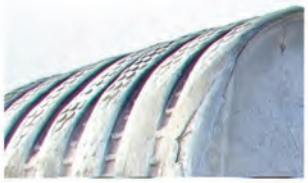
PLANIT
CONSULTING

DUNLOE SANDS QUARRY

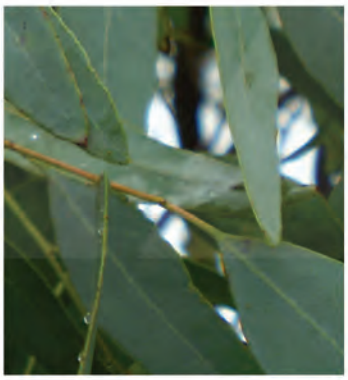
Ramtech Pty Ltd
Pottsville Mooball Rd,
Pottsville NSW

Annual Environmental Monitoring Report
November 2012 - October 2013










Prepared by Planit Consulting - November 2013

Review and Amendments Schedule – PLANIT CONSULTING PTY LTD

		Date
Author	BL	November 2013
Reviewer	AS	November 2013

Amendments

Planit Consulting Pty Ltd declares that it does not have, nor expect to have, a beneficial interest in the subject project.

PLANIT CONSULTING PTY LTD©
November 2013

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Introduction & Context

Development consent for Ramtech Pty Ltd's (Ramtech) proposal to construct and operate a sand quarry at Lot 1 in DP 755721 & Lots 1 & 2 in DP 780199 Pottsville Mooball Road, Mooball was granted by the Minister for Planning on 24th November 2008. Schedule 3 of the development consent requires that individual management plans for the key environmental issues be prepared and that environmental management and monitoring conditions be fulfilled. To this end, an EMP was approved by the Department of Planning which integrates the prescribed environmental monitoring programs in accordance with Condition 2 of Schedule 5 into a planning and operations framework.

Construction commenced on a general trial basis in September 2010 with formal commencement occurring in October of 2010. Operations are at a basic level with estimated annual production in the order of 20,000 tonnes per annum only at this stage.

Within Schedule 5 of the consent, Condition No.5 requires that within twelve (12) months of the date of the approval and annually thereafter, Ramtech is to submit an Annual Environmental Management Report (AEMR). This AEMR is to be submitted to the Director General of the Department of Planning and other relevant agencies in accordance with the abovementioned Condition 5. This AEMR describes works undertaken, provides a summary and analysis of any complaints and monitoring results, identifies any trends in the monitoring results and identifies any non compliance over the preceding 12 months. Also included is any proposed construction, extraction and rehabilitation activities planned for the following 12 months.

Description of Resource

Concrete Sand

The Dunloe Park sand, after washing, is suitable as a concrete sand additive. It is expected that this will be the major use of the sand. Low extraction costs will make the sand competitive within the local Pottsville markets. As sand demand increases, the Dunloe Park sand may become competitive within the Brisbane market.

Loam

Further investigation into loam resources were carried out in mid 2007 (Coffey Geosciences, 2007), the area selected for investigation being the initial mining area proposed for the sand quarry (Gilbert and Sutherland, 2007). A 200m x 200m area approximately 1.2 m deep in the alluvial soil below the topsoil (which averaged approximately 0.3m depth) equating to approximately 90,000t of loam, was sampled by auger drilling and assessed for suitability as a loam.

Fill Material

Fill material represents a portion of demand in South East Queensland and Northern NSW. The sand appears to match Rocla specifications for fill sand in NSW (Rocla, 2007). From investigations carried out by Coffey Mining, it is considered that the Dunloe Park sand can be used as "low grade" fill material which is not dissimilar to fill material supplied into the northern and central coast of NSW. Major local sources of fill include sandstone fill from Kangaroo Creek (near Grafton) which also provides road base and hard materials.

Plastering and Rendering Sand

Coffey Mining is of the opinion that the sand in the Dunloe Park Resource, when washed, will be suitable for lower grade plastering and rendering sand and this is similar to current material supplied into the northern and central NSW market. To confirm this, it is recommended that the following be completed:

- Washed material be prepared and provided to agents for trialing and feedback.
- Laboratory tests be completed for fineness modulus, clay/silt content (<3%), organics and shell content.

Other Uses

Other "specialist" products which fit closely to the grading of the Dunloe Park sands include:

• Golf course sands – colour (usually whiteness) is a major issue.
• Grout sands.
• Fine filter sands.

Sale of these sands (except for local demand) is not considered to be a major opportunity for Dunloe Park due to established marketing strategies (including bagging of filter sands and grout sands) by other manufacturers. If these products are required in the future, then blending with imported (generally coarser size ranges) will be required. This is commonplace within the sand industry.

Dunloe Park *in situ* Indicated Mineral Resources

Pit	Overburden Mm^3	Sand Mm^3	Total Mm^3
North Pit	0.14	3.70	3.84
South Pit	0.08	2.96	3.04
Total	0.22	6.66	6.88

Extraction rates are not to exceed 300,000 tonnes per annum in accordance with Condition 7 of Schedule 2 of the Development Consent. Condition 5 of Schedule 2 provides for operations being permitted until 1 January 2035.

Monitoring

Planit Consulting has been contracted by Ramtech Pty Ltd to prepare this report based on environmental monitoring undertaken upon site by the proponents.

The monitoring includes;

- Blue Green Algae;
- Vegetation Management and Regeneration (within a separate report);
- Ground Waters; and
- Surface Waters.

All monitoring was undertaken by Ramtech staff.

This report was prepared by Planit Consulting and includes the following;

- Algae Level results for November 2012 to October 2013;
- Ground Water chemical results (pH, EC, DO and RP) for November 2012 to October 2013;
- Quarterly groundwater chemical results (Chloride, Calcium, Magnesium, Sodium, Potassium, Sulphate, Arsenic, Iron and Manganese);
- Quarterly Surface Water chemical results (December 2012, March, June and September 2013);
- Rainfall levels from November 2012 to October 2013; and
- Dust Monitoring from 16th and 23rd November 2012.

The Bureau of Meteorology (BOM) recorded rainfall within surrounding suburbs over the 12 month period from November 2012 to October 2013. The recorded rainfall averaged from three sites – Coolangatta, Murwillumbah and Byron Bay – was approximately 1,783mm of rain was recorded on-site.

Vegetation Management and Regeneration Works

As part of the Dunloe Sand Quarry's approved Environmental Management Plan, revegetation and regenerative landscaping is required (Appendix C of the EMP). Ongoing management of the surrounding vegetation is being carried out by Ramtech P/L over the lifetime of the Dunloe Quarry operations. As such, progress photographs have been included within this report to allow for the ongoing monitoring of the vegetation works (**Appendix D**).

