Gerroa Sand Resource Annual Environmental Management Report

Period 01 July 2019 – 30 June 2020

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Title Block

Name of operation	Gerroa Sand Resource
Name of operator	Cleary Bros (Bombo) Pty Ltd
Development consent #	05/0099
Name of holder of development consent	Cleary Bros (Bombo) Pty Ltd
AEMR start date	1/7/2019
AEMR end date	30/6/2020
I, Helen Cleary, certify that this audit report is a true and accurate record of the compliance status of the Gerroa Sand Resource for the period 1 July 2019 to 30 June 2020 and that I am authorised to make this statement on behalf of Cleary Bros (Bombo) Pty Ltd. *Note* *a) The Annual Review is an 'environmental audit' for the purposes of section 122B(2) of the Environmental Planning and Assessment Act 1979. Section 122E provides that a person must not include false or misleading information (or provide information for inclusion in) an audit report produced to the Minister in connection with an environmental audit if the person knows that the information is false or misleading in a material respect. The maximum penalty is, in the case of a corporation, $1 million and for an individual, $250,000.* *b) The Crimes Act 1900 contains other offences relating to false and misleading information: section 192G (Intention to defraud by false or misleading statement—maximum penalty 5 years imprisonment); sections 307A, 307B and 307C (False or misleading applications/information/documents—maximum penalty 2 years imprisonment or $22,000, or both).*	
Name of authorised reporting officer	Helen Cleary
Title of authorised reporting officer	Executive General Manager
Signature of authorised reporting officer	
Date	15/7/2020

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Abbreviations

AEMR	Annual Environmental Management Report
CB	Cleary Bros (Bombo) Pty Ltd
DC	Development Consent (PA 05/0099)
EPA	Environmental Protection Authority
DP	Deposited Plan
DPIE	Department of Planning, Industry and Environment
EPL	Environmental Protection Licence
LEC	Land & Environment Court
MW	Monitoring Well
QEMP	Quarry Environmental Management Plan

Internal Document Control

Version	Description	Prepared By	Approved By	Prepared Date
1	Initial Draft	M Hammond		9/7/2020
2	Final	M Hammond	H Cleary	15/7/2020

1. Introduction

1.1. Statement of Compliance

Were all conditions of the relevant approvals complied with?	
Development consent #05/0099	Yes
Environmental Protection Licence #4146	Yes

1.2. Background

Sand has been extracted from Cleary Bros (CB) sand quarry at Gerroa for approximately 60 years. The works have been authorised by a succession of development approvals.

On 2 September 2008 the Land and Environment Court granted the current project approval to Cleary Bros (Bombo) Pty Ltd for "Extension and Continuation of Gerroa Sand Quarry". Sand extraction by dredging on the property is licensed by the Environment Protection Authority (EPA).

CB currently operates in accordance with the site's Quarry Environmental Management Plan (QEMP) in accordance with the requirements of the sites EPL and Development Consent (DC), which was most recently approved by the Department of Planning, Industry and Environment (DPIE) on 1 February 2017. The location of the property is shown on Figure 1.

1.3. Objectives of the Annual Environmental Management Report

Condition 4 of Schedule 5 in Land and Environment Court Consent number 10801 of 2007 requires CB to submit an Annual Environmental Management Report (AEMR). The condition requires the AEMR to:

- Identify the standards and performance measures that apply to the project.
- Describe the works carried out in the last 12 months.
- Describe the works that will be carried out in the next 12 months.
- Include a summary of the complaints received during the past year, and compare this to the complaints received in previous years.
- Include a summary of the monitoring results for the project during the past year.
    - Include an analysis of these monitoring results against the relevant:
    - Impact assessment criteria/limits.
    - Monitoring results from previous years.
    - Predictions in the Environmental Assessment (EA).
- Include an evaluation of the effectiveness of the environmental protection requirements and procedures in the AEMR.
- Identify any trends in the monitoring results over the life of the project.
- Identify any non-compliance during the previous year.
- Describe what actions were, or are being taken to ensure compliance.

Figure 1 - Locality Plan

2. Site Description and Activities

2.1. Site Identification

The site comprises all of Lot A DP 185785 and part of Lot 2 DP 1111012. The property is owned by Bridon Pty Ltd, a member of the Cleary Bros group of companies.

The site lies across a local government boundary with approximately two thirds being contained within Kiama Municipal Councils area of governance and approximately one third lying within Shoalhaven City Councils area of governance. The operational area is contained within a small portion of the site in an area totalling approximately 27.5 hectares. The operational area fronts Crooked River Road and Berry Beach Road. The remainder of the property is used for agricultural activities.

The quarrying process involves dredging the sand mixed with water by suction based on a barge and piped back to the wet sorter located on the western edge of the dredge pond. In the wet sorter the gravel and larger materials such as shells are removed from the sand before the sand is sent to the cyclone which removes any remaining silt. From here the sand is deposited into stockpile and the removed silt and excess water are returned to the dredge pond. When the sand stockpile is of sufficient size, it is re-stockpiled away from the wet sorter and cyclone systems to dry. The sand is eventually transferred to the processing area away from the dredging area for storage and sale to the Cleary Bros concrete plants and to the public.

3. Key Licence Issues

3.1. Environmental Protection Licence Annual Reports

The Environment Protection Authority (EPA) has issued an Environmental Protection Licence (Licence No. 4146) for the dredging works on site, which was most recently updated on 9 December 2011.

The licence, issued under s55 of the Protection of the Environment Operations Act 1997, requires an annual return to be submitted to the EPA, for the reporting period of 2nd February to 31st January.

The EPA Annual Returns for 2005 to 2020 reporting periods were reviewed to provide a background to this report. These Annual Returns can be summarised as follows:-

01 February 2005 to 31 January 2006
B1. Pollution complaints - Nil.
B2. Concentration monitoring summary – None required.
B3. Volume or mass monitoring summary - None required.
C1. Compliance with licence condition – All conditions complied with.

01 February 2006 to 31 January 2007
B1. Pollution complaints - Nil.
B2. Concentration monitoring summary – None required.
B3. Volume or mass monitoring summary - None required.
C1. Compliance with licence condition – All conditions complied with.

01 February 2007 to 31 January 2008
B1. Pollution complaints - Nil.
B2. Concentration monitoring summary – None required.
B3. Volume or mass monitoring summary - None required.
C1. Compliance with licence condition – All conditions complied with.

01 February 2008 to 31 January 2009
B1. Pollution complaints - Nil.
B2. Concentration monitoring summary – None required.
B3. Volume or mass monitoring summary - None required.
C1. Compliance with licence condition – All conditions complied with.

01 February 2009 to 31 January 2010
B1. Pollution complaints - Nil.[1]
B2. Concentration monitoring summary – None required.
B3. Volume or mass monitoring summary - None required.
C1. Compliance with licence condition – All conditions complied with.

01 February 2010 to 31 January 2011
B1. Pollution complaints - Nil.
B2. Concentration monitoring summary – None required.
B3. Volume or mass monitoring summary - None required.
C1. Compliance with licence condition – All conditions complied with.

01 February 2011 to 31 January 2012
B1. Pollution complaints - Nil.
B2. Concentration monitoring summary – None required.
B3. Volume or mass monitoring summary - None required.
C1. Compliance with licence condition – All conditions complied with.

[1] One other complaint was reported to CB from DoP as a letter dated 2 December 2009 relating to the extent of clearing. This was investigated and found not to be factual (refer CB letter to DoP dated 15 December 2009).

01 February 2012 to 31 January 2013
B1. Pollution complaints - Nil.
B2. Concentration monitoring summary – None required.
B3. Volume or mass monitoring summary - None required.
C1. Compliance with licence condition – All conditions complied with.

01 February 2013 to 31 January 2014
B1. Pollution complaints - Nil.
B2. Concentration monitoring summary – None required.
B3. Volume or mass monitoring summary - None required.
C1. Compliance with licence condition – All conditions complied with.

01 February 2014 to 31 January 2015
B1. Pollution complaints - Nil.
B2. Concentration monitoring summary – None required.
B3. Volume or mass monitoring summary - None required.
C1. Compliance with licence condition – All conditions complied with.

01 February 2015 to 31 January 2016
B1. Pollution complaints - Nil.
B2. Concentration monitoring summary – None required.
B3. Volume or mass monitoring summary - None required.
C1. Compliance with licence condition – All conditions complied with.

01 February 2016 to 31 January 2017
B1. Pollution complaints - Nil.
B2. Concentration monitoring summary – None required.
B3. Volume or mass monitoring summary - None required.
C1. Compliance with licence condition – All conditions complied with.

01 February 2017 to 31 January 2018
B1. Pollution complaints - Nil.
B2. Concentration monitoring summary – None required.
B3. Volume or mass monitoring summary - None required.
C1. Compliance with licence condition – All conditions complied with.

01 February 2018 to 31 January 2019
B1. Pollution complaints - Nil.
B2. Concentration monitoring summary – None required.
B3. Volume or mass monitoring summary - None required.
C1. Compliance with licence condition – All conditions complied with.

01 February 2019 to 31 January 2020
B1. Pollution complaints - Nil.
B2. Concentration monitoring summary – None required.
B3. Volume or mass monitoring summary - None required.
C1. Compliance with licence condition – All conditions complied with.

3.2. Development Consent

The Development Consent (DC) was approved by the Land and Environment Court (LEC) on 02 September 2008 and is the primary consent relevant to sand quarrying operations.

As a requirement of the DC the first AEMR must be completed within 12 months of the aforementioned approval date (which has been complied with) and subsequent AEMRs must be completed annually thereafter.

3.3. Standards and Performance Measures that apply

The Development Consent (DC) was approved by the Land and Environment Court (LEC) on 02 September 2008 and is the primary consent relevant to sand quarrying operations. The Environmental Assessment dated October 2006 outlines the predicted impacts of the most recent extension of the operation. The Gerroa Sand Resource is also licenced by the Environmental Protection Authority under Environmental Protection License 4146. These documents contain the standards and performance measures for the Gerroa Sand Resource, which are identified separately in Section 4.

3.4. Works Carried Out in Reporting Period

The total sand transported from site during the 2019/2020 reporting year was 54,178 tonnes. In the current reporting period, sand was extracted from previous laydown and stockpiling areas, as well as from previously dredged parts, with the current dredge able to extract to a greater depth than the previously used dredge. The previous year's return (2018/2019) to the Department of Trade and Investment, Resources and Energy is included as Annexure A for 55,784 tonnes. The return for the 2019/2020 is due in November 2020 to the Department of Trade and Investment, Resources and Energy and will be included in next year's AEMR.

3.5. Works to be Carried Out in the Next Period

The dredge will continue into the eastern extents of the stockpile areas, which have been identified in the geotechnical report contained in the Gerroa Sand Resource Environmental Impact Statement. As such the dredge will be operating in the area described in Figure 2.

Other works that may be undertaken during the 2020/2021 reporting period include the early works associated with the modification of the current consent. Any works for this purpose are dependent on passage of the modification, which is currently being assessed by the DPIE.

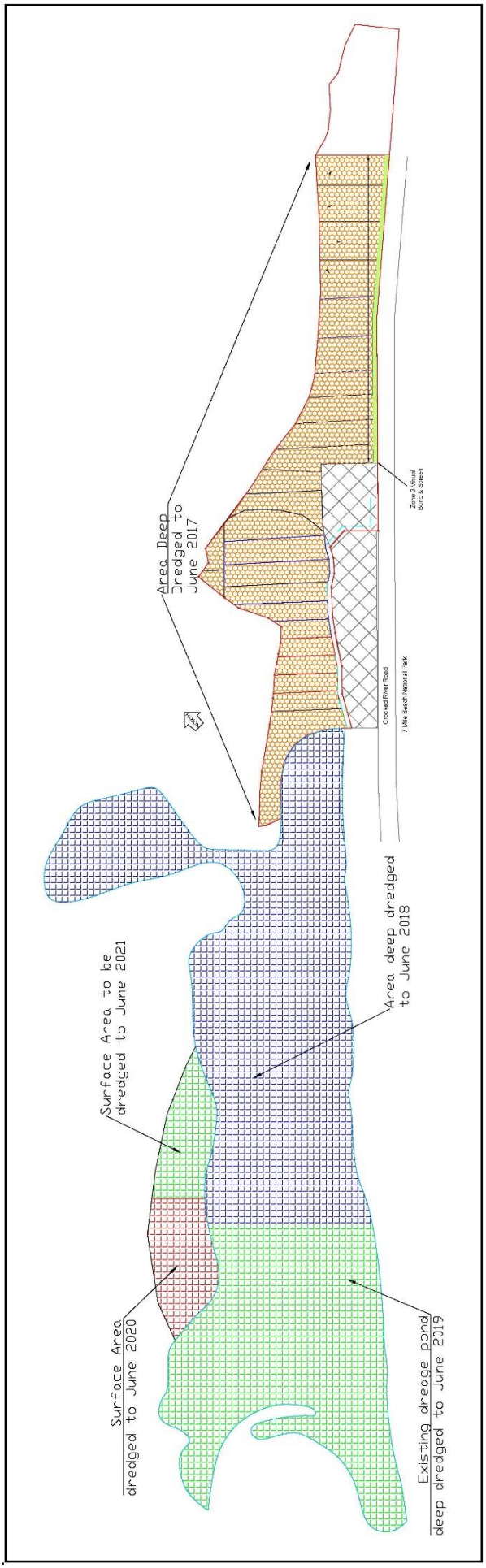


Figure 2 – Description of works

4. Review of Environmental Performance

4.1. Meteorological Monitoring

4.1.1. Licence Requirements

The DC requires Cleary Bros to maintain a meteorological station on site.

4.1.2. Compliance Assessment

A meteorological station is maintained onsite that provides information on rainfall, air temperature, solar radiation and wind speed via mobile telemetry to an online portal. The current weather station was installed in September 2016. A new rainfall gauge was installed in April 2020 to replace the previous gauge which had ceased to function.

4.1.3. Meteorological Monitoring

The current reporting period has continued the trend of recent years of below average rainfall. The below graph shows that the site received approximately 56% of the average rainfall for the year, with 696mm falling for the 12 month period, with all but one month (February) recording below average rainfall. This continuing below average rainfall has resulted in a rainfall deficit for the past 4 years of over 1800mm. This extended rainfall deficit has led to a reduction in water levels recorded in the dredge pond and groundwater monitoring bores around the site, which will be addressed in the following sections.

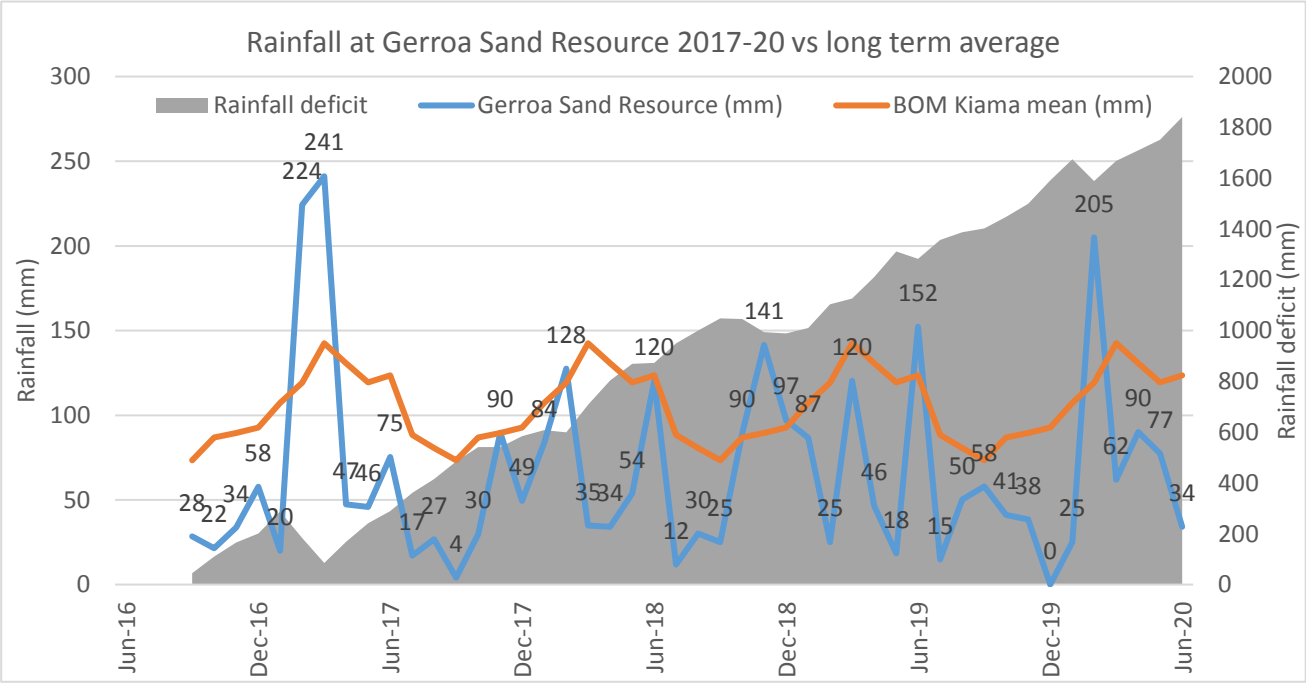


Figure 3 – Rainfall measured on site FY17-20 against long term average

4.2. Groundwater Management

4.2.1. Standards and Performance Measures

There are no specific criteria for groundwater quality in the sites EPL.

The groundwater monitoring requirements from the DC are realised by the sites QEMP. Section 8.6 of the QEMP details the groundwater testing requirements and specifies that 13 boreholes on site require monthly water level readings and quarterly analyte testing. The tabulated results of groundwater monitoring are included in Annex B. The EA predicted that the project is not expected to result in variation in the range of groundwater levels previously experienced in the monitoring bores on the site. Furthermore, the EA identified that existing low pH levels in groundwater bores to be relatively benign, signifying natural impacts from naturally occurring pyrites and organic acids, with sand extraction not predicted to lead to any deterioration of the groundwater quality.

The groundwater quality objectives which CB should “aim to meet” from the DC (and adopted in the QEMP) are as follows:-

Analyte	Units	Objective
pH	pH	6.0 – 8.5
Electrical Conductivity	µS/cm	<1,500
Total Phosphorus	µg/L	<30
Total Nitrogen	µg/L	<350
Chlorophyll-A	µg/L	<5
Faecal Coliforms	Median No./100 mL	<1,000
Enterococci	Median No./100 mL	<230
Sodium	mg/L	<400
Potassium Ion	mg/L	<50
Magnesium Ion	mg/L	<50
Chloride Ion	mg/L	<300
Sulphate Ion	mg/L	<250
Bicarbonate Ion	mg/L	<750
Soluble Iron Ion	mg/L	<6
Ammonium Ion	mg/L	<20

However, the target for groundwater dependant ecosystems extracted from the QEMP is that no discernible deterioration of ecosystems or vegetation, attributable to measured changes in groundwater levels or quality.

4.2.2. Environmental Performance

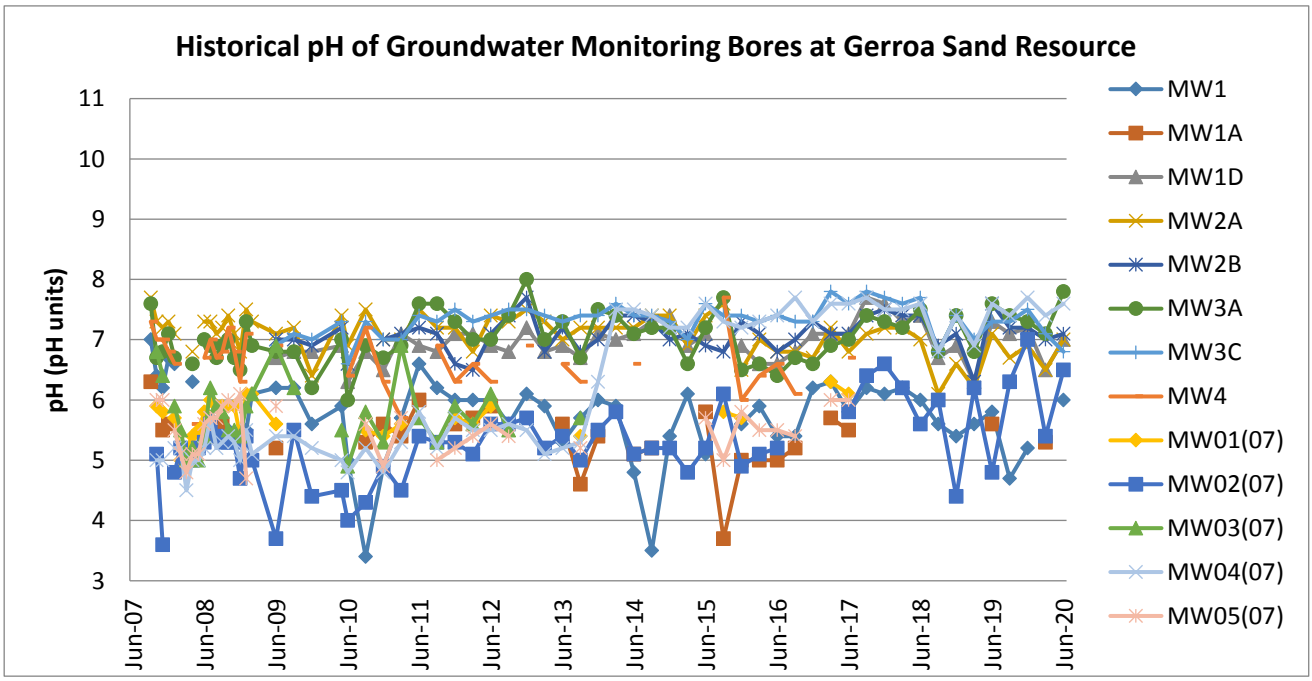
CB has implemented the Groundwater Monitoring Program and Acid Sulphate Soils Management Plan to meet the requirements of the DC. ALS Laboratory Group were engaged during the reporting period to conduct quarterly sampling and testing of the groundwater monitoring sites, as well as monthly testing of the groundwater depths and the leachate from sand extracted by the dredging operation for Total Oxidisable Sulphur.

