



ANNUAL REVIEW

1 January 2019 – 31 December 2019

Dunloe Sand Quarry

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SITE DETAILS

Name of operation	Dunloe Sand Quarry
Name of operator	Holcim (Australia) Pty Ltd
Project Approval	Project Approval 06- 0030
Name of holder of Project Approval	Holcim (Australia) Pty Ltd
Annual review start date	January 1, 2019
Annual review end date	December 31, 2019
<p>I, Garth Stacey, certify that this audit report is a true and accurate record of the compliance status of the DUNLOE SAND QUARRY for the period of 1 JANUARY 2019 - 31 DECEMBER 2019 and that I am authorised to make this statement on behalf of HOLCIM (AUSTRALIA) PTY LTD.</p> <p>Note.</p> <p>a) <i>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.</i></p> <p>b) <i>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).</i></p>	
Name of authorised reporting officer	Garth Stacey
Title of authorised reporting officer	Quarry Manager
Signature of authorised reporting officer	
Date	30 March 2020

1 STATEMENT OF COMPLIANCE

The statement of commitments for the 2019 reporting period for the Dunloe Sand Quarry is provided in **Table 1**. **Table 3** details the non-compliances of Project Approval (PA) 06-0030 identified within the 2019 reporting period, with the compliance status key provided in **Table 2**.

Table 1: Statement of Commitments

Were all conditions of the relevant approval(s) complied with?	
PA 06_0030	NO - see Table 3 for further details.
EPL 13077	Yes

Table 2: DPIE Compliance Status Key

Risk level	Colour code	Description
High	Non-compliant	Non-compliance with potential for significant environmental consequences, regardless of the likelihood of occurrence
Medium	Non-compliant	Non-compliance with: <ul style="list-style-type: none"> • potential for serious environmental consequences, but is unlikely to occur; or • potential for moderate environmental consequences, but is likely to occur
Low	Non-compliant	Non-compliance with: <ul style="list-style-type: none"> • potential for moderate environmental consequences, but is unlikely to occur; or • potential for low environmental consequences, but is likely to occur
Admin NC	Non-compliant	Only to be applied where the non-compliance does not result in any risk of environmental harm (e.g. submitting a report to government later than required under approval conditions)

Table 3: Non-Compliances of PA 06-0030 for 2019

Relevant approval	Condition	Condition Description	Compliance Status	Section addressed in Annual Review
PA 06_ 0030	Schedule 3, Condition 22	<p>Schedule 3 Condition 22 Blue Green Algae Management Plan (a) be prepared by a suitably qualified blue-green algae expert, whose appointment has been approved by the Secretary; (b) be consistent with extant guidelines for blue-green algae management including the NHMRC's <i>Guidelines for Managing Risks in Recreational Water</i>; (c) describe the measures that would be implemented to prevent and control the sources of algal blooms over the short, medium and long term; and (d) define procedures for the management and notification of identified algal blooms.</p>	Non- compliant	<p>Non-compliance relating to missed monitoring of Blue Green Algae in 2019.</p> <p>Section 7 (Water Management) Section 11</p>
PA 06_ 0030	Schedule 3, Condition 23	<p>Schedule 3 Condition 23 The Surface Water Monitoring Program must include: (a) detailed baseline data on surface water quality; (b) surface water impact assessment criteria; (c) a program to monitor surface water flows and quality; (d) a program to manage water releases from the site; (e) a program to monitor bank and bed stability; and (f) a protocol for the investigation, notification and mitigation of identified exceedances of the surface water impact assessment criteria.</p>	Non- compliant	<p>Non-compliance relating to missed water quality monitoring of vertical profile of extraction ponds.</p> <p>Section 7 (Water Management) Section 11</p>

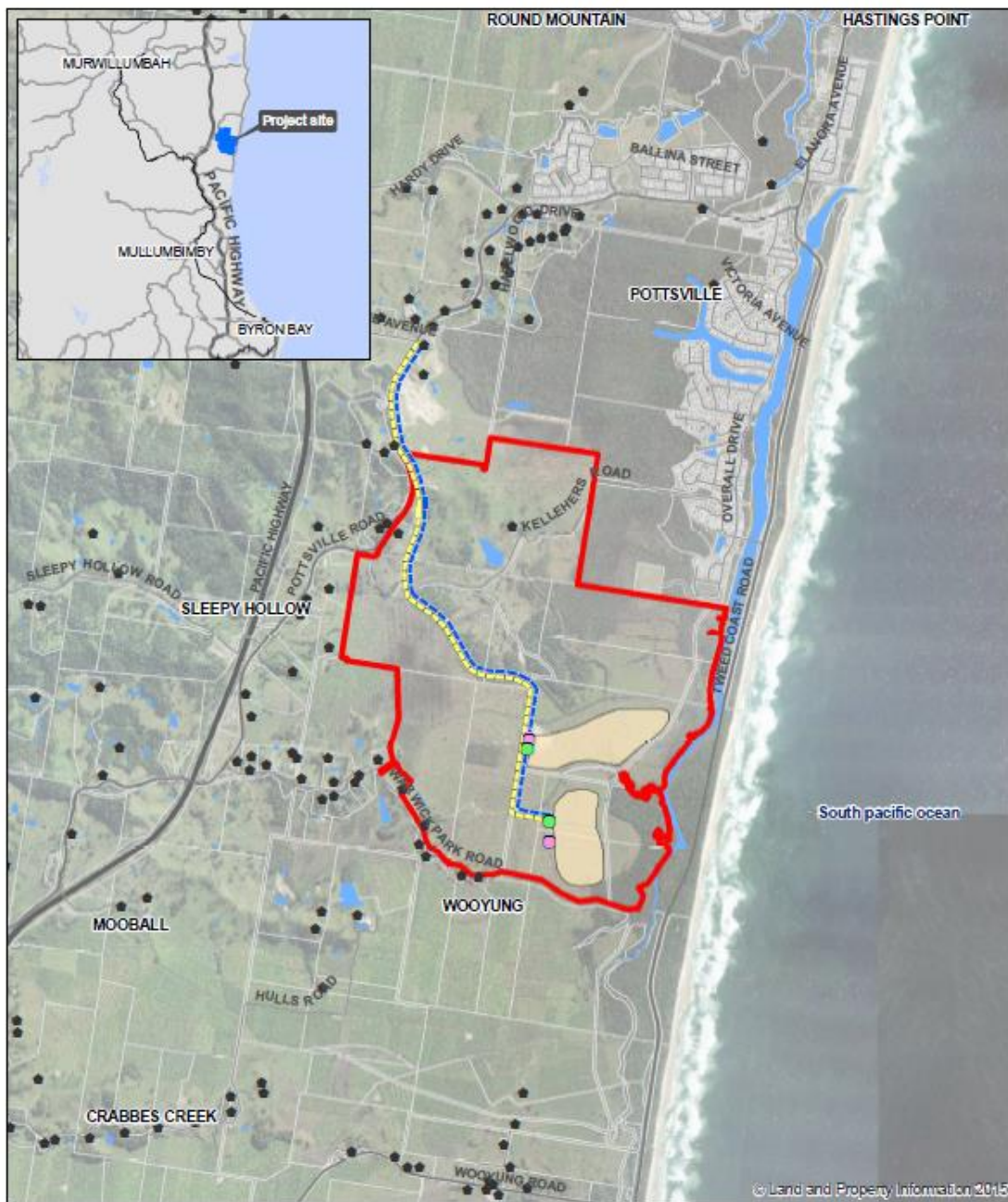
2 INTRODUCTION

The Dunloe Sand Quarry was granted Project Approval (PA06_0030) on 24 November 2008, with subsequent modifications to this approval granted on 28 August 2009 (Mod 1) and 6 November 2018 (Mod 2).

The Dunloe Sand Quarry operations are located approximately 4.5 km south-southwest of Pottsville on the Pottsville Mooball Road, New South Wales (NSW). The site is located adjacent to Mooball Creek, and is approximately 4 km upstream of the creek mouth. Surrounding properties are currently used for agricultural purposes including sugar cane farming and grazing.



Figure 1: Aerial view of the Dunloe Sand Quarry located at Dunloe Park, Pottsville (Source: Near maps November 2019).



- Legend**
- Project boundary
 - Sand extraction areas
 - Incoming haul road
 - Outgoing haul road
 - Site office
 - Washplant
 - Existing dwelling house

<p>Paper Size A4</p> <p>0 0.25 0.5 1</p> <p>Kilometers</p> <p>Map Projection: Transverse Mercator Horizontal Datum: GDA 1984 Grid: GDA 1984 MGA Zone 56</p>			<p>Holcim (Australia) Pty Ltd Dunloo Sand Modification</p>	<p>Job Number 22-18823 Revision A Date 10 Apr 2017</p>
<p>Level 15, 130 Castlereagh Street Sydney NSW 2000 T 61 2 9236 7100 F 61 2 9236 7199 E sydmail@ghd.com.au W www.ghd.com.au</p>			<p>Site location and layout Figure 2</p>	
<p>© 2017. While every care has been taken to prepare this map, GHD (and its maps, LPs) make no representations or warranties about its accuracy, reliability, completeness or suitability for any particular purpose and cannot accept liability and responsibility of any kind (whether in contract, tort or otherwise) for any expenses, losses, damages and/or costs (including indirect or consequential damage) which are or may be incurred by any party as a result of the map being inaccurate, incomplete or unsuitable in any way and for any reason.</p> <p>Data source: Aerial Imagery: Skymaps (2017 - NSW LP), LPI DCDR: Cadastre, 2012; LPI DTDR: Topo base data, 2012. Created by myking!</p>				

Figure 2: Site Location and Layout (Source GHD: 2017)



Figure 3: Environmental Monitoring Locations (Source: VGT)

Holcim commenced operations on the site on August 1, 2016 with all previous responsibilities falling under the management of Ramtech Pty Ltd (Ramtech). Ramtech have previously been responsible for the commencement and operation of the site since Project Approval was granted in 2007.

In accordance with Schedule 5, Condition 5 of the modified Project Approval (PA 06_0030) the site is required to undertake an Annual Review of the site in accordance with the conditions provided in **Table 4**.

Table 4: Annual Review Requirements

Condition	Section Addressed in Annual Review
<p>5. ANNUAL REVIEW <i>Within 12 months of the date of this approval, and annually thereafter, the Proponent shall submit an Annual Review to the Secretary and relevant agencies. This report must:</i></p>	
a) <i>identify the standards and performance measures that apply to the project;</i>	Section 4 and 6
b) <i>describe the works carried out in the last 12 months;</i>	Section 4 and 6
c) <i>describe the works that will be carried out in the next 12 months;</i>	Section 13
d) <i>include a summary of the complaints received during the past year, and compare this to the complaints received in previous years;</i>	Section 9.3
e) <i>include a summary of the monitoring results for the project during the past year;</i>	Section 6 and 7
f) <i>include an analysis of these monitoring results against the relevant: • impact assessment criteria/limits; • monitoring results from previous years; and • predictions in the documents listed in condition 2 of Schedule 2.</i>	Section 6 and 7
g) <i>identify any trends in the monitoring results over the life of the project;</i>	Section 6 and 7 Appendix 2
h) <i>identify any non-compliance during the previous year; and</i>	Section 6, 7 and 11
i) <i>describe what actions were, or are being, taken to ensure compliance.</i>	Section 6, 7 and 11

This Annual Review has also been prepared in accordance with the *Annual Review Guideline: Post-approval requirements for State significance mining developments* (October 2015). This report documents the environmental performance of the site from 1 January to 31 December 2019.

2.1 Name and Contact Details

The key contact details for the site are outlined below:

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3 APPROVALS

The site operates under the approvals listed in **Table 5**.

Table 5: Approvals for the Dunloe Sand Quarry Operations

Approval	Regulatory Authority
PA 06_0300	NSW Department of Planning, Industry & Environment (DPIE)
EPL No. 13077	NSW Environment Protection Authority (EPA)
Bore Licence 30BL183076, 30BL183077, 30BL183078, 30BL183079, 30BL183080, 30BL183081, 30BL183082, 30BL183084 and 30BL183086	NSW Department of Industry - Water

Holcim holds Environment Protection Licence (**EPL**) **13077** which covers its activities at the Dunloe Sand Quarry. **Table 6** outlines these licensing limits.

Table 6: EPL Fee-Based Activity at the Dunloe Sand Quarry

Scheduled Activity	Fee Based Activity	Scale
Extractive Activities	Land-based extractive activity	>100,000 – 500,000 T annual capacity to extract, process or store

4 OPERATIONS SUMMARY

4.1 Exploration

There was no exploration undertaken at the Dunloe Sand Quarry during the 2019 reporting period.

4.2 Land Preparation

There was no land preparation (clearing) the Dunloe Sand Quarry in 2019.

4.3 Construction Activities

There were no construction activities undertaken at the Dunloe Sand Quarry during the 2019 reporting period.

4.4 Quarry Operations

The Dunloe Sand Quarry officially commenced operations under Holcim on August 1, 2016.