The regenerative works have been undertaken via a combination of assisted and natural regrowth and all areas have been fenced so as to limit the intrusion of cattle. In this regard, depending on soil types, each of the areas has been very successful in establishing quality regrowth. The only limiting factors have been some cattle getting in and around existing fences (primarily at low tide where they have been able to traverse the creek lines. There are also some areas of extensive grass intrusion that will be subject to ongoing spray control so as to allow for further natural regrowth to occur. The works have been successful to date as shown within the photo plates at **Appendix D**.

Fig 1. Rehabilitation Areas Active

Complaints Recorded

No complaints have been registered by the proponents to date.

Chapter
1.0 Sampling Program

Sampling Program

Dunloe Sand Quarry conducts environmental monitoring in accordance to Development Consent, Condition 2 of Schedule 5 and the approved Environmental Management Plan (EMP). Ramtech undertake algae, surface water and groundwater monitoring for the project.

Groundwater sites are monitored monthly for pH, EC, Redox Potential and DO and quarterly for Chloride, Calcium, Magnesium, Sodium, Potassium, Sulphate, Arsenic, Iron and Manganese. Samples are collected from sites DLP1, DLP3, DLP5, DLP6 and DLP7. Sites locations are shown on the **Ground Water Location Map** under **Appendix A**.

Surface water analysis includes pH, electro-conductivity (EC), dissolved oxygen (DO), suspended solids, total phosphorus and total nitrogen and is conducted quarterly at sites SW3, SW4, SW9 and SW10. Site locations are depicted within the **Surface Water Location Map** under **Appendix B**.

Note: No sampling was undertaken during January due to laboratory closure/weather interruptions. It is considered that the samples taken during February illustrate that acceptable monitoring levels remain evident in the sampling area.

All of the **Sampling Raw Data** that has been used to compile this report is included in **Appendix C**.

Chapter
2.0 Monthly Monitoring Results

2.1 Algae Results

The results of the algae monitoring for the period of November 2012 to October 2013 are displayed within **Table 1**. Results are presented in cells/mL.

Table 1: Dunloe Sands – Lake – Algae Results November 2012 to October 2013

	28/11 2012	24/12 2012	17/01 2013	01/02 2013	15/02 2013	08/03 2013	30/05 2013	30/06 2013	30/07 2013	28/08 2013	30/09 2013	25/10 2013
Cyanophyta (cells/mL)	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
Chlorophyta (cells/mL)	7,900	**80,670**	-	-	-	215	880	-	34,000	205	-	17430

The cyanophyta results gathered between November 2012 and October 2013 remains consistently low being <100 cells/mL. The chlorophyta results gathered between November 2012 and October 2013 detail mixed results. All but one of the readings were below the maximum algae level prescribed within the EMP of 50,000 cells/mL. This level receded back to a zero reading by the January sample. Continued monitoring will ensure the conditions relating to green algae growth are monitored and reduced where possible. No potentially hazardous levels of cyanophyta were noted.

2.2 Ground Water

Monthly ground water monitoring was conducted between November 2012 and October 2013. Samples monitored the pH, EC, Redox Potential and DO levels of five (5) sample sites. The locations of the DLP sites are illustrated within the **Ground Water Locations Map** - **Appendix A**.

The results are displayed within four separate graphs illustrating the results of each test site over the twelve (12) month monitoring period. **Figure 2** depicts the pH test results, **Figure 3** illustrates the EC, **Figure 4** shows the Redox Potential and **Figure 5** shows DO levels.

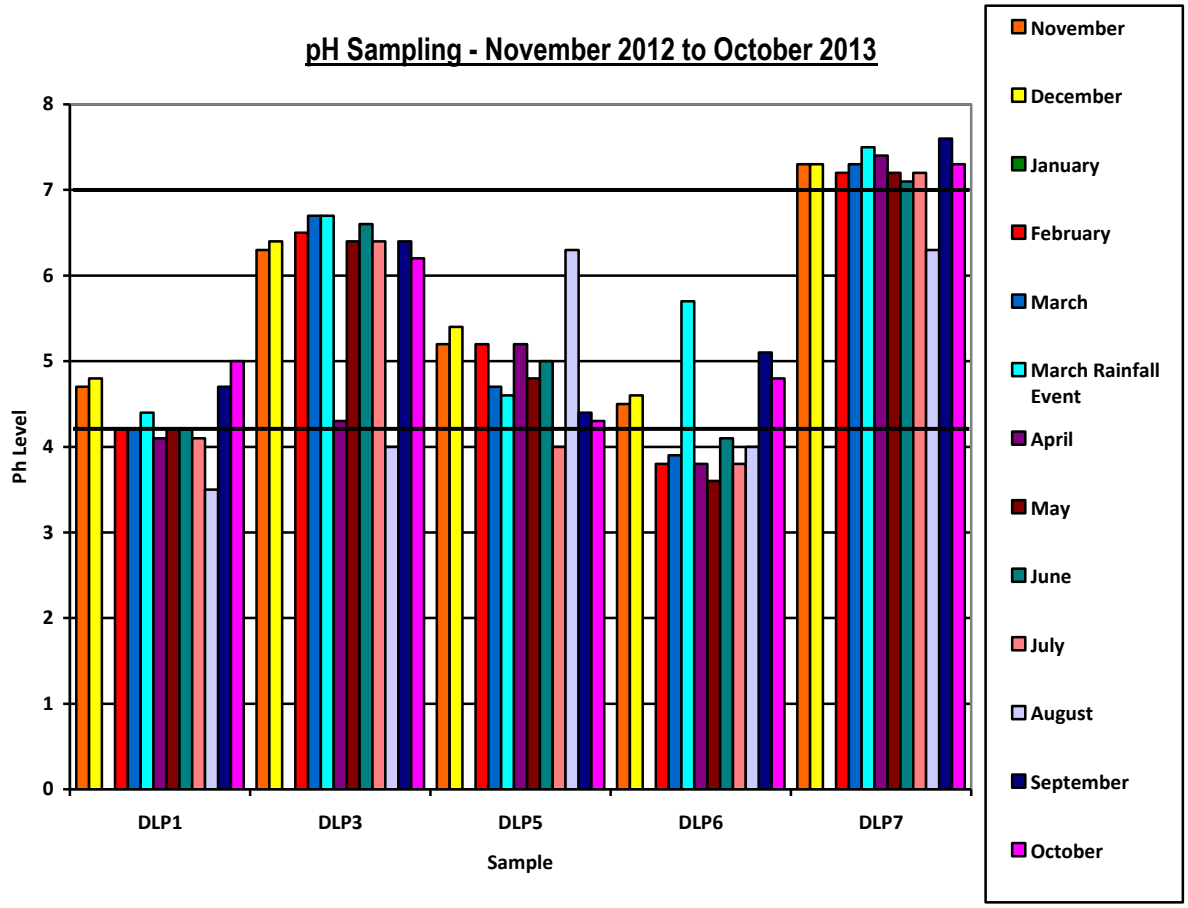

Figure 1: Dunloe Sands - Ground Water - Chemical (pH Test) Results November 2012 to October 2013

The EMP provides the interim target range regarding the pH levels of ground water sampling. The majority of the results displayed are between the minimum of 4.2pH and maximum of 7.0pH (shown as black lines). DLP 7 shows some samples outside of the maximum interim target levels by between 0.1 and 0.6pH. This presents a more alkaline pH level than the target range. These minimal exceedances of pH at DLP7 are not considered to be of any significance as small fluctuations in groundwater pH is common within regions which experience both high and low levels of rainfall and are consistent with background levels which were consistently acidic before operations commenced (particularly DLP7). DLP1, 3, 5 and 6 record samples below the 4.2pH interim target. This presents a more acidic pH level than the target range. This is considered to have been caused by high levels of rainfall following dry periods. The majority of results present within the target range and therefore the sampling for the year in considered to be generally consistent with the EMP requirements.