4.2.3. Groundwater Monitoring

A summary of groundwater monitoring results for the period is displayed in this section, separated into the different analytes required to be monitored as per the DC. For each analyte, the range and average of the current period's monitoring are displayed, alongside the historical range and average, objectives as described in the DC, and any EA predictions. Where groundwater monitoring results trend outside of the historical range or DC objectives, these are highlighted in the summary with discussion into these results below. For each analyte, a historical graph is also included showing the variations in measurements for each groundwater bore throughout the historical monitoring period.

pH (pH units)

BORE HOLE	2019/20 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	4.7	5.3	6.0	3.4	5.7	7.0	6.0 - 8.5	N/A
MW1A	5.3	5.3	5.3	3.7	5.4	6.3	6.0 - 8.5	N/A
MW1D	6.5	7.0	7.2	6.3	7.0	7.7	6.0 - 8.5	N/A
MW2A	6.5	6.8	7.0	6.1	7.1	7.7	6.0 - 8.5	N/A
MW2B	7.0	7.1	7.2	6.3	7.1	7.7	6.0 - 8.5	N/A
MW3A	7.1	7.4	7.8	6.0	7.0	8.0	6.0 - 8.5	N/A
MW3C	6.8	7.2	7.5	6.6	7.3	7.8	6.0 - 8.5	N/A
MW4	Dry/insufficient water for sample			5.6	6.6	7.7	6.0 - 8.5	N/A
MW01(07)	Dry/insufficient water for sample			5.0	5.7	6.3	6.0 - 8.5	N/A
MW02(07)	5.4	6.3	7.0	3.6	5.2	6.6	6.0 - 8.5	N/A
MW03(07)	Dry/insufficient water for sample			4.9	5.8	6.9	6.0 - 8.5	N/A
MW04(07)	7.4	7.5	7.7	4.5	6.1	7.7	6.0 - 8.5	N/A
MW05(07)	Dry/insufficient water for sample			4.7	5.5	6.1	6.0 - 8.5	N/A

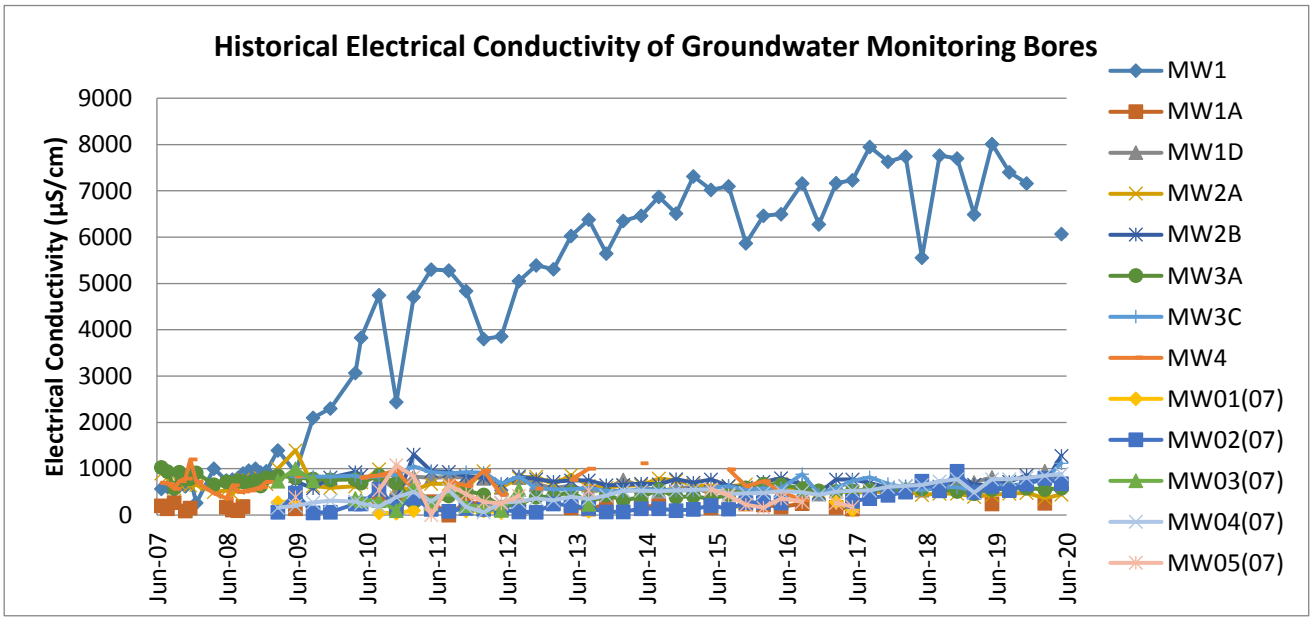


The pH values over the past 12 months have exhibited variability similar to that observed across the historical record. Most groundwater bores recorded pH levels in line with historical averages, with only MW02(07) recording a value above the historical range but still within the groundwater quality objectives, which is likely to reflect natural small-scale fluctuations in groundwater quality. The extended rainfall deficit has meant that four of the bores were unable to be sampled during the reporting period, while one bore could only be sampled on one occasion. All other bores were sampled at each quarterly interval.

Bores MW1 and MW1A, MW02(07) have continued to exhibit mildly acidic groundwater in line with historical results. Dredging has now progressed through the area of the new (2007) monitoring bores, with pH relatively unchanged as a consequence of dredging. The mildly acidic groundwater in certain bores appears to be a result of natural conditions, rather than as a result of dredging operations.

Electrical Conductivity (µS/cm)

BORE HOLE	2019/20 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	6070	6877	7400	260	4269	8010	< 1500	N/A
MW1A	254	254	254	90	197	350	< 1500	N/A
MW1D	621	724	945	457	644	850	< 1500	N/A
MW2A	366	437	476	397	655	1400	< 1500	N/A
MW2B	690	887	1280	300	728	1310	< 1500	N/A
MW3A	550	571	581	176	587	1030	< 1500	N/A
MW3C	633	802	1120	453	687	1050	< 1500	N/A
MW4	Dry/insufficient water for sample			327	688	1200	< 1500	N/A
MW01(07)	Dry/insufficient water for sample			40	142	310	< 1500	N/A
MW02(07)	535	669	793	50	262	948	< 1500	N/A
MW03(07)	Dry/insufficient water for sample			100	419	1000	< 1500	N/A
MW04(07)	775	830	892	60	435	775	< 1500	N/A
MW05(07)	Dry/insufficient water for sample			158	438	1080	< 1500	N/A

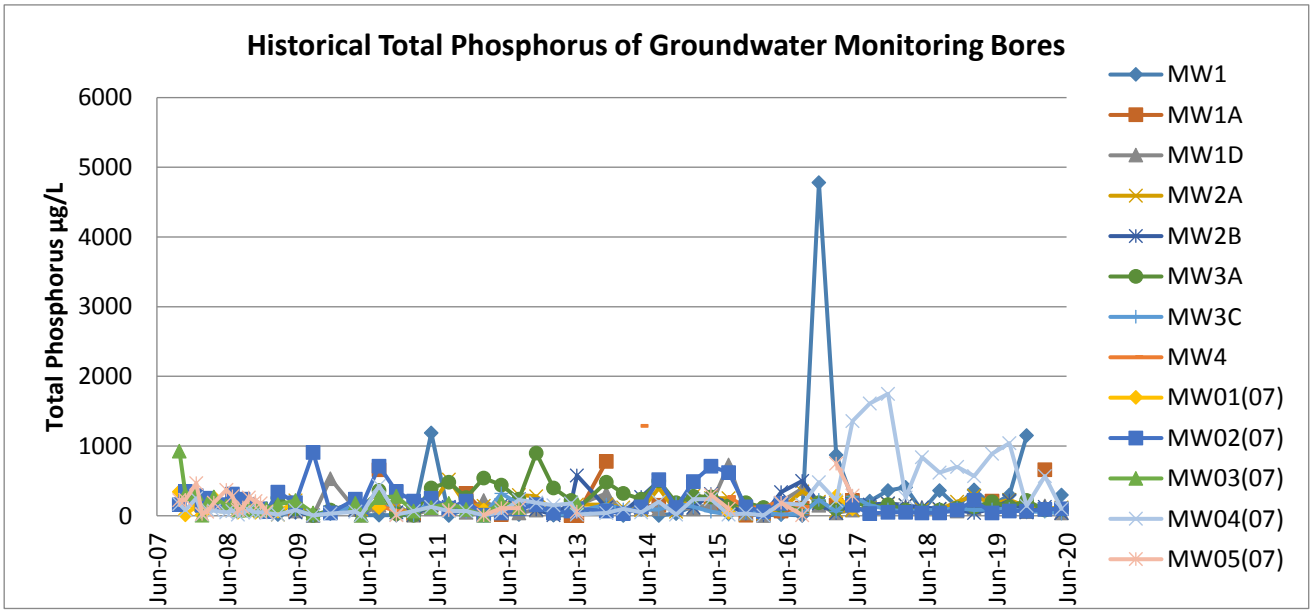


The results over the 12 month period show that the Electrical Conductivity (EC) of the groundwater in the boreholes is within the objective levels for all bores with the exception of MW1. The brackish groundwater in MW1 has not been observed at any other bore or within the dredge pond, and is consistent with other recorded groundwater records for bores screened within the Berry Siltstone unit to the southwest. CB will continue to monitor the EC in this bore as part of the groundwater monitoring programme to track any changes in EC within the local groundwater.

During the reporting year, a consistent increase in EC was observed in certain bores across the monitoring network, with MW1D, MW3C, and MW04(07) recording EC values above the historical range, but still within the groundwater quality objectives. All three bores are located close to Blue Angle Creek to the west of the dredge pond. It is likely that due to the extended rainfall deficit, a saline influence from the Crooked River estuary associated with tidal water is providing a greater contribution to the water present within these bores than during the wetter periods preceding, reflecting the natural variance within the shallow groundwater system.

Total Phosphorus (µg/L)

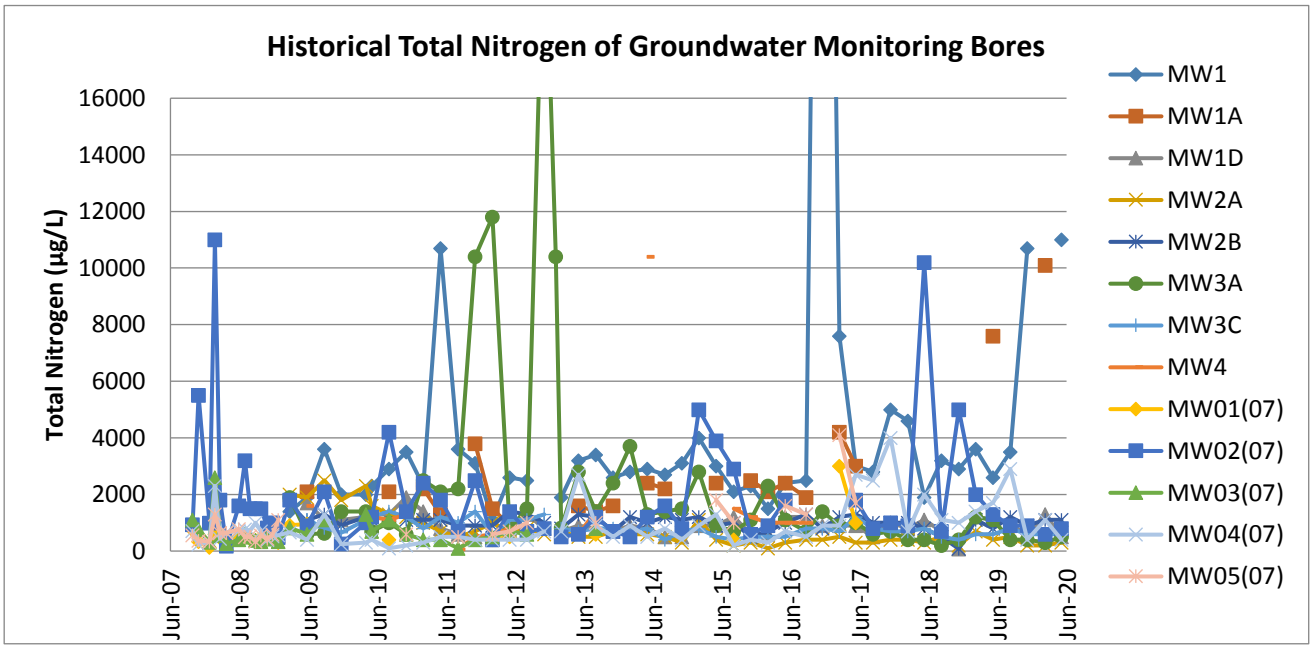
BORE HOLE	2019-20 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	300	583	1150	<10	256	4780	< 30	N/A
MW1A	660	660	660	<10	169	780	< 30	N/A
MW1D	40	90	140	<10	133	730	< 30	N/A
MW2A	100	145	230	10	156	520	< 30	N/A
MW2B	40	110	220	<10	144	580	< 30	N/A
MW3A	80	130	220	<10	227	900	< 30	N/A
MW3C	30	63	100	<10	99	320	< 30	N/A
MW4	Dry/insufficient water for sample			70	215	1290	< 30	N/A
MW01(07)	Dry/insufficient water for sample			12	117	346	< 30	N/A
MW02(07)	70	83	100	10	201	910	< 30	N/A
MW03(07)	Dry/insufficient water for sample			8	172	929	< 30	N/A
MW04(07)	100	463	1040	<10	241	1750	< 30	N/A
MW05(07)	Dry/insufficient water for sample			10	184	750	< 30	N/A



Concentrations of total phosphorus in the boreholes were generally above the groundwater quality objective, however they were all within the historical range for their respective bores. During the reporting period, the concentration of total phosphorus in the dredge pond was generally less than that measured in all bores, suggesting the agricultural land uses surrounding the Gerroa Sand Resource may have contributed to the measurements of total phosphorus in all bores.

Total Nitrogen (µg/L)

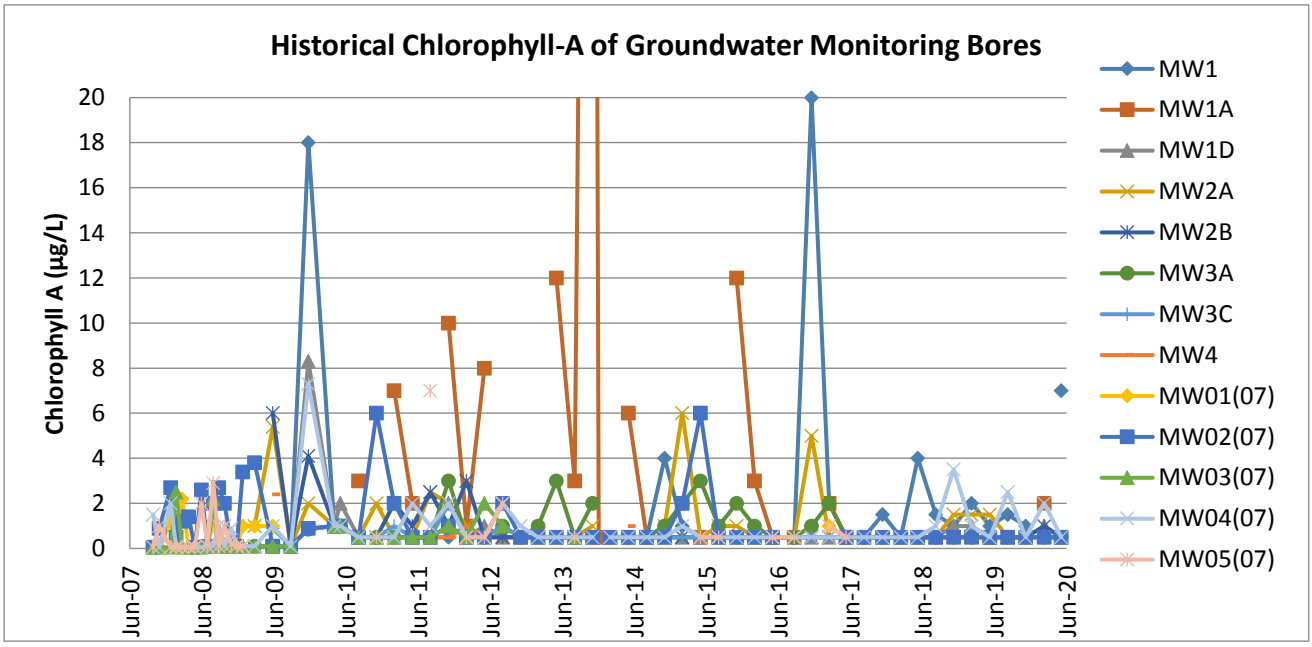
BORE HOLE	2019/20 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	3500	8400	11000	1100	4249	51100	< 350	N/A
MW1A	10100	10100	10100	900	2460	7600	< 350	N/A
MW1D	500	825	1300	400	921	1900	< 350	N/A
MW2A	200	300	500	300	767	2500	< 350	N/A
MW2B	900	1075	1200	700	1000	1400	< 350	N/A
MW3A	300	400	500	600	2473	23200	< 350	N/A
MW3C	600	650	800	400	816	1400	< 350	N/A
MW4	Dry/insufficient water for sample			60	1579	10400	< 350	N/A
MW01(07)	Dry/insufficient water for sample			130	620	3000	< 350	N/A
MW02(07)	600	800	900	180	1933	11000	< 350	N/A
MW03(07)	Dry/insufficient water for sample			100	645	2600	< 350	N/A
MW04(07)	400	1200	2900	100	857	4000	< 350	N/A
MW05(07)	Dry/insufficient water for sample			330	959	4100	< 350	N/A



The concentrations of Total Nitrogen in all groundwater monitoring bores have consistently exceeded the objective levels since monitoring of groundwater quality began. In the current reporting period, nitrogen concentrations were recorded within the historical range in all bores with the exception of the single result for bore MW1A, which was above the previous historical range. The presence of Total Nitrogen at those levels recorded in the bores are likely to be related to the presence of agricultural activities in the area surrounding the Gerroa Sand Resource. This is supported by an analysis of water quality within the dredge pond, which shows that nitrogen concentrations in the pond are generally consistently lower than that recorded in the groundwater monitoring bores.

Chlorophyll A (µg/L)

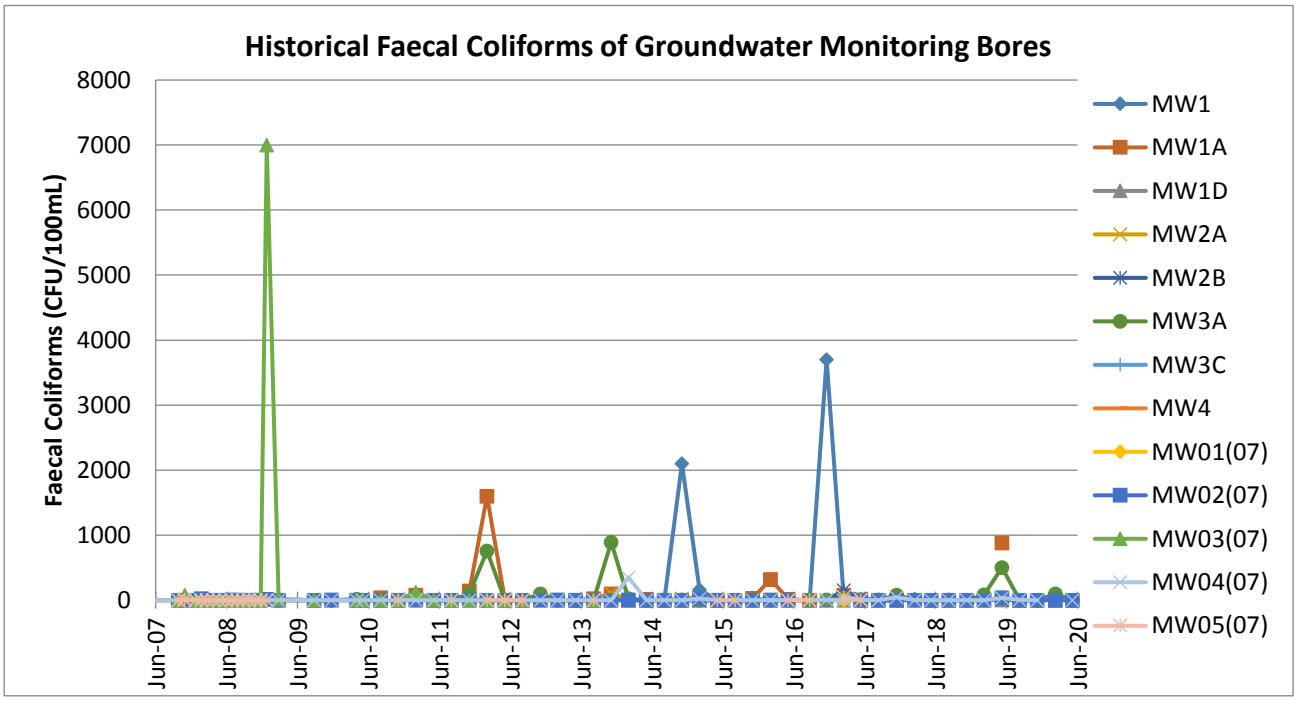
BORE HOLE	2019/20 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	1	3	7	<1	2	20	< 5	N/A
MW1A	<4	<4	<4	<1	8	90	< 5	N/A
MW1D	<1	<1	<2	<1	1	8	< 5	N/A
MW2A	<1	<1	<1	<1	1	6	< 5	N/A
MW2B	<1	<1	<2	<1	1	6	< 5	N/A
MW3A	<1	<1	<1	<1	1	3	< 5	N/A
MW3C	<1	<1	<1	<1	1	2	< 5	N/A
MW4	Dry/insufficient water for sample			<1	1	2	< 5	N/A
MW01(07)	Dry/insufficient water for sample			<1	1	2	< 5	N/A
MW02(07)	<1	<1	<1	<1	1	6	< 5	N/A
MW03(07)	Dry/insufficient water for sample			<1	1	3	< 5	N/A
MW04(07)	<1	1	<5	<1	1	7	< 5	N/A
MW05(07)	Dry/insufficient water for sample			<1	1	7	< 5	N/A



Chlorophyll-A can fluctuate greatly with plant materials being flushed into the system and any results away from the low levels generally observed can be attributed to tree and leaf matter after windy or rainy periods. The chlorophyll-A levels for the reporting period were within the historical ranges for the respective bores and were mostly below the limit of reporting, with a single result for bore MW1 slightly above the objective level.