Activities undertaken in 2019 included:

- Stripping of topsoil and overburden within the existing extraction limit boundary;
- Load and haul activities;
- Washing, screening and stockpiling of product;
- Overburden removal and stockpiling;
- Maintenance of rehabilitation undertaken in the north and eastern areas of the site; and
- Load out and sales of topsoil, brickies loam and concrete sands to the local market.

Operating hours in 2019 were undertaken between 7am to 5pm, Monday to Friday and 7am-12pm on Saturdays. These timeframes were applied for all operations on-site with no works occurring outside the approved operating hours. All activities took place within the approved operating hours in 2019.

Table 7 includes a summary of the operations undertaken during the reporting period against the Project Approval conditions regarding product transported from the Dunloe Sand Quarry.

Table 7: Total Product Distributed (Dunloe Sand Quarry)

Material	Approval Limit (Tonnes/Annum)	2018 Reporting Period (Tonnes)	2019 Reporting Period (Tonnes)
Product Distributed- Total	300,000	174,583	186,280

Total product tonnes in 2019 were well below the approved limit.

4.5 Next Reporting Period

Development activities proposed at the Dunloe Sand Quarry in 2020, include:

- Stripping of topsoil and overburden within the existing extraction limit boundary;
- Load and haul activities;
- Washing, screening and stockpiling of product;
- Overburden removal and stockpiling;
- Maintenance of rehabilitation undertaken north eastern area; and
- Load out and sales of topsoil, brickies loam and concrete sands to the local market.

No exploration, land preparation or construction activities are proposed to occur in the 2020 reporting period.

5 ACTIONS REQUIRED FROM PREVIOUS ANNUAL REVIEW

The DPIE reviewed the 2018 Annual Review and provided an approval letter to Holcim on 21 06.2019
The status of proposed actions from Holcim that were outlined in the 2018 Annual Review are shown in **Table 8**.

Table 8: Actions required from Annual Review – Holcim Proposed Actions

Commitment	Compliance Status
Development Application (Truck Movements Modification) - Application to modify the current Project Approval condition limiting truck movement to 4 (in and out) per hour.	Complete. New limit of 24 per hour.
Water Quality Monitoring - Ensure water quality monitoring is completed in accordance with the EMP.	Areas of water quality monitoring not completed in 2019. See Section 7 .
Dust Monitoring - Ensure dust monitoring is completed in accordance with the EMP.	Dust monitoring for depositional dust and PM ¹⁰ were completed at site.
Biodiversity - Weed spraying will continue at site during the next Annual Review period.	Continued in 2019
Biodiversity - Conduct fauna box monitoring annually.	Not completed in 2019. To be completed in the next report period.

6 ENVIRONMENTAL PERFORMANCE

6.1 Meteorological Monitoring

Condition M4 of the EPL requires the installation of rainfall depth measuring device for Dunloe Sands Quarry. This was not completed in 2019 resulting in a non-compliance with Condition M4, however a meteorological station was installed in February 2020. The nearby Bureau of Meteorology Ballina Airport Weather Station (Station ID 058198) has been used for this Annual Review. Monthly rainfall, wind and temperature data for 2019 has been provided in **Table 9**.

Table 9: Weather Observations at Teven Quarry 2019 (Ballina Airport AWS 058198)

Month	Temperature		Rain			Wind
	Min Temp (°C)	Max Temp (°C)	Total (mm)	Max Daily (mm)	No rain days > 1 mm	Max Wind Gust (km/h)
Jan-19	27.6	33.7	2.4	1.2	1	59
Feb-19	24.7	35.2	70.2	25.2	9	76
Mar-19	23.3	33	139.2	37.6	11	55
Apr-19	22.5	28.6	158.8	34.4	15	48
May-19	18.5	26.8	94.0	25.8	15	-
Jun-19	16.7	24	268.2	51.4	14	61
Jul-19	15	24.5	74.8	15.2	8	61
Aug-19	18.4	27.3	52.0	34.8	4	63
Sep-19	19.3	32.1	4.2	1.4	1	-
Oct-19	19.2	32.4	5.0	1.8	2	63
Nov-19	24.6	38	6.2	3.0	2	67
Dec-19	26.6	36.2	96.6	38.0	9	63

There was a total of 972 mm of rain at the Ballina Airport Weather Station in 2019.

6.2 Noise

6.2.1 EIS Predictions

The EIS (2007) stated that based on noise modelling the operations within the south west corner of the southern extraction pond (stage 2) may generate levels which exceed the relevant noise impact requirements.

The EIS (2007) stated that to mitigate this minor impact, the dredge is to have acoustical treatment when operating within the southern extraction pond.

6.2.2 Approved Criteria

In accordance with Schedule 3, Condition 2 of PA 06_0030, the approved noise criteria for the Dunloe Sand Quarry are outlined in **Table 10**.

Table 10: Noise Impact Criteria for the Dunloe Sand Quarry (PA 06_0030)

2. The Proponent must ensure that the noise generated by the project does not exceed the criteria in Table 1 at any residence on privately-owned land.

Table 1: Noise Impact Assessment Criteria

<i>Receiver Location</i>	<i>Day LAeq (15 min) dB(A)</i>
R6 and R7	42
R8	48
All other residences	41

Noise generated by the project must be monitored and measured in accordance with the relevant procedures and exemptions (including certain meteorological conditions) of the NSW Noise Policy for Industry (EPA, 2017).

The noise criteria in Table 1 do not apply if the Proponent has an agreement with the owner/s of the relevant residence or land to exceed the noise criteria, and the Proponent has advised the Department in writing of the terms of this agreement.

6.2.3 Key Environmental Performance

Attended noise monitoring was undertaken quarterly at the Dunloe Sand Quarry in 2019 by Muller Acoustic Consulting on the following dates:

- 7 March 2019;
- 18 June 2019;
- 20 August 2019; and
- 28 November 2019.

The compliance assessments for each residential receiver (R1, R2, R3 and R4) are presented in **Table 11**.

The assessments identified that noise emissions generated by the Dunloe Sand Quarry were in compliance with relevant statutory noise criteria specified in the Project Approval on all occasions at all assessed residential receivers. Copies of the quarterly noise monitoring reports for 2019 are attached as **Appendix 1**.

Long-term Trends:

Noise monitoring completed over a number of years for this project has generally been inaudible and within criteria. This trend continued for noise monitoring in 2019.

Comparison to EIS Predictions:

As noise levels were within criteria in 2019, results were within the EIS predictions.

6.2.4 Management Measures

Management measures relating to noise are outlined within the Dunloe Sand *Environmental Management Plan* and the *Noise Management and Monitoring Program*. These include:

- Restriction of operation hours of the Dunloe Sand Quarry to Monday to Friday 7.00 am to 5.00 pm and Saturday 7.00 to 12.00 pm;
- No work on Sundays or Public Holidays;
- All trucks to be well maintained and fitted with residential mufflers;
- Acoustic testing at commencement of quarry operations to ensure compliance with noise limit criteria;

- Dredge to be fitted with suitable mufflers if noise limit criteria is exceeded;
- Trucks to be limited to a speed of 25km/h on internal roads; and
- Prescribed buffer zones around the extraction ponds to be planted and maintained.

6.2.5 Proposed Improvements

There are no proposed improvements related to noise management.

Table 11: Noise Monitoring Assessment for the Dunloe Sand Quarry (MAC, 2019)

Assessment Period	Receiver No.	Quarrying Noise Criteria LAeq(15min)	Q1		Q2		Q3		Q4	
			Quarry Noise Contribution LAeq(15min)	Compliant	Quarry Noise Contribution LAeq(15min)	Compliant	Quarry Noise Contribution LAeq(15min)	Compliant	Quarry Noise Contribution LAeq(15min)	Compliant
Day	R1	48	<31	✓	<25	✓	<25	✓	<30	✓
	R2	48	<43	✓	<38	✓	<37	✓	<30	✓
	R3	48	<32	✓	<27	✓	<35	✓	<30	✓
	R4	48	<30	✓	<18	✓	<30	✓	<30	✓

6.3 Air Quality

6.3.1 EIS Predictions

The EIS (2017) Executive Summary states the following:

Airborne particulate matter concentrations and dust deposition from the proposed development were predicted to exceed the relevant requirements prescribed by the Office of Environment and Heritage (OEH) at three of the eight monitoring locations.

In particular, exceedances are expected as a result of dust generated from the use of unsealed access roads by haul vehicles. In order to meet prescribed requirements, proposed dust controls include sealing of the entire internal roadway length, planting of a vegetated buffer along the southern boundary adjoining Warwick Park Road and the proposed outbound internal road.

6.3.2 Approved Criteria

Air Quality monitoring conducted at Dunloe Sand Quarry is compared to the monitoring criteria stipulated in PA 06-0030 and listed in **Table 12**, **Table 13** and **Table 14**.

Table 12: Long Term Impact Assessment Criteria for Deposited Dust

Pollutant	Averaging Period	Maximum increase in deposited dust level	Maximum total deposited dust level
Deposited Dust	Annual	2 g/m ² /month	4 g/m ² /month

Table 13: Short Term Impact Assessment Criteria for Particulate Matter

Pollutant	Averaging Period	Criterion
Particulate Matter < 10 µm (PM ₁₀)	24 Hour	50 µg/m ³

Table 14: Long Term Impact Assessment Criteria for Particulate Matter

Pollutant	Averaging Period	Criterion
Total suspended particulate (TSP) matter	Annual	90 µg/m ³
Particulate Matter < 10 µm (PM ₁₀)	Annual	30 µg/m ³

6.3.3 Key Environmental Performance

6.3.3.1 Depositional Dust

Dust deposition monitoring was undertaken at 4 locations during the 2019 reporting period (see **Table 15**). All four monitoring points were found to be well below the annual average (4g/m²/month) and in compliance with the Project Approval.

Table 15: 2019 Dust Monitoring (Depositional Dust) at Dunloe Sand Quarry

Date Sampled	DDG1	DDG2	DDG3	DDG4
	(g/m ² /month)			
08-01-2019	0.5	0.6	0.5	0.3
05-02-2019	0.2	0.2	0.2	0.2
08-03-2019	1.1	1	1.2	0.9
05-04-2019	0.5	0.2	0.2	0.9
07-05-2019	0.1	0.4	0.2	1.2
04-06-2019	0.2	0.4	0.7	0.2
04-07-2019	0.3	0.3	0.2	1.1
29-08-2019	0.5	0.5	0.4	1.8
26-09-2019	0.7	0.6	0.5	1.5
24-10-2019	1.2	0.7	0.5	1.4
22-11-2019	0.8	0.5	0.8	0.5
20-12-2019	1.8	1.8	1.6	1.0
Minimum Insoluble Solids	0.1	0.2	0.2	0.2
Maximum Insoluble Solids	1.8	1.8	1.6	1.8
Annual Average (4g/m²/year)	0.7	0.6	0.6	0.9
Result	Within Criteria	Within Criteria	Within Criteria	Within Criteria

A comparison of results from 2016 - 2019 has been undertaken in **Table 16**. The monthly average at all gauges remained below the allowable maximum increase of 2 g/m²/month and below the annual average of 4 g/m²/month. The 2019 results for the annual average were very similar to the 2018 results.

Table 16: Depositional Dust Monitoring Summary (2016-2019)

Dust Depositional Gauge	Monitoring Summary for Annual Review Period	Monitoring Period			
		2019	2018	2017	2016
		(g/m ² /month)			
DDG1	Min. Insoluble Solids	0.1	0.1	0.1	0.13
	Max. Insoluble Solids	1.8	2.7	0.8	0.8
	Insoluble Solids Reporting Period Average	0.7	0.6	0.4	0.4
DDG2	Min. Insoluble Solids	0.2	0.1	<0.1	0.4
	Max. Insoluble Solids	1.8	0.7	0.9	4.7
	Insoluble Solids Reporting Period Average	0.6	0.31	0.32	1.23
DDG3	Min. Insoluble Solids	0.2	0.1	0.2	0.2
	Max. Insoluble Solids	1.6	1.6	2.4	1.6
	Insoluble Solids Reporting Period Average	0.6	0.8	0.8	0.5
DDG4	Min. Insoluble Solids	0.2	0.1	<0.1	0.3
	Max. Insoluble Solids	1.8	0.7	0.9	1.6
	Insoluble Solids Reporting Period Average	0.9	0.4	0.4	0.6

Long term Trends:

The annual average depositional dust levels recorded in the 2019 reporting period at all monitoring locations are generally consistent with those recorded in 2016-2018. Annual averages for depositional dust were well below the Project Approval criteria.

Comparison to EIS Predictions:

The results for depositional dust were below the predicted limits of the EIS predictions (see **Section 6.3.1**).

6.3.3.2 PM₁₀ Monitoring

PM₁₀ monitoring is required to be undertaken in accordance with the criteria provided in **Table 13** and **Table 14**.

During 2016, the DPIE advised Holcim of the requirement to undertake monitoring at the Dunloe Sand Quarry, unless changes were made to the site *Air Quality Management Plan*.

The updated *Dust Monitoring Program*, proposing PM₁₀ monitoring only be required once extraction on the site exceeded 200,000 tonnes per annum, was submitted to the DPIE for approval on 23 October 2016. During this time, Holcim worked to procure a mobile PM₁₀ monitor whilst an updated management plan was under review by DPIE.