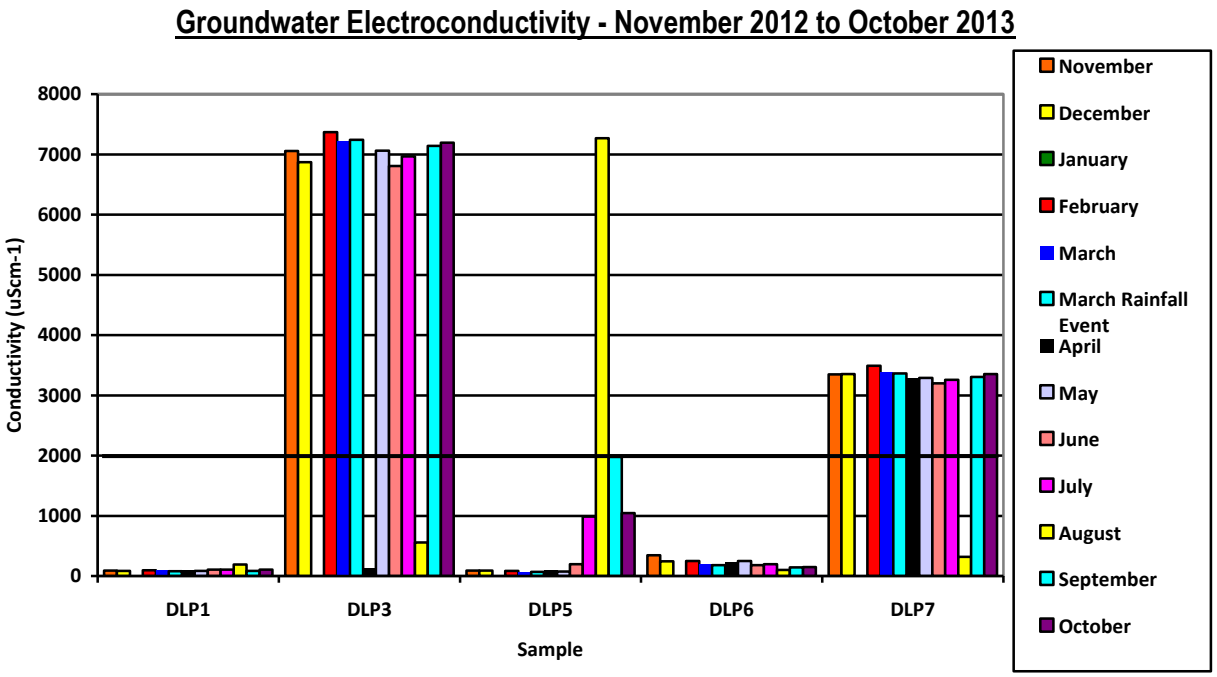

Figure 2: Dunloe Sands - Ground Water - Chemical (EC Test) Results November 2012 to October 2013

The majority of the samples taken produce considerably low EC levels when compared to the EMP maximum interim target of 2000uS/cm^{-1}. However, three samples sites; DLP3, DLP 5 and DLP7 present conductivity levels above the maximum interim target of 2,000uS/cm$_{-1}$ stated within the EMP (shown as a black line). These sites have also expressed similar levels of EC within background testing. This can be explained by the sampling wells being installed in the low-lying portion of the floodplain. The wells are adjacent to sections of Mooball Creek and the main agricultural drainage line which can be subject to tidal influences. It is therefore considered likely that some localised salinisation of surficial groundwater has occurred within the vicinity of monitoring locations DLP3, DLP5 and DLP7.

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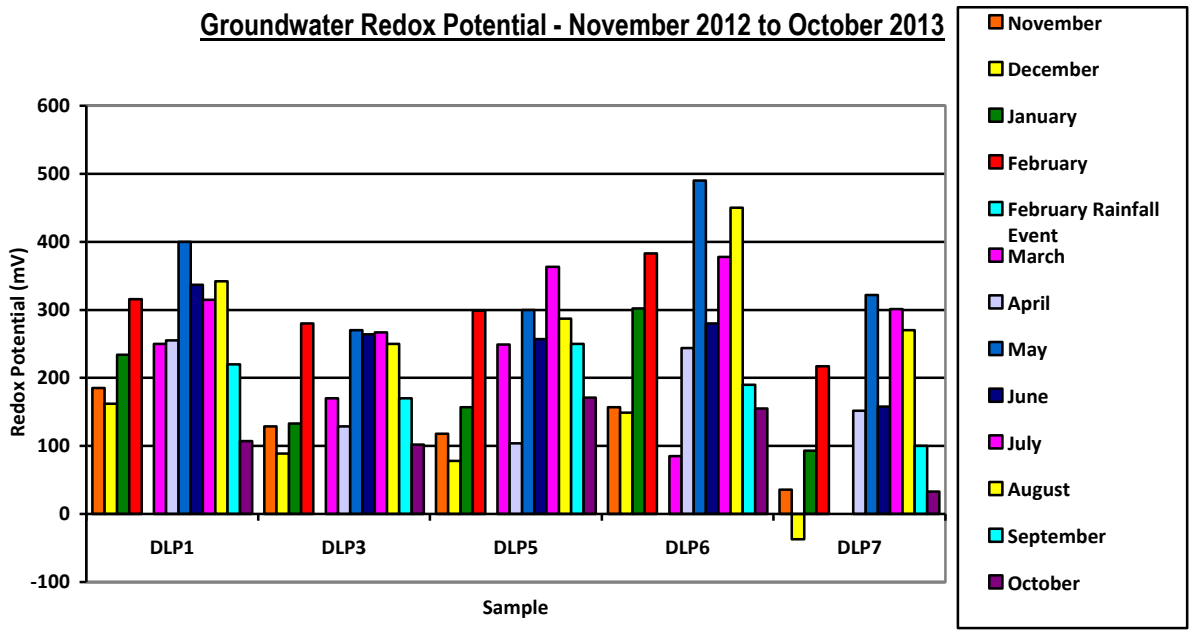

Figure 3: Dunloe Sands - Ground Water - Chemical (Redox Potential Test) Results November 2012 to October 2013

The EMP does not provide an interim target level for Redox Potential but instead states that results should be monitored for outlier samples. All samples present in a uniform manner, with no outliers present.