Faecal Coliforms (median number/100mL)

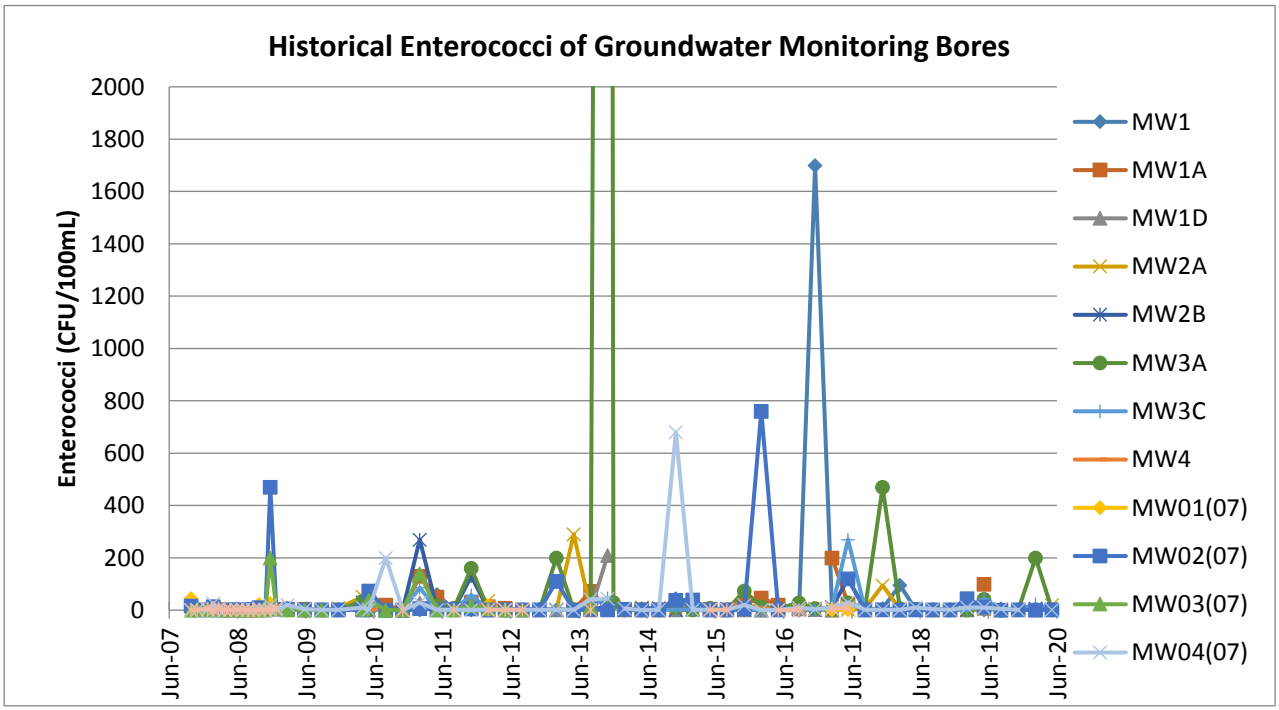
BORE HOLE	2019/20 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	<2	<2	<10	<1	147	3700	<1000	N/A
MW1A	Sample outside of holding time			<1	129	1600	<1000	N/A
MW1D	<1	<2	<2	<1	2	18	<1000	N/A
MW2A	<1	1	1	<1	7	110	<1000	N/A
MW2B	<2	4	14	<1	6	150	<1000	N/A
MW3A	<1	26	100	<1	55	890	<1000	N/A
MW3C	<2	2	2	<1	3	52	<1000	N/A
MW4	Dry/insufficient water for sample			<1	3	36	<1000	N/A
MW01(07)	Dry/insufficient water for sample			<1	2	10	<1000	N/A
MW02(07)	<1	<2	<2	<1	3	30	<1000	N/A
MW03(07)	Dry/insufficient water for sample			<1	250	7000	<1000	N/A
MW04(07)	<2	1	2	<1	10	350	<1000	N/A
MW05(07)	Dry/insufficient water for sample			<1	3	50	<1000	N/A



Faecal coliforms were within the objective levels and historical ranges during the reporting period. Two samples collected in March 2020 were not analysed by the laboratory within the required holding period, with these results not representative of coliform levels in the bores, and as such these results have been excluded from the above analysis.

Enterococci (median number/100mL)

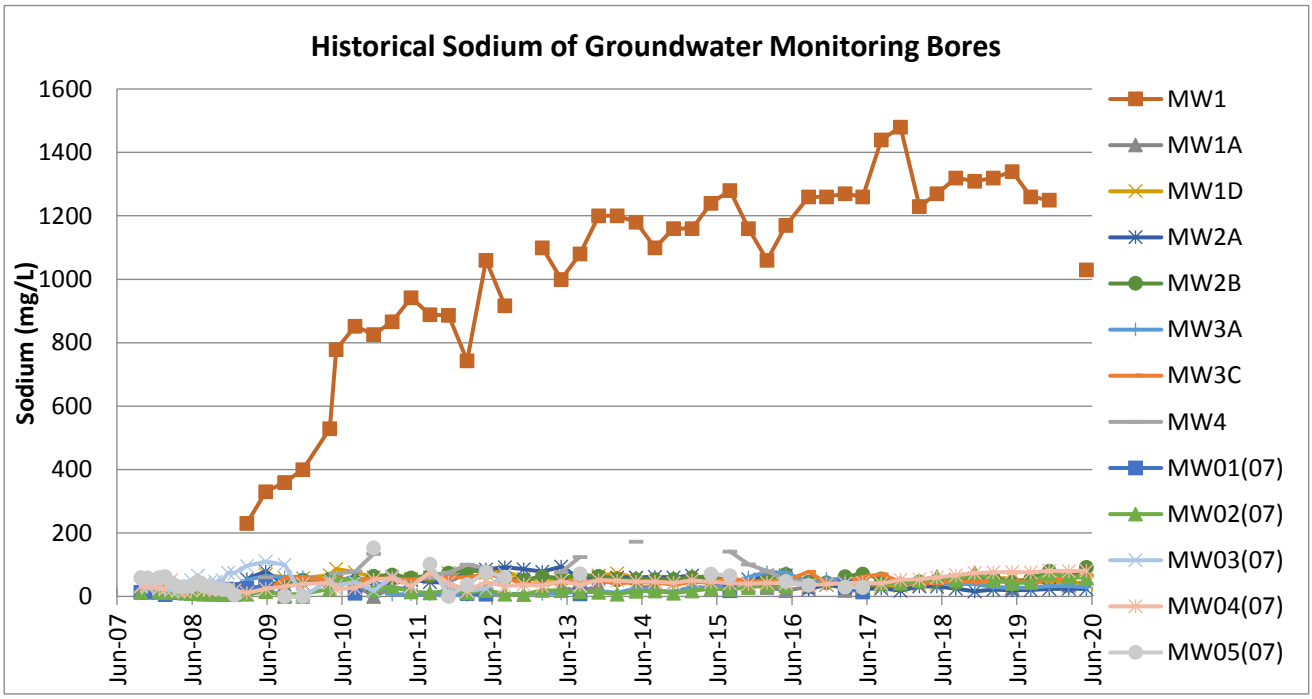
BORE HOLE	2019/20 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	<2	<2	<10	<1	53	1700	<230	N/A
MW1A	<2	100	100	<2	35	200	<230	N/A
MW1D	<1	<2	<2	<2	11	210	<230	N/A
MW2A	<2	9	20	<1	15	290	<230	N/A
MW2B	<2	3	6	<1	18	270	<230	N/A
MW3A	<1	51	200	<1	414	15000	<230	N/A
MW3C	<2	7	24	<1	15	270	<230	N/A
MW4	Dry/insufficient water for sample			<1	7	32	<230	N/A
MW01(07)	Dry/insufficient water for sample			<1	7	44	<230	N/A
MW02(07)	<1	<2	<2	<1	34	760	<230	N/A
MW03(07)	Dry/insufficient water for sample			<1	15	200	<230	N/A
MW04(07)	<2	<2	5	<1	23	680	<230	N/A
MW05(07)	Dry/insufficient water for sample			<1	2	10	<230	N/A



Enterococci concentrations were within the objective levels and the historical ranges during the reporting period. Two samples collected in March 2020 were not analysed by the laboratory within the required holding period, with these results not representative of coliform levels in the bores, and as such these results have been excluded from the above analysis.

Sodium (mg/L)

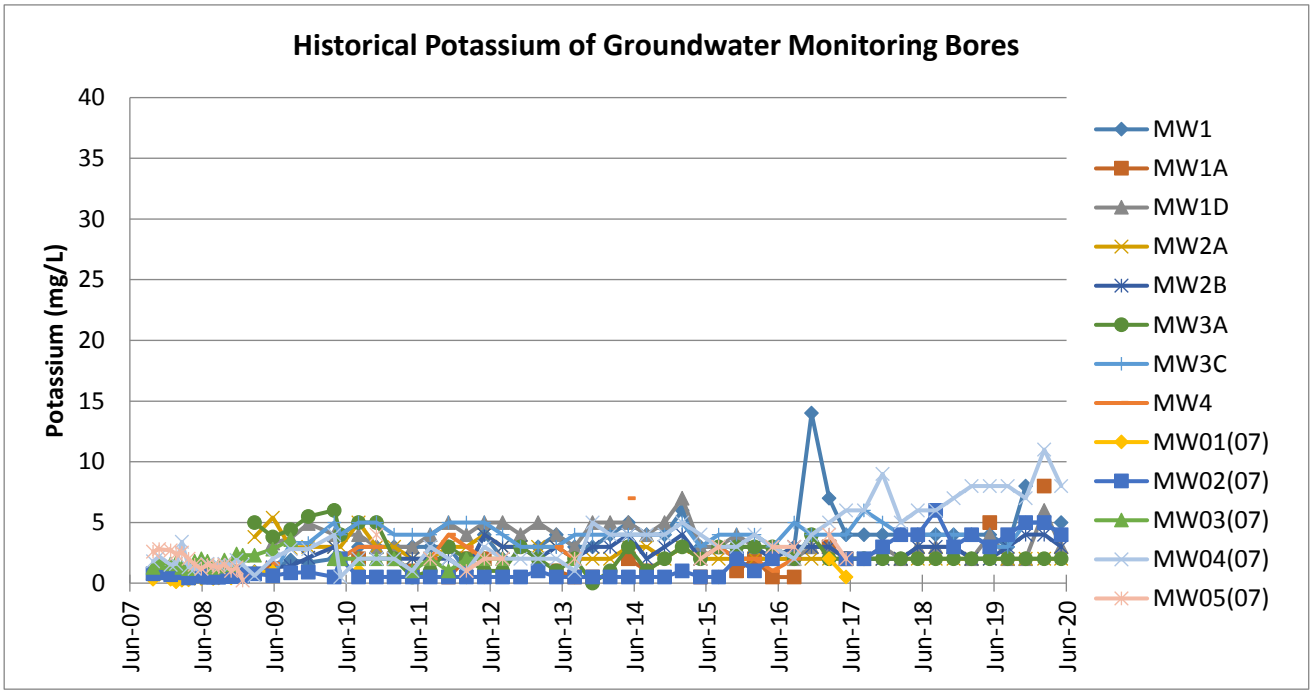
BORE HOLE	2019/20 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	1030	1180	1260	230	1036	1480	< 400	N/A
MW1A	36	36	36	14	26	36	< 400	N/A
MW1D	41	44	46	33	54	87	< 400	N/A
MW2A	20	23	25	16	50	94	< 400	N/A
MW2B	55	71	92	38	57	83	< 400	N/A
MW3A	28	31	33	4	34	77	< 400	N/A
MW3C	45	56	67	11	50	78	< 400	N/A
MW4	Dry/insufficient water for sample			45	92	173	< 400	N/A
MW01(07)	Dry/insufficient water for sample			6.2	16	33	< 400	N/A
MW02(07)	45	60	73	5.4	23	75	< 400	N/A
MW03(07)	Dry/insufficient water for sample			17	48	110	< 400	N/A
MW04(07)	76	80	81	11	40	77	< 400	N/A
MW05(07)	Dry/insufficient water for sample			5.5	50	154	< 400	N/A



With the exception of borehole MW1, all sodium concentrations recorded in the boreholes are within the DC objectives, and consistently at a low level. Two bores (MW2B and MW04(07)) recorded sodium concentrations marginally above the historical ranges for the respective bores. These mirrored the EC recorded in the bores, and are likely reflective of the extended rainfall deficit experienced over the last 4 years.

Potassium Ion (mg/L)

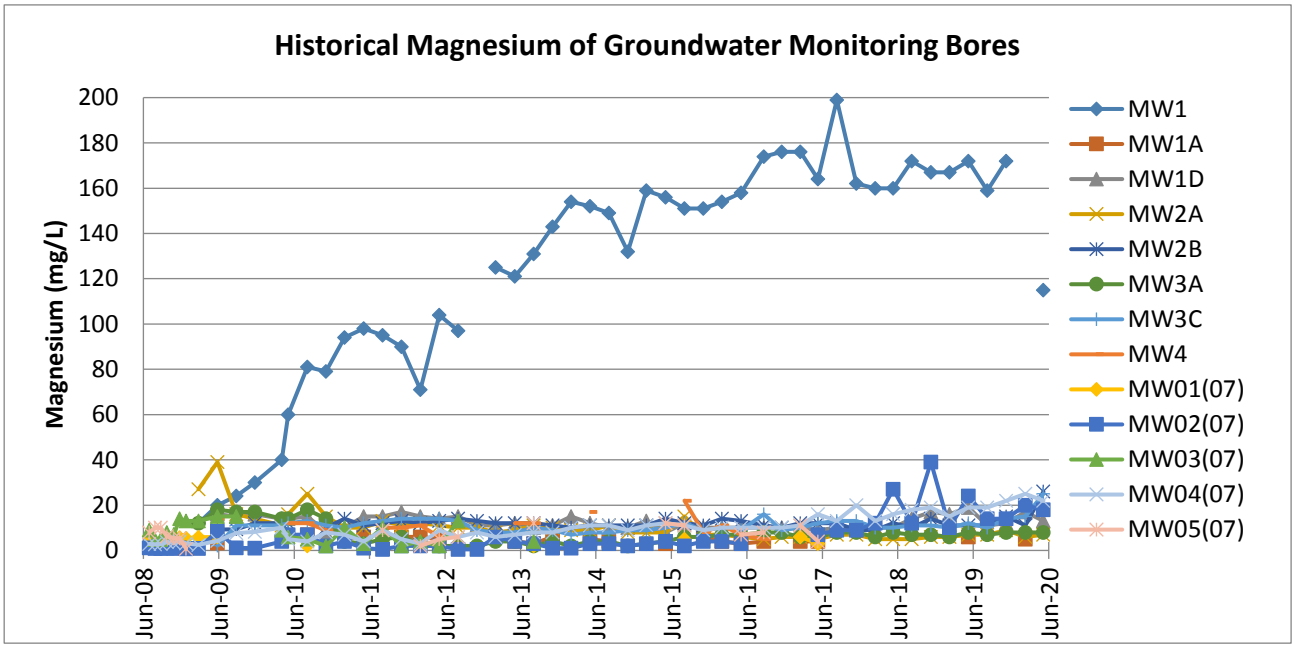
BORE HOLE	2019/20 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	3	5	8	<1	3	14	< 50	N/A
MW1A	8	8	8	<1	2	5	< 50	N/A
MW1D	2	3	6	2	4	7	< 50	N/A
MW2A	2	2	2	2	3	5.4	< 50	N/A
MW2B	3	4	4	1	2	4	< 50	N/A
MW3A	2	2	2	<1	3	6	< 50	N/A
MW3C	3	4	5	<1	4	6	< 50	N/A
MW4	Dry/insufficient water for sample			1	3	7	< 50	N/A
MW01(07)	Dry/insufficient water for sample			<1	1	2	< 50	N/A
MW02(07)	4	5	5	<1	1	6	< 50	N/A
MW03(07)	Dry/insufficient water for sample			1	2	3.6	< 50	N/A
MW04(07)	7	9	11	<1	3	9	< 50	N/A
MW05(07)	Dry/insufficient water for sample			<1	2	4	< 50	N/A



Potassium ion concentrations have remained well below DC objective levels during the reporting period. All samples were within the historical range for their respective sites with the exception of a single sample in each of bores MW1A and MW05(07). The concentration of potassium is typically very low and a minor component of the ionic balance in all bores. The monitoring results indicate no deterioration in groundwater quality related to potassium ion concentrations in the current reporting year.

Magnesium Ion (mg/L)

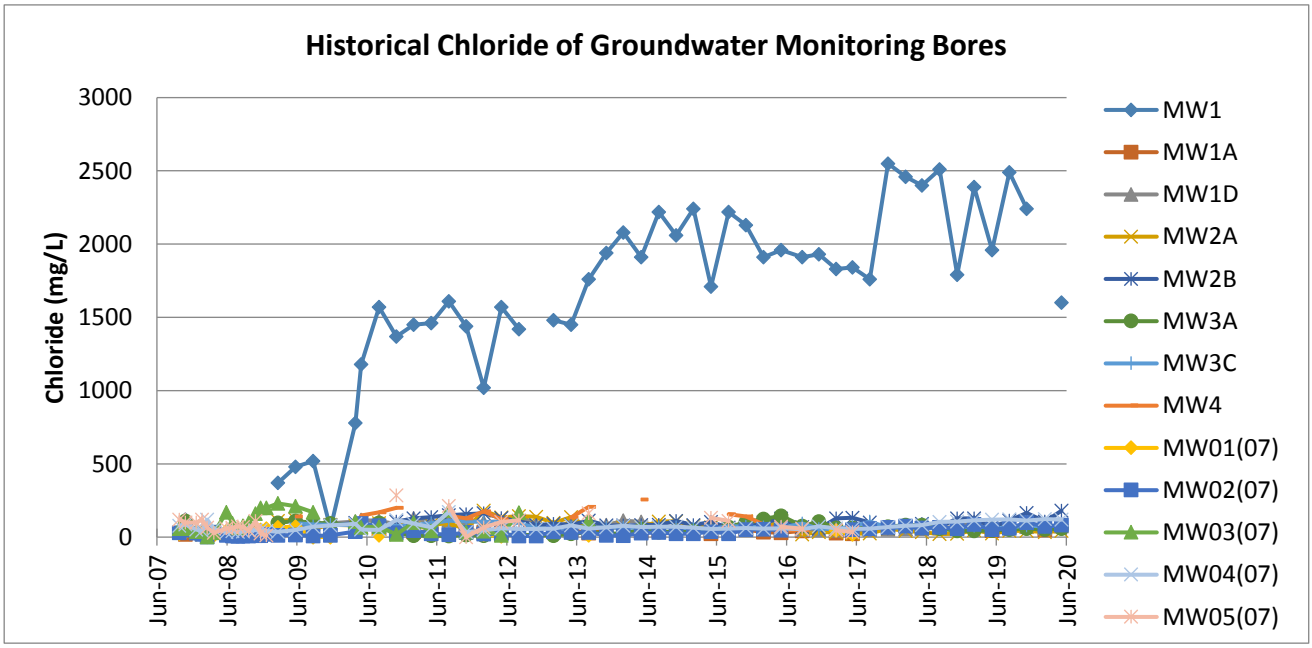
BORE HOLE	2019/20 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	115	149	172	12	124	199	< 50	N/A
MW1A	5	5	5	3	5	7	< 50	N/A
MW1D	11	13	17	8	12	19	< 50	N/A
MW2A	6	7	9	5	11	39	< 50	N/A
MW2B	11	16	26	9	12	14	< 50	N/A
MW3A	7	8	8	2	7	18	< 50	N/A
MW3C	10	16	25	2.1	11	16	< 50	N/A
MW4	Dry/insufficient water for sample			5	11	22	< 50	N/A
MW01(07)	Dry/insufficient water for sample			2	4	6.1	< 50	N/A
MW02(07)	14	17	20	0.5	5	39	< 50	N/A
MW03(07)	Dry/insufficient water for sample			2	8	15	< 50	N/A
MW04(07)	19	22	25	2.5	9	20	< 50	N/A
MW05(07)	Dry/insufficient water for sample			0.79	7	12	< 50	N/A



All magnesium ion concentrations were within DC objective levels with the exception of MW1, which has followed similar trends as for conductivity and sodium. As for conductivity and sodium, magnesium ion concentrations appear to be relatively stable in the current reporting period. All samples were within the historical range for their respective sites with the exception of bores MW2B, MW3C and MW04(07) which recorded concentrations above their respective historical ranges. These variations are in line with observations relating to electrical conductivity and represent the impact of the continued rainfall deficit.

Chloride Ion (mg/L)

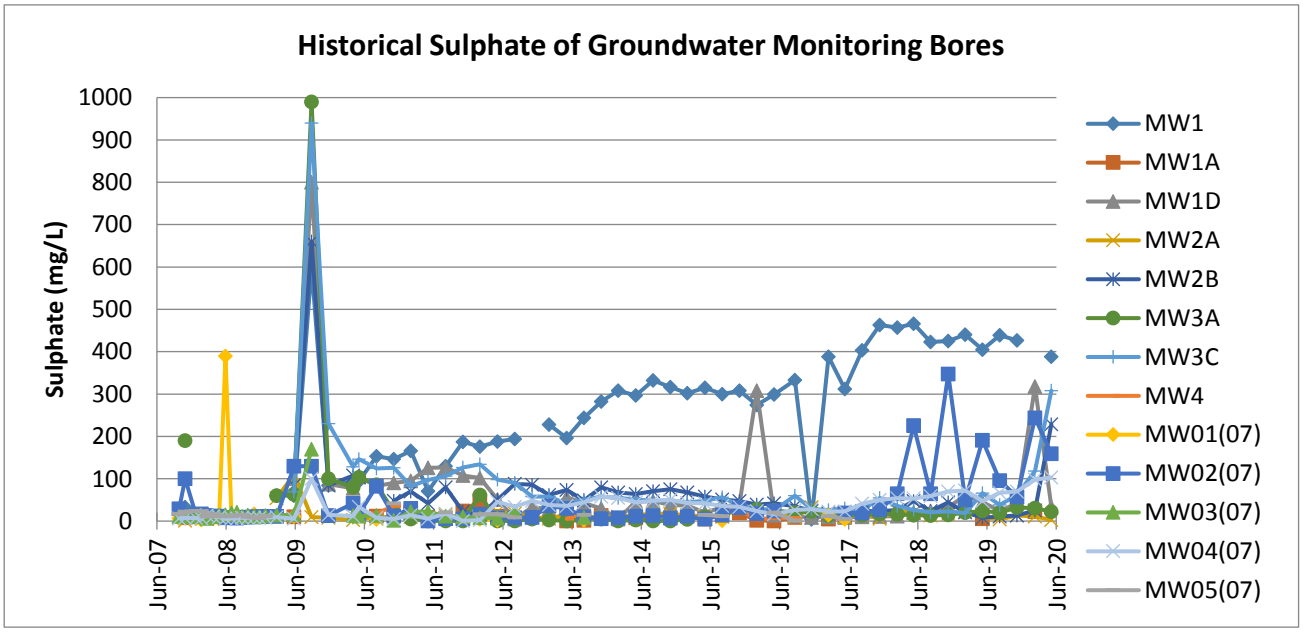
BORE HOLE	2019/20 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	1600	2110	2490	60	1639	2550	< 300	N/A
MW1A	50	50	50	18	37	56	< 300	N/A
MW1D	63	70	75	48	83	142	< 300	N/A
MW2A	34	40	42	18	75	181	< 300	N/A
MW2B	107	141	180	57	99	162	< 300	N/A
MW3A	51	55	59	8	57	146	< 300	N/A
MW3C	65	76	85	55	76	112	< 300	N/A
MW4	Dry/insufficient water for sample			47	141	256	< 300	N/A
MW01(07)	Dry/insufficient water for sample			<1	30	72	< 300	N/A
MW02(07)	60	79	100	0.5	32	93.2	< 300	N/A
MW03(07)	Dry/insufficient water for sample			<1	98	230	< 300	N/A
MW04(07)	113	120	124	33	67	172	< 300	N/A
MW05(07)	Dry/insufficient water for sample			11	92	286	< 300	N/A



As for sodium, the concentration of chloride in all groundwater bores were within DC objectives with the exception of MW1. Chloride concentrations in MW1 have been variable within the reporting period, consistent with results from recent years. All samples from other bores were measured within the respective historical ranges during the current reporting period, with the exception of a single sample in each of bores MW2B and MW02(07). These variations are in line with observations relating to electrical conductivity and represent the impact of the continued rainfall deficit.