On 15 November 2016, Holcim received what was mistakenly understood by the former Holcim Planning & Environment Coordinator, to be approval of the *Dust Monitoring Program*, subject to the comment from DPIE being noted and complied with. This happened prior obtaining the mobile PM₁₀ monitor on site.

Holcim provided DPIE a letter on 22 September 2017 detailing the reasons behind the site's failure to monitor PM₁₀. Holcim were issued with an Official Caution from DPIE on 4 October 2017.

In 2018, PM₁₀ monitoring was completed from 1 January 2018 until 18 July 2018.

It should be noted that with the revision and approval of the *Dust Monitoring Program* by the DPIE on 27 July 2018, Holcim is no longer required to monitor for PM₁₀ unless the annual production rates increase to 200,000 tonnes or above.

Annual production rates were below 200,000 tonnes during 2019 (production 165,562 tonnes in 2019), therefore no PM₁₀ monitoring was undertaken.

Trends

Trends relating to PM₁₀ monitoring is outlined in **Table 17**.

Table 17: PM₁₀ Monitoring Trends

Monitoring Summary for Annual Review Period	Monitoring Results 2019 Period (µg/m ³)	Monitoring Results January – July 2018 Period (µg/m ³)	Monitoring Results November and December 2017 Period (µg/m ³)
PM ₁₀ Reporting Period Average	NS	24.9	10.97
Max. PM ₁₀	NS	125	35.9
Min. PM ₁₀	NS	2	1.2

NS – Not Sampled

During the 2019 reporting period extraction remained below 200,000 tonnes per annum, therefore no monitoring was undertaken. The site has maintained dust suppression techniques throughout the reporting period in accordance with the requirements of the EMP.

6.3.4 Management Measures

Management measures relating to air quality are outlined within the *Dunloe Sand Quarry Environmental Management Plan* and *Dust Monitoring Program*. These include:

- Sealing access and egress road from the Quarry to Pottsville Road;
- The wheel shaker screen is to be utilised by all traffic leaving the quarry;
- The route for trucks within the quarry will be wet down daily by a water sprinkler/spray system;
- Additional vegetation rehabilitation areas throughout the site contributing as a buffer to Mooball Creek and surrounding areas;
- Loaded trucks will be covered before exiting the site;
- Dust that is transported onto the access road immediately outside the active quarry area will be removed from the road at least once per month using a local street sweeper;
- Visual daily inspections of all stockpiles will be undertaken to ensure that dust emissions do not occur;
- Visual review of exposed areas, and whether these areas are generating dust, should be undertaken daily;
- Dust generation is generally limited to freshly disturbed areas. To facilitate dampening, a portable hose or water spray/sprinkler system has been installed. The system installed is capable of servicing the entire site;
- Topsoil will not be stripped during windy weather conditions; and
- Six monthly audits of dust levels are to be undertaken by management.

6.3.5 Proposed Improvements

Completion of monitoring as per the EMP and Project Approval requirements.

6.4 Traffic Management

6.4.1 EIS Predictions

The proposed operational times outlined within the EIS are outlined below:

Table 18: Estimated Operational Times, Periods and Truck Movements (EIS 2007)

Yearly Operation	Days Per Week	Hours per Week	Daily Times Operating	Truck Movements per Hour
50 weeks/year	5.5	46	Mon-Fri: 7:30am -5:00pm Sat: 7:30am -12:30pm	4

6.4.2 Approved Criteria

As per the Project Approval (Schedule 3 Condition 3), operations will be conducted Monday to Saturday. No operations are to be undertaken on Sunday or public holidays.

Table 19: Operational Times, Periods and Truck Movements

Yearly Operation	Days Per Week	Hours per Week	Daily Times Operating	Truck Movements per Hour
52 weeks/year	5.5	55	Mon-Fri: 7:30am -5:00pm Sat: 7:30am -12:00pm	8*

* Not to exceed more than 8 heavy vehicle movements (in and out) per hour

Internal roads are signposted to a 25-30km/h speed limit.

6.4.3 Key Environmental Performance

Holcim staffs were notified during due diligence activities by representatives of Ramtech that operations prior to the acquisition by Holcim were based on a maximum of 8 movements per hour (i.e. - 8 in, 8 out). The DPIE compliance team has since notified Holcim that this interpretation is incorrect, and the site is only allowed 4 movements per hour (i.e. - 4 in, 4 out).

Holcim has operated in accordance with revised truck movements since direction was given by the DPIE on October 20, 2016. An application to modify this condition to allow greater flexibility to hourly and daily movements of trucks entering and exiting the site was approved in November 2018. Schedule 2 Condition 8 of the Project Approval allows 24 movements per hour.

Daily records of truck movements are recorded by Holcim. Based on the records, all truck movements were 4 movements per hour or below. A summary of the daily truck movements is provided in **Appendix 3**.

Traffic travelling to and from the site continued to make use of the Pacific Highway, via the Cudgera Creek interchange during the 2019 reporting period.

In summary:

- There was a total of 5251 trucks recorded leaving site during 2019. This is a decrease from the 5320 trucks recorded leaving site during 2018;
- There were 248 haulage days during 2019; and
- Haulage occurred at an average of 21.2 trucks during haulage days during 2019. This is an increase on the average from 2018, which had 20.6 trucks.

6.4.4 Management Measures

Management measures relating to air quality are outlined within the *Dunloe Sand Quarry Environmental Management Plan* and the *Traffic Management Procedure*, including:

- Construction of a dedicated haulage road (sealed) to provide vehicular access between the sand extraction area and Pottsville-Mooball Road;
- Average truck movements limited to 24 movements per hour (24 in, 24 out);
- All vehicles to observe speed limits for public roads;
- No trucks are to leave the site via Warwick Park Road;
- Appropriate advisory signage placed on public roads to notify of trucks entering Pottsville – Mooball Road;
- Appropriate relevant advisory signage placed along the haulage road (especially approaches to the intersections with Kelleher’s Road and Pottsville – Mooball Road);
- Truck speed on the internal roads is to be limited to a maximum of 25km/h;
- All loaded vehicles entering or leaving the site are to have their loads covered; and
- Holcim shall ensure that all loaded vehicles leaving the site are cleaned of materials that may fall on the road before they leave the site.

6.4.5 Proposed Improvements

There are no proposed changes to transport management. Truck movements will continue to be monitored and recorded in the oncoming reporting period to ensure that they remain within the approved criteria.

6.5 Biodiversity

6.5.1 EIS Predictions

As part of the EIS (2007), a number of threatened species were identified within the surrounding vegetated areas of the site with none being found, or expected to occur, within the previously disturbed areas of the site (including proposed extraction areas).

Rehabilitation and revegetation measures proposed will provide improved flora and fauna links, additional food resources for identified threatened species, improved opportunities for breeding through the installation of breeding boxes and other benefits associated with visual screening and the like.

No clearing of vegetation is required in respect of the proposal, inclusive of haulage routes and operational areas. There is no proposed clearing for 2019.

6.5.2 Approved Criteria

There are no specific criteria associated with biodiversity management for the site. Activities need to be completed in accordance with the EIS.

6.5.3 Key Environmental Performance

There were no biodiversity issues identified during the Annual Review period. There was no clearing during 2019. There was some weed spraying at the site in 2019.

In accordance with the Project Approval, 11 fauna nest boxes have been installed across the rehabilitation zones in a bid to increase potential nesting options for fauna.

During the 2019 monitoring period, fauna was found within all zones including a wedge tail eagle located in Zone 1A and a Brahming Kite in Zone 1B and 2A. Nil or minor weeds were found across zones. Tree height ranged from 6–16m with Paperbark and She Oak the predominant species present. The 2019 Rehabilitation and Revegetation Monitoring Report is provided in **Appendix 5**.

6.5.4 Management Measures

Management measures relating to biodiversity are outlined within the *Dunloe Sand Quarry Rehabilitation and Revegetation Management Plan* and the *Dunloe Sand Vegetation Management Plan*. These include:

- Detailed clearing protocol as per Section 5.1 of the *Dunloe Sand Quarry Rehabilitation and Revegetation Management Plan*;
- Weed management;
- Installation of nest boxes; and
- Rehabilitation/Ecological monitoring.

6.5.5 Proposed Improvements

Continuation of weed management in 2020. Undertake fauna box monitoring during 2020 report period in accordance with the *Dunloe Sand Quarry Rehabilitation and Revegetation Management Plan* and the *Dunloe Sand Vegetation Management Plan*.

6.6 Heritage

6.6.1 EIS Predictions

A heritage assessment focusing on both Aboriginal and non-Aboriginal heritage was completed for the EIS (2007). An area of potential Aboriginal heritage significance was cordoned off.

6.6.2 Approved Criteria

There are no specific criteria associated with heritage relating to the project.

6.6.3 Key Environmental Performance

There were no issues relating to Aboriginal and historic heritage during the reporting period. An area was previously identified as having potential Aboriginal heritage significance. During 2018 the area was reviewed for potential artefacts with the assistance of Aboriginal Groups. The Aboriginal Groups did not find any items of heritage significance as part of the survey. Holcim can now complete quarrying activities within the area that was previously demarcated. No quarrying activities were completed within this area in 2019.

The *Dunloe Sand Quarry Aboriginal Cultural Heritage Management Plan* was updated in December 2019.

The approved excavation strategy was completed in late 2018 and early 2019 in accordance with Condition 32(c) of Schedule 3 of the development consent.

The implementation of the excavation strategy identified no Aboriginal objects or places as a result of the pedestrian survey and subsequent archaeological test excavations. It was determined that the project area possesses nil archaeological significance. The outcomes of the excavation strategy are reported in the *Aboriginal Cultural Heritage Assessment Report – Dunloe Sand Quarry, Pottsville, NSW* (RPS 2019).

6.6.4 Management Measures

Management measures relating to heritage are outlined within the *Dunloe Sand Quarry Aboriginal Cultural Heritage Management Plan*. These include:

- Training of all staff and contractors through the induction process;
- Detailed excavation strategy and control of any finds; and
- Procedure for impacts of unexpected finds.

6.6.5 Proposed Improvements

No proposed improvements.

6.7 Acid Sulphate Soils Management and Management of Fines

Holcim undertakes fines management in accordance with Schedule 3 of Conditions 10 and 11, Project Approval 06_0030, in the following manner:

10. The Proponent shall ensure that all excavated potential acid sulfate soil fines material is returned back to below the water table as soon as possible to prevent oxidation. No potential acid sulfate soil shall be removed from the site, unless adequately neutralised in accordance with methods approved under the Soil and Water Management Plan.

11. The Proponent shall ensure that all potential acid sulfate soil fines material is discharged into the pond at a depth of no less than 3 metres from the water surface, and that all fines are deposited to a final depth of at least 8 metres from the water surface, unless an alternative method(s) is approved by OOW and the Director-General.

Under the operation of Holcim, the site has undertaken a number of improvement works to ensure the effective management of **Acid Sulphate Soils (ASS) and Potential Acid Sulphate Soils (PASS)** during extraction, processing and sales operations. Details of specific management measures are outlined below.

6.7.1 Acid Sulphate Soils Sampling

Holcim undertakes acid sulphate soils sampling in advance of extraction. A sand core drilling program was undertaken in 2016, in accordance with the site's Environmental Management Plan (EMP), for an area of extraction required for the following 2-3 years. The drilling program was developed and undertaken in line with the following activities:

1. A minimum of 2 sand cores are drilled per hectare;
2. All samples are sent to Soil Surveys Australia Pty Ltd for immediate testing in accordance with the ASSMAC Guidelines;
3. Soil Surveys Australia Pty Ltd (NATA Accredited lab) test results provided a volume per m² for lime to be seeded across each hectare before stripping takes place;
4. Lime was spread across the reserve and then stripped to expose the loam and sand product; and
5. Stockpiled topsoil is tested by a NATA accredited laboratory to confirm there is no presence of PASS.
6. A minimum of 2 sand cores are drilled per hectare;
7. All samples are sent to Soil Surveys Australia Pty Ltd for immediate testing in accordance with the ASSMAC Guidelines;
8. Soil Surveys Australia Pty Ltd (NATA Accredited lab) test results provided a volume per m² for lime to be seeded across each hectare before stripping takes place;
9. Lime was spread across the reserve and then stripped to expose the loam and sand product; and
10. Stockpiled topsoil is tested by a NATA accredited laboratory to confirm there is no presence of PASS.

The ongoing management of acid sulphate soils during extraction in the sampled area is undertaken in accordance with the site's EMP. Further to the monitoring program that was completed in 2016, ongoing acid sulphate soils monitoring were completed during 2019, with no acid sulphate soils determined during the 2019 testing. A selection of monitoring results is attached in **Appendix 4**.

6.7.2 Extraction

Excavation of loam, dredging and washing activities is undertaken in accordance with the EMP and has been developed in line with the following activities:

1. Excavated loam is stockpiled and tested by NATA accredited laboratory to confirm there is no presence of PASS;

2. In the event that PASS is present in loam stockpiles a NATA accredited laboratory will provide a detailed report with liming rates for lime to be added by Holcim staff to screened loam to ensure no presence of PASS;
3. All dredged material is sent through the plant with fines re-interned below the 3 meter water mark at a depth of 8 metres in the returns pond; and
4. Testing of stockpiles to ensure that no PASS are present in concrete sands.