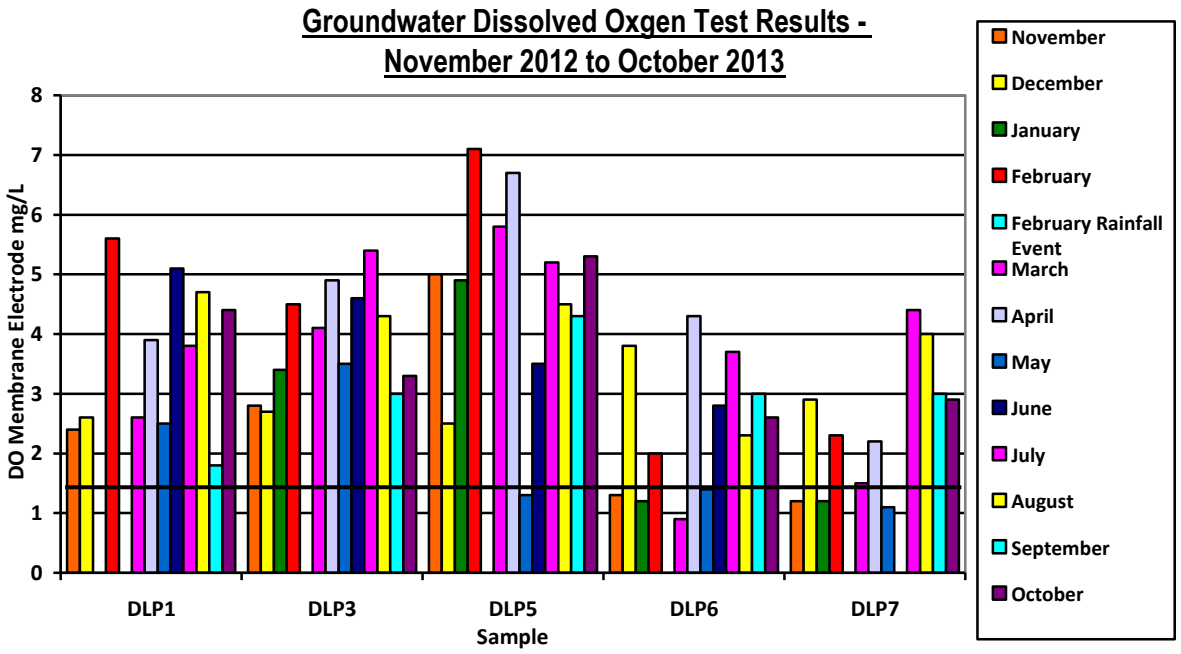

Figure 4: Dunloe Sands - Ground Water - Chemical (DO Test) Results November 2012 to October 2013

The minimum DO level provided within the EMP is 1.5mg/mL (shown as a black line). The results vary in DO levels considerably with the majority not presenting or conforming to a pattern over the twelve (12) month monitoring period. The majority of the groundwater samples that were collected are above the minimum interim target however samples collected from varied locations present levels below the target. Whilst background testing indicated generally low DO levels inherently across the site, the results for DLP 6 and 7 require some further consideration; particularly with respect to the temperature of samples at these locations as exceedingly warm samples will automatically generate a low DO reading. Low results may also be related to excessive faecal matter and nutrients associated with livestock use. Each of these potential reasons should be considered in the context of future sample results so as to look towards potential ameliorative measures, however in the main results at DLP 3 and 7 remain generally low due to proximity to saline environments (Mooball Creek).

2.3 Lake Samples

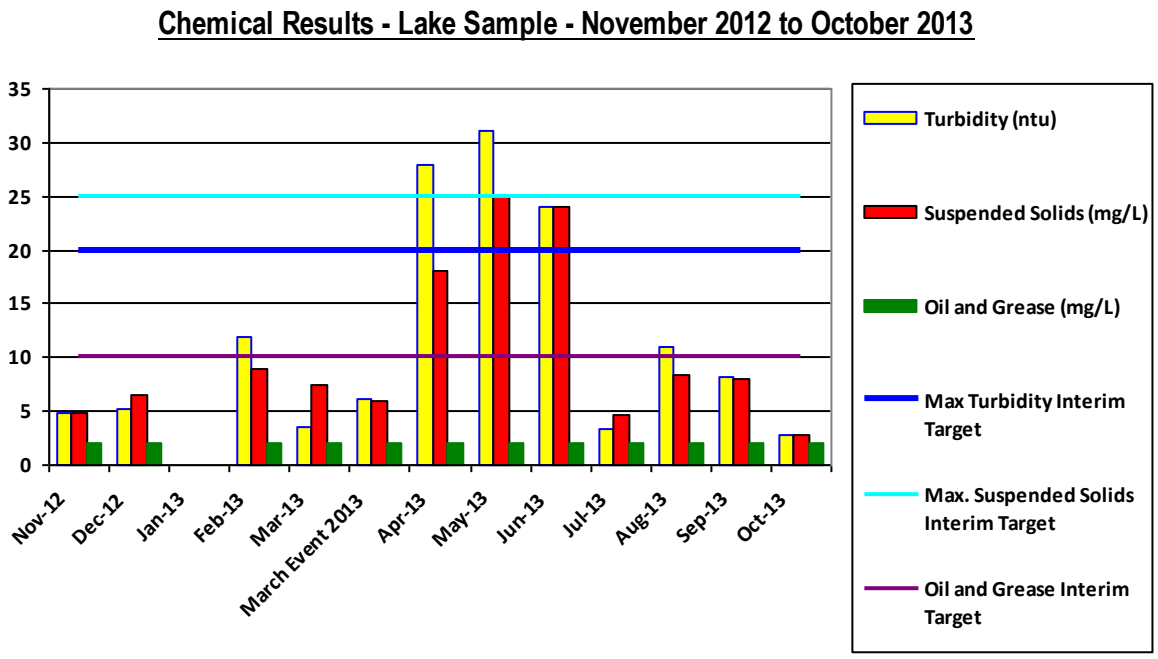

Figure 5: Dunloe Sands - Lake - Chemical Results – November 2012 and October 2013

Interim target levels for turbidity present a maximum level of 20ntu within the EMP. The levels recorded over the twelve (12) month monitoring period show levels below the maximum levels during the majority of samples. The April, May and June samples present above the interim target. This correlates with a higher than usual level of suspended solids. The results present back at below the interim target levels from July onwards. The maximum interim target level for the suspended solids within the EMP is 25mg/L. Results present equal to or below the maximum levels throughout the sampling period. The EMP states a maximum level of 10mg/L in regard to oil and grease. Levels of oil and grease within the samples are consistent over the six month monitoring period at less than 2mg/L.