Sulphate Ion (mg/L)

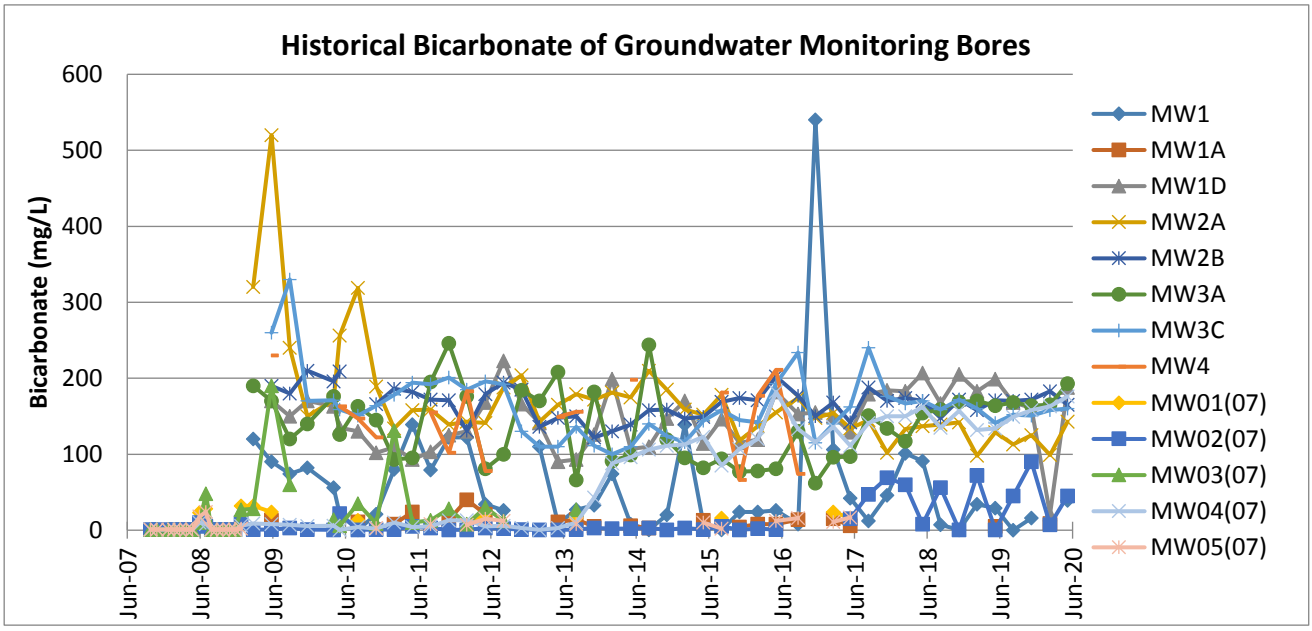
BORE HOLE	2019/20 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	388	418	439	4	261	600	< 250	N/A
MW1A	22	22	22	0.5	11	48	< 250	N/A
MW1D	24	105	318	5	73	800	< 250	N/A
MW2A	3	8	13	1	17	110	< 250	N/A
MW2B	11	70	229	8	67	660	< 250	N/A
MW3A	20	26	32	0.5	49	990	< 250	N/A
MW3C	38	132	308	19	88	940	< 250	N/A
MW4	Dry/insufficient water for sample			2	15	36	< 250	N/A
MW01(07)	Dry/insufficient water for sample			1	24	390	< 250	N/A
MW02(07)	57	139	244	0.5	38	347	< 250	N/A
MW03(07)	Dry/insufficient water for sample			2	18	170	< 250	N/A
MW04(07)	67	85	103	0.5	28	100	< 250	N/A
MW05(07)	Dry/insufficient water for sample			1	15	42	< 250	N/A



The concentration of sulphate in all groundwater bores were within DC objectives with the exception of MW1. Sulphate concentrations in MW1 appear to have followed the trend of other major ions, with all samples within the historical range of measurements. All samples were within the historical ranges for the respective bores with the exception of a single sample from MW04(07) which was slightly above the historical range for this bore.

Bicarbonate Ion (mg/L)

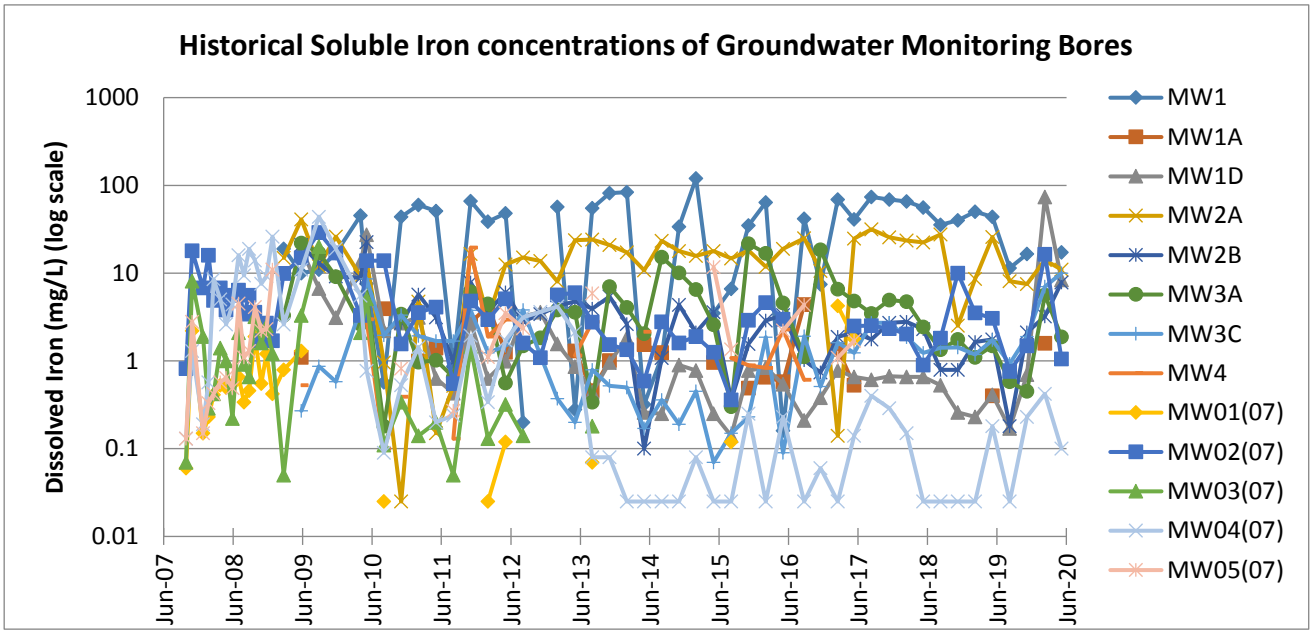
BORE HOLE	2019/20 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	<1	28	39	<1	63	540	< 750	N/A
MW1A	9	9	9	3	12	40	< 750	N/A
MW1D	21	135	188	90	149	223	< 750	N/A
MW2A	99	120	143	98	176	520	< 750	N/A
MW2B	165	173	183	122	167	210	< 750	N/A
MW3A	164	173	193	62	135	246	< 750	N/A
MW3C	151	155	160	100	165	330	< 750	N/A
MW4	Dry/insufficient water for sample			66	150	230	< 750	N/A
MW01(07)	Dry/insufficient water for sample			<2	11	32	< 750	N/A
MW02(07)	7	47	90	0.5	8	72	< 750	N/A
MW03(07)	Dry/insufficient water for sample			<2	24	190	< 750	N/A
MW04(07)	149	162	176	<1	53	182	< 750	N/A
MW05(07)	Dry/insufficient water for sample			<2	7	24	< 750	N/A



Bicarbonate concentrations remained below the objective level in all groundwater bores during the current reporting year. All bores have remained relatively stable, with only bore MW02(07) recording bicarbonate ion concentrations above the historical range in a single sample, and one sample in MW1D below the historical range. These are within expected and historical variabilities, and as such does not reflect a deterioration in groundwater quality.

Soluble Iron Ion (mg/L)

BORE HOLE	2019/20 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	11.4	15.0	17.2	0.16	37.9	120	< 6	N/A
MW1A	1.59	1.6	1.59	0.4	1.5	4.4	< 6	N/A
MW1D	0.17	20.7	73.5	0.14	2.6	27.3	< 6	N/A
MW2A	7.52	10.2	14.1	<0.05	15.6	41	< 6	N/A
MW2B	0.18	3.3	7.86	0.1	4.3	22.5	< 6	N/A
MW3A	0.45	2.1	5.63	0.18	5.5	22	< 6	N/A
MW3C	0.93	5.0	9.99	0.07	1.5	8.57	< 6	N/A
MW4	Dry/insufficient water for sample			0.1	2.5	19.5	< 6	N/A
MW01(07)	Dry/insufficient water for sample			<0.05	0.8	4.23	< 6	N/A
MW02(07)	0.76	4.9	16.4	0.36	5.3	29	< 6	N/A
MW03(07)	Dry/insufficient water for sample			0.05	2.0	20	< 6	N/A
MW04(07)	<0.05	0.2	0.42	<0.05	4.1	44	< 6	N/A
MW05(07)	Dry/insufficient water for sample			0.13	2.6	11.7	< 6	N/A

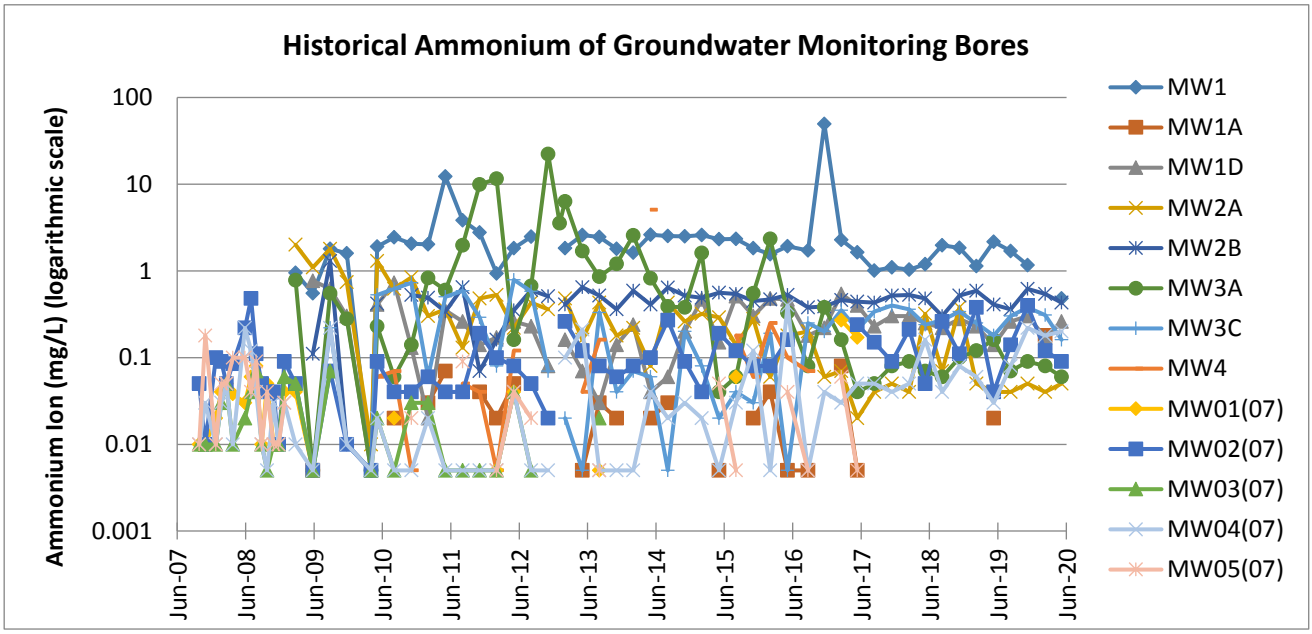


The dissolved iron concentrations were above the objective levels for several bores at times during this reporting period. This is a common phenomenon, with the graph above showing significant fluctuations throughout the historical period of monitoring for all bores. This historical trend has continued in the current reporting period. Despite these changes in soluble iron, pH has been relatively neutral in each of these bores suggesting minimal opportunities for further mobilisation of metals. The concentrations of dissolved iron in all bores for the reporting period are within the historical range for the respective bores with the exception of a single sample in each of bores MW1D and MW3C. This indicates no deterioration in groundwater quality as evident by soluble iron concentration across the monitoring network.

below the limit of reporting in the dredge pond.

Ammonium Ion (mg/L)

BORE HOLE	2019/20 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	0.48	1.1	1.69	<0.01	3.28	49.5	< 20	N/A
MW1A	0.18	0.2	0.18	<0.01	0.03	0.08	< 20	N/A
MW1D	0.17	0.2	0.3	<0.01	0.27	0.77	< 20	N/A
MW2A	0.04	0.0	0.05	<0.01	0.38	2	< 20	N/A
MW2B	0.36	0.5	0.62	<0.01	0.45	1.3	< 20	N/A
MW3A	0.06	0.1	0.09	<0.01	1.72	22.3	< 20	N/A
MW3C	0.16	0.3	0.38	<0.01	0.23	0.79	< 20	N/A
MW4	Dry/insufficient water for sample			<0.01	0.39	5.07	< 20	N/A
MW01(07)	Dry/insufficient water for sample			<0.01	0.05	0.27	< 20	N/A
MW02(07)	0.09	0.2	0.4	<0.01	0.11	0.48	< 20	N/A
MW03(07)	Dry/insufficient water for sample			<0.01	0.02	0.07	< 20	N/A
MW04(07)	0.08	0.2	0.22	<0.01	0.05	0.4	< 20	N/A
MW05(07)	Dry/insufficient water for sample			<0.01	0.04	0.18	< 20	N/A

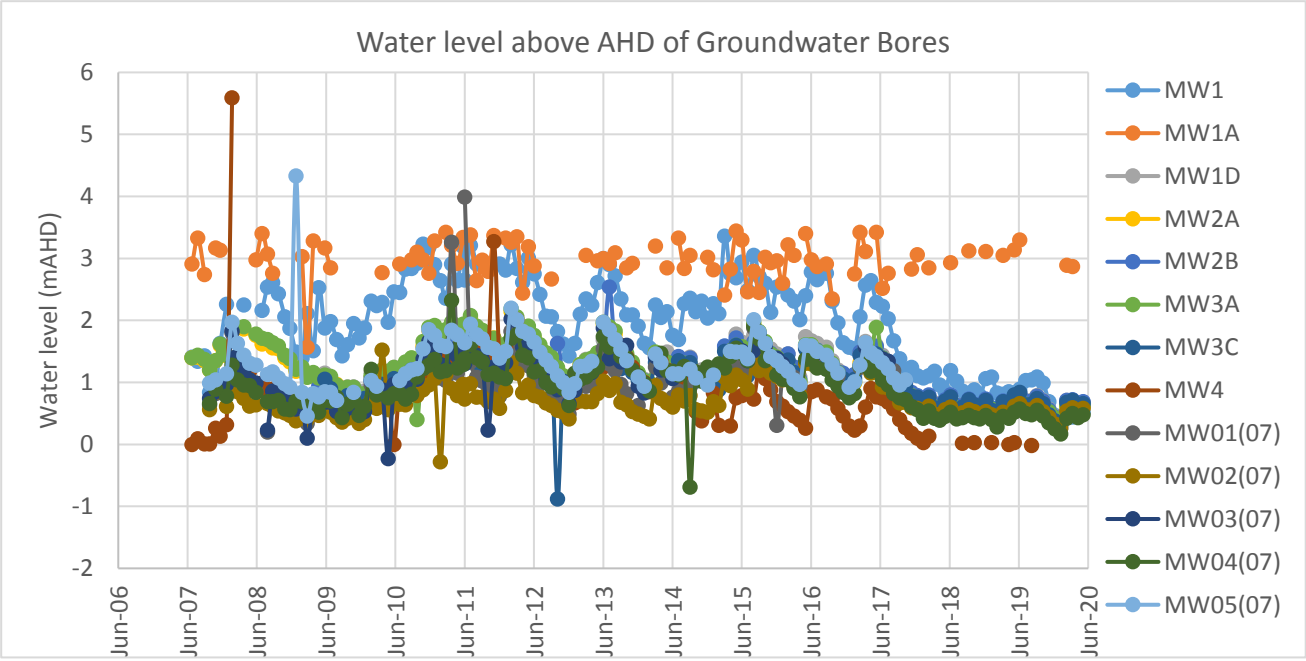


Ammonium ion concentrations were below the objective levels and within the historical ranges for all samples collected during the current reporting period, with the exception of a single sample for MW1A, which while within the typical range of ammonium observed across the monitoring network, was above previous measurements for this bore. This indicates that there is no deterioration in groundwater quality as a result of dredging operations, and the low levels recorded give a strong indication that minimal human influence has been imparted on the groundwater system at the Gerroa Sand Resource.

Depth (m)

The depths of the borehole are reported as Australian Height Datum

BORE HOLE	2019/20 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
MW1	0.26	0.72	1.09	0.58	2.09	3.36	N/A	N/A
MW1A	2.87	3.02	3.3	1.57	2.98	3.44	N/A	N/A
MW1D	0.35	0.65	0.8	0.44	1.27	1.83	N/A	N/A
MW2A	0.34	0.57	0.7	0.44	1.27	2.14	N/A	N/A
MW2B	0.35	0.65	0.83	0.51	1.21	2.54	N/A	N/A
MW3A	0.34	0.59	0.73	0.4	1.30	2.19	N/A	N/A
MW3C	0.31	0.61	0.84	-0.88	1.09	1.6	N/A	N/A
MW4	0.4	0.40	0.4	0.43	1.39	6.95	N/A	N/A
MW01(07)	Dry			0.2	1.06	3.99	N/A	N/A
MW02(07)	0.26	0.52	0.66	-0.28	0.73	1.52	N/A	N/A
MW03(07)	Dry			-0.23	1.12	2.02	N/A	N/A
MW04(07)	0.17	0.43	0.57	-0.69	0.99	2.32	N/A	N/A
MW05(07)	Dry			0.46	1.36	4.33	N/A	N/A



Groundwater levels have remained fairly steady and at historical low levels in the current reporting period, consistent with what would be expected from the extended rainfall deficit. A small rise was observed in March 2020, which coincided with the only month of above average rainfall (February) during the reporting period. Six bores (MW1, MW1D, MW2A, MW2B, MW3A, and MW4) recorded levels below their historical ranges, while six bores were recorded as dry at some time during the reporting period, where the water level was below the screened zone of the monitoring bore. All bores are following a similar pattern, which is closely aligned to rainfall patterns, suggesting climate is the predominant driver of groundwater levels within each bore across the monitoring network.

4.1.4 Groundwater Monitoring Results Interpretation

From the data gathered above as part of the groundwater monitoring programme for the Gerroa Sand Resource, groundwater quality has for the most part remained relatively stable during the current reporting period. Some steady increases were observed in major ion concentrations in bores close to Blue Angle Creek, which is likely attributable to the effect of tidal influence from the Crooked River estuary, given the lower than normal rainfall

inflows experienced over successive years. This reflects the background variability of the environment, with no changes to groundwater quality as a result of dredging operations, as predicted by the Gerroa Sand Quarry Extension Environmental Assessment (2006).

Monitoring bore MW1 is connected to the Berry Siltstone aquifer, which forms the topographical high to the southwest of the project area. The Berry Siltstone aquifer is a slightly brackish water reservoir, with a relative deficiency of potassium, which is reflected in the monitoring results of MW1. Historical monitoring from this bore shows that higher salinity and major ion concentrations have been observed at various times since 1993. These records show that many of the water quality objectives in the Development Consent are not appropriate for this bore, given the inherent natural variability at the interface of the Berry Siltstone aquifer and alluvial aquifer. Nevertheless, the current monitoring program is well placed to both monitor any variations in groundwater quality over time, as well as monitoring the spatial distribution of any brackish influence in the vicinity of the dredging operation.

One of the key observations made during previous annual reviews revolved around the shortcomings of the current groundwater quality objectives and their applicability to the natural groundwater regime of the site. This is highlighted by the natural presence of iron sulphides in the local geology, which has contributed to a number of bores regularly and naturally recording pH levels below the objective range, and soluble iron concentrations above the objective level. Similarly, concentrations of nitrogen and phosphorus in the groundwater are regularly higher than the objective levels, despite no forms of these substances used or brought on to site as part of extraction activities. Nitrogen and phosphorus concentrations in the surface water of the dredge pond are typically close to or below standard laboratory reporting limits, supporting determinations that extraction activities are not contributing to the observed concentrations of these analytes in the groundwater. For these reasons, the objective levels of these analytes do not suitably reflect the natural groundwater regime, and assessment against individual historical results provides a far better method for detecting any adverse impacts on groundwater resources as a result of dredging and associated activities.