6.7.3 Stockpiling & Sales

Holcim have developed and implemented a testing regime using a NATA accredited laboratory to ensure compliance with PASS requirements for all sales of sand materials. This process includes:

1. Routine sampling of sales material stockpiles at designated locations; and
2. Implementation of a series of sales and production stockpiles to ensure any materials that have not been tested are isolated until tests confirm no presence of PASS thereafter sales loading occurs.

6.8 Summary of Environmental Performance

A summary of the performance of environmental management measures and sampling results for 2019 are detailed in **Table 20**.

Table 20: Environmental Performance at the Dunloe Sand Quarry in 2019

Aspect	Approval Criteria / EIS Prediction	Performance during 2019 reporting period	Trend / key management implications	Implemented / proposed management actions
Meteorology	EIS predictions are all below Project Approval criteria.	Non-compliance as no meteorological station data for 2019.	Non-compliance	The meteorological station was fixed in February 2020.
Noise	EIS predictions are all below Project Approval criteria.	Quarterly monitoring has met the Project Approval Criteria.	Consistently meets criteria.	None Required.
Air Quality	EIS predictions are all below Project Approval criteria.	Dust deposition results are within criteria of EPL, EIS and Project Approval. PM ₁₀ monitoring is no longer required at the site (when production remains below 200,000T/annum). Therefore, no PM ₁₀ monitoring was undertaken in 2019.	Improvement from previous years with no issues relating to monitoring. PM ₁₀ not required in 2019	None Required.
Traffic Management	EIS predictions are all below Project Approval criteria.	Met operating criteria (number of trucks per day).	This is an improvement on some past years.	None Required.
Water Management	EIS predictions are all below Project Approval criteria.	Criteria meets EIS, EPL and Project Approval criteria. There were some inconsistencies with testing of monitoring parameters (including	Groundwater consistent with trend data. Water monitoring generally consistent with trend data.	Ensure water quality monitoring and analysis is completed in accordance with the EMP.

Aspect	Approval Criteria / EIS Prediction	Performance during 2019 reporting period	Trend / key management implications	Implemented / proposed management actions
		algae and vertical profile of extraction ponds).		
Biodiversity	No impacts to threatened species. No Project Approval criteria.	Biodiversity monitoring was not undertaken in 2019.	Non-compliance	Biodiversity monitoring is to be completed in accordance with the <i>Dunloe Sands Quarry Rehabilitation and Revegetation Plan</i> in 2020.
Heritage	No impacts to Aboriginal Heritage. No Project Approval criteria.	No impacts. See Section 6.6 for an update on Heritage surveys.	Consistently no impacts.	None required.

7 WATER MANAGEMENT

7.1 EIS Predictions

The site is located within the Mooball Creek catchment and Sheens Creek sub-catchment areas. Detailed flood modelling confirms that the proposal will have no significant impact upon existing drainage regimes within the catchment.

Extraction operations have been designed in conformity with best practice environmental management procedures, including the use of appropriate sediment and water quality devices and the retention of ground cover in areas outside of the extraction ponds.

No negative impacts predicted to water quality with controls in place.

7.2 Criteria

The site has the requirement to monitor discharges from the two Licenced Discharge Points (LDP) as per the criteria listed in EPL 13077 and reproduced in **Table 21**. LDP001 refers to Silt Pond discharge and monitoring point and LDP002 refers to Dredge Pond discharge and monitoring point.

Table 21: Discharge Criteria – LDP001 and LDP002

POINT 1

Pollutant	Units of Measure	50 Percentile concentration limit	90 Percentile concentration limit	3DGM concentration limit	100 percentile concentration limit
Oil and Grease	Visible				nil
pH	pH				6.5 - 8.5
TSS	milligrams per litre				50

POINT 2

Pollutant	Units of Measure	50 Percentile concentration limit	90 Percentile concentration limit	3DGM concentration limit	100 percentile concentration limit
Oil and Grease	Visible				nil
pH	pH				6.5 - 8.5
TSS	milligrams per litre				50

Exceedance of a quality limit specified in EPL 13077 (**Table 21**) for the discharge of TSS, pH or Oil and Grease from LDP001 or LDP002 is permitted if the discharge from LDP001 or LDP002 occurs solely as the result of rainfall on site exceeding a total of 82.5 mm over any consecutive five day period. Holcim must take all practical measures to avoid or minimise TSS, pH and Oil and Grease exceedances in wet weather discharges.

Table 22: LDP001 and LDP002 monitoring requirements

POINT 1,2

Pollutant	Units of measure	Frequency	Sampling Method
Oil and Grease	Visible	Special Frequency 1	Visual Inspection
pH	pH	Special Frequency 1	Probe
TSS	milligrams per litre	Special Frequency 1	Grab sample

Special Frequency 1 means: sampling once <24hours prior to; and sampling the discharge daily during, each discharge event arising from rainfall of less than 82.5 mm falling in total over a period of up to five days duration.

The site also has criteria outlined within the EMP. This includes commitments to undertaking monthly and quarterly monitoring at the Dredge Pond (Dam 1) and Silt Pond (Dam 2) (see **Table 23, Table 24, Table 25**). Other sampling criteria and commitments from the EMP are outlined within **Tables 26-29**.

Table 23: Monthly Surface Water Quality Criteria – Dam 1 and Dam 2

Parameter	Interim Target Criteria	Baseline monitoring 9/06-8/07
pH	5.0 – 8.5	3.55-8.44 (6.49)
Electrical Conductivity (EC)	<5.90 mS/cm	0.286 - 45mS/cm (11.930mS/cm)
Dissolved Oxygen (DO)	>4.00 mg/L	0.81-7.49 (4.34)mg/L
Turbidity	<20 (NTU)	3-67 (14.4) NTU
Oil and Grease	10 mg/L	

Table 24: Quarterly Surface Water Quality Criteria – Dam 1 and Dam 2

Quarterly monitoring		
Quarterly monitoring shall include the above parameters as well as the parameters listed in the table below.		
Parameter	Interim Target Criteria	Baseline monitoring 9/06-8/07
Manganese	0.15 mg/L	0.01 – 0.56 mg/L
Magnesium	40 mg/L	0.8 – 173.0 (20) mg/L

Sodium	280 mg/L	7-1770 (213) mg/L
Potassium	17.5 mg/L	0 – 71 (12) mg/L
Bicarbonate	400 mg/CaCo3	-
Chloride	285 mg/L	15-3500 (356)mg/L
Sulphate	175 mg/L	9-753 (100) mg/L
Aluminium	0.75 mg/L	<0.01-4.96 (0.50) mg/L
Arsenic	<0.005 mg/L	<0.005 – 0.027 (0.01) mg/L
Iron	<7.5 ug/L	0.03-43 (6.12) ug/L
Chlorophyll a	2-10 ug/L	2-10 ug/L

Table 25: Quarterly Vertical Profile Water Quality Criteria – Dam 1 and Dam 2

Pollutant	Unit of Measure	Water Quality Objectives
Turbidity	NTU	5 – 20 NTU
pH	pH	6.5 – 8.5
Oil and Grease	mg/L	10 mg/L
Salinity	µS/cm	<3,000 µS/cm
Dissolved oxygen	mg/L	>6 mg/L
Chlorophyll-a	µg/L	2-10 µg/L
Faecal coliforms	Median No./100mL	<1000 cfu/100mL
Enterococci	Median No./100mL	<230 cfu/100mL
Algae and blue-green algae	No.cells/mL (M.aeruginosa)	<50,000 cells/mL
	mm ³ /L (total biovolume)	<4 mm ³ /L
Sodium	mg/L	500mg/L
Potassium ion	mg/L	40mg/L
Magnesium ion	mg/L	100mg/L
Chloride ion	mg/L	1000mg/L
Sulphate ion	mg/L	800mg/L
Bicarbonate ion	mg/L	400mg/L
Soluble iron	mg/L	20mg/L
Soluble aluminium ion	mg/L	0.5mg/L

Ammonium ion	mg/L	20mg/L
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- 1) *The Department acknowledges that short term exceedances of these objectives may occur during natural events such as flooding.*
- 2) *The Department acknowledges that pre-existing water quality may not meet the objectives for some analytes, including salinity. The proponent shall strive to meet the water quality objectives through implementation of the Soil and Water Management Plan (see condition 18 below), as far as is reasonable and feasible and within the Proponent's control, to the satisfaction of the Secretary.*

The site has a commitment to Blue Green Algae monitoring within the extraction ponds at the site in accordance with the criteria listed in **Table 26**.

Table 26: Monthly Monitoring Criteria – Blue Green Algae

Algae and Blue-green algae	No.cells/mL (M.aeruginosa)	<50,000
	mm ³ /L (total biovolume)	<4

The site has a commitment to complete quarterly creek water monitoring within the surrounding environment in accordance with the criteria listed in **Table 27**.

Table 27: Quarterly Surface Water Quality Criteria – Surrounding Environment

<i>Pollutant</i>	<i>Unit of Measure</i>	<i>Interim Target Criteria</i>	<i>Baseline Monitoring 9/06-8/07</i>
pH	pH	5.5 – 7.5	3.55-8.44 (6.49)
Electrical Conductivity	uS/cm	1800-24000	286-45000 (11930)
Dissolved Oxygen	mg/L	>6	0.81-7.49 (4.34)
Turbidity	NTU	<20	3-67 (14.4)
Suspended Solids	mg/L	<25	1.5-48 (19)

Groundwater

The site has the requirement to monitor water quality from the five groundwater bores installed on site annually as per the criteria listed in EPL 13077 and reproduced in **Table 28**.

Table 28: Groundwater monitoring requirements (DLP3-DLP7)

POINT 3,4,5,6,7

Pollutant	Units of measure	Frequency	Sampling Method
Ammonia	milligrams per litre	Yearly	Grab sample
Chloride	milligrams per litre	Yearly	Grab sample
Electrical conductivity	microsiemens per centimetre	Yearly	Grab sample
Oil and Grease	milligrams per litre	Yearly	Grab sample
pH	pH	Yearly	Grab sample
Standing Water Level	metres (Australian Height Datum)	Yearly	No method specified
Sulfate	milligrams per litre	Yearly	Grab sample

The site also has a commitment to complete monthly groundwater monitoring within the surrounding environment in accordance with the criteria listed in **Table 29**.

Table 29: Monthly Groundwater Quality Criteria – Surrounding Environment

Monthly Monitoring		
Parameter	Interim Target Criteria	Baseline Monitoring 9/06-8/07 Range (mean)
pH	4.2 – 7.0	3.58-7.54 (5.43)
Electrical Conductivity (EC)	<2.0 mS/cm	0.07-6.47 (1.24)
Dissolved Oxygen (DO)	>1.50 mg/L	0.16 – 4.83 (0.84)
REDOX Potential	Maximum (mg/L)	
Groundwater level	M (AHD)	0.25-1.52 (0.68)

The site has a commitment to complete quarterly groundwater monitoring within the surrounding environment in accordance with the criteria listed in **Table 30**.

Table 30: Quarterly Groundwater Quality Criteria – Surrounding Environment

Parameter	Interim Target Criteria	Baseline monitoring 9/06-8/07
Calcium	55	0.7-114 (26)
Manganese	0.15	0.01 – 0.56
Magnesium	40	0.8 – 173.0 (20)
Sodium	280	7-1770 (213)
Potassium	17.5	0 – 71 (12)
Bicarbonate	400	-
Chloride	285	15-3500 (356)
Alkalinity	185	0-534 (109)
Sulphate	175	9-753 (100)
Aluminium	0.75	<0.01-4.96 (0.50)
Arsenic	0.005	<0.005 – 0.027 (0.01)
Iron	7.5	0.03-43 (6.12)

7.3 Surface Water Monitoring

It should be noted that there were no surface water discharges in 2019 therefore criteria related to **Table 21** have not been triggered. A summary of results obtained from monthly sampling in the ponds is provided in **Table 31**.

Table 31: Monthly Dredge Pond (Dam 1) Water Quality Monitoring 2019 Results

Parameter	Unit	Interim Target Criteria	Baseline (2006/07)	Dredge Pond (Dam 1)				Silt Pond (Dam 2)		
				Min	Max	2019 Average	2018 Average for Comparison	Min	Max	2019 Average
pH	-	6.5-8.5	3.55-8.44	4.0	5.5	4.4	4.2	3.94	9.85	6.94
EC	uS/cm	<2000	286-450	120	783	545	388	130	719	508
DO	mg/L	>4.00	0.81-7.49	1.2	116	35.7	22.4	0.5	111.3	33.3
Turbidity	NTU	<20	3-67	0	50.8	7.5	5.3	0	57.3	12.2
Oil and Grease	mg/L	10	-	<5	<5	<5	<5	<5	8	5

A comparison of the 2019 results compared to 2018 results for the Ponds are outlined below:

- pH results – there was a slight increase in average pH from 4.2 in 2018 to 4.4 in 2019 in the Dredge Pond (Dam 1);
- EC results – there was a significant increase in average EC from 388 uS/cm in 2018 to 545 uS/cm in 2019;
- DO Results – there was an increase in DO from 22.4 mg/L in 2018 to 35.7 mg/L in 2019;
- Turbidity Results – there was an increase in the average turbidity level from 5.3 NTU in 2018 to 7.5 NTU in 2019; and
- Oil and Grease were <5 Mg/L in 2018 and 5 mg/L in 2019.