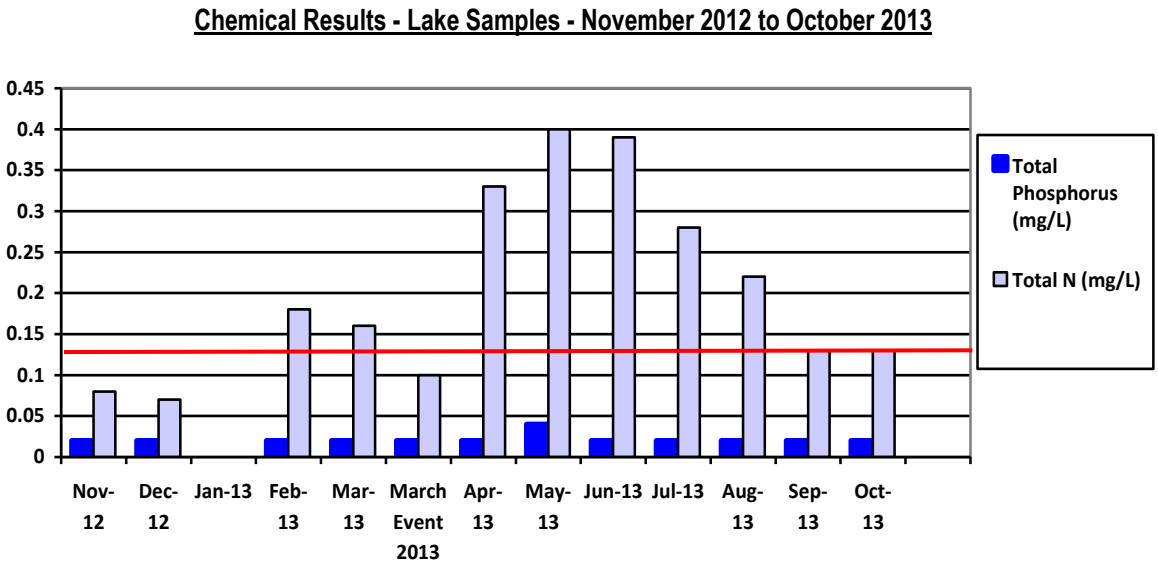

Figure 6: Dunloe Sands - Lake - Chemical Results – November 2012 to October 2013

Total phosphorus levels have a maximum interim target of 0.08mg/L (shown as red line). All sample data results in levels of below the maximum interim target levels contained within the EMP. Total nitrogen levels remain consistently lower than the interim target of 20mg/L with a maximum result of 0.4 mg/L.

2.4 Recorded Rainfall

The Bureau of Meteorology (BOM) have recorded rainfall within the surrounding areas of Pottsville; including Coolangatta (24.3km from Pottsville), Murwillumbah – Bray Park (18.9km from Pottsville) and Byron Bay (28.5km from Pottsville). The results are illustrated within **Figure 8** along with the recorded rainfall average. November 2012 to October 2013.

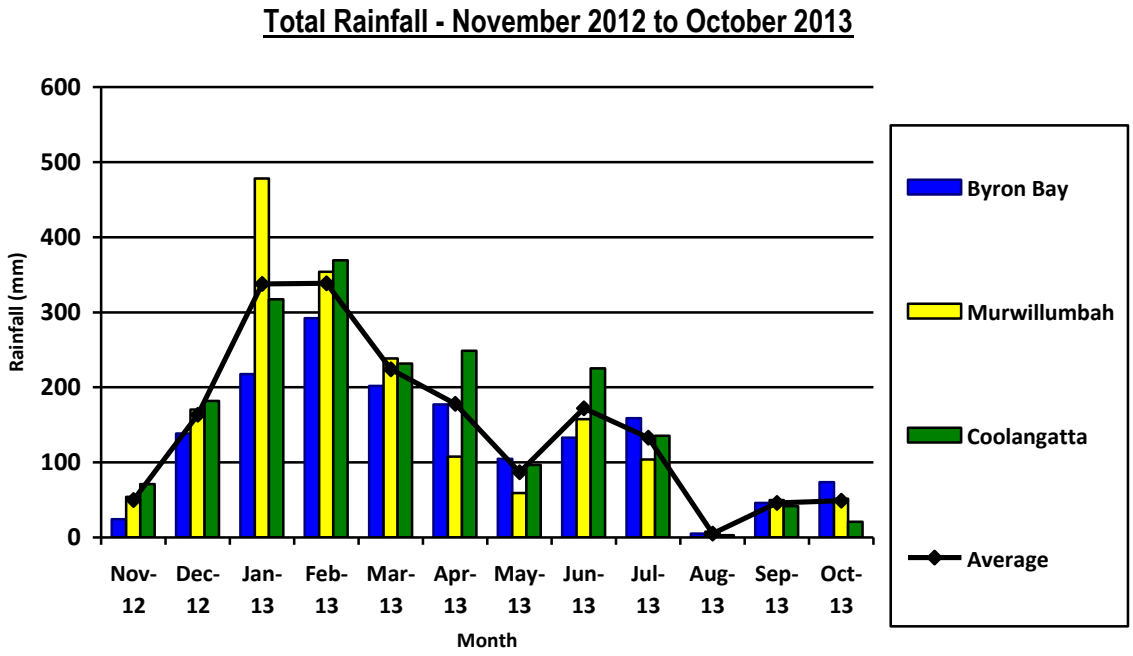

Figure 7: Recorded Rainfall November 2012 to October 2013 (graph needs to change start month)

The recorded rainfall of the three suburbs surrounding Pottsville has been averaged to produce an approximate on-site rainfall. January 2013 presented the highest level of rainfall within the region with an average of 478.4mm of total rainfall being recorded. In total over the twelve (12) month period approximately 1,783mm of rain was recorded on-site.

Chapter
3.0 Quarterly Monitoring Results

3.1 Quarterly Ground Water Chemical Results

Quarterly monitoring of the ground waters on-site from locations DLP 1, DLP 3, DLP 5, DLP 6 and DLP 7 have been undertaken to determine levels of chloride **(Table 2)**, calcium **(Table 3)**, magnesium **(Table 4)**, sodium **(Table 5)**, potassium M8 **(Table 6)**, sulphate **(Table 7)**, arsenic **(Table 8)**, iron **(Table 9)** and Manganese **(Table 10).** Samples were collected in December 2012, March, June and September 2013. Tables present the results compared against the interim target criteria contained within the EMP.

The majority of the samples collected are consistent with the interim target criteria of the EMP. Some variants are illustrated within the results. These variants have been highlighted with bold text.