The current groundwater monitoring programme is sufficient in monitoring for any spatial or temporal changes in the groundwater quality and quantity in the local environment. Current procedures allow for an accurate representation of any longer term trends in groundwater quality and availability.

There were no non-compliances with conditions of the Development Consent or Environmental Protection Licence 4146 related to groundwater in the 2019-2020 reporting period.

4.3. Surface Water Management

4.3.1. Standards and Performance Measures

There are no specific requirements for surface water quality in the sites EPL other than with regard to discharges from the site, as detailed below:

Water and land

EPA Identification no.	Type of Monitoring Point	Type of Discharge Point	Location Description
1		Discharge to waters	The end of the "Overflow Pipe" from the dredge pond as labelled on the map titled "Gerroa Sand Resource" dated 7/12/11 and held on EPA file 281283A8.

The overflow pipe indicated is licenced in case of extreme wet weather in which flood water would be allowed to drain to the adjacent Foy's Swamp. To date the dredge pond water has never required use of the overflow pipe.

The surface water monitoring requirements from the DC are realised by the sites QEMP. Section 8.5 of the QEMP details the surface water testing requirements and specifies that the dredge pond and main channel require weekly water level readings and the dredge pond requires quarterly analyte testing. The EA predicted that the project is not predicted to lead to any deterioration of the water quality of the dredge pond, or the surrounding area.

The groundwater quality objectives which CB should "aim to meet" from the DC (and adopted in the QEMP) are as follows:-

Analyte	Units	Objective
Turbidity	NTU	5 - 20
pH	pH	6.0 – 8.5
Salinity	µS/cm	<1,500
Dissolved Oxygen	mg/L	>6
Total Phosphorus	µg/L	<30
Total Nitrogen	µg/L	<350
Chlorophyll-A	µg/L	<5
Faecal Coliforms	Median No./100 mL	<1,000
Enterococci	Median No./100 mL	<230
Algae & BGA	No. Cells/mL	<15,000
Sodium	mg/L	<400
Potassium	mg/L	<50
Magnesium	mg/L	<50
Chloride	mg/L	<300
Sulphate	mg/L	<250
Bicarbonate	mg/L	<750
Soluble Iron	mg/L	<6
Ammonium	mg/L	<20

4.3.2. Environmental Performance

CB has implemented the Surface Water Monitoring Program and Acid Sulphate Soils Management Plan to meet the requirements of the DC. ALS Laboratory Group were engaged during the reporting period to conduct monthly sampling and testing of the water in the dredge pond for pH and Electrical Conductivity and of the leachate from sand extracted by the dredging operation for Total Oxidisable Sulphur, as well as quarterly testing of the dredge pond water for the larger suite of water quality parameters listed in Section 4.3.1 above.

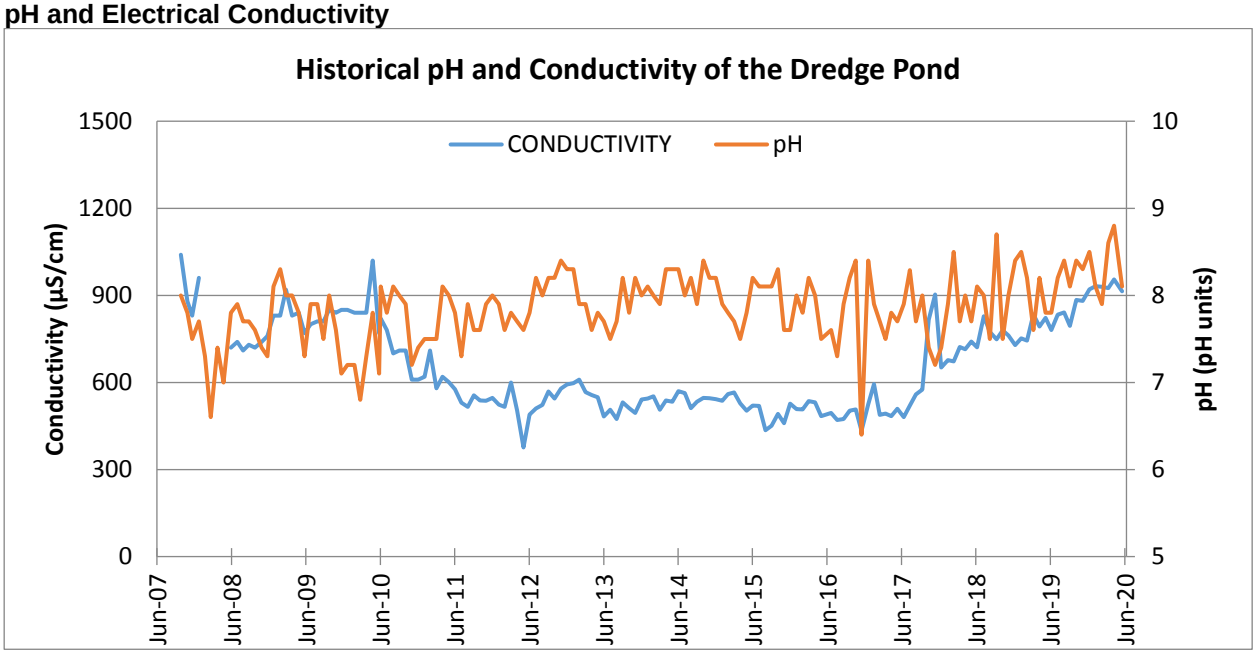
4.3.3. Surface Water Monitoring

A summary of surface water monitoring results for the period is tabulated in this section, with the range and average of each analyte displayed alongside the historical range and average, objectives as described in the Development Consent, and any EA predictions. Units of reporting are listed in the table in Section 4.3.1. Graphs are also included to show trends in all analytes over the historical period of monitoring in the dredge pond. Where surface water monitoring results trend outside of the historical range or DC objectives, these are discussed after each graph.

Analyte	2019/20 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
Conductivity	781	883	955	376	641	1040	< 1,500	N/A
pH	7.8	8.3	8.8	6.4	7.8	8.7	6 - 8.5	N/A
Total Algae	10700	269250	743000	525	126576	2070000	< 15,000	N/A
Cyanophyta	2150	264188	741000	0	96172	2070000	< 15,000	N/A
Total phosphorus	10	25	50	<5	47	790	< 30	N/A
Total nitrogen	400	700	1300	40	612	6900	< 350	N/A
Chlorophyll-a	3	18	49	<0.1	6	41	< 5	N/A
Faecal coliforms	22	72	150	1	123	2100	< 1000	N/A
Enterococci	4	30	52	<1	45	690	< 230	N/A
Sodium	73	83	91	33	52	81	< 400	N/A
Potassium ion	1	6	8	3	5	8	< 50	N/A

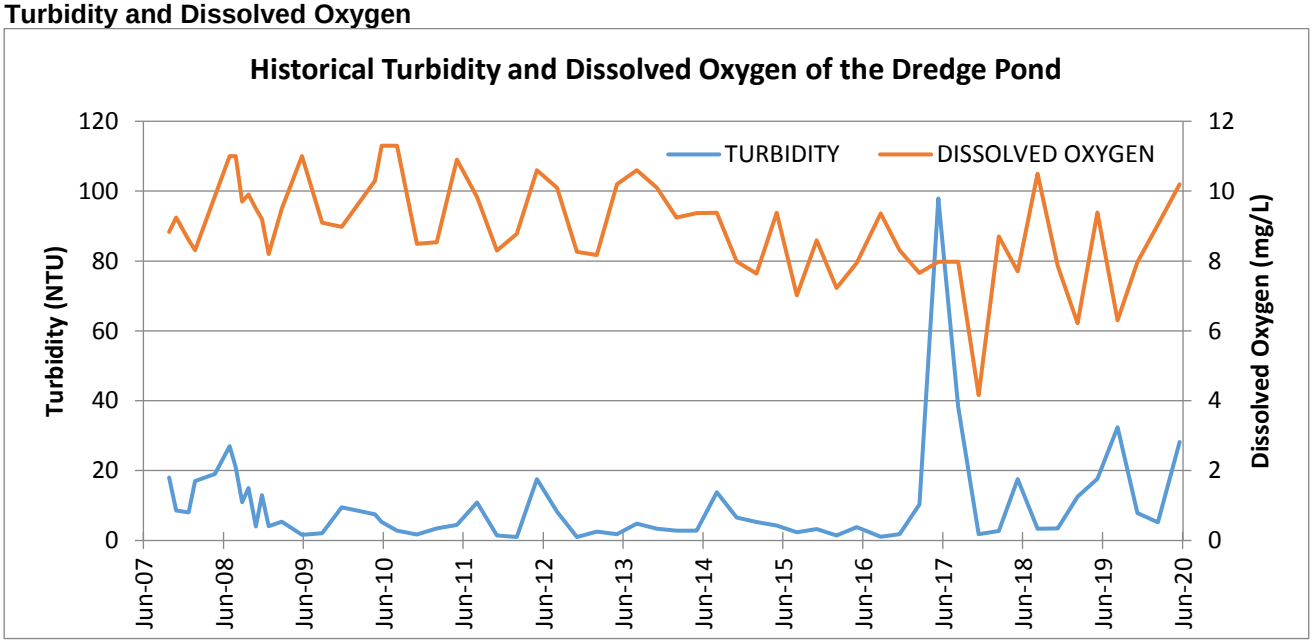
Analyte	2019/20 Reporting Period			Historical Results			DC Objectives	EA Predictions
	Min	Ave	Max	Min	Ave	Max		
Magnesium ion	17	21	22	9	13	21	< 50	N/A
Chloride	116	128	138	16	79	140	< 300	N/A
Sulphate ion	98	124	155	25	109	1300	< 250	N/A
Bicarbonate ion	141	145	148	<2	92	313	< 750	N/A
Soluble iron ion	<0.05	<0.05	<0.05	<0.01	0.087	0.770	< 6	N/A
Ammonium ion	<0.01	0.01	0.04	<0.01	0.03	0.36	< 20	N/A
Turbidity	5	18	32	1	10	98	5 - 20	N/A
DO (mg/L)	6.3	8.4	10.2	4.2	9.0	11.3	> 6	N/A
DO (%)	71	89	103	52	100	125	> 80-90%	N/A

pH and Electrical Conductivity



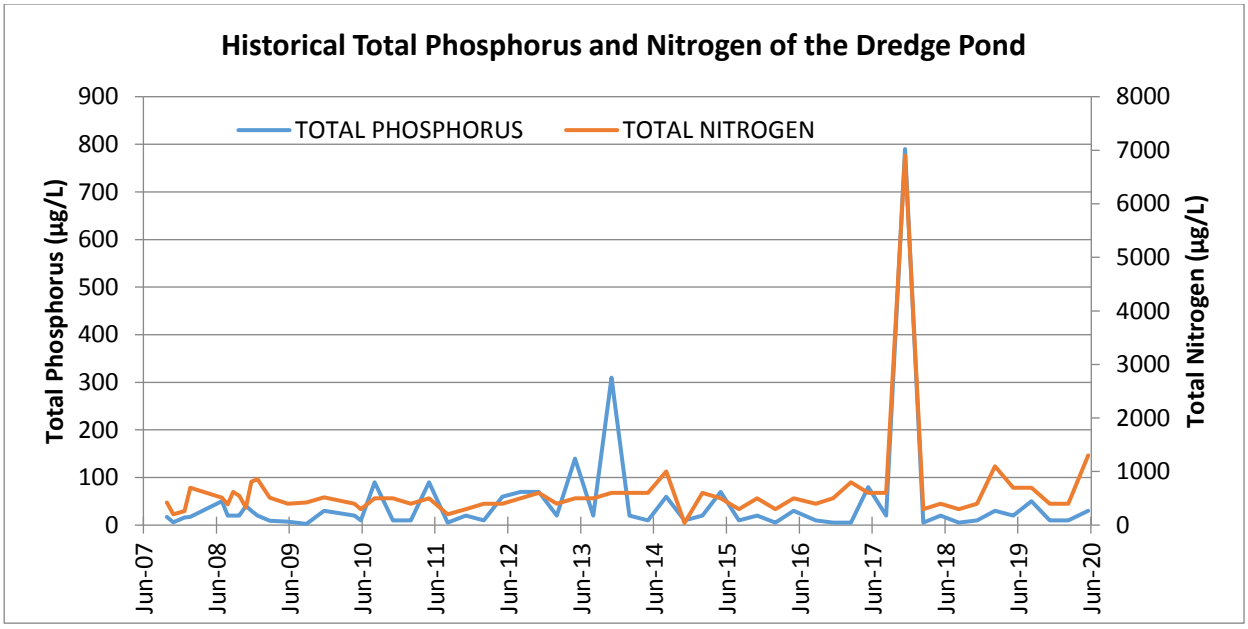
In the current reporting period, the dredge pond pH has fluctuated at the upper end of the historical range, and within the surface water quality objectives with the exception of two measurements (8.6 and 8.8) in Autumn 2020. These higher concentrations are likely related to the increase in algae levels and low water levels, and the excellent management of acid sulphate soils. Electrical Conductivity has shown a steady increase over the past 36 months, which is attributable to the significant rainfall deficit that has reduced the replenishment of the dredge pond with rainwater. Despite this slow increase, the EC has remained within both the historical range and water quality objectives throughout the reporting period.

Turbidity and Dissolved Oxygen



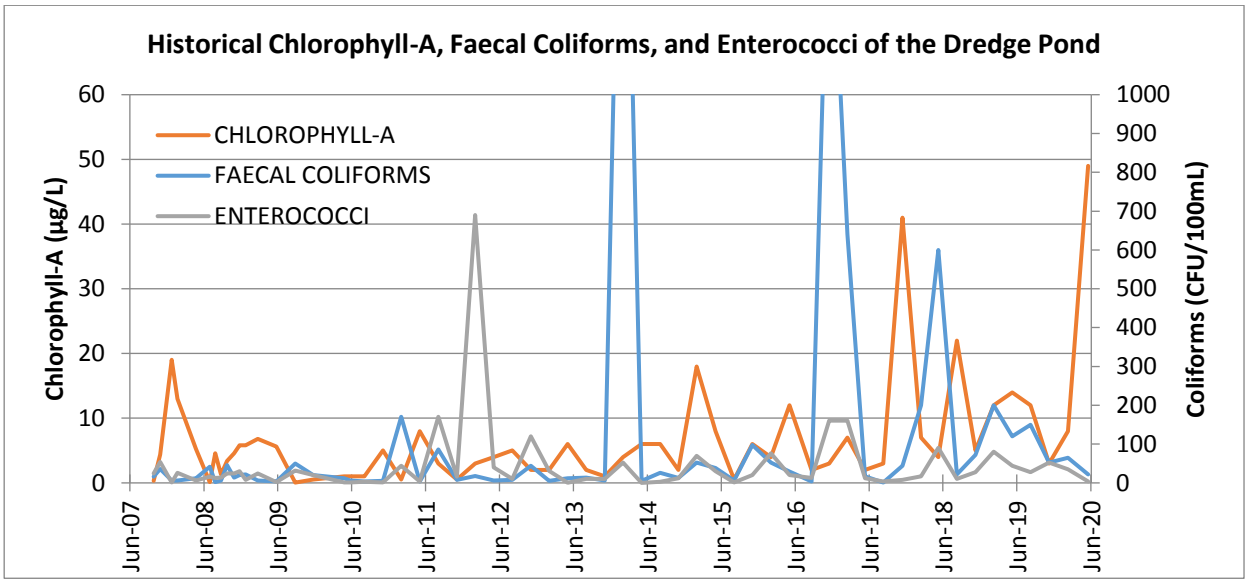
Turbidity and dissolved oxygen have remained within their historical ranges in the current reporting period. One sample recorded slightly below the percent saturation objective level for DO, however this sample met the mg/L objective level, and returned to 90% saturation in the following monitoring period. Two samples were above the upper limit of the turbidity objectives, however this is likely related to the close proximity of the monitoring point to the dredging activities at the time of sampling, and not representative of turbidity levels in the broader dredge pond.

Total Phosphorus and Nitrogen



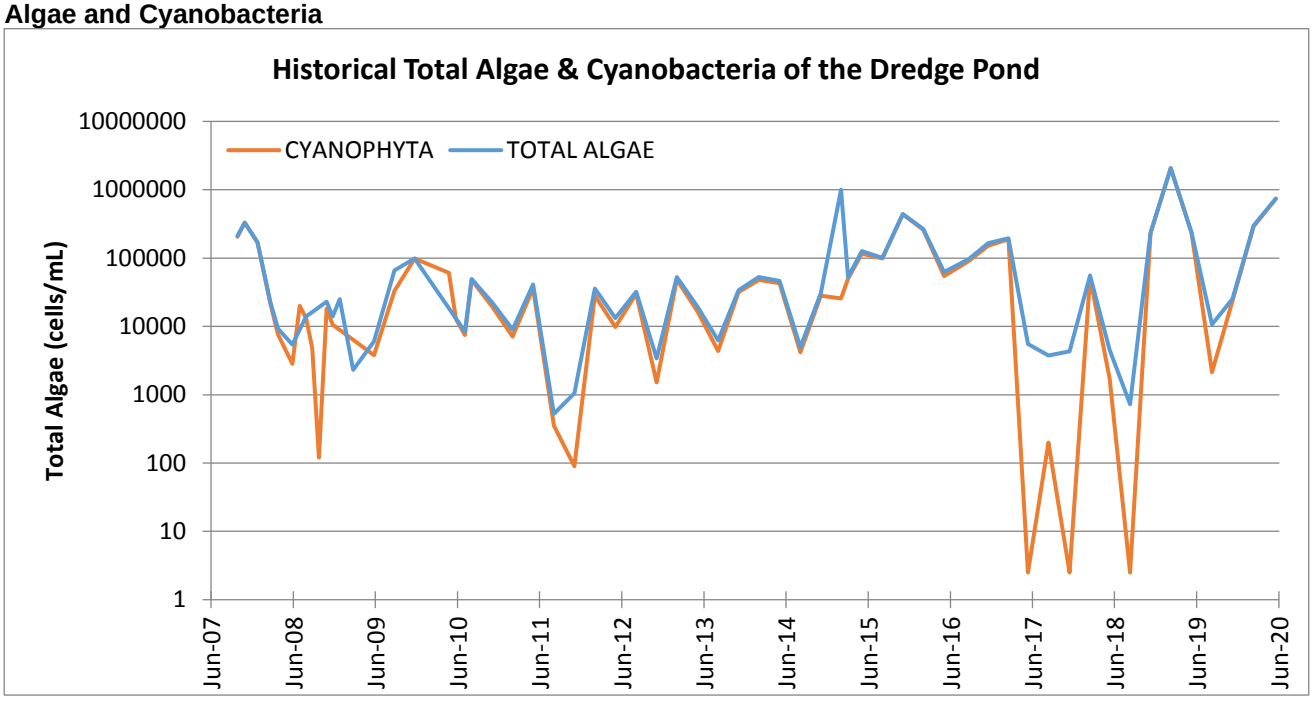
All nitrogen and phosphorus samples remained within the historical ranges for these analytes in the current reporting period, while phosphorus also met the objective levels in all but one sample. Nitrogen was recorded above the objective level in the reporting period, however the graph above shows levels very consistent with the long term trends. This is reflective of the agricultural land use prevalent in the district, and unrelated to dredging operations.

Chlorophyll-A, Faecal Coliforms, and Enterococci



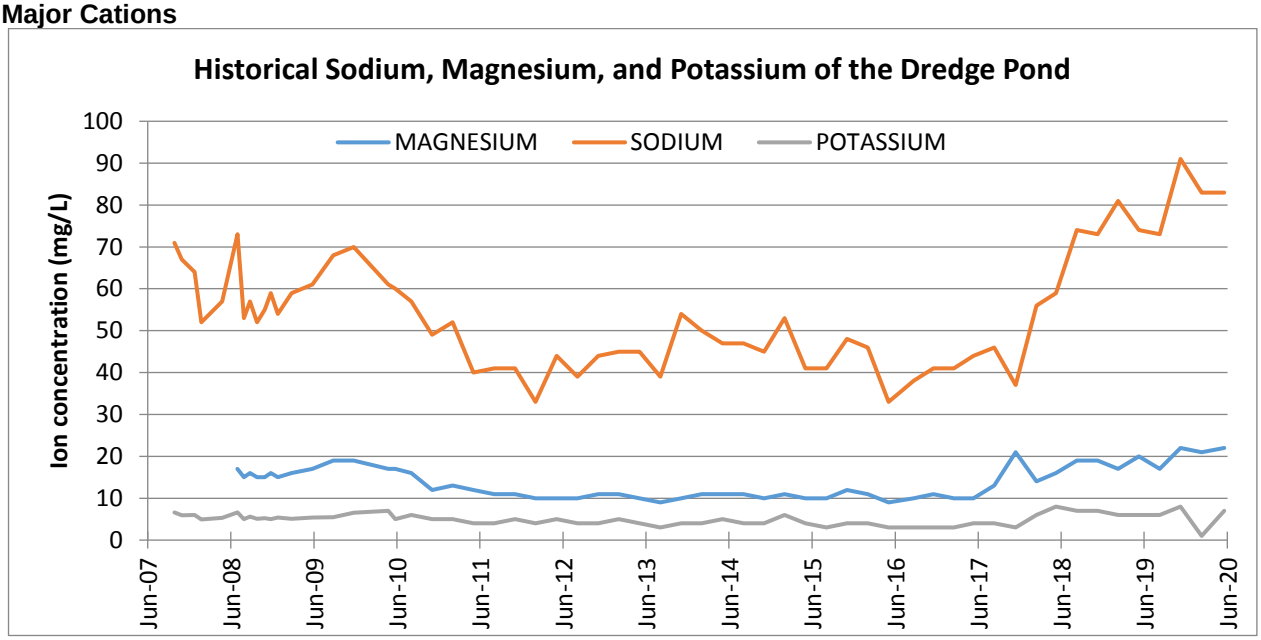
All chlorophyll-A, faecal coliform, and enterococci results were within the historical ranges for the respective analytes with the exception of a single chlorophyll-A result. All faecal coliform and enterococci results were also within the objective levels for the site. While chlorophyll-A concentrations were above the objective levels for most of the year, this is a common occurrence and is expected on a large standing water body of high quality water.