There are no long-term trends available for the Silt Pond (Dam 2).

A summary of results obtained from quarterly chemical analysis in the ponds is provided in **Table 32**.

Table 32: Quarterly Chemical Analysis Monitoring 2019 Results

Parameter (mg/L)	Interim Target Criteria	Baseline (2006/07)	Dredge Pond (Dam 1)				Silt Pond (Dam 2)		
			2019 Min	2019 Max	2019 Average	2018 Average for comparison	2019 Min	2019 Max	2019 Average
Manganese	0.15	0.01-0.56	0.235	0.278	0.258	0.247	0.076	0.203	0.142
Magnesium	40	0.8-173.0	9	11	10	6	9	11	10
Sodium	280	7-1,770	37	53	45	24	36	46	42
Potassium	17.5	0-71	4	5	4.8	3.7	4	5	4
Bicarbonate	400	-	1	1	1	-	5	22	12
Chloride	285	15-3,500	66	95	79	42	65	80	72
Sulphate	175	9-753	164	174	170	114	158	164	163
Aluminium	0.75	<0.01-4.96	0.68	0.92	0.80	0.74	0	0.58	0.16
Arsenic	0.005	<0.005-0.027	0.001	0.001	0.001	Not detected	0.001	0.003	0.0015
Iron (Dissolved)	7.5	0.03-43	0.2	0.55	0.30	0.086	0.05	0.05	0.05
Chlorophyll a	2-10	2-10	1	2	1	-	1	8	4

Results obtained from quarterly chemical analysis of extraction pond water shows the results to be generally in accordance with the baseline criteria and interim target criteria of the EMP. The largest change between 2018 and 2019 was in relation to Chloride which increased from an average of 42mg/L to 79mg/L.

Manganese in the Dredge Pond (Dam 1) was above interim criteria in 2017, 2018 and 2019.

The site has also committed to completing quarterly creek monitoring within the surrounding environment in accordance with the EMP. A summary of results obtained from quarterly water quality monitoring is provided in **Table 32** and **Table 33**.

Table 33: Quarterly Northern Creek Water Quality Monitoring 2019 Results

Parameter (mg/L)	Interim Target Criteria	Baseline (2006/07)	SW3			SW4		
			Min	Max	Avg	Min	Max	Avg
pH	5.5-7.5	3.55-8.44	6.4	6.9	6.7	6.9	7.6	7.2
EC	1800-24000	286-45000	41	43000	19988	51	45300	23298
DO	>6	0.81-7.49	3.0	108.0	32.2	4.7	103.0	31.3
Turbidity	<20	3-67	0	18	9	0	7	3
Suspended Solids	<25	1.5-48	5	10	7	5	8	6

Table 34: Quarterly Southern Creek Water Quality Monitoring 2019 Results

Parameter (mg/L)	Interim Target Criteria	Baseline (2006/07)	SW9			SW10		
			Min	Max	Avg	Min	Max	Avg
pH	5.5-7.5	3.55-8.44	6.8	7.5	7.1	5.8	7.0	6.6
EC	1800-24000	286-45000	38	44300	12907	42	38700	15138
DO	>6	0.81-7.49	3.6	71.1	22.9	4.3	54.8	18.3
Turbidity	<20	3-67	0	3	2	11	20	17
Suspended Solids	<25	1.5-48	5	10	6	8	15	10

Results obtained from quarterly water quality monitoring shows the results to be generally in accordance with the baseline criteria and interim target criteria of the EMP. However, maximum EC at all monitoring site was above interim target criteria but within the baseline criteria. Similarly, minimum DO was below interim criteria at all sites.

Creek monitoring was not undertaken in the 2018 reporting period.

A copy of all creek monitoring water quality data is included in **Appendix 2** of this report.

The results of the monthly algae monitoring for the 2019 reporting period are displayed within **Table 35**.

Table 35: Surface Water Quality Monitoring 2019 Results – Blue Green Algae

Date	Dredge Pond (Dam 1)		Silt Pond (Dam 2)	
	Total Algae Count (cells/ml) Criteria: <50,000	Total Biovolume (mm ³ /L)	Total Algae Count (cells/ml) Criteria: <50,000	Total Biovolume (mm ³ /L)
January 2019	-	-	-	-
February 2019	-	-	-	-
8 March 2019	<5	<0.001	<5	<0.001
April 2019	-	-	-	-
May 2019	-	-	-	-
4 June 2019	550	<0.001	500	<0.001
July 2019	-	-	-	-
29 August 2019	30900	0.002	525	<0.001
September 2019	-	-	-	-
October 2019	-	-	-	-
22 November 2019	900	0.002	10800	2.13
December 2019	-	-	-	-

It is noted that there were some months where total algae count and total biovolume were not recorded. This is a non-compliance with the frequency outlined in the EMP. Holcim aims to improve data analysis in 2020.

When tested, the total biovolume results remained below the detection limit throughout the 2019 reporting period. The maximum total algae count in 2019 (30900 cells/ml) was higher than the maximum from 2018 (16,000 cells/ml) but within historical trends.

The total algae count results gathered at site across several years have illustrated a large degree of variability. It is noted that variations in total algae count results are not identified as exceedances of the monitoring criteria listed in the EMP and the key to monitoring Blue Green Algae activity generally lies with total algae count readings.

Long-term Trends:

Appendix 2 outlined the long-term monitoring data, including a summary of minimum, maximum and average for key parameters. Key parameters continued to follow long-term trends, including:

- There was no surface water discharge in 2019;
- Generally acidic pH readings;
- High variability of turbidity;
- Low levels of oil and grease;
- Variable levels of total algae, but within long-term trends; and
- EC was highly variable, but within long-term trends.

Comparison to EIS Predictions:

There was no evidence of any detrimental impact from the Quarry on surface water. This is consistent with the EIS predictions.

7.4 Groundwater Results

Monthly groundwater monitoring was undertaken at 5 locations (DLP 1, DLP 3, DLP 5, DLP 6 and DLP 7) during the 2019 reporting period. Results obtained at each bore in 2019 have been generally consistent at each location with previous results.

DLP3, DLP6 and DLP 7 present conductivity levels above the maximum interim target of 2000 $\mu\text{S}/\text{cm}$ stated within the EMP, with this also being the case in previous years. These sites have also expressed similar levels of electrical conductivity (EC) within legacy background testing and are not causing any environmental impacts outside of the existing environment.

DLP 7 sits immediately adjacent to the existing wetland, which 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 DLP 7 due to tidal influences within these nearby waterways and wetlands. This trend has previously been identified in Annual Reports prepared under the previous operator and is considered to be consistent with the natural salinity levels in the local environment.

A summary of monthly groundwater results for pH and EC is provided in **Table 36**. A copy of all monthly groundwater monitoring has been provided in **Appendix 2** of this report.

Table 36: Monthly Groundwater Quality Monitoring 2019 Results

Location	Parameter	Interim Target Criteria	Minimum	Maximum	2019 Average	2018 Average for comparison	2017 Average for Comparison
DLP1	pH	4.2-7.0	4.1	6.6	4.9	4.4	4.3
	EC (uS/cm)	<2000	38	3570	698	146	134
DLP3	pH	4.2-7.0	3.88	6.4	5.5	5.9	6
	EC (uS/cm)	<2000	568	10400	6731	7320	7464
DLP5	pH	4.2-7.0	4.4	9.89	5.4	4.7	5.1
	EC (uS/cm)	<2000	22	5623	1782	847.5	406
DLP6	pH	4.2-7.0	3.9	5.78	4.6	3.9	3.8
	EC (uS/cm)	<2000	109	10190	2561	607.5	1270
DLP7	pH	4.2-7.0	4.4	7.51	6.3	7.0	6.9
	EC (uS/cm)	<2000	367	3820	3039	3379	3125

There was a large degree in variability across the sites for the 2019 monitoring, with this also being the case in 2018. Generally, the pH has been acidic to neutral. The EC has a high variability across sites ranging from 22 uS/cm to 10190 uS/cm.

A summary of quarterly monitoring for Manganese and Magnesium is outlined in **Table 37**.

Table 37: Quarterly Groundwater Quality Monitoring 2019 Results

Location	Parameter	Interim Target Criteria	Q1	Q2	Q3	Q4	2019 Average	2018 Average for comparison	2017 Average for comparison
DLP1	Manganese (mg/L)	0.15	0.05	0.038	0.033	0.034	0.039	0.014	0.024
	Magnesium (mg/L)	40	2	1	<1	<1	1.25	0.87	0.65
DLP3	Manganese (mg/L)	0.15	0.988	0.789	0.797	1.11	0.92	0.65	0.63
	Magnesium (mg/L)	40	193	142	130	236	175.3	131.2	126.7
DLP5	Manganese (mg/L)	0.15	0.02	0.127	0.212	0.16	0.13	0.031	0.060
	Magnesium (mg/L)	40	5	41	56	55	39.3	11.2	14.5
DLP6	Manganese (mg/L)	0.15	0.576	0.54	0.538	0.225	0.47	0.49	1.12
	Magnesium (mg/L)	40	8	8	6	6	7.0	6.8	14.45
DLP7	Manganese (mg/L)	0.15	0.072	0.078	0.082	0.074	0.077	0.21	0.068
	Magnesium (mg/L)	40	39	40	38	39	39.00	39.25	37.3

Note: Where results are below the detectable limit (i.e. <0.5) the average has been calculated by removing the <.

When comparing the 2019 annual average for Manganese and Magnesium to 2018 totals, there is a large degree of similarity. However annual averages for Manganese and Magnesium have increase at DLP1, DLP3, and DLP5. The largest change is the Manganese level at DLP5 which increased from 0.031 mg/L to 0.13 mg/L in 2019. DLP3 was once again above the interim criteria, as per 2017 and 2018 results. Manganese levels at DPL6 were also above interim criteria in 2019.

Long-term Trends:

Results for Manganese and Magnesium are similar to previous years. DLP3 has been consistently above the interim target criteria, with this a trend across several years.

A copy of all Quarterly groundwater monitoring has been attached as **Appendix 2** to this report.

Comparison to EIS Predictions:

There was no evidence of any detrimental impact from the Quarry on groundwater. This is consistent with the EIS predictions.

7.5 Water Take

There is no water take associated with the Dunloe Sand Quarry.

8 REHABILITATION AND LANDSCAPE MANAGEMENT

8.1 Rehabilitation Performance during the Reporting Period

As part of the site's approved EMP, re-vegetation and regenerative landscaping is required (Appendix C of the EMP). Ongoing management of the surrounding vegetation is being carried out by Ramtech Pty Ltd over the lifetime of the Dunloe Sand Quarry operations.

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 and topography, 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).

Quarterly rehabilitation monitoring was undertaken during 2019. A copy of all rehabilitation works, checklist and photos showing work areas have been attached as **Appendix 5** to this report.

A summary of rehabilitation at the Dunloe Sand Quarry is outlined in **Table 38**.

Table 38: Rehabilitation Performance in 2019

Guideline Requirement	Site Comment
Extent of the operations and rehabilitation at completion of the reporting period	There was no rehabilitation at site in 2019.
Agreed post- rehabilitation land use	The proposed rehabilitation aims to return the land to an endangered ecological community (EEC) Swamp Sclerophyll plus Eucalypt Open Forest species and EEC Coastal Wetland within the localised soaks.
Key rehabilitation performance indicators	Criteria are outlined in the <i>Rehabilitation and Revegetation Management Plan</i> .
Renovation or removal of buildings	None during reporting period
Any other Rehabilitation taken including: <ul style="list-style-type: none"> • Exploration activities; • Infrastructure; • Dams; and • The installation or maintenance of fences, bunds and any other works. 	No rehabilitation of these features was completed.
Any rehabilitation areas which have received formal sign off from the Resources Regulator.	None.
Variations to activities undertaken to those proposed (including why there were variations and whether Resources Regulator was notified)	No variations to the <i>Rehabilitation and Revegetation Management Plan</i> .
Outcomes of trials, research projects and other initiatives	No specific trials.
Key issues that may affect successful rehabilitation	There are several potential issues including availability of material, seed stock, climatic events, tidal inundation and rehabilitation methodology.

8.2 Summary of Current Rehabilitation and Performance

A summary of the rehabilitation and disturbance status is outlined in **Table 39**. This is also shown in **Figure 4**.

Table 39: Rehabilitation and Disturbance Status

Quarry Area Type	Previous Reporting Period (Actual)	This Reporting Period (Actual)	Next Reporting Period (Forecast)
	2018	2019	2020
	(ha)		
A. Total Quarry Footprint	32.2	32.2	32.2
B. Total Active Disturbance	18.8	18.8	18.8
C. Land Being Prepared for Rehabilitation	0	0	0
D. Land Under Active Rehabilitation	13.4	13.4	13.4
E. Completed Rehabilitation	0	0	0

At the end of 2019 there was approximately 18.8 Ha of active disturbance and 13.4 Ha of active rehabilitation (see **Figure 4**). There is no rehabilitation proposed in 2020.