Table 2: Dunloe Sands - Ground Water - Chemical (Chloride Test) Results (mg/L)

December 2012	DLP 1	DLP 3	DLP 5	DLP 6	DLP 7
Sample	36	**2,270**	18	15	**730**
Interim Target	285.0	285.0	285.0	285.0	285.0
March 2013	DLP 1	DLP 3	DLP 5	DLP 6	DLP 7
Sample	12	**2,280**	12	14	**750**
Interim Target	285.0	285.0	285.0	285.0	285.0
June 2013	DLP 1	DLP 3	DLP 5	DLP 6	DLP 7
Sample	19	**2,310**	30	18	**740**
Interim Target	285.0	285.0	285.0	285.0	285.0
September 2013	DLP 1	DLP 3	DLP 5	DLP 6	DLP 7
Sample	16	**2,280**	640	16	**750**
Interim Target	285.0	285.0	285.0	285.0	285.0

Comments: As highlighted previously, two (2) samples sites (DLP3 and DLP7) presented conductivity levels above the maximum interim target of 285mg/L stated within the EMP, each of which also expressed similar levels of EC within background testing. The latter also correlates with the high chloride levels shown above, which indicate a high level of saltwater intrusion at these points. This is quite easily explained as these sampling wells have been installed in the low lying portion of the floodplain adjacent to the sections of Mooball Creek and the main agricultural drainage line that are subject to tidal influences. It is also not unexpected in the instance of DLP 7 given that it sits immediately adjacent the existing wetland which would in itself act as a 'drawer' of permanently saline conditions in order to sustain its dominant vegetative makeup. It is therefore considered likely that some localised salinisation of surficial groundwater has occurred within the vicinity of DLP3 and DLP7 due to tidal influences within these nearby waterways and wetlands.

Table 3: Dunloe Sands - Ground Water - Chemical (Calcium Test) Results (mg/L)

December 2012	DLP 1	DLP 3	DLP 5	DLP 6	DLP 7
Sample	1.0	68.0	0.6	4.7	16.0
Interim Target	55.0	55.0	55.0	55.0	55.0
March 2013	DLP 1	DLP 3	DLP 5	DLP 6	DLP 7
Sample	0.2	74.0	0.5	3.6	18.0
Interim Target	55.0	55.0	55.0	55.0	55.0
June 2013	DLP 1	DLP 3	DLP 5	DLP 6	DLP 7
Sample	0.1	66.0	0.7	3.1	16.0
Interim Target	55.0	55.0	55.0	55.0	55.0
September 2013	DLP 1	DLP 3	DLP 5	DLP 6	DLP 7
Sample	0.4	60.0	13.0	2.4	16.0
Interim Target	55.0	55.0	55.0	55.0	55.0

NB. Major cation

Comments: The spike associated with the DLP3 sample is consistent with background testing and consistent with the sites location proximate to the adjacent tidal waterway. All other samples present at levels lower than the interim target.

Table 4: Dunloe Sands - Ground Water - Chemical (Magnesium Test) Results (mg/L)

December 2012	DLP 1	DLP 3	DLP 5	DLP 6	DLP 7
Sample	0.7	103.0	1.2	4.7	34.0
Interim Target	40.0	40.0	40.0	40.0	40.0
March 2013	DLP 1	DLP 3	DLP 5	DLP 6	DLP 7
Sample	0.1	115.0	1.3	2.5	38.0
Interim Target	40.0	40.0	40.0	40.0	40.0
June 2013	DLP 1	DLP 3	DLP 5	DLP 6	DLP 7
Sample	<0.1	105.0	1.9	2.1	36.0
Interim Target	40.0	40.0	40.0	40.0	40.0
September 2013	DLP 1	DLP 3	DLP 5	DLP 6	DLP 7
Sample	0.2	93.0	40.0	1.6	34.0
Interim					

Target	40.0	40.0	40.0	40.0	40.0

NB. Major cation

Comments: The spike associated with DLP3 is consistent with background testing and consistent with the sites location proximate to the adjacent tidal waterway. All other samples present at levels lower than the interim target.

Table 5: Dunloe Sands - Ground Water - Chemical (Sodium Test) Results (mg/L)

December 2012	**DLP 1**	**DLP 3**	**DLP 5**	**DLP 6**	**DLP 7**
Sample	6.3	**946.0**	5.9	13.0	**673**
Interim Target	280.0	280.0	280.0	280.0	280.0
March 2013	**DLP 1**	**DLP 3**	**DLP 5**	**DLP 6**	**DLP 7**
Sample	9.2	**1,296.0**	8.2	11.0	**610.0**
Interim Target	280.0	280.0	280.0	280.0	280.0
June 2013	**DLP 1**	**DLP 3**	**DLP 5**	**DLP 6**	**DLP 7**
Sample	0.1	**66.0**	0.7	3.1	**16.0**
Interim Target	280.0	280.0	280.0	280.0	280.0
September 2013	**DLP 1**	**DLP 3**	**DLP 5**	**DLP 6**	**DLP 7**
Sample	7.5	**1,003.0**	243.0	11.0	**543.0**
Interim Target	280.0	280.0	280.0	280.0	280.0

NB. Major cation

Comments: As highlighted previously, two (2) sample sites (DLP3 and DLP7) presented conductivity levels above the maximum interim target of 280mg/L stated within the EMP, each of which also expressed similar levels of EC within background testing. The latter also correlates with the high sodium levels shown above, which indicate a high level of saltwater intrusion at these points. This is explained as the sampling wells were installed in the low-lying portion of the floodplain adjacent to the sections of Mooball Creek and the main agricultural drainage line that are subject to tidal influences. It is also not unexpected in the instance of DLP 7 given that it sits immediately adjacent the existing wetland, which would in itself act as a 'drawer' of permanently saline conditions in order to sustain its dominant vegetative makeup. It is therefore considered likely that some localised salinisation of surficial groundwater has occurred within the vicinity of DLP3 and DLP7 due to tidal influences within these nearby waterways and wetlands.

Table 6: Dunloe Sands - Ground Water - Chemical (Potassium M8 Test) Results (mg/L)

December 2012	DLP 1	DLP 3	DLP 5	DLP 6	DLP 7
Sample	< 5.0	61.0	<5.0	< 5.0	29.0
Interim Target	17.5	17.5	17.5	17.5	17.5
March 2013	DLP 1	DLP 3	DLP 5	DLP 6	DLP 7
Sample	< 5.0	48.0	<5.0	< 5.0	27.0
Interim Target	17.5	17.5	17.5	17.5	17.5
June 2013	DLP 1	DLP 3	DLP 5	DLP 6	DLP 7
Sample	<5.0	44.0	<5.0	<5.0	25.0
Interim Target	17.5	17.5	17.5	17.5	17.5
September 2013	DLP 1	DLP 3	DLP 5	DLP 6	DLP 7
Sample	<5.0	38.0	9.0	<5.0	23.0
Interim Target	17.5	17.5	17.5	17.5	17.5

NB. Major cation

Comments: As highlighted previously, two (2) samples sites (DLP3 and DLP7) presented conductivity levels above the maximum interim target of 17.5mg/L stated within the EMP, each of which also expressed similar levels of EC within background testing. The latter also correlates with the high potassium levels shown above, which indicate a high level of saltwater intrusion at these points. This is quite easily explained as the sampling wells were installed in the low-lying portion of the floodplain adjacent to the sections of Mooball Creek and the main agricultural drainage line that are subject to tidal influences. It is also not unexpected in the instance of DLP 7 given that it sits immediately adjacent the existing wetland, which would in itself act as a 'drawer' of permanently saline conditions in order to sustain its dominant vegetative makeup. It is therefore considered likely that some localised salinisation of surficial groundwater has occurred within the vicinity of DLP3 and DLP7 due to tidal influences within these nearby waterways and wetlands. Efforts to date to clear these wells have not had a noticeable impact upon readings, indicating that levels are naturally high in this regard.