Algae and Cyanobacteria



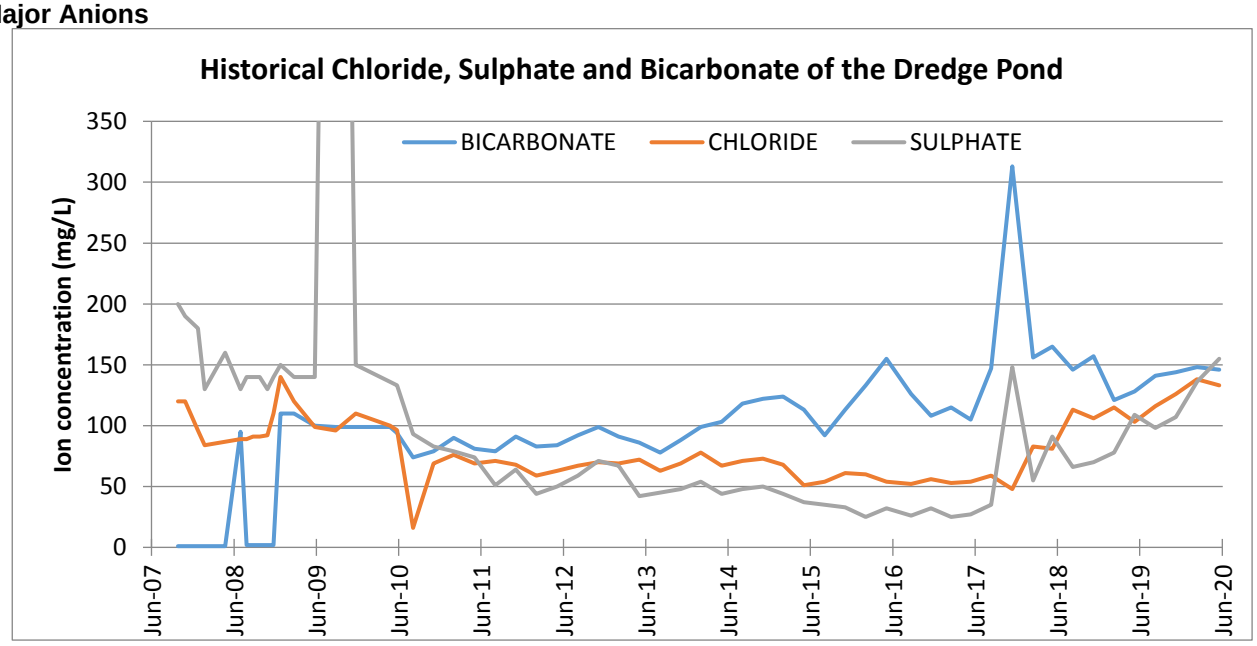
Total algae and cyanobacteria concentrations followed historical patterns, with a spike observed in summer and low levels observed during the cooler months. All results were within the historical range of measurements for these analytes. Concentrations of both analytes were recorded above the objective levels during the year, which is consistent with historical results and does not reflect a decline in the water quality of the dredge pond.

Major Cations



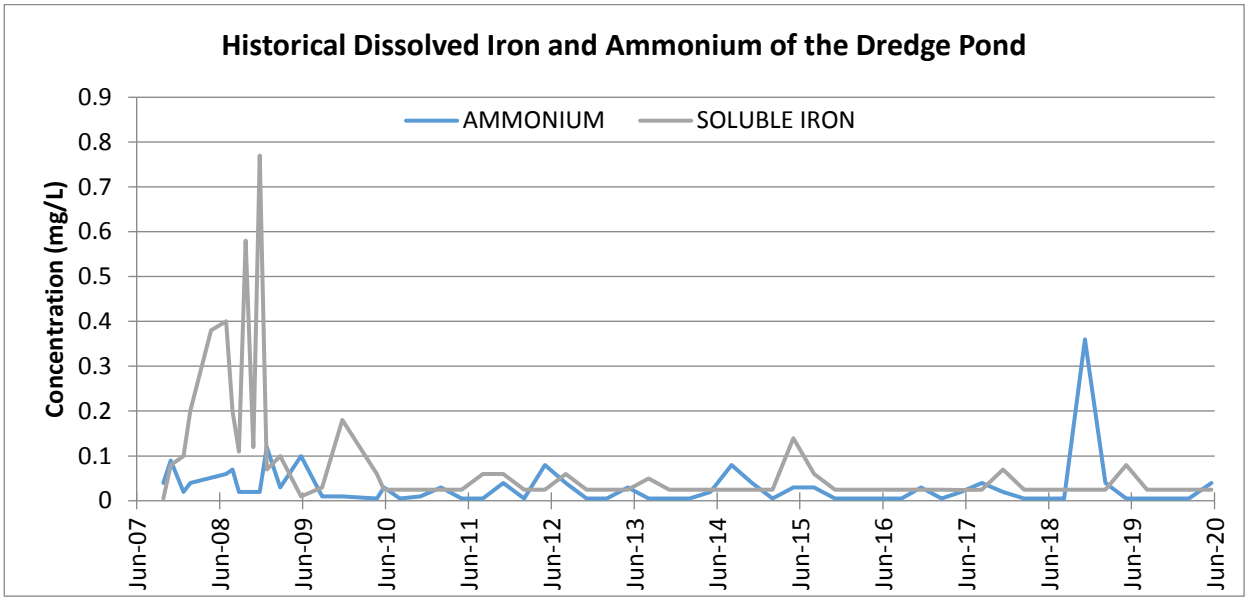
Sodium, magnesium, and potassium ion concentrations have followed the recent trends in electrical conductivity, with a steady rise over the past three years. This is related to the extended rainfall deficit, with evaporation in the past four years exceeding rainfall on site. All analytes remain within the objective levels for the site, while sodium and magnesium concentrations were recorded slightly above historical results during the reporting period.

Major Anions



Concentrations of chloride, sulphate, and bicarbonate have remained well below the objective levels during the current reporting period and are consistent with historical levels. Concentrations of chloride and sulphate have exhibited a steady increasing trend over the past three years, consistent with the extended rainfall deficit.

Soluble Iron and Ammonium



Soluble iron and ammonium ion concentrations have remained stable at very low levels and consistently below surface water quality objectives.

4.3.4. Surface Water Monitoring Results Interpretation

The dredge pond continues to represent a surface water body of excellent water quality, with the median physicochemical parameters measured either within the surface water quality objectives for the project, and/or within the ANZECC Guideline trigger levels for freshwater lakes and reservoirs. However, concentrations of algae and cyanobacteria continue to be present at levels generally above these guidelines at times.

The cyanobacteria concentrations identified in the dredge pond during the reporting period follow a trend largely in line with seasonal expectations (exhibiting a summer spike). This may have been exacerbated in the current reporting period by the extended rainfall deficit (and thus low water level). Concentrations of algae are likely to fall further through winter.

The current surface water monitoring program is sufficient in monitoring for any changes in the water quality of the dredge pond. Current procedures allow for an accurate representation of any longer term trends in surface water quality and any potential impacts on surface and groundwater quality of the wider area.

There were no non-compliances with conditions of the Development Consent or Environmental Protection Licence 4146 related to surface water in the 2019-2020 reporting period.

4.4. Air Quality

4.4.1. Standards and Performance Measures

There are no specific requirements for air quality in the sites EPL.

The air quality monitoring requirements from the Development Consent are realised by the sites QEMP. Section 8.4 of the QEMP details the air quality testing requirements and specifies that 3 dust gauges are to be tested on site. The contribution from site operations to annual average dust deposition must not cause additional exceedances of the following criteria at any residence on privately owned land or on more than 25% of any privately owned land:-

- 2g/m^2/month, maximum increase in deposited dust level; and
- 4g/m^2/month, maximum annual average deposited dust level.

4.4.2. Environmental Performance

CB has implemented the Air Quality Monitoring Program to meet the requirements of the DC. ALS Laboratory Group were engaged during the reporting period to service the three depositional dust gauges on a monthly basis, in line with *AS/NZS 3580.10.1-2003: Methods for Sampling and Analysis of Ambient Air – Determination*

of Particulates – Deposited Matter – Gravimetric Method. In addition, Cleary Bros has sealed the first 200 metres of the site entrance and utilised a water truck when required on the unsealed sections to minimise the generation of dust from unsealed roads.

4.4.3. Air Quality Monitoring

The following table provides Total Insoluble Solids concentrations (in g/m2/month) recorded in the three dust depositional gauges at the Gerroa Sand Resource.

Dust Gauge	2019/20 Reporting Period			Historical Results		
Units: g/m^2/month	Min	Average	Max	Min	Average#	Max
1A	0.9	2.1	5.6	0.1	2.2	20.1
2A	0.2	2.5	6.9	0.1	2.2	49.7
3A	0.1	1.7	5.2	0.1	1.4	220.0
DC Criteria / EA Predictions		< 4			< 4	

Average excluding samples contaminated or tampered with

4.4.4. Air Quality Monitoring Results Interpretation

The results indicate that the activities associated with the Gerroa Sand Resource are having very little effect on local dust deposition, with levels consistent with the historical performance and well below the total annual average deposition criteria. Dredging operations at the site commenced in the 1960's, well before depositional dust monitoring commenced, and as such the incremental impact of the project cannot be accurately determined. Therefore monitoring will continue to focus on measuring compliance with the total annual average deposition criteria. Higher levels of depositional dust were recorded across the December 2019 to February 2020 monitoring periods due to elevated regional dust levels.

The depositional dust monitoring results demonstrate that the measures to control dust generation associated with the Gerroa Sand Mine are effective in minimising any dust impacts from activities on site, and in maintaining a high standard of air quality in the local area. The air quality monitoring programme currently in place is sufficient to monitor any potential impacts on air quality to surrounding receivers.

There were no non-compliances with conditions of the Development Consent or Environmental Protection Licence 4146 related to air quality in the 2019-2020 reporting period.

4.5. Noise Monitoring

4.5.1. Standards and Performance Measures

There are no specific requirements for noise monitoring in the sites EPL.

The noise monitoring requirements from the Development Consent are realised by the site's QEMP. Section 8.3 of the QEMP details the noise testing requirements and specifies that noise testing is required within 3 months of commencement of operations on the extension site. Subsequent noise monitoring will only be required if there are exceedances or a significant change to operations or machinery likely to have noise implications.

4.5.2. Environmental Performance

CB has constructed the visual and acoustic bund along the northern, eastern, and southern boundaries of the dredging operation. A preventative maintenance programme is in place to ensure all equipment employed at the site are maintained in accordance with manufacturers' specifications, with no changes to equipment in operation at the site during the current reporting period. Dredging operations were restricted to the approved hours during the current reporting period.

4.5.3. Noise Monitoring

There was no requirement to conduct noise monitoring during this reporting period as there were no exceedances or any significant change to operations or machinery likely to have noise implications.

4.5.4. Noise Findings

Current strategies described above to minimise noise impacts on surrounding receivers have been effective during the current reporting year, which is supported by the continued absence of any noise related complaints related to the site.

There were no non-compliances with conditions of the Development Consent or Environmental Protection Licence 4146 related to noise in the 2019-2020 reporting period.

4.6. Community

4.6.1. Licence Requirement

Licence condition M4 of the site's EPL provides that Cleary Bros must keep records of all complaints received for the site including any action taken regarding the complaint.

The Development Consent has no direct requirements for complaint handling however, the QEMP dedicates chapter 7 to Complaints Management, which describes the process for recording and responding to community complaints. Furthermore, Cleary Bros held two Community Consultative Committee meetings during the reporting period. Minutes of these meetings have been sent to the DPIE and are also available on the Cleary Bros website.

4.6.2. Tabulated Results

No complaints were received in relation to the Gerroa Sand Resource in 2019/2020, which is in line with number of complaints received in previous years.

Year	Environmental Complaints
2005/2006	0
2006/2007	0
2007/2008	0
2008/2009	0
2009/2010	0**
2010/2011	0
2012/2013	0

Year	Environmental Complaints
2013/2014	0
2014/2015	0
2015/2016	0
2016/2017	0
2017/2018	0
2018/2019	0
2019/2020	0

**One complaint was reported to Cleary Bros from DoP as a letter dated 2 December 2009 relating to the extent of clearing. This was investigated and found not to be factual (refer Cleary Bros letter to DoP dated 15 December 2009).

4.6.3. Environmental Complaints Results Interpretation

The absence of any environmental complaints since 2005 reinforces the low environmental and amenity impact of the Gerroa Sand Resource and demonstrates that the site is functioning in harmony with the surrounding residents.

4.7. Rehabilitation & Vegetation Management

4.7.1. Standards and Performance Measures

There are no specific requirements for rehabilitation or vegetation management in the sites EPL.

The DC and QEMP set out long and short term requirements and objectives regarding rehabilitation and vegetation management. These objectives are included in the Land and Environment Court approved Landscape and Rehabilitation Management Plan. For the purposes of this AEMR only conditions required to be completed within the twelfth year of operation will be reviewed. The twelfth year requires routine maintenance only in all areas as required, including weed control, maintenance of fences, pest control, and the replacement of dead plants. The QEMP requires that Cleary Bros inspect the planting and conservation works quarterly and that a qualified ecologist monitors the entire area annually. Quarterly inspections of the plantings and the conservation works are carried out by site personnel. An ecologist from Good Bush Pty Ltd carried out the twelfth annual survey in July 2020 and it is attached as Annexure C.

4.7.2. Summary of Quarterly Inspections of Plantings and Conservation Areas

The quarterly inspections were carried out in September 2019, December 2019, March 2020 and June 2020.

All plantings are now completed for all areas of revegetation and maintenance of these areas is continuing and ongoing. Infill planting in Zones 2C.1, 2D, and 4 were undertaken during the reporting period with 700 trees planted, including a mix of tubestock and advanced plantings.

The batters of the dredge pond foreshore are stable on both the east and west sides with minimal erosion evident. The sections of the batter that were planted in earlier years have established very well with significant growth and cover now evident. Some areas of the eastern batter have been identified as requiring further planting to maintain batter stability and promote vegetation growth. Redundant tree guards were removed from established trees in some of the planting areas in the year, with further tree guards to be removed in the coming year as they are no longer required on established trees.

The focus of management efforts during the reporting period centred on weed control. The main weeds targeted included the ongoing suppression of lantana and control of some emergent bitou bush. Approximately 53 hours of weed control was undertaken across the management areas during the reporting period, with efforts concentrated during the warmer months. Other weeds that have been identified on site which are to be controlled over the next year include tobacco bush, African Lovegrass, and blackberry.

4.7.3. Success of the Northern Corridor

The flora and fauna surveys over the first six years of this project, that is since the habitat establishment began in the Northern Corridor, found that the indigenous biota that inhabits and that traverses the corridor is equal to or greater than that recorded in the East-West Link. The following results are relevant to the success of the Northern Corridor as measured against the criteria contained in the Landscape and Rehabilitation Plan approved by the Court.

The conditions of approval set out the criteria that must be considered in determining the success of the Northern Corridor. Surveys have shown that these criteria have been achieved and in some cases surpassed when comparing the data for the East-West Link and the Northern Corridor.

Results of the surveys indicate that the indigenous plant species now established and growing in the Northern Corridor meet or exceed the requirements set out in the consent conditions.

Self-colonising shrubs are common and the cover of indigenous understorey plants, most notably *Lomandra longifolia* now provides an extensive cover. The most recent annual survey also identified Blady Grass and Burrawang regenerating in this area, demonstrating its success. Weeds are no longer prevalent in the northern corridor, with minor occurrences of African Lovegrass and some woody weeds forming a minor constituent of the zone and which will be the focus of management efforts in the next year for this zone.

The results of previous surveys for vertebrate animals in the Northern Corridor demonstrate an increase in the cumulative number of species present each time the surveys are carried out. Photographs taken at permanent sites over the years show the progress in the development of the habitat in the Northern Corridor.

4.7.4. Planting/Rehabilitation Areas

The planting/rehabilitation zones as described in the Landscape and Rehabilitation Plan have been completed. The twelfth annual report identified that with consistent monitoring and weed management across the zones, the success of plantings has been high. There are some issues with wild animals grazing on new growth (e.g. Swamp Wallabies) but overall the plants are establishing and will continue to grow and thrive.

Management activities to be undertaken in the 2020-21 period will be in accordance with the recommendations in the twelfth annual report. This will include weed control focusing on localised control of lantana and other minor weeds, maintenance of fencing, and some minor infill planting as mat be required.

4.8. Acid Sulphate Monitoring

4.8.1. Standards and Performance Measures

There are no requirements for acid sulphate soils monitoring in the sites EPL.

The DC for the site requires an Acid Sulphate Management Plan to be prepared. This plan has been prepared and is included in the sites QEMP, which requires regular sampling and testing of the sand, stockpile leachate, and dredge pond water for analytes including pH, total oxidisable sulphur and other analytes to assess the site-specific risk of acid sulphate soils. Where an elevated risk is identified, further controls are required to be executed to minimise the risk of increased acidity developing in the dredge pond, and its effects on the local environment.

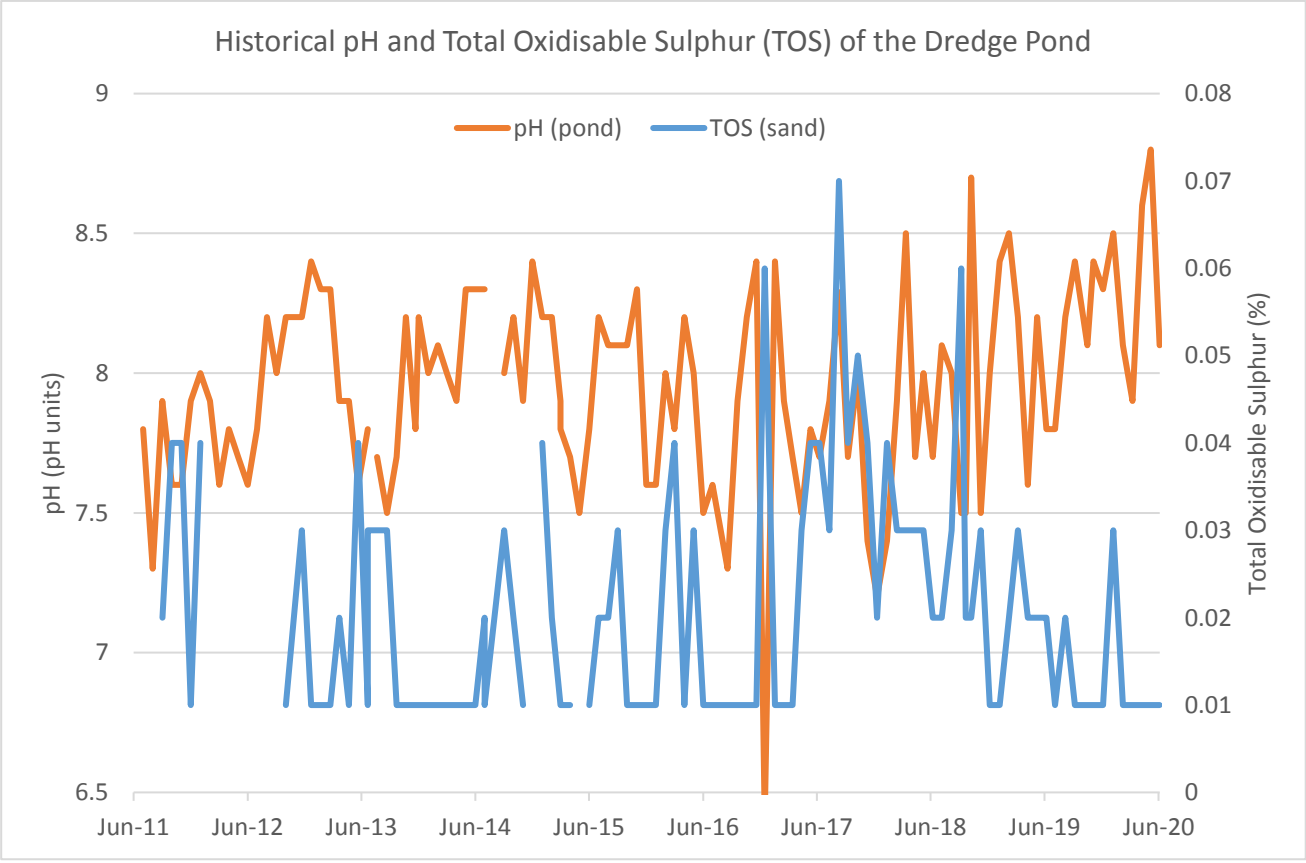
4.8.2. Environmental Performance

Stockpiles were examined regularly during the reporting period, and where leachate was present, pH was sampled. Water sampling of the dredge pond water was also undertaken on a monthly basis, as described in Section 4.3. Sampling of stockpiles was also undertaken for pH and the concentration of total oxidisable sulphur in the washed sand. The sand stockpiles are oriented to ensure runoff was towards the dredge pond and the sand also tested to ensure it could be used in concrete manufacture.

4.8.3. Acid Sulphate Monitoring

Progressive pH testing has not yet found any results outside the desired range of 6.5 – 9 pH units in the current reporting period. During the year, the constituency of the sand has had some minor variability, as dredging continues through areas previously dredged, however all but two results were below the standard laboratory limit of reporting (0.02%), with the remaining two at very low levels.. A summary of the results of TOS of the extracted sand and pH of the dredge pond water is shown in the table below, with a graphical representation of historical trends also shown.

Parameter	2019/20 Reporting Period			Historical Results		
	Min	Average	Max	Min	Average	Max
pH (pH units)	7.8	8.2	8.8	6.4	7.9	8.7
TOS (%)	<0.02	<0.02	0.03	0.01	0.02	0.07
DC Criteria	N/A					
EA Predictions	N/A					



4.8.4. Acid Sulphate Monitoring Results Interpretation

As detailed above, testing indicates that the sand extracted for the period could not be considered an acid sulphate soil, with all results generally low and within the historical range.

Current strategies described above to minimise the risk of adverse impacts from acid sulphate soils have been effective during the current reporting year, which is supported by the stable water and soil quality of the site.

There were no non-compliances with conditions of the Development Consent or Environmental Protection Licence 4146 related to acid sulphate soils in the 2019-2020 reporting period.

4.9. General Environmental Management & Reporting

4.9.1. Licence Requirements

The EPL has various conditions regarding general environmental performance including reporting requirements for complaints, environmental harm and lodgement of an annual return.

The DC includes various environmental management and reporting procedural requirements that are implemented in the sites QEMP. The conditions that required attention beyond implementation into the QEMP are assessed below.

4.9.2. Performance Criteria and Compliance Assessment

Cleary Bros employs an authorised Environmental Officer to manage all compliance activities at the site, in association with the Quarry Manager.

4.10. Traffic Management

4.10.1. Licence Requirements

The DC requires Cleary Bros to ensure that no truck associated with the project uses Gerroa Road, except where the destination lies along or adjacent to that road.

