 3 Day (ppm P)	30.16	27.59	22.63	15.18	26.92	21.26	16.83	8.06
120 hour - 5 Day (ppm P)	28.67	27.27	22.24	14.42	26.90	19.97	15.15	7.85
168 hour - 7 Day (ppm P)	26.89	26.52	21.91	13.92	26.30	19.89	14.09	6.90
Equilibrium Phosphorus (ppm P)	24.94	25.99	21.44	13.05	26.10	18.65	12.19	6.41

Notes:

1. ppm = mg/kg dried soil
2. Insitu P determined using 0.1 M NaOH and shaking for 24 h before determining phosphate
3. Soils were crushed using a ceramic grinding head and mill; five 1 g subsamples of each soil were used to which 40 mL of 0.1 M NaCl with 30 ppm phosphorus was added to each. The samples were shaken on an orbital shaker
4. All results as dry weight DW - soils were dried at 60°C for 48 h prior to crushing and analysis.
5. Phosphorus Capacity method from Ryden and Pratt, 1980.
6. Analysis conducted between sample arrival date and reporting date.
7. .. Denotes not requested.
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10. This report was issued on 24/04/2024

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Checked:.....

PHOSPHORUS SORPTION TRIAL

40(8) samples supplied by Australian Wetlands Consulting Pty Ltd on 28/03/2024 - Lab Job No. R2395

Analysis requested by Jesse Munro. - Customer Reference: RVC Landfill

8 George Street BANGALOW NSW 2479

Calculations for Equilibrium Absorption Maximum for Soil provided

I.D.	JOB NO.	Equilibrium P mg P/L (in solution)	Added P mg P/L	P Sorb at Equil. mg P/kg	Native P mg P/kg	Equilibrium P Sorption Level µg P/g soil	Divide Θ (from Table)	Equilibrium Absorption Maximum (B) µg P/g soil
NZ A 0-20	**R2395/C1**	24.9	30.69	230	304	534	0.93	**573**
NZ B 20-40	**R2395/C2**	26.0	30.69	188	235	423	0.94	**450**
NZ C 40-70	**R2395/C3**	21.4	30.69	370	36	406	0.90	**449**
NZ D 70-100	**R2395/C4**	13.1	30.69	706	13	718	0.81	**882**
EZ A 0-20	**R2395/C5**	26.1	30.69	184	195	378	0.94	**402**
EZ B 20-40	**R2395/C6**	18.7	30.69	481	35	516	0.88	**588**
EZ C 40-70	**R2395/C7**	12.2	30.69	740	12	753	0.80	**937**
EZ D 70-100	**R2395/C8**	6.4	30.69	971	0	972	0.70	**1,386**

Calculations for phosphorus sorption capacity

	JOB NO.	Equilibrium Absorption Maximum (B) µg P/g soil	multiply by theta of wastewater to be applie (=X)	minus the native P (=Y)	**kg P sorption / hectare (to a depth of 15 cm)** (1.95 is a correction factor for density, etc	**kg P sorption / hectare (to a depth of 100 cm)** (1.95 is a correction factor for density, etc)
NZ A 0-20	*R2395/C1*	573	(=B x theta)	(=X -native P)	(=Y x 1.95)	(=Y x 1.95 x 100/15)
NZ B 20-40	*R2395/C2*	450	(=B x theta)	(=X - native P)	(=Y x 1.95)	(=Y x 1.95 x 100/15)
NZ C 40-70	*R2395/C3*	449	(=B x theta)	(=X -native P)	(=Y x 1.95)	(=Y x 1.95 x 100/15)
NZ D 70-100	*R2395/C4*	882	(=B x theta)	(=X - native P)	(=Y x 1.95)	(=Y x 1.95 x 100/15)
EZ A 0-20	*R2395/C5*	402	(=B x theta)	(=X - native P)	(=Y x 1.95)	(=Y x 1.95 x 100/15)
EZ B 20-40	*R2395/C6*	588	(=B x theta)	(=X - native P)	(=Y x 1.95)	(=Y x 1.95 x 100/15)
EZ C 40-70	*R2395/C7*	937	(=B x theta)	(=X - native P)	(=Y x 1.95)	(=Y x 1.95 x 100/15)
EZ D 70-100	*R2395/C8*	1386	(=B x theta)	(=X - native P)	(=Y x 1.95)	(=Y x 1.95 x 100/15)

EXAMPLE 1 - Calculations for phosphorus sorption capacity using a wastewater phosphorus of 15 mg/L P