Rehabilitation monitoring of established rehabilitation has shown:

- Most of the rehabilitation has been from natural regeneration;
- Dominant species are paper bark, melaleuca, banksia, casuarina and bracken fern;
- Evidence of grass and leaf litter; and
- Some tree species greater than 15 metres high, shrub species greater than 5 m high and groundcover to 2 m.

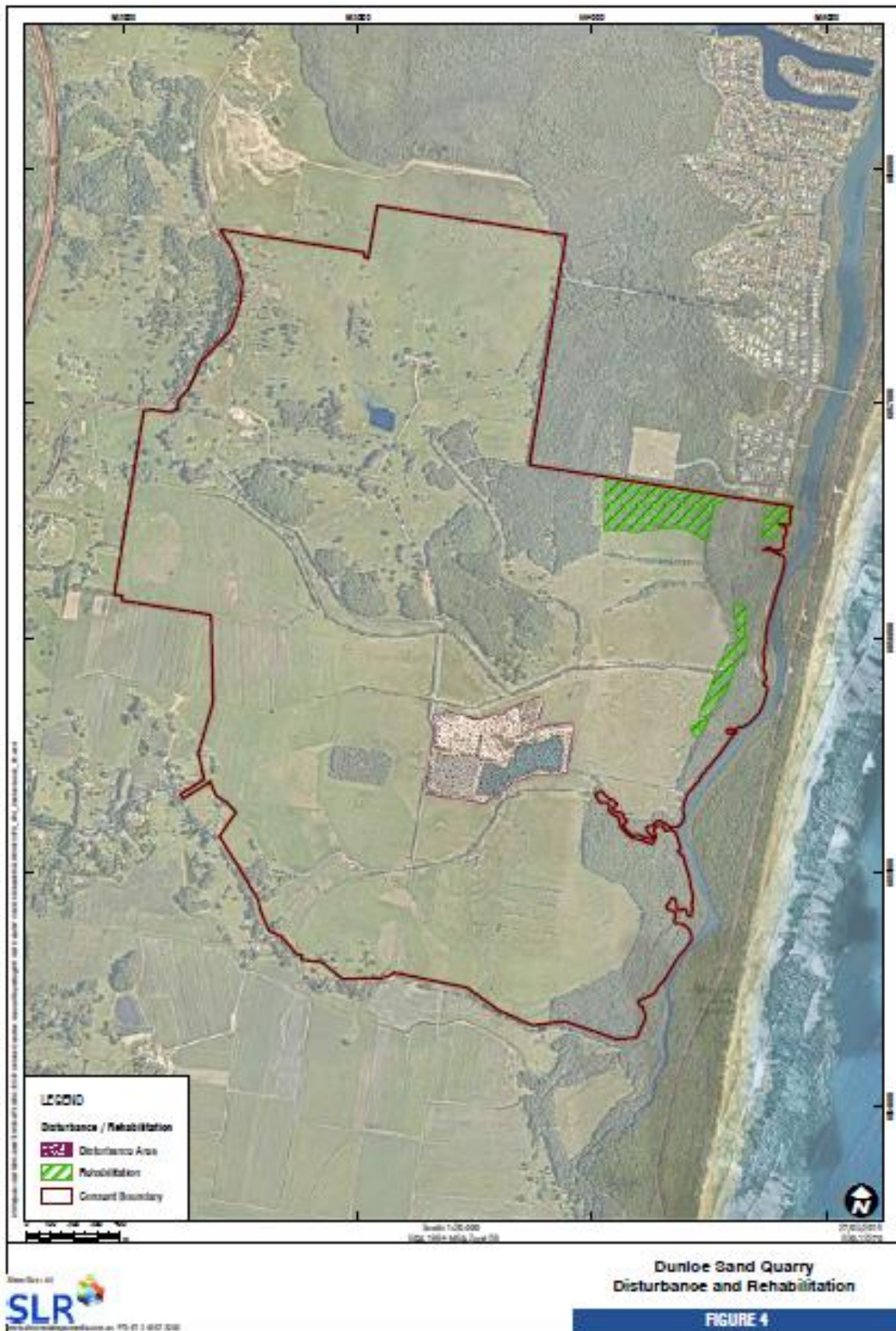


Figure 4: Rehabilitation and Disturbance

8.3 Actions for the Next Reporting Period

The DPIE 2015 *Annual Review Guidelines* require the Annual Review to outline the rehabilitation actions proposed during the next reporting period (1 January 2020 to 31 December 2020). These actions are detailed in **Table 40**.

Table 40: Rehabilitation and Closure Actions for the Next Reporting Period (2020)

Requirement	Site Comment
Describe the steps to be undertaken to progress agreement during next reporting period, where final rehabilitation outcomes have not yet been agreed between stakeholders.	No rehabilitation proposed in 2020.
Outline proposed rehabilitation trials, research projects and other initiatives to be undertaken during next reporting period.	Rehabilitation inspections/monitoring to continue. An update will be provided in the 2020 Annual Review.
Summary of rehabilitation activities proposed for next report period.	No specific rehabilitation proposed for 2020. The three rehabilitation zones will continue to be managed and worked on in accordance with the approved EMP including invasive species removal and monitoring.

9 COMMUNITY

9.1 Community Engagement Activities

The site implemented a Community Consultative Committee (CCC) when under the operation of Ramtech as part of the conditions of consent. CCC meetings were undertaken on 15 February 2019 and 27 September 2019. All minutes from each of the meetings undertaken in 2019, along with a copy of the complaints register and all publicly listed information including contacts for locals in the community is available on the Dunloe Sand Quarry webpage in accordance with the Project Approval requirements

<https://www.holcim.com.au/dunloe-sand-quarry-pottsville-nsw>

Holcim has maintained community engagement measures, including:

- Maintenance of a website (containing publicly available documents);
- A telephone number, email and postal address (on the website) for community complaints and feedback;
- A copy of the Complaints Register is maintained on the company website; and
- All documents and items displayed on the website are regularly updated by Holcim staff.

9.2 Community Contributions

Holcim supplied some sand free of charge to local schools during the Annual Review period.

9.3 Complaints

There were no community complaints at site during 2019. This trend continues from 2018. Community complaints reports are published on the Holcim website quarterly.

10 INDEPENDENT AUDIT

The site undertook an expansion of Independent Environmental Audit (IEA) in 2016 in accordance with the timeframes of the Project Approval. All actions raised in the IEA have been undertaken in accordance with the recommendations made by Consultants Mark Rigby & Associates. All actions were closed out in 2016. The next audit is due in 2021.

11 INCIDENTS AND NON-COMPLIANCE

Table 41 summarises the incidents and non-compliances at the Dunloe Sand Quarry in 2019.

Table 41: Summary of Incidents and Non-Compliances

Date	Incident/ Non – Compliance	Action
Overall report period	<p>Schedule 3 Condition 22</p> <p>It is noted that there were some months where total algae count and total bio volume were not recorded. This is a non - compliance with the frequency outlined in the Blue – Green Algae Management (Component of the EMP).</p> <p>It is noted that vertical profile water quality monitoring was not undertaken in 2019 (Component of the EMP).</p>	Improve monitoring of surface water for 2020.

12 ACTIVITIES TO BE COMPLETED IN THE NEXT REPORTING PERIOD

Holcim staff will undertake the following works and improvement measures and projects in 2020 to ensure compliance with the consent and to ensure that effective environmental management controls are in place and operating in accordance with the requirements of the Consent.

Table 42: Improvement Actions for 2020

Improvement Measure	Activities
Water Quality Monitoring	Ensure water quality monitoring is completed in accordance with the EMP.
Dust Monitoring	Ensure dust monitoring is completed in accordance with the EMP.
Biodiversity	Weed spraying will continue at site during the next Annual Review period.
	Conduct fauna box monitoring annually.

13 REFERENCES

DPI Water (2017) Water Access Licence Usage

EPA (Ongoing) Environment Protection Licence) – 13077

GHD (2020) Environmental Management Strategy

GHD (2020) Environmental Monitoring Program

GHD (2019) Traffic Management Plan

Holcim (2018) CCC Minutes

Planit Consulting (2007) Environmental Assessment – Dunloe Park

RPS (2019) Aboriginal Cultural Heritage Assessment Report – Dunloe Sands Quarry, Pottsville, NSW

14 APPENDICES

APPENDIX 1

DUNLOE SAND QUARRY NOISE MONITORING 2018

Noise Monitoring Assessment

Dunloe Quarry, Pottsville, NSW
Quarter 1 Ending March 2019.

Document Information

Noise Monitoring Assessment

Dunloe Quarry, Pottsville, NSW

Quarter 1 Ending March 2019

Prepared for: Holcim (Australia) Pty Ltd



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Document ID	Status	Date	Prepared By	Signed	Reviewed By	Signed
MAC180611-07RP3	Final	18 March 2019	Nicholas Shipman		Rod Linnett	

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APPENDIX A - GLOSSARY OF TERMS

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1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by Holcim (Australia) Pty Ltd (Holcim) to complete a Noise Monitoring Assessment (NMA) for the quarterly period ending March 2019 for Dunloe Quarry (the 'quarry'), Pottsville, NSW.

The monitoring has been conducted in accordance with the Dunloe Project Approval and Noise Management Plan at four representative monitoring locations. This assessment represents the operations undertaken during Quarter 1, ending March 2019 and forms part of the annual noise monitoring program to address conditions of the project approval.

The assessment has been conducted in accordance with the following documents:

- NSW Environment Protection Authority (EPA), Noise Policy for Industry (NPI), 2017;
- Dunloe Noise Management Plan (NMP), 2016; and
- Australian Standard AS 1055:2018- Acoustics - Description and measurement of environmental noise - General Procedures.

A glossary of terms, definitions and abbreviations used in this report is provided in **Appendix A**.

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2 Noise Criteria

Schedule 3 Section 2 of the sites Project Approval outlines the applicable noise criteria for residential receivers surrounding the quarry site.

The noise criteria are applicable when the site undertakes quarrying operations with the site permitted to operate Monday to Friday 7am – 5pm, Saturday 7am – 12pm with no operations on Sunday.

Table 1 presents the noise criteria for each of the receivers as outlined in the Project Approval.

Table 1 Noise Criteria	
Location	Day Criteria dB LAeq(15min) ²
All privately-owned receivers ¹	48

Note 1: Receiver locations are shown in Figure 1.

Note 2: Criteria applicable between Monday to Friday 7am – 5pm, Saturday 7am – 12pm with no operations on Sunday as the Table 2 of the Project Approval.

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3 Methodology

3.1 Locality

The quarry is approximately 2.5km south west of Pottsville, NSW. Receivers surrounding the quarry are primarily rural/residential situated in coastal bushland with elevated and undulating topography. The monitoring locations with respect to the quarry and assessed receivers are presented in the locality plan shown in **Figure 1**.

3.2 Noise Monitoring Locations

Four monitoring locations have been selected as part of the NMA and are listed below:

- R1 is located at the property on Kellehers Road situated north of the quarry;
- R2 is located west of the quarry on the boundary of 574 Pottsville Road;
- R3 is located to the south-west of the quarry at the address of 122 Warwick Park Road; and
- R4 is located at 265 Warwick Park Road, south of the quarry.

3.3 Assessment Methodology

Attended noise surveys were conducted in general accordance with the procedures described in Australian Standard AS 1055:2018, "Acoustics - Description and Measurement of Environmental Noise and Dunloe Quarry's Project Approval. Measurements were carried out using a Svantek Type 1, 971 noise analyser on Thursday 7 March 2019. Acoustic instrumentation used carries current NATA calibration and complies with AS NZS IEC 61672.1-2019-Electroacoustics - Sound level meters - Specifications. Calibration of all instrumentation was checked prior to and following measurements. Drift in calibration did not exceed ± 0.5 dBA.

One measurement was conducted at each monitoring location during the daytime period. Measurements were of 15 minutes in duration and where possible, throughout each survey the operator quantified the contribution of each significant noise source.

Extraneous noise sources were excluded from the analysis to determine the $L_{Aeq}(15min)$ quarry noise contribution for comparison against the relevant criteria. Where the quarry was inaudible, the contribution is estimated to be at least 10dB below the ambient noise level.

FIGURE 1
LOCALITY PLAN
REF: MAC180611-07



KEY

 RECEIVER LOCATION

 SITE LOCATION



©Imagery Source: reamaps

4 Results

4.1 Assessment Results - Location R1

The monitored noise level contributions and observed meteorological conditions for R1 for are presented in **Table 2**.

Table 2 Operator-Attended Noise Survey Results – Location R1						
Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L _{Amax}	L _{Aeq}	L _{A90}		
						Birds 38-46
					WD: S	Wind in grass 38-42
07/03/19	09:47	83	55	41	WS: 2m/s	Local residential noise 36-42
					Rain: Nil	Distant traffic <36
						Local traffic 38-83
						Quarry Inaudible
Dunloe Quarry L _{Aeq} (15min) Contribution						<31

4.2 Assessment Results - Location R2

The monitored noise level contributions and observed meteorological conditions for R2 are presented in **Table 3**.