4.10.2. Compliance Assessment

Cleary Bros Site Induction and Work Instructions for the site indicates which roads are to be used when entering and exiting the site and further prohibits incidental use of Gerroa road. Staff are trained in these Work Instructions regularly.

4.11. Independent Environmental Audit

4.11.1. Licence Requirements

The DC requires Cleary Bros to commission and carry out an Independent Environmental Audit within 12 months of the commencement of the Project and every three years thereafter.

4.11.2. Compliance Assessment

Cleary Bros commissioned ERM to carry out the fourth Independent Environmental Audit in November 2019. No “high” or “medium” non-compliances with the Site’s Environmental Protection Licence or Development Consent were identified in the audit. A copy of the audit was sent to the EPA, Kiama Council, Shoalhaven Council and the CCC members. A copy of the audit was also posted on Cleary Bros web site.

The below table summarises the progress of the corrective actions undertaken to address the non-conformances identified in the 2019 Independent Environmental Audit. The next audit is scheduled for 2022.

Condition Number	Auditor Comment	Auditor Recommendation	Progress of Corrective Actions
Sch 2 Cond 1	Site management advised ERM that waste drums are being squashed with a front-end loader and recycled with scrap metal. Crushing used drums which have not been triple rinsed may resulting minor quantities of waste oil products being released to ground.	The practice of crushing drums on un-sealed ground should be ceased.	Completed - Oil drums will be removed from site once empty, and as such will no longer be crushed on site.

Condition Number	Auditor Comment	Auditor Recommendation	Progress of Corrective Actions
Sch 2 Cond 6	The annual production volumes records presented by management are summarized below: • FY2017 - 80,020 t • FY2018 - 49,128 t • FY2019 - 55,790 t The exceedance for the FY2017 period was reported to the Department and a caution was Issued in relation to this matter.	ERM reviewed the letter from CB to the Department in relation to the production exceedance which outlined plans for the Environmental Officer to undertake monthly cumulative production quantity monitoring.	Completed - Corrective action in relation to this notified event has been completed. No further action proposed.
Sch 2 Cond 8	During the site visit, ERM observed a drum suspended above a pump which appeared to be in use for oil storage. The drum appeared to be corroded, which suggests there is an increased likelihood of failure.	ERM recommends that this drum be replaced.	Completed - Drum replaced with appropriate storage vessel
Sch 3 Cond 11(d)	ERM understands that CB are not currently undertaking any hydraulic conductivity testing required by Section 6.5 of the QEMP. Site management advised ERM that the original objective or this design feature was to prevent low hydraulic conductivity material from being imported and placed on site, altering the conditions which were present prior to dredging. The site is currently only emplacing processing returns from the wash-plant screening process which has a high hydraulic conductivity. Given that no imported material is being emplaced at the site and the hydraulic conductivity would be expected to be similar to the surrounding material, this non-conformance is considered minor in nature.	ERM recommends CB review the QEMP and revise the plan in consultation with the Department to allow emplacement of processing returns without hydraulic conductivity testing.	Completed - QEMP updated with proposed procedure and submitted to DPIE for approval. Hydraulic conductivity of emplaced material has been tested and is consistent with reference site.
Sch 3 Cond 16	ERM has reviewed correspondence from CB to the Department and the proposed Planning Agreement document. Management advised that the Department have not yet responded and therefore no agreement has been formally entered into, therefore this requirement has not been formally met.	No action required while awaiting response from the Department.	In progress - CB has followed up with the Department. Department's legal team are currently undertaking a final check of the proposed Planning Agreement.

5. Conclusion

The primary issue identified in this AEMR is the continuing departure of surface and ground water quality from the objective levels listed in the DC. However monitoring undertaken in the current reporting period demonstrates that the water quality is generally consistent with historical levels, with no deterioration in groundwater or surface water quality related to dredging operations.

Site conditions during the current reporting period were largely impacted by the continuing below average rainfall, with rainfall now well below average for four successive years. This is supported by the NSW Department of Primary Industry characterising the area as drought affected as of July 2020. This has led to low water levels in all groundwater monitoring bores on site. This has led to a general increase in major ion concentrations measured across the surface and ground water monitoring network. At such dry times, any adverse impacts that may be associated with site activities would likely be heightened, however the monitoring conducted during the current reporting period has conversely shown that dredging activities are having minimal impact on the quality of the surface and ground water resources of the area. Furthermore, the health of the groundwater dependent ecosystems in the vicinity of the site have shown no obvious signs of stress during the current reporting period. The vegetative growth across the planted areas of the site has been excellent in the current reporting period, despite the adverse climatic conditions.

Generally the site is performing well within the individual criteria and limits assigned to it in regard to environmental performance. There have been no non-compliances with the DC and no community complaints in the reporting period, with the site continuing to have no unexpected impacts on the local environment.

Annexure A

Return to Department of Trade and Investment,
Resources and Energy Return 2018/2019

NSW GOVERNMENT | Planning, Industry & Environment

Form S 1

RETURN FOR EXTRACTIVE MATERIALS: YEAR ENDED 30 JUNE 2019

Quote RIMS ID in all correspondence

Quarry Id: 4507	Rims ID: 400491
Operators Name:	CLEARY BROS (BOMBO) PTY LTD
Address:	PO BOX 210 PORT KEMBLA NSW 2505
Email:	
Quarry Name:	GERROA SAND RESOURCE
Quarry Address:	CNR BEACH RD & CROOKED RIVER RD

Inquiries please telephone: (02) 4063 6713

Completed or Nil Returns
Email – mineral.royalty@planning.nsw.gov.au
Postal Address (see below)

Please amend name, postal address and location of mine or quarry if incorrect or incomplete.

2018-2019

The return should be completed and forwarded to **Senior Advisory Officer, RESOURCE ECONOMICS, RESOURCE PLANNING & PROJECTS, NSW DEPARTMENT OF PLANNING, INDUSTRY & ENVIRONMENT, PO BOX 344 HUNTER REGION MAIL CENTRE NSW 2310 on or before 31 October 2019**. If completion of the return is unavoidably delayed, an application for extension of time should be requested **before** the due date. If no work was done during the year, a **NIL** return must be forwarded.

The return should relate to the **above quarrying establishment** and should cover the operations of quarrying and treatment (such as crushing, screening, washing etc.) carried out at or near the quarry. A return is required even if the operations are solely of a developmental nature and whether the area being worked is held under a mining title or otherwise.

Director, Resource Planning & Projects

Please complete all of the following information to assist in identifying the location of the Quarry

Typical Geology _Sand_____

Nearest Town to Quarry _Gerroa_____

Local Council Name _Kiama Municipal Council; Shoalhaven Regional Council_____

Deposited Plan and Lot Number/s of Quarry _Lot A DP185785, Lot 2 DP1111012_____

Email Address of Operator _ _____

Name of Owner or Licensee _Cleary Bros (Bombo) Pty Ltd_____

Postal Address of Licensee _PO Box 210, Port Kembla NSW 2505_____

Licence/Lease Number/s (if any)
From Mineral Resources NSW (Industry & Investment NSW) _____

From Department of Lands or other Department _____

If any output was obtained from land NOT held under licence from the above Departments, state the Name/s and Address/es of the Owners of the land _Bridon Pty Ltd, PO Box 210, Port Kembla NSW 2505_____

To the best of my knowledge, information entered in this return is correct and no blank spaces left where figures should have been inserted.

- **SIGNATURE of PROPRIETOR or MANAGER** _ _____ **DATE** 10/10/2019
- **CONTACT PERSON for this return** _ _____
- **NAME (Block letters)** _ _____ **Telephone** _ _____

SALES During 2018-2019

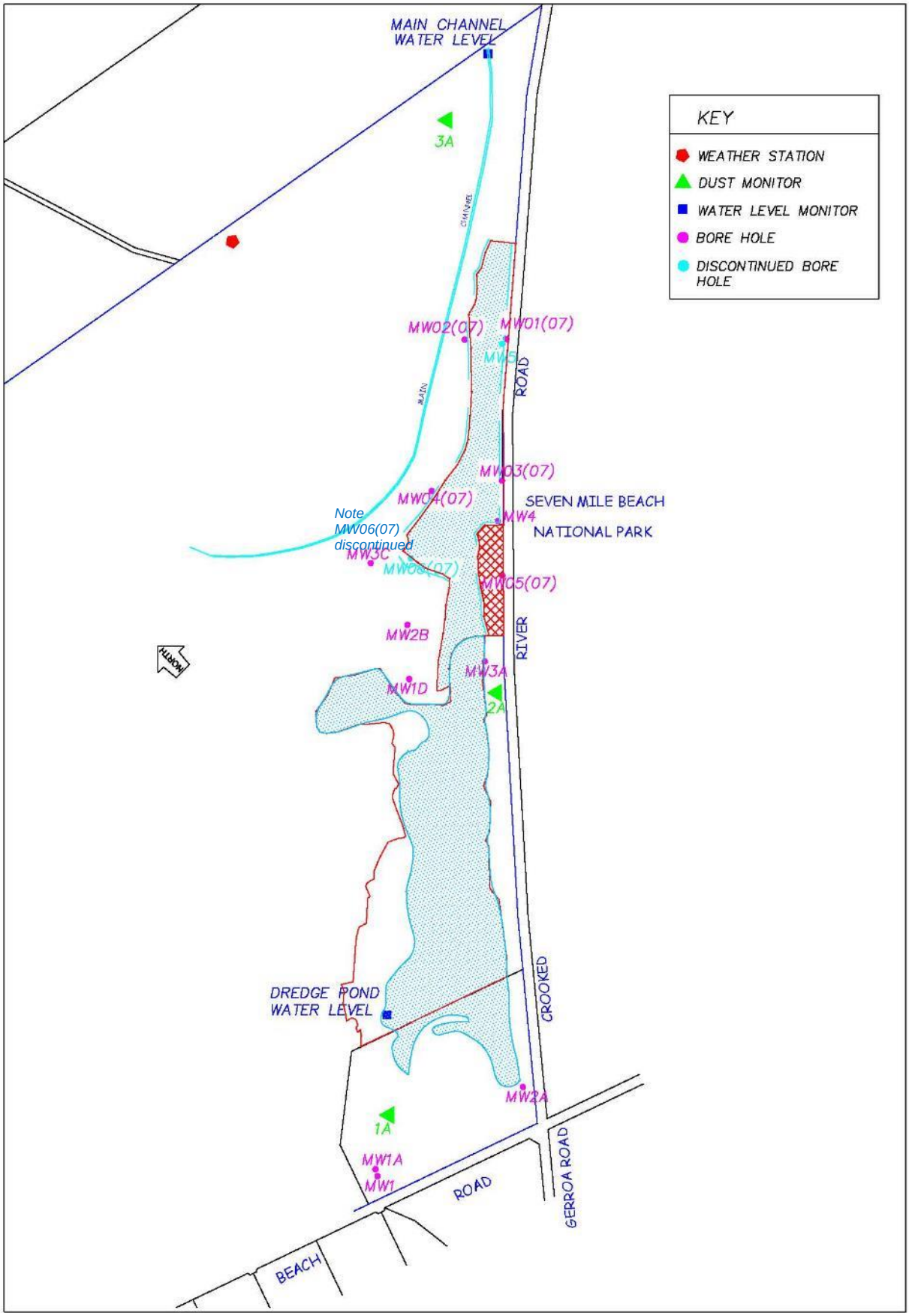
Production information may be published in aggregated form for statistical reporting. However, production data for individual operations is kept strictly confidential.

Product	Description	Quantity Tonnes
Virgin Materials		
• **Crushed Coarse Aggregates**		
Over 75mm		-
Over 30mm to 75mm		-
5mm to 30mm		-
Under 5mm		-
Natural Sand		-
Manufactured Sand		-
Prepared Road Base & Sub Base		-
Other Unprocessed Materials		-
Recycled Materials		
• **Crushed Coarse Aggregates**		
Over 75mm		-
Over 30mm to 75mm		-
5mm to 30mm		-
Under 5mm		-
Natural Sand		-
Manufactured Sand		-
Prepared Road Base & Sub Base		-
Other Unprocessed Materials		-
• **River Gravel**		
Over 30mm		-
5mm to 30mm		-
Under 5mm		-
• **Construction Sand**	Excluding Industrial	**55,784**
• **Industrial Sand**		
Foundry, Moulding		-
Glass		-
Other (Specify)		-
• **Dimension Stone**	Building, Ornamental, Monumental	
Quarried in Blocks		-
Quarried in Slabs		-
• **Decorative Aggregate**	Including Terrazzo	-
• **Loam**	Soil for Topdressing, Garden soil, Horticultural purposes)	-
• **TOTAL SITE PRODUCTION**		**55,784**
• **Gross Value ($) of all Sales**		
• **Type of Material**	Sand	
• **Number of Full-Time Equivalent (FTE) Employees**	Employees: 4	Contractors: 3

Please Note: A return for clay based products can be obtained by contacting the inquiry number.

Annexure B

Environmental Monitoring Locations



Annexure B – Environmental Monitoring Locations

Annexure C

2019/20 Environmental Monitoring Results

Groundwater Monitoring Results

	pH (pH units)				EC (µS/cm)				Total Phosphorus (µg/L)				Total Nitrogen (µg/L)			
	Sep-19	Dec-19	Mar-20	Jun-20	Sep-19	Dec-19	Mar-20	Jun-20	Sep-19	Dec-19	Mar-20	Jun-20	Sep-19	Dec-19	Mar-20	Jun-20
MW1	4.7	5.2	dry	6	7400	7160	dry	6070	300	1150	dry	300	3500	10700	dry	11000
MW1A	dry	dry	5.3	dry	dry	dry	254	dry	dry	dry	660	dry	dry	dry	10100	dry
MW1D	7.1	7.2	6.5	7	656	621	945	672	120	60	140	40	1000	500	1300	500
MW2A	6.7	6.9	6.5	7	463	476	366	441	230	130	100	120	500	200	200	300
MW2B	7.2	7.2	7	7.1	718	860	690	1280	220	50	130	40	1200	900	1100	1100
MW3A	7.4	7.3	7.1	7.8	570	581	550	581	130	220	80	90	400	400	300	500
MW3C	7.3	7.5	7.1	6.8	633	677	776	1120	100	60	60	30	800	600	600	600
MW4	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
MW01(07)	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
MW02(07)	6.3	7	5.4	6.5	535	668	793	678	70	70	90	100	900	900	600	800
MW03(07)	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
MW04(07)	7.4	7.7	7.4	7.6	775	804	848	892	1040	140	570	100	2900	400	1100	400
MW05(07)	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry

	Sodium (mg/L)				Potassium (mg/L)				Magnesium (mg/L)				Chloride (mg/L)			
	Sep-19	Dec-19	Mar-20	Jun-20	Sep-19	Dec-19	Mar-20	Jun-20	Sep-19	Dec-19	Mar-20	Jun-20	Sep-19	Dec-19	Mar-20	Jun-20
MW1	1260	1250	dry	1030	3	8	dry	5	159	172	dry	115	2490	2240	dry	1600
MW1A	dry	dry	36	dry	dry	dry	8	dry	dry	dry	5	dry	dry	dry	50	dry
MW1D	44	45	46	41	2	2	6	3	11	12	17	13	70	72	63	75
MW2A	20	23	25	23	2	2	2	2	7	9	6	7	42	42	34	42
MW2B	55	80	57	92	3	4	4	3	11	15	11	26	112	165	107	180
MW3A	28	33	33	30	2	2	2	2	7	8	8	8	51	59	52	59
MW3C	45	56	56	67	3	5	5	4	10	14	15	25	65	80	72	85
MW4	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
MW01(07)	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
MW02(07)	45	73	62	58	4	5	5	4	14	14	20	18	60	100	74	81
MW03(07)	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
MW04(07)	76	81	80	81	8	7	11	8	19	22	25	22	122	113	124	120
MW05(07)	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry

	Sulphate (mg/L)				Bicarbonate (mg/L)				Soluble Iron (mg/L)				Ammonium (mg/L)			
	Sep-19	Dec-19	Mar-20	Jun-20	Sep-19	Dec-19	Mar-20	Jun-20	Sep-19	Dec-19	Mar-20	Jun-20	Sep-19	Dec-19	Mar-20	Jun-20
MW1	439	427	dry	388	<1	16	dry	39	11.4	16.5	dry	17.2	1.69	1.16	dry	0.48
MW1A	dry	dry	22	dry	dry	dry	9	dry	dry	dry	1.59	dry	dry	dry	0.18	dry
MW1D	24	43	318	34	168	161	21	188	0.17	0.7	73.5	8.37	0.26	0.3	0.17	0.26
MW2A	4	13	11	3	113	125	99	143	8.13	7.52	14.1	11	0.04	0.05	0.04	0.05
MW2B	11	13	25	229	170	172	183	165	0.18	2.12	3.22	7.86	0.36	0.62	0.54	0.43
MW3A	20	32	31	22	168	164	165	193	0.58	0.45	5.63	1.88	0.07	0.09	0.08	0.06
MW3C	38	62	118	308	152	151	158	160	0.93	1.89	7.05	9.99	0.3	0.38	0.31	0.16
MW4	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
MW01(07)	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
MW02(07)	96	57	244	159	45	90	7	45	0.76	1.49	16.4	1.05	0.14	0.4	0.12	0.09
MW03(07)	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
MW04(07)	67	70	98	103	149	158	163	176	<0.05	0.23	0.42	0.1	0.08	0.22	0.18	0.2
MW05(07)	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry

	Chlorophyll-a (µg/L)				Faecal Coliforms (CFU/100mL)				Entercocci (CFU/100mL)			
	Sep-19	Dec-19	Mar-20	Jun-20	Sep-19	Dec-19	Mar-20	Jun-20	Sep-19	Dec-19	Mar-20	Jun-20
MW1	<3	1	dry	7	<10	<2	dry	<2	<10	<2	dry	<2
MW1A	dry	dry	<4	dry	dry	dry	3300*	dry	dry	dry	8700*	dry
MW1D	<1	<1	<2	<1	<1	<2	<2	<2	<1	<2	<2	<2
MW2A	<1	<1	<1	<1	<2	<2	1200*	<1	<10	<2	4200*	~20
MW2B	<1	<1	<2	<1	<2	<2	~14	<2	~2	<2	~6	<2
MW3A	<1	<1	<1	<1	<1	<2	100	<2	<1	<2	200	<2
MW3C	<1	<1	<1	<1	~2	<2	~2	<2	<2	<2	24	<2
MW4	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
MW01(07)	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
MW02(07)	<1	<1	<1	<1	<1	<2	<2	<2	<1	<2	<1	<2
MW03(07)	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
MW04(07)	<5	<1	<4	<1	2	<2	74*	<2	<10	<2	20*	<2
MW05(07)	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry

* Sample not analysed within required holding times

Groundwater and Surface Water Level Monitoring Results

(mAHD)	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20
MW1	3.02	2.88	2.87	2.82	2.92	3.22	3.44	3.65	dry	3.47	3.43	3.39
MW1A	0.61	dry	dry	dry	dry	dry	dry	dry	1.02	1.04	dry	dry
MW1D	2.15	2.28	2.24	2.16	2.24	2.38	2.5	2.6	2.24	2.24	2.33	2.27
MW2A	3.27	3.31	3.32	3.24	3.33	3.43	3.52	3.6	3.33	3.36	3.37	3.34
MW2B	2.29	2.42	2.43	2.34	2.42	2.56	2.68	2.77	2.41	2.4	2.49	2.43
MW3A	2.5	2.57	2.57	2.48	2.58	2.68	2.78	2.87	2.58	2.57	2.63	2.58
MW3C	2.04	2.24	2.23	2.14	2.22	2.4	2.5	2.57	2.2	2.17	2.3	2.22
MW4	dry	6.55	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
MW01(07)	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
MW02(07)	1.9	2	2	1.93	2.03	2.12	2.23	2.3	2.02	1.97	2.05	1.98
MW03(07)	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
MW04(07)	3.83	3.9	3.92	3.85	3.94	4.05	4.15	4.23	3.98	3.9	3.97	3.92
MW05(07)	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry	dry
Dredge Pond	0.8	0.8	0.6	0.8	0.6	0.4	0.2	0.2	0.7	0.6	0.4	0.6
Channel (depth)	0.6	0.6	0.4	0.35	0.2	0.2	0.1	0.1	out of order	0.4	0.4	0.4

Dredge Pond Surface Water Monitoring Results

	Jul-19	Aug-19	Sep-19	Oct-19	Nov-19	Dec-19	Jan-20	Feb-20	Mar-20	Apr-20	May-20	Jun-20
EC (µS/cm)	781	833	841	795	884	881	921	932	929	925	955	914
pH (pH units)	7.8	8.2	8.4	8.1	8.4	8.3	8.5	8.1	7.9	8.6	8.8	8.1
Total Algae (cells/mL)			10700			25300			298000			743000
Cyanophyta (cells/mL)			2150			23600			290000			741000
Total Phosphorus (µg/L)			50			10			10			30
Total Nitrogen (µg/L)			700			400			400			1300
Chlorophyll-a (µg/L)			12			3			8			49
Faecal Coliforms (CFU/100mL)			150			~52			65			22
Entercocci (CFU/100mL)			28			52			35			~4
Sodium (mg/L)			73			91			83			83
Potassium (mg/L)			6			8			1			7
Magnesium (mg/L)			17			22			21			22
Chloride (mg/L)			116			126			138			133
Sulphate (mg/L)			98			107			136			155
Bicarbonate (mg/L)			141			144			148			146
Soluble Iron (mg/L)			<0.05			<0.05			<0.05			<0.05
Ammonium (mg/L)			<0.01			<0.01			<0.01			0.04
Turbidity (NTU)			32.4			7.9			5.2			28.2
Dissolved Oxygen (mg/L)			6.3			7.97			9.04			10.2
Dissolved Oxygen (%)			70.6			89.6			103			92.7

Air Quality Monitoring Results – Depositional Dust Gauges

TIS (g/m2/month)	1A	2A	3A
Jul-19	0.9	0.8	0.8
Aug-19	1.0	1.1	1.5
Sep-19	1.0	2.0	1.5
Oct-19	2.1	2.0	0.3
Nov-19	1.7	3.1	0.7
Dec-19	3.8	3.6	5.2
Jan-20	3.4	6.8	3.0
Feb-20	5.6	6.9	4.0
Mar-20	1.0	1.3	2.3
Apr-20	2.1	0.2	0.3
May-20	1.2	1.0	0.4
Jun-20	1.9	1.7	0.1

Acid Sulphate Monitoring

	TOS (%)
Jul-19	<0.02
Aug-19	0.02
Sep-19	<0.02
Oct-19	<0.02
Nov-19	<0.02
Dec-19	<0.02
Jan-20	0.03
Feb-20	<0.02
Mar-20	<0.02
Apr-20	<0.02
May-20	<0.02
Jun-20	<0.02

Annexure D

Twelfth Annual Review

Landscape and Rehabilitation Management Plan

Good Bush Pty Ltd

13 July 2020

Gerroa Sand Quarry Annual Monitoring Report

Report prepared by Marcus Burgess
Manager Good Bush Pty Ltd
13/07/2020

Contents

Introduction

Good Bush Pty Ltd were commissioned by Cleary Bros (Bombo) to produce a report for the annual monitoring and condition assessment of the natural bushland and revegetation areas of Gerroa Sand Quarry.