	JOB NO.	Equilibrium Absorption Maximum (B) µg P/g soil	multiply by theta of wastewater to be applie (ie. 0.84)	minus the native P (=Y)	**kg P sorption / hectare (to a depth of 15 cm)** (1.95 is a correction factor for density, etc	**kg P sorption / hectare (to a depth of 100 cm)** (1.95 is a correction factor for density, etc)
NZ A 0-20	*R2395/C1*	573	481	177	**345**	**2,297**
NZ B 20-40	*R2395/C2*	450	378	143	**278**	**1,854**
NZ C 40-70	*R2395/C3*	449	377	341	**665**	**4,437**
NZ D 70-100	*R2395/C4*	882	741	728	**1,420**	**9,464**
EZ A 0-20	*R2395/C5*	402	337	143	**279**	**1,857**
EZ B 20-40	*R2395/C6*	588	494	459	**895**	**5,970**
EZ C 40-70	*R2395/C7*	937	787	775	**1,511**	**10,075**
EZ D 70-100	*R2395/C8*	1386	1164	1164	**2,269**	**15,129**

Checked:.....

PHOSPHORUS SORPTION CAPACITY

2 samples supplied by Australian Wetlands Consulting Pty Ltd on 28/03/2024 - Lab Job No. R2397

Analysis requested by Jesse Munro. - **Customer Reference: RVC Landfill** EZ 0-10 & NZ 0-10

8 George Street BANGALOW NSW 2479

	SAMPLE 1 EZ 0-10	**SAMPLE 2 NZ 0-10**
Job No.	*R2397/1*	*R2397/2*
Native NaOH Phosphorus (mg/kg P)	130	397
Residual phosphorus remaining in solution from the initial phosphate phosphorus		
Initial Phosphorus concentration (ppm P)	**30.69**	**30.69**
72 hour - 3 Day (ppm P)	28.59	27.76
120 hour - 5 Day (ppm P)	27.90	26.85
168 hour - 7 Day (ppm P)	27.29	25.77
Equilibrium Phosphorus (ppm P)	26.45	24.58

Notes:

1. ppm = mg/kg dried soil
2. Insitu P determined using 0.1 M NaOH and shaking for 24 h before determining phosphate
3. Soils were crushed using a ceramic grinding head and mill; five 1 g subsamples of each soil were used to which 40 mL of 0.1 M NaCl with 30 ppm phosphorus was added to each. The samples were shaken on an orbital shaker
4. All results as dry weight DW - soils were dried at 60°C for 48 h prior to crushing and analysis.
5. Phosphorus Capacity method from Ryden and Pratt, 1980.
6. Analysis conducted between sample arrival date and reporting date.
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Checked:.....

PHOSPHORUS SORPTION TRIAL

2 samples supplied by Australian Wetlands Consulting Pty Ltd on 28/03/2024 - Lab Job No. R2397

Analysis requested by Jesse Munro. - Customer Reference: RVC Landfill EZ 0-10 & NZ 0-10

8 George Street BANGALOW NSW 2479

Calculations for Equilibrium Absorption Maximum for Soil provided

I.D.	JOB NO.	Equilibrium P mg P/L (in solution)	Added P mg P/L	P Sorb at Equil. mg P/kg	Native P mg P/kg	Equilibrium P Sorption Level µg P/g soil	Divide Θ (from Table)	Equilibrium Absorption Maximum (B) µg P/g soil
EZ 0-10	**R2397/1**	26.5	30.69	169	130	299	0.94	**317**
NZ 0-10	**R2397/2**	24.6	30.69	244	397	641	0.93	**690**

Calculations for phosphorus sorption capacity

	JOB NO.	Equilibrium Absorption Maximum (B µg P/g soil	multiply by theta of Wastewater to be applie (=X)	minus the native P (=Y)	**kg P sorption / hectare (to a depth of 15 cm)** (1.95 is a correction factor for density, etc	**kg P sorption / hectare (to a depth of 100 cm)** (1.95 is a correction factor for density, etc)
EZ 0-10	*R2397/1*	317	(=B x theta)	(=X -native P)	(=Y x 1.95)	(=Y x 1.95 x 100/15)
NZ 0-10	*R2397/2*	690	(=B x theta)	(=X - native P)	(=Y x 1.95)	(=Y x 1.95 x 100/15)

EXAMPLE 1 - Calculations for phosphorus sorption capacity using a wastewater phosphorus of 15 mg/L P

	JOB NO.	Equilibrium Absorption Maximum (B µg P/g soil	multiply by theta of Wastewater to be applie (ie. 0.84)	minus the native P (=Y)	**kg P sorption / hectare (to a depth of 15 cm)** (1.95 is a correction factor for density, etc	**kg P sorption / hectare (to a depth of 100 cm)** (1.95 is a correction factor for density, etc)
EZ 0-10	*R2397/1*	317	266	136	**266**	**1,773**
NZ 0-10	*R2397/2*	690	579	182	**355**	**2,369**

Checked:.....