Table 7: Dunloe Sands - Ground Water - Chemical (Sulphur as Sulphate Test) Results (mg/L)

December 2012	DLP 1	DLP 3	DLP 5	DLP 6	DLP 7
Sample	4.9	132.0	3.5	63.0	203.0
Interim Target	175	175	175	175	175
March 2013	DLP 1	DLP 3	DLP 5	DLP 6	DLP 7
Sample	7.3	149.0	4.0	34.0	223.0
Interim Target	175	175	175	175	175
June 2013	DLP 1	DLP 3	DLP 5	DLP 6	DLP 7
Sample	5.9	169.0	8.2	40.0	274.0
Interim Target	175	175	175	175	175
September 2013	DLP 1	DLP 3	DLP 5	DLP 6	DLP 7
Sample	-	-	-	-	-
Interim Target	175	175	175	175	175

Comments: Minor exceedances were experienced during both sampling periods at DLP 7. This well is located near the stockpile and plant. Background testing shows that DLP 7 has previously tested with high test results. Efforts to date to clear this well has not had a noticeable impact upon readings, indicating that levels are naturally high in this regard.

Table 8: Dunloe Sands - Ground Water - Chemical (Arsenic Test) Results (mg/L)

December 2012	DLP 1	DLP 3	DLP 5	DLP 6	DLP 7
Sample	< 0.005	< 0.005	<0.005	< 0.005	< 0.005
Interim Target	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
March 2013	DLP 1	DLP 3	DLP 5	DLP 6	DLP 7
Sample	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Interim Target	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
June 2013	DLP 1	DLP 3	DLP 5	DLP 6	DLP 7
Sample	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Interim Target	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
September 2013	DLP 1	DLP 3	DLP 5	DLP 6	DLP 7
Sample	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Interim Target	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005

Comments: The samples are fully compliant with the interim targets as set out by the EMP.

Table 9: Dunloe Sands - Ground Water - Chemical (Iron Test) Results (mg/L)

December 2012	DLP 1	DLP 3	DLP 5	DLP 6	DLP 7
Sample	4.32	2.46	2.16	15.0	0.56
Interim Target	< 7.5	< 7.5	< 7.5	< 7.5	< 7.5
March 2013	DLP 1	DLP 3	DLP 5	DLP 6	DLP 7
Sample	1.68	1.78	0.09	20.0	0.72
Interim Target	< 7.5	< 7.5	< 7.5	< 7.5	< 7.5
June 2013	DLP 1	DLP 3	DLP 5	DLP 6	DLP 7
Sample	1.50	1.63	0.31	15.0	1.56
Interim Target	< 7.5	< 7.5	< 7.5	< 7.5	< 7.5
September 2013	DLP 1	DLP 3	DLP 5	DLP 6	DLP 7
Sample	5.82	3.05	15.0	10.0	1.20
Interim Target	< 7.5	< 7.5	< 7.5	< 7.5	< 7.5

Comments: Exceedance of the target iron levels is noted at DLP 6. Background testing suggests a history of DLP6 and a high reading of iron. Efforts to date to clear these wells have not had a noticeable impact upon readings, indicating that levels are naturally high in this regard.

Table 10: Dunloe Sands - Ground Water - Chemical (Manganese Test) Results (mg/L)

December 2012	DLP 1	DLP 3	DLP 5	DLP 6	DLP 7
Sample	<0.01	0.52	<0.01	0.07	0.02
Interim Target	0.15	0.15	0.15	0.15	0.15
March 2013	DLP 1	DLP 3	DLP 5	DLP 6	DLP 7
Sample	<0.01	0.58	<0.01	0.07	0.05
Interim Target	0.15	0.15	0.15	0.15	0.15
June 2013	DLP 1	DLP 3	DLP 5	DLP 6	DLP 7
Sample	<0.01	0.52	<0.01	0.04	0.03
Interim Target	0.15	0.15	0.15	0.15	0.15
September 2013	DLP 1	DLP 3	DLP 5	DLP 6	DLP 7
Sample	<0.01	0.52	0.14	0.04	0.05
Interim Target	0.15	0.15	0.15	0.15	0.15

Comments: Manganese is typically associated brackish or slightly saline conditions. The readings at DLP3 are entirely expected and consistent with background sampling. Efforts to date to clear these wells have not had a noticeable impact upon readings, indicating that levels are naturally high in this regard.

3.2 Surface Water Results

Quarterly monitoring of the surface waters on site within locations SW 3, SW4, SW9 and SW10 sample water for levels of pH **(Table 11)**, EC **(Table 12)**, DO **(Table 13)**, suspended solids **(Table 14)**, phosphorus **(Table 15)** and nitrogen **(Table 16).** Samples were collected in December 2012, March, June and September 2013. Tables present the results compared against the interim target criteria contained within the EMP.

The majority of the samples collected are consistent with the interim target criteria of the EMP. Some variants are illustrated within the results. These variants have been highlighted with bold text.

Table 11: Dunloe Sands - Surface Water - Chemical (pH Test) Results (pH)

December 2012	SW 3	SW 4	SW 9	SW 10
Sample	6.7	7.0	6.8	6.7
Interim Target	5 – 8.5	5 – 8.5	5 – 8.5	5 – 8.5
March 2013	SW 3	SW 4	SW 9	SW 10
Sample	6.7	7.6	6.7	6.8
Interim Target	5 – 8.5	5 – 8.5	5 – 8.5	5 – 8.5
June 2013	SW 3	SW 4	SW 9	SW 10
Sample	6.0	5.9	4.9	4.8
Interim Target	5 – 8.5	5 – 8.5	5 – 8.5	5 – 8.5
September 2013	SW 3	SW 4	SW 9	SW 10
Sample	7.0	6.8	7.0	7.8
Interim Target	5 – 8.5	5 – 8.5	5 – 8.5	5 – 8.5

Comments: All of the samples taken are compliant with the interim target levels outlined within the EMP.