The objectives of this report is to assess the condition of the revegetation and natural bushland areas and to provide management recommendations to assist establishment of plantings and natural regeneration of intact bushland.

This report aims to meet the approval conditions of the NSW Land and Environment Court for the extension of the quarrying operational areas in 2009. A Vegetation Landscape and Rehabilitation Management Plan was prepared for the site in 2008 (KMA) and this has guided the restoration of the site.

This report should be read in conjunction with "Landscape and Rehabilitation Management Plan, Extension and Continuation of Gerroa Sand Quarry, Municipality of Kiama, City of Shoalhaven"(KMA 2008) and Kevin Mills and Associates "Gerroa Sand Quarry Annual Reports" of which the tenth and most recent report was produced in 2018 (KMA 2018)

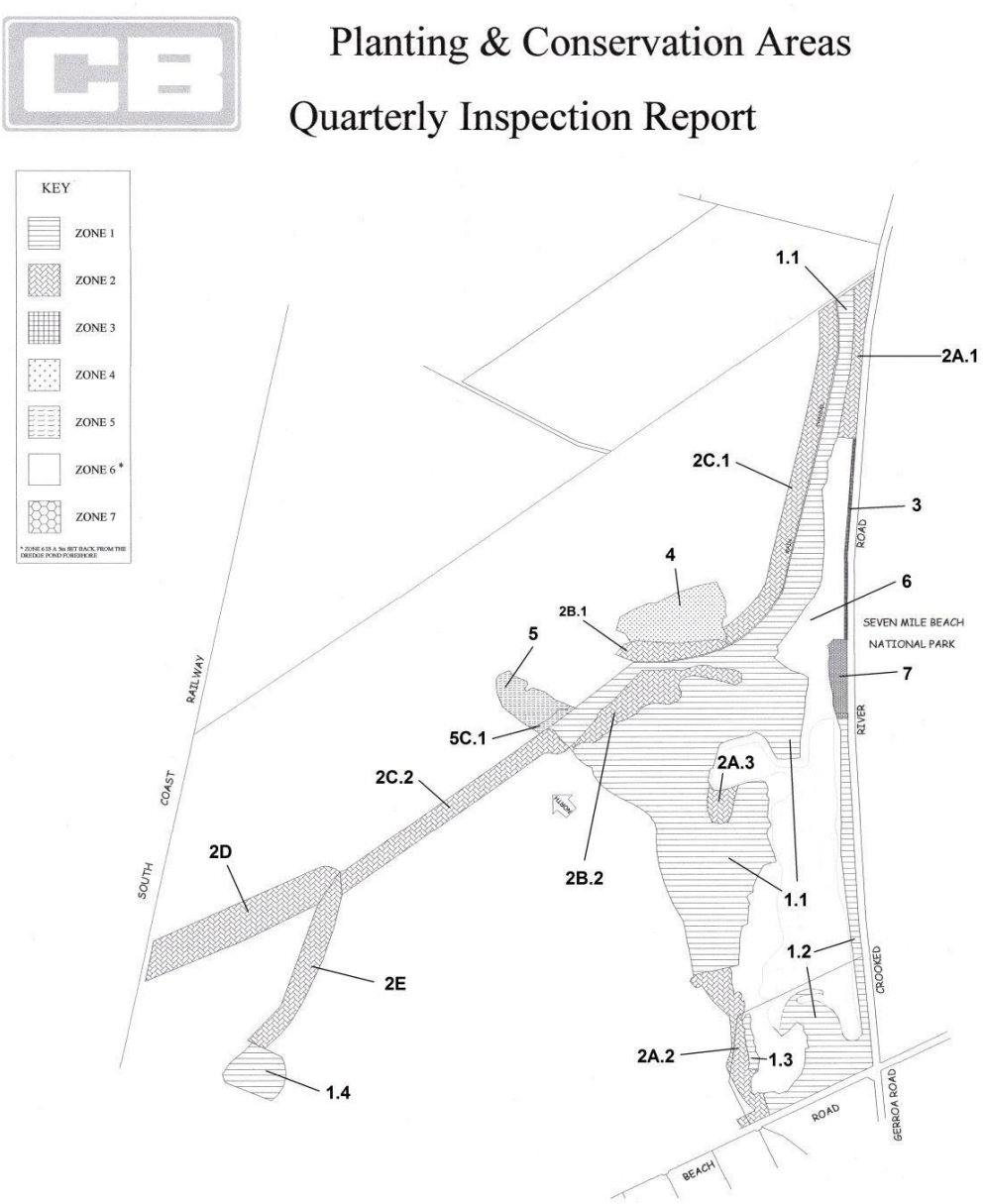
Site Location

Gerroa Sand Quarry is located at the corner of Crooked River Road and Beach Road, Gerroa and the revegetation areas extend west to the South Coast railway line. The total area of the quarry consists of approximately 100 hectares including bushland areas and operational areas.

Location Map

Site Map

The following site map shows the zones delineated in the Court approved Landscape and Rehabilitation Management Plan (KMA 2008). This map of zones was used as the basis for assessing the individual zones for the purpose of this report.



Assessment of Individual Zones

Zone 1	Description / Previous Works	Recommendations
1	Forest Enhancement Zone This the largest and main zone consisting of existing forest from the southern to northern property boundaries and comprising the operational areas of Gerroa Sand Quarry. The Objectives of this Zone are: • Improve the quality of the forest by removing weeds • Restrict grazing from the forest areas • Monitor the health of the forest Strengthen tree cover south of the dredge pond	
1.1	This is the largest zone extending from the southern to northern end of the property boundary. Work in the past has involved treatment of woody weeds Lantana and Bitou Bush and selective weed control on reportable weed species	• Treat Giant Arundo Grass (*Arundo donax*) on the roadside using cut and paint methods (Photographs 1 and 2) • Treatment of additional woody weeds such as Lantana and Wild Tobacco using cut and paint methods • Treatment of annual weeds and invasive grasses using spraying methods
1.2	This area covers the intact forest on the eastern and western edges of the dredge pond where revegetation was carried out many years ago and has become well established	• Treatment of annual weeds and invasive grasses using spraying methods • Treat small amount of Bitou Bush at the southern end of the dredge pond (Photograph 10) • Treat proliferating Morning glory (*Ipomoea indica*) on the western side of the old bund wall (Photograph 3)
1.3	This area covers the old bund wall where revegetation was carried out many years ago and has become well established	• Treat proliferating Morning glory (*Ipomoea indica*) on the western side of the old bund wall (Photograph 3)

1.4	This area consists of a fenced patch of Swamp Oak Forest which has been connected to the broader conservation areas by the planting of Zone 2E	• Treatment of woody weeds such as Lantana and Wild Tobacco using cut and paint methods

Zone 2	Description / Previous Works	Recommendations
2	Broad Scale Planting Zone This zone consists of extensive areas of revegetation stretching from the northern to the western property boundaries roughly following the line of Blue Angle Creek. Large areas of revegetation have become established within the subzones. The Objectives of this Zone are: • Develop habitat by planting forest communities in accordance with the Landscape and Rehabilitation Management Plan (KMA 2008) • Establish habitat corridors to the north and south of the existing forest by utilising revegetation and importing structure • Monitor plantings and maintain where necessary including spraying of management rings and removal of unnecessary plant guards • Strengthen east-west and north-south links between the established forest and Seven Mile Beach NP	
2A.1	This area consists of the main site for developing the forested link with Seven Mile Beach NP in the northeast corner of the site. Extensive work has been carried out over the past nine years to develop this area as habitat for native fauna by carrying out revegetation and importing habitat structure. Blady Grass (*Imperata cylindrica*) and Burrawang Cycad (*Macrozamia communis*) readily regenerating within this zone demonstrates the success of this area	• Treatment of minor amounts of woody weeds such as Lantana and Wild Tobacco using cut and paint methods (Photograph 9) • Treatment of African Lovegrass (*Eragrostis curvula*) particularly at the northern extent of the zone • Woody weed control along the established forest adjacent to Blue Angle Creek
2A.2	This area is important for the forest link to the south and into Seven Mile Beach NP on the southern side of Beach Road. Extensive revegetation has become well established within this zone. Spraying has been carried out to treat invasive grass species within this area	• Treatment of woody weeds such as Lantana and Wild Tobacco using cut and paint methods
2A.3	This small area was revegetated early in the program but was made problematic by continued grazing from native fauna in particular Swamp Wallaby. Most recently the revegetation within this area has become well established and resistant to grazing	• Additional revegetation maintenance including weeding around establishing plants and spraying management rings • Remove unnecessary plant guards
2B.1	This narrow area required revegetation to link the forest with with Zone 4. The subzone was spread with topsoil and some timber debris and a small amount of revegetation was undertaken.	• Additional revegetation maintenance including weeding around establishing plants and spraying management rings

		• Remove unnecessary plant guards • Woody weed control along the established forest adjacent to Blue Angle Creek • Treatment of ascending Moth Vine (*Araujia sericifera)* within the planted canopy using cut and paint methods and removing viable fruit where applicable
2B.2	This consists of a low lying swamp and is being colonised by Swamp Oak. Natural regeneration within this area is adequate and only minimal planting has been required in the past	• Additional revegetation maintenance including weeding around establishing plants and spraying management rings • Remove unnecessary plant guards • Woody weed control along the established forest adjacent to Blue Angle Creek
2C.1	This long area has now been revegetated and trees have become well established.	• Additional revegetation maintenance including weeding around establishing plants and spraying management rings • Infill planting with trees to exclude weeds and assist canopy establishment • Woody weed control along the established forest adjacent to Blue Angle Creek
2C.2	This area was revegetated several years ago and trees have become well established	• Treatment of woody weeds such as Lantana and Wild Tobacco using cut and paint methods
2D	This area has a mixture of well established revegetation and recent plantings using advanced plants carried out in early 2020 (Photograph 6). Recent follow up planting is showing signs of grazing from native animals but are surviving and becoming established	• Monitor plant growth and provide plant protection if grazing persists (Photograph 5) • Reinstate fallen plants (Photograph 7) • Infill planting with additional diversity • Treatment of minor amounts of Blackberry using spraying methods
2E	This area was revegetated several years ago and trees have become well established	• Treatment of woody weeds such as Lantana and Wild Tobacco using cut and paint methods

Zone 3	Description / Previous Works	Recommendations
3	Screen Planting Zone This zone consists of the eastern bank of the dredge pond. Extensive revegetation was carried out within this area at the completion of the pond extension. The Objectives of this Zone are: • Establish a screen of native vegetation along the eastern edge of pond extension • Maintain existing trees on south eastern boundary and remove lantana and replace with native plantings • Monitor the health of the forest	• Treatment of woody weeds such as Lantana and Wild Tobacco using cut and paint methods • Treatment of annual weeds and invasive grasses using spraying methods

Zone 4	Description / Previous Works	Recommendations
4	Bangalay Sand Forest This zone consists of an established remnant of the once vast Bangalay Sand Forest vegetation community that dominates the Seven Mile Beach NP and surrounding areas. This zone has an excellent intact canopy of Bangalay and Blackbutt and high habitat value with dead trees, hollows and other natural structure still intact The Objectives of this Zone are: • Restrict access to grazing stock • Establish a revegetated link to Zone 2 planted areas • Monitor the health of the forest • Treat significant invasive weed species as required	• Treatment of woody weeds such as Lantana and Wild Tobacco using cut and paint methods • Treatment of annual weeds and invasive grasses using spraying methods

Zone 5	Description / Previous Works	Recommendations
5	Swamp Oak Forest This zone consists of an established remnant Swamp Oak Forest with woody weeds dominating the understorey The Objectives of this Zone are: • Maintain the perimeter fencing to exclude stock Treat woody weeds such as Lantana and Wild Tobacco as required	
5C.1	This zone consists of a planted Swamp Oak Forest that is dominated by invasive grasses with Kikuyu encroaching onto the plantings. A regenerating stand of *Melaleuca ericifolia* exists within this zone	• Additional revegetation maintenance including weeding around establishing plants and spraying management rings • Remove unnecessary plant guards • Woody weed control along the established forest adjacent to Blue Angle Creek

Zone 6	Description / Previous Works	Recommendations
6	Dredge Pond Foreshore This zone consists a five metre setback form the pond and batter slopes. The foreshore areas have been shaped, topsoil spread and planted as the dredge pond has progressed northwards. The pond banks are stable and minor erosion is evident. Planting and natural regeneration has assisted stabilisation of the batter slopes and native tree growth is well established. The Objectives of this Zone are: • Stabilise the batters on the edges of the dredge pond. • Undertake plantings within the 5 m set back area along the edge of the retained littoral forest (zone 7) ahead of the quarrying operation. • Continue rehabilitation of previous dredge pond areas	• Additional planting as required to assist stabilisation of the dredge pond batter particularly on the eastern batter as the western batter has become well established (Photograph 8) • Treatment of woody weeds such as Lantana and Wild Tobacco using cut and paint methods • Treatment of annual weeds and invasive grasses using spraying methods

Zone 7	Description / Previous Works	Recommendations
7	Littoral Rainforest This zone consists an area listed as littoral rainforest (KMA 2008). The listed threatened species Illawarra Zieria (*Zieria granulata*) was observed within this area (Photographs 11 and 12). The Objectives of this Zone are: • Treatment of woody weeds such as lantana and Wild Tobacco • Monitor the health of the forest • Protect the western edges of the zone from quarrying.	• Treatment of woody weeds such as Lantana and Wild Tobacco using cut and paint methods • Treatment of annual weeds and invasive grasses using spraying methods

Priority Weeds

The following invasive weed species were identified on this site and treatment methods for their removal. These weeds have been listed in their order for priority for removal as legislated and based on their invasive potential:

Botanical Name / Common Name	**Control Methods**
African Love Grass (*Eragrostis curvula*)	Treat with spraying using a 1% mixed rate of Glyphosate 360
Bitou Bush (*Chrysanthemoides monilifera* subsp *rotundata*)	Cut and paint and mulch materials on site
Blackberry (Rubus fruticosis)	Spray treatment using Grazon or Metsulfuron based herbicide
Giant Arundo Grass (*Arundo donax*)	Cut and paint and mulch materials on site
Morning Glory (*Ipomoea indica*)	Hand remove running stems, cut and paint all nodes, spray with Metsulfuron based herbicide
Cassia (*Senna pendula var. glabrata*)	Cut and paint and mulch materials on site after removal of viable seed
Cape Ivy (*Delairea odorata*)	Hand remove all stems and root points and raft materials in an elevated position until dry then mulch material on site
Moth Vine (*Araujia sericifera*)	Cut and paint and mulch materials on site after removal of viable and bagging fruit
Wild Tobacco (*Solanum mauritianum*	Cut and paint and mulch materials on site after removal of viable seed
Lantana (*Lantana camara*)	Cut and paint and mulch materials on site

Conclusion

Overall the health of the conservation areas at the Gerroa Sand Quarry are in fairly good condition. Natural regeneration of local native plant species is evident within most areas of the site and weed encroachment is minimal. Where weed encroachment is high generally the dominant weed species tends to be Lantana which is in comparison with other weeds easy and cheap to control and eradicate.

Weed treatments have been carried out by site personnel as evidenced by sprayed Lantana (Photograph 4) and various annual weeds and grasses. It is recommended that Lantana control be undertaken by hand using the cut and paint method rather than by spray treatment. This will ensure that off target plants are not affected and will improve the kill rate of Lantana, resulting in a greater reduction of the overall Lantana population. Lantana should be treated by hand using the cut and paint method in a mosaic pattern ensuring small areas of approximately 1000, to 2,000m² is treated at a time. This will allow suitable fauna habitat to be retained while natural vegetation becomes established within the treated areas before any additional Lantana is removed.

Revegetation at this site has become well established, particularly at the northern extent of the site where the oldest revegetation exists. Infill planting may be required within some areas where plants have not succeeded.

Continuation of revegetation maintenance will assist establishment of plants and help to create further canopy connectivity and reach the goals of the Landscape Rehabilitation Management Plan (KMA 2008).

Photographs

Photograph 1. Giant Arundo Grass within zone 1.1 requiring treatment

Photograph 1. Giant Arundo Grass within zone 1.1 requiring treatment

Photograph 3. Morning Glory requiring treatment in zones 1.2 and 1.3

Photograph 4. Spray treated Lantana

Photograph 5. Grazed plantings within Zone 2D

Photograph 6. Revegetation area within zone 2D

Photograph 7. fallen Coastal Banksia within Zone 2D

Photograph 8. Zone 6 revegetation and regeneration on western side of dredge pond well established. More planting required on eastern side to assist soil stablilisation

Photograph 9. Lantana encroachment within Zone 2A.1 requiring treatment

Photograph 10. Bitou Bush encroachment within Zone 1.2 requiring treatment

Photograph 11. Illawarra Zieria within Zone 7

Photograph 12. Illawarra Zieria within Zone 7

Appendix 1: Weed Control Method Definitions

The following weed removal methods will be used to complete these works:

Cut and Paint

The Cut-and-Paint removal technique involves the cutting of the stem using loppers and saws as low to the ground as possible and immediately applying undiluted Glyphosate to the cut stump. Woody weed materials can be cut and composted on site after removal of any seeds or propagules. Weeds treated using this technique include large woody weeds such as Lantana *(Lantana camara*), Cassia (*Senna pendula var. glabrata*), Privets (*Ligustrum spp.*) and Bitou Bush (*Chrysanthemoides monilifera*). Several smaller annual and perennial weeds will require this treatment when hand removal is not possible or has the potential to create soil erosion.

Scrape and Paint

The Scrape-and-Paint removal technique involves scraping a knife along one side of the plant stem covering as much stem surface area as possible. Undiluted Glyphosate is then applied immediately to the scrape. This technique can be effectively utilised to treat weeds with particularly strong root systems and large tap roots such as Mickey Mouse plant (*Ochna serrulata*), Blackberry (*Rubus fruticosis*) and Paddys Lucerne (*Sida rhombifolia*) and difficult to treat invasive vines such as Coastal Morning Glory (*Ipomea cairica*), Madiera Vine (*Anredera cordifolia*) and Honeysuckle (*Lonicera japonica*).

Hand Removal

The Hand-Removal technique involves removing the whole plant after careful removal of any propagules and mulching the plant on site. Where the threat of vegetative regrowth is present all parts of the plant will require bagging and removal from the site. This technique is most effective for controlling annual weeds such as Cobblers Pegs (*Bidens pilosa*), Fleabane (*Conyza spp*.) and Stinking Roger (*Tagetes minuta*). Targeting woody weeds prior to seeding using hand removal techniques can reduce future work loads by depleting available seed stored in the soil.

Frilling

Frilling of trees can be utilised when the target tree carries too much material for disposal or the dead tree is to be retained as habitat for birds, animals or climbing plants. The frilling technique involves using a sharp chisel to create a series of 20 mm deep cuts at 30mm intervals around the base of the trunk as low to the ground as possible and the immediate application of undiluted Glyphosate to the cut. All Tree weeds such as Privet, Coral Tree, African Olive, Camphor Laurel and Cotoneaster can be successfully treated using this method.

Herbicide Use

Use of herbicides must be limited to the use of Round Up Biactive® for cut and paint and scrape and paint applications at all times.
Spraying activities should only be carried out by qualified weed managers with a current Smart Train or Chemcert certificate.
Spraying should only be utilised after careful inspection of spray areas to ensure no naturally occurring species are targeted, and at all times follow the manufacturers specifications.

Appendix 2: Herbicide Compositions

Spraying activities should only be carried out by qualified weed managers with a current Smart Train or Chemcert certificate. Herbicide compositions for various weed treatments are as follows:

1. For spraying activities targeting Panic veldt grass and various annual weed seedlings use the following herbicide composition:

Chemical	Mixed Rate per 10 Litres of Water
Glyphosate (Round Up®)	50 mls (0.5 %)
Indicator Dye (Tru-Blu®)	30 mls (0.25%)

2. For spraying activities targeting annuals, grasses, various woody weeds and weed seedlings use the following herbicide composition:

Chemical	Mixed Rate per 10 Litres of Water
Glyphosate (Round Up®)	100 mls (1.0 %)
Indicator Dye (Tru-Blu®)	30 mls (0.25%)

3. For spraying activities targeting Wandering Jew *(Tradescantia flumiensis),* Moth Vine seedlings *(Araujia sericifera.)* and Madiera Vine *(Anredera cordifolia*) use the following herbicide composition:

Chemical	Mixed Rate per 10 Litres of Water
Starane 200®	150 mls (1.5%)
Indicator Dye (Tru-Blu®)	30 mls (0.25%)

4. For spraying activities targeting Blackberry (*Rubus fruticosis*), Turkey Rhubarb *(Acetosa sagitatta)* and Asparagus Fern *(Protosparagus aethiopicus*) use the following herbicide composition:

Chemical	Mixed Rate per 10 Litres of Water
Glyphosate (Round Up®)	100 mls (1 %)
Metsolfuron (Brush Off®)	1 gram (0.1%)
Indicator Dye (Tru-Blu®)	30 mls (0.25%)
Synetrol Surfactant (Vegetable Oil Concentrate)	50 mls (0.5%)

References

Kevin Mills & Associates (2008). Landscape and Rehabilitation Management Plan, Extension and Continuation of Gerroa Sand Quarry, Municipality of Kiama, City of Shoalhaven. Prepared for Cleary Bros (Bombo) Pty Limited, Port Kembla, August

Kevin Mills & Associates (2019). Tenth Annual Survey. Flora and Fauna Monitoring Surveys, Gerroa Sand Quarry, Municipality of Kiama. Prepared for Cleary Bros (Bombo) Pty Limited, Port Kembla, June.