Table 3 Operator-Attended Noise Survey Results – Location R2						
Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L _{Amax}	L _{Aeq}	L _{A90}		
					WD: S	Highway traffic 48-60
07/03/19	10:09	82	64	53	WS: 2m/s	Local traffic 46-82
					Rain: Nil	Wind in trees <48
						Quarry Inaudible
Dunloe Quarry L _{Aeq} (15min) Contribution						<43

4.3 Assessment Results - Location R3

The monitored noise level contributions and observed meteorological conditions R3 are presented in **Table 4**.

Table 4 Operator-Attended Noise Survey Results – Location R3						
Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L _{Amax}	L _{Aeq}	L _{A90}		
07/03/19	10:31	62	46	42	WD: S WS: 2m/s Rain: Nil	Wind in trees 38-48 Birds 42-46 Distant traffic <38 Quarry Inaudible
Dunloe Quarry L _{Aeq} (15min) Contribution						<32

4.4 Assessment Results - Location R4

The monitored noise level contributions and observed meteorological conditions for R4 are presented in **Table 5**.

Table 5 Operator-Attended Noise Survey Results – Location R4						
Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L _{Amax}	L _{Aeq}	L _{A90}		
07/03/19	10:53	64	46	40	WD: S WS: 2m/s Rain: Nil	Aircraft 38-53 Wind in grass 36-46 Birds 48-62 Quarry Inaudible
Dunloe Quarry L _{Aeq} (15min) Contribution						<30

5 Noise Compliance Assessment

The compliance assessment for each residential receiver R1, R2, R3 and R4 are presented in **Table 6** for day assessment periods.

Table 6 Daytime Noise Compliance Summary			
Receiver No.	Quarry Noise Contribution	Quarry Noise Criteria	Compliant
	dB LAeq(15min)	dB LAeq(15min)	
R1	<31	48	✓
R2	<43	48	✓
R3	<32	48	✓
R4	<30	48	✓

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6 Discussion

6.1 Discussion of Results - Location R1

Quarry noise emissions were inaudible during noise monitoring conducted on Thursday 7 March 2019 at location R1, satisfying the relevant daytime noise limit of 48dB LAeq(15min). Extraneous noise sources included birds, wind in grass, local residential noise, distant traffic, local traffic and were generally constant throughout the measurement.

6.2 Discussion of Results - Location R2

Quarry noise emissions were inaudible during noise monitoring conducted on Thursday 7 March 2019 at location R2, satisfying the relevant daytime noise limit of 48dB LAeq(15min). Extraneous noise sources included the continuous noise of the wind in trees, highway traffic and intermittent sources such as passing local traffic.

6.3 Discussion of Results - Location R3

Quarry noise emissions were inaudible during noise monitoring conducted on Thursday 7 March 2019 at location R3, satisfying the relevant daytime noise limit of 48dB LAeq(15min). Extraneous noise sources included highway traffic, local traffic and wind in trees. All extraneous noises were generally constant during the 15 minute measurement at R3.

6.4 Discussion of Results - Location R4

Quarry noise emissions were inaudible during noise monitoring conducted on Thursday 7 March 2019 at location R4, satisfying the relevant daytime noise limit of 48dB LAeq(15min). Extraneous noise sources included aircraft passby, wind in grass and birds were audible throughout the measurement.

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7 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed a Noise Monitoring Assessment (NMA) on behalf of Holcim (Australia) Pty Ltd at Dunloe Quarry, Pottsville, NSW. The assessment was completed to determine the quarry's compliance with the relevant criteria outlined in their Project Approval for relevant surrounding residential receivers for the Quarter 1, ending March 2019.

Attended noise monitoring was undertaken on Thursday 7 March 2019 at representative monitoring locations, with quarry noise contributions compared against the relevant criteria. The assessment has identified that noise emissions generated by Dunloe Quarry comply with relevant noise criteria specified in the Project Approval at all assessed residential receivers.

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Appendix A - Glossary of Terms

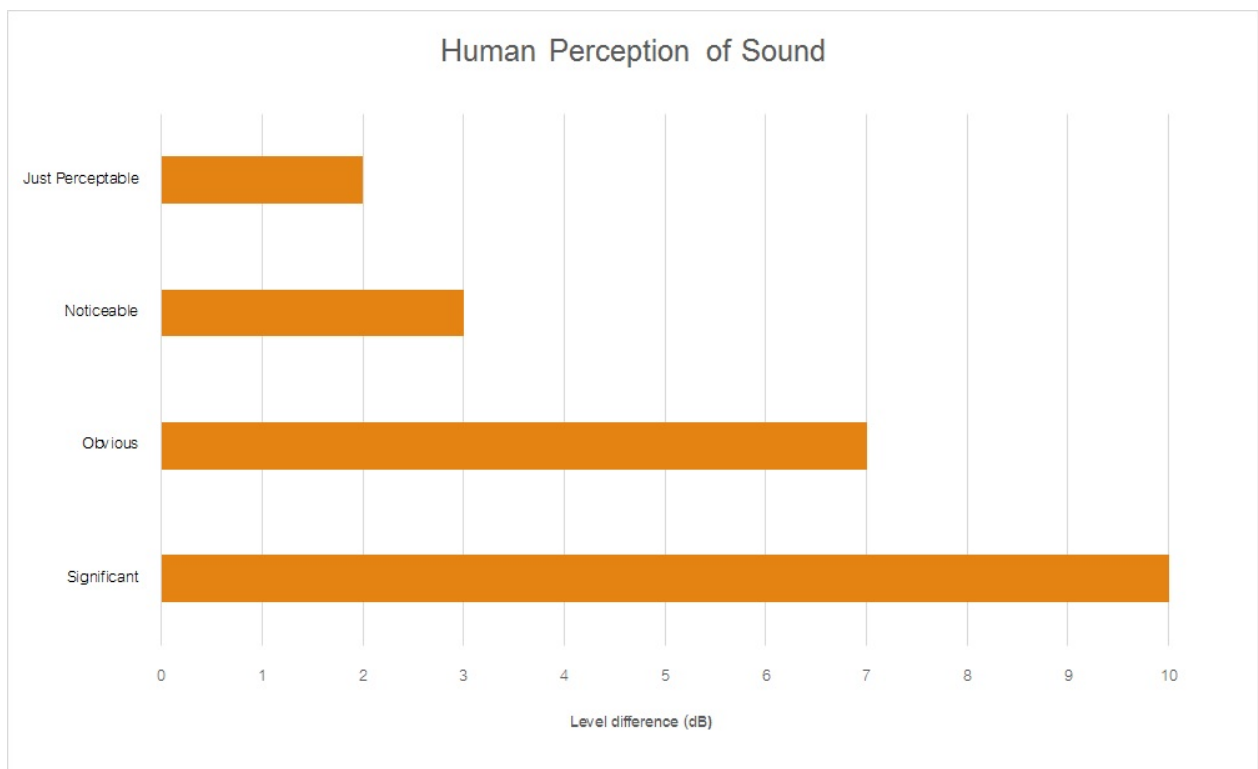
Table A1 provides a number of technical terms have been used in this report.

Table A1 Glossary of Terms	
Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the NPI as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured LA90 statistical noise levels.
Adverse Weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient Noise	The noise associated with a given environment. Typically a composite of sounds from many sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dB(Z), dB(L)	Decibels Linear or decibels Z-weighted.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
LA10	A noise level which is exceeded 10 % of the time. It is approximately equivalent to the average of maximum noise levels.
LA90	Commonly referred to as the background noise, this is the level exceeded 90 % of the time.
LAeq	The summation of noise over a selected period of time. It is the energy average noise from a source, and is the equivalent continuous sound pressure level over a given period.
LAm _{ax}	The maximum root mean squared (rms) sound pressure level received at the microphone during a measuring interval.
RBL	The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the ABL's.
Sound power level (LW)	This is a measure of the total power radiated by a source. The sound power of a source is a fundamental location of the source and is independent of the surrounding environment. Or a measure of the energy emitted from a source as sound and is given by : $= 10 \cdot \log_{10} (W/W_0)$ Where : W is the sound power in watts and W ₀ is the sound reference power at 10-12 watts.

Table A2 provides a list of common noise sources and their typical sound level.

Table A2 Common Noise Sources and Their Typical Sound Pressure Levels (SPL), dBA	
Source	Typical Sound Level
Threshold of pain	140
Jet engine	130
Hydraulic hammer	120
Chainsaw	110
Industrial workshop	100
Lawn-mower (operator position)	90
Heavy traffic (footpath)	80
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
Bedroom (night with windows closed)	20
Threshold of hearing	0

Figure A1 – Human Perception of Sound



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Noise Monitoring Assessment

Dunloe Quarry, Pottsville, NSW
Quarter 2 Ending June 2019.



Document Information

Noise Monitoring Assessment

Dunloe Quarry, Pottsville, NSW

Quarter 2 Ending June 2019

Prepared for: Holcim (Australia) Pty Ltd

Prepared by: Muller Acoustic Consulting Pty Ltd

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Document ID	Status	Date	Prepared By	Signed	Reviewed By	Signed
MAC180611-07RP4	Final	9 July 2019	Robin Heaton	<i>Robin Heaton</i>	Rod Linnett	<i>RM LSA</i>

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All documents produced by Muller Acoustic Consulting Pty Ltd (MAC) are prepared for a particular client's requirements and are based on a specific scope, circumstances and limitations derived between MAC and the client. Information and/or report(s) prepared by MAC may not be suitable for uses other than the original intended objective. No parties other than the client should use or reproduce any information and/or report(s) without obtaining permission from MAC. Any information and/or documents prepared by MAC is not to be reproduced, presented or reviewed except in full.

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APPENDIX A - GLOSSARY OF TERMS

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1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by Holcim (Australia) Pty Ltd (Holcim) to complete a Noise Monitoring Assessment (NMA) for the quarterly period ending June 2019 for Dunloe Quarry (the 'quarry'), Pottsville, NSW.

The monitoring has been conducted in accordance with the Dunloe Project Approval and Noise Management Plan at four representative monitoring locations. This assessment represents the operations undertaken during Quarter 2, ending June 2019 and forms part of the annual noise monitoring program to address conditions of the project approval.

The assessment has been conducted in accordance with the following documents:

- NSW Environment Protection Authority (EPA), Noise Policy for Industry (NPI), 2017;
- Dunloe Noise Management Plan (NMP), 2016; and
- Australian Standard AS 1055:2018- Acoustics - Description and measurement of environmental noise - General Procedures.

A glossary of terms, definitions and abbreviations used in this report is provided in **Appendix A**.

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2 Noise Criteria

Schedule 3 Section 2 of the Project Approval outlines the applicable noise criteria for residential receivers surrounding the quarry site.

The noise criteria are applicable when the site undertakes quarrying operations within the permitted operating hours Monday to Friday 7am – 5pm, Saturday 7am – 12pm with no operations on Sunday.

Table 1 presents the noise criteria for each of the receivers as outlined in the Project Approval.

Table 1 Noise Criteria	
Location	Day Criteria dB LAeq(15min) ²
All privately-owned receivers ¹	48

Note 1: Receiver locations are shown in Figure 1.

Note 2: Criteria applicable between Monday to Friday 7am – 5pm, Saturday 7am – 12pm with no operations on Sunday as the Table 2 of the Project Approval.

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3 Methodology

3.1 Locality

The quarry is approximately 2.5km south west of Pottsville, NSW. Receivers surrounding the quarry are primarily rural/residential situated in coastal bushland with elevated and undulating topography. The monitoring locations with respect to the quarry and assessed receivers are presented in the locality plan shown in **Figure 1**.

3.2 Noise Monitoring Locations

Four monitoring locations have been selected as part of the NMA and are listed below:

- R1 is located at the property on Kellehers Road situated north of the quarry;
- R2 is located west of the quarry on the boundary of 574 Pottsville Road;
- R3 is located to the south-west of the quarry at the address of 122 Warwick Park Road; and
- R4 is located at 265 Warwick Park Road, south of the quarry.

3.3 Assessment Methodology

Attended noise surveys were conducted in general accordance with the procedures described in Australian Standard AS 1055:2018, "Acoustics - Description and Measurement of Environmental Noise and Dunloe Quarry's Project Approval. Measurements were carried out using a Svantek Type 1, 971 noise analyser on Tuesday 18 June 2019. Acoustic instrumentation used carries current NATA calibration and complies with AS/NZS IEC 61672.1-2019-Electroacoustics - Sound level meters - Specifications. Calibration of all instrumentation was checked prior to and following measurements. Drift in calibration did not exceed ± 0.5 dBA.

One measurement was conducted at each monitoring location during the daytime period. Measurements were of 15 minutes in duration and where possible, throughout each survey the operator quantified the contribution of each significant noise source.

Extraneous noise sources were excluded from the analysis to determine the $L_{Aeq}(15min)$ quarry noise contribution for comparison against the relevant criteria. Where the quarry was inaudible, the contribution is estimated to be at least 10dB below the ambient noise level.