Table 12: Dunloe Sands - Surface Water - Chemical (EC Test) Results (uS/cm^{-1})

December 2012	SW 3	SW 4	SW 9	SW 10
Sample	25,765	30,543	17,219	19,403
Interim Target	< 5,500	< 5,500	< 5,500	< 5,500
March 2013	SW 3	SW 4	SW 9	SW 10
Sample	3,489	29,821	3,708	1,025
Interim Target	< 5,500	< 5,500	< 5,500	< 5,500
June 2013	SW 3	SW 4	SW 9	SW 10
Sample	692	890	305	302
Interim Target	< 5,500	< 5,500	< 5,500	< 5,500
September 2013	SW 3	SW 4	SW 9	SW 10
Sample	17,686	16,825	2,753	2,870
Interim Target	< 5,500	< 5,500	< 5,500	< 5,500

Comments: All of the December samples taken are exceeded the interim target levels outlined within the EMP. The March sample shows all samples except for SW 4 back within acceptable levels. The June results are all compliant with the interim target levels. The September sample exceeds the interim target at SW3 and SW4. Saltwater has a high level of electroconductivity and therefore saltwater intrusion is considered the most likely explanation for the exceeding samples. The SW3 and SW4 samples from March and September 2013 are noted as outlier samples that may have contained higher levels of salt. Further monitoring of these sites is to be carried out to discover what is causing the high EC levels at this location, however it is expected that sampling has occurred in error (i.e the incoming tide), therefore giving a higher than normal reading.

Table 13: Dunloe Sands - Surface Water - Chemical (DO Test) Results - (mg/L)

December 2012	SW 3	SW 4	SW 9	SW 10
Sample	6.0	5.7	6.9	6.9
Interim Target	> 4	> 4	> 4	> 4
March 2013	SW 3	SW 4	SW 9	SW 10
Sample	6.8	7.0	7.3	5.6
Interim Target	> 4	> 4	> 4	> 4
June 2013	SW 3	SW 4	SW 9	SW 10
Sample	7.2	7.4	6.5	5.7
Interim				

Target	> 4	> 4	> 4	> 4
September 2013	**SW 3**	**SW 4**	**SW 9**	**SW 10**
Sample	7.3	7.2	9.9	15
Interim Target	> 4	> 4	> 4	> 4

Comments: All of the samples taken are compliant with the interim target levels outlined within the EMP.

Table 14: Dunloe Sands - Surface Water - Chemical (Suspended Solids Test) Results (mg/L)

December 2012	**SW 3**	**SW 4**	**SW 9**	**SW 10**
Sample	14	9.4	9.4	7.4
Interim Target	< 25	< 25	< 25	< 25
March 2013	**SW 3**	**SW 4**	**SW 9**	**SW 10**
Sample	8.4	9.6	6.8	16
Interim Target	< 25	< 25	< 25	< 25
June 2013	**SW 3**	**SW 4**	**SW 9**	**SW 10**
Sample	48	16	27	30
Interim Target	< 25	< 25	< 25	< 25
September 2013	**SW 3**	**SW 4**	**SW 9**	**SW 10**
Sample	14	8.8	29	45
Interim Target	< 25	< 25	< 25	< 25

Comment: The increased suspended solids reading at SW3 SW9 and SW10 (in June and September) are outlier samples when compared to background sampling (which had upper level readings of 43mg/L). It is recommended that these surface water sites are monitored in addition to the function of the flood gates that are upstream of the site, particularly as it relates to SW10, which traditionally has lower levels than that registered. This higher than normal sample may also be relative to disturbance from stock which are readily accessible to this site. Further monitoring is required to ensure water clarity.

Table 15: Dunloe Sands - Surface Water - Chemical (Total Phosphorus Test Results (mg/L)

December 2012	SW 3	SW 4	SW 9	SW 10
Sample	0.04	<0.02	0.04	0.03
Interim Target	< 0.08	< 0.08	< 0.08	< 0.08
March 2013	SW 3	SW 4	SW 9	SW 10
Sample	0.03	0.02	0.03	0.05
Interim Target	< 0.08	< 0.08	< 0.08	< 0.08
June 2013	SW 3	SW 4	SW 9	SW 10
Sample	-	-	-	-
Interim Target	< 0.08	< 0.08	< 0.08	< 0.08
September 2013	SW 3	SW 4	SW 9	SW 10
Sample	0.02	0.02	**0.13**	**0.29**
Interim Target	< 0.08	< 0.08	< 0.08	< 0.08

Comments: The majority of the samples taken are compliant with the interim target levels outlined within the EMP. SW9 and SW10 present levels greater that the interim target. This is an outlier in terms of background results. Further monitoring results are to be noted to ensure that Total P levels recede back to acceptable levels.

Table 16: Dunloe Sands - Surface Water - Chemical (Total Nitrogen Test) Results (mg/L)

December 2012	SW 3	SW 4	SW 9	SW 10
Sample	0.70	0.39	0.76	0.71
Interim Target	< 20	< 20	< 20	< 20
March 2013	SW 3	SW 4	SW 9	SW 10
Sample	0.53	0.54	0.43	0.77
Interim Target	< 20	< 20	< 20	< 20
June 2013	SW 3	SW 4	SW 9	SW 10
Sample	-	-	-	-
Interim Target	< 20	< 20	< 20	< 20
September 2013	SW 3	SW 4	SW 9	SW 10
Sample	0.38	0.41	1.34	2.15
Interim				

Target	< 20	< 20	< 20	< 20

Comments: All of the samples taken are compliant with the interim target levels outlined within the EMP.

3.3 Dust Monitoring

Dust monitoring was undertaken for the operations on November 16th and 23rd 2012. The resultant report and detail is provided within **Appendix E.** The report found minimal to zero impact of dust on the surrounding area and as such, further dust monitoring will not be carried out.

3.4 Vegetation Rehabilitation & Regeneration

As part of the Dunloe Sand Quarry's approved Environmental Management Plan, revegetation and regenerative landscaping is required (Appendix C of the EMP). Ongoing management of the surrounding vegetation is being carried out by Ramtech P/L over the lifetime of the Dunloe Quarry operations. As such, progress photographs have been included within this report to allow for the ongoing monitoring of the vegetation works (**Appendix D**).

The regenerative works have been undertaken via a combination of assisted and natural regrowth and all areas have been fenced so as to limit the intrusion of cattle. In this regard, depending on soil types, each of the areas has been very successful in establishing quality regrowth. The only limiting factors have been some cattle getting in and around existing fences (primarily at low tide where they have been able to traverse the creek lines. There are also some areas of extensive grass intrusion that will be subject to ongoing spray control so as to allow for further natural regrowth to occur. The works have been successful to date as shown within the photo plates at **Appendix D**.

Chapter 4.0 Conclusion

4.1 Conclusion

This report represents the ongoing monitoring for the operation of the Dunloe Sands Quarry. It is to be utilised in respect of operational compliance and environmental characteristics on the site, as well as to be cross referenced with future monitoring reports. This will allow the identification of potential trends and areas requiring intervention and environmental amelioration.

The results within this report demonstrate that the environmental characteristics on-site remain consistent with background readings and within the acceptable limit set out within the consent and approved EMP.

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Town Planner
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November 2013

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Appendix A
Ground Water Location Map

Appendix B
Surface Water Location Map

Appendix C
Sampling Raw Data

Appendix D
Vegetation Regeneration Photographs

Appendix E
Dust Monitoring Report