FIGURE 1
LOCALITY PLAN
REF: MAC180611-07



KEY

 RECEIVER LOCATION

 SITE LOCATION



*Imagery Source: reamaps

4 Results

4.1 Assessment Results - Location R1

The monitored noise level contributions and observed meteorological conditions for R1 for are presented in **Table 2**.

Table 2 Operator-Attended Noise Survey Results – Location R1						
Date	Time (hrs)	Descriptor (dBA re 20 μ Pa)			Meteorology	Description and SPL, dBA
		L _{Amax}	L _{Aeq}	L _{A90}		
18/06/2019	13:00	89	61	35	WD: NW	Cars on Farm 40-89
					WS: 1.6m/s	Residents Talking 45-55
					Rain: Nil	Cows 63-80
						Quarry Truck (5 Secs) 43
Dunloe Quarry L _{Aeq} (15min) Contribution						<25

4.2 Assessment Results - Location R2

The monitored noise level contributions and observed meteorological conditions for R2 are presented in **Table 3**.

Table 3 Operator-Attended Noise Survey Results – Location R2						
Date	Time (hrs)	Descriptor (dBA re 20 μ Pa)			Meteorology	Description and SPL, dBA
		L _{Amax}	L _{Aeq}	L _{A90}		
18/06/2019	13:25	87	66	48	WD: NW	Traffic 50-87
					WS: 1.3m/s	Construction pumps in adjacent field 45-48
					Rain: Nil	Quarry Inaudible
Dunloe Quarry L _{Aeq} (15min) Contribution						<38

4.3 Assessment Results - Location R3

The monitored noise level contributions and observed meteorological conditions R3 are presented in **Table 4**.

Table 4 Operator-Attended Noise Survey Results – Location R3						
Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L _{Amax}	L _{Aeq}	L _{A90}		
18/06/2019	13:45	63	44	37	WD: NW WS: 0.5m/s Rain: Nil	Chainsaw 40-45
						Distant Traffic 35-40
						Birds 50-63
						Wind in Trees 30-35
Dunloe Quarry L _{Aeq} (15min) Contribution						<27

4.4 Assessment Results - Location R4

The monitored noise level contributions and observed meteorological conditions for R4 are presented in **Table 5**.

Table 5 Operator-Attended Noise Survey Results – Location R4						
Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L _{Amax}	L _{Aeq}	L _{A90}		
18/06/2019	14:04	65	36	28	WD: NW WS: 0.1m/s Rain: Nil	Distant Traffic 30-34
						Aircraft 36-44
						Birds 40-65
						Quarry Inaudible
Dunloe Quarry L _{Aeq} (15min) Contribution						<18

5 Noise Compliance Assessment

The compliance assessment for each residential receiver R1, R2, R3 and R4 are presented in **Table 6** for day assessment periods.

Table 6 Daytime Noise Compliance Summary			
Receiver No.	Quarry Noise Contribution	Quarry Noise Criteria	Compliant
	dB LAeq(15min)	dB LAeq(15min)	
R1	<25	48	✓
R2	<38	48	✓
R3	<27	48	✓
R4	<18	48	✓

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6 Discussion

6.1 Discussion of Results - Location R1

Quarry noise emissions were briefly audible during noise monitoring conducted on Tuesday 18 June 2019 at location R1 however satisfied the relevant daytime noise limit of 48dB LAeq(15min). Extraneous noise sources included birds, wind in grass, local residential noise, distant traffic, farm vehicles and were generally constant throughout the measurement.

6.2 Discussion of Results - Location R2

Quarry noise emissions were inaudible during noise monitoring conducted on Tuesday 18 June 2019 at location R2, satisfying the relevant daytime noise limit of 48dB LAeq(15min). Extraneous noise sources included the continuous noise of the wind in trees, traffic noise and pumps operating in the adjacent field.

6.3 Discussion of Results - Location R3

Quarry noise emissions were inaudible during noise monitoring conducted on Tuesday 18 June 2019 at location R3, satisfying the relevant daytime noise limit of 48dB LAeq(15min). Extraneous noise sources included distant traffic, birds and wind in trees. All extraneous noises were generally constant during the 15 minute measurement at R3.

6.4 Discussion of Results - Location R4

Quarry noise emissions were inaudible during noise monitoring conducted on Tuesday 18 June 2019 at location R4, satisfying the relevant daytime noise limit of 48dB LAeq(15min). Extraneous noise sources included aircraft passby, distant traffic and birds were audible throughout the measurement.

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7 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed a Noise Monitoring Assessment (NMA) on behalf of Holcim (Australia) Pty Ltd at Dunloe Quarry, Pottsville, NSW. The assessment was completed to determine the quarry's compliance with the relevant criteria outlined in their Project Approval for relevant surrounding residential receivers for the Quarter 2, ending June 2019.

Attended noise monitoring was undertaken on Tuesday 18 June 2019 at representative monitoring locations, with quarry noise contributions compared against the relevant criteria. The assessment has identified that noise emissions generated by Dunloe Quarry complies with the relevant noise criteria specified in the Project Approval at all assessed residential receivers.

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Appendix A - Glossary of Terms

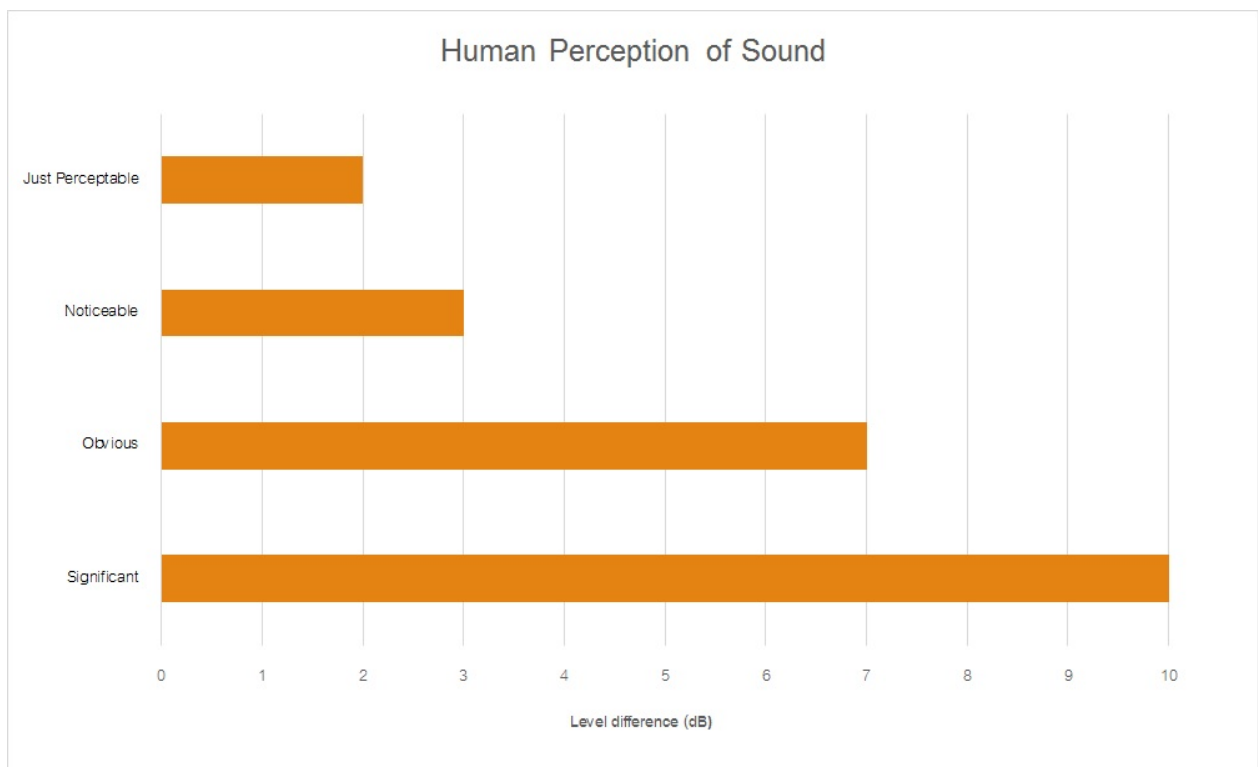
Table A1 provides a number of technical terms have been used in this report.

Table A1 Glossary of Terms	
Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the NPI as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured LA90 statistical noise levels.
Adverse Weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient Noise	The noise associated with a given environment. Typically a composite of sounds from many sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dB(Z), dB(L)	Decibels Linear or decibels Z-weighted.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
LA10	A noise level which is exceeded 10 % of the time. It is approximately equivalent to the average of maximum noise levels.
LA90	Commonly referred to as the background noise, this is the level exceeded 90 % of the time.
LAeq	The summation of noise over a selected period of time. It is the energy average noise from a source, and is the equivalent continuous sound pressure level over a given period.
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RBL	The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the ABL's.
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Table A2 provides a list of common noise sources and their typical sound level.

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Source	Typical Sound Level
Threshold of pain	140
Jet engine	130
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Chainsaw	110
Industrial workshop	100
Lawn-mower (operator position)	90
Heavy traffic (footpath)	80
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
Bedroom (night with windows closed)	20
Threshold of hearing	0

Figure A1 – Human Perception of Sound



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Noise Monitoring Assessment

Dunloe Quarry, Pottsville, NSW
Quarter 3 Ending September 2019.



Document Information

Noise Monitoring Assessment

Dunloe Quarry, Pottsville, NSW

Quarter 3 Ending September 2019

Prepared for: Holcim (Australia) Pty Ltd



Prepared by: Muller Acoustic Consulting Pty Ltd

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Document ID	Status	Date	Prepared By	Signed	Reviewed By	Signed
MAC180611-07RP5	Final	27 August 2019	Rod Linnett		Oliver Muller	

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 6.3 DISCUSSION OF RESULTS - LOCATION R3 15

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APPENDIX A - GLOSSARY OF TERMS

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1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by Holcim (Australia) Pty Ltd (Holcim) to complete a Noise Monitoring Assessment (NMA) for the quarterly period ending September 2019 for Dunloe Quarry (the 'quarry'), Pottsville, NSW.

The monitoring has been conducted in accordance with the Dunloe Project Approval (2008) and Noise Management Plan at four representative monitoring locations. This assessment represents the operations undertaken during Quarter 3, ending September 2019 and forms part of the annual noise monitoring program to address conditions of the project approval.

The assessment has been conducted in accordance with the following documents:

- NSW Environment Protection Authority (EPA), Noise Policy for Industry (NPI), 2017;
- Dunloe Noise Management Plan (NMP), 2016; and
- Australian Standard AS 1055:2018- Acoustics - Description and measurement of environmental noise - General Procedures.

A glossary of terms, definitions and abbreviations used in this report is provided in **Appendix A**.

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2 Noise Criteria

Schedule 3 Section 2 of the Project Approval outlines the applicable noise criteria for residential receivers surrounding the quarry site.

The noise criteria are applicable when the site undertakes quarrying operations within the permitted operating hours Monday to Friday 7am – 5pm, Saturday 7am – 12pm with no operations on Sunday.

Table 1 presents the noise criteria for each of the receivers as outlined in the Project Approval.

Table 1 Noise Criteria	
Location	Day Criteria dB LAeq(15min) ²
All privately-owned receivers ¹	48

Note 1: Receiver locations are shown in Figure 1.

Note 2: Criteria applicable between Monday to Friday 7am – 5pm, Saturday 7am – 12pm with no operations on Sunday as the Table 2 of the Project Approval.

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3 Methodology

3.1 Locality

The quarry is approximately 2.5km south west of Pottsville, NSW. Receivers surrounding the quarry are primarily rural/residential situated in coastal bushland with elevated and undulating topography. The monitoring locations with respect to the quarry and assessed receivers are presented in the locality plan shown in **Figure 1**.

3.2 Noise Monitoring Locations

Four monitoring locations have been selected as part of the NMA and are listed below:

- R1 is located at the property on Kellehers Road situated north of the quarry;
- R2 is located west of the quarry on the boundary of 574 Pottsville Road;
- R3 is located to the south-west of the quarry at the address of 122 Warwick Park Road; and
- R4 is located at 265 Warwick Park Road, south of the quarry.

3.3 Assessment Methodology

Attended noise surveys were conducted in general accordance with the procedures described in Australian Standard AS 1055:2018, "Acoustics - Description and Measurement of Environmental Noise and Dunloe Quarry's Project Approval. Measurements were carried out using a Svantek Type 1, 971 noise analyser on Tuesday 20 August 2019. Acoustic instrumentation used carries current NATA calibration and complies with AS/NZS IEC 61672.1-2019-Electroacoustics - Sound level meters - Specifications. Calibration of all instrumentation was checked prior to and following measurements. Drift in calibration did not exceed ± 0.5 dBA.



One measurement was conducted at each monitoring location during the daytime period. Measurements were of 15 minutes in duration and where possible, throughout each survey the operator quantified the contribution of each significant noise source.

Extraneous noise sources were excluded from the analysis to determine the $L_{Aeq}(15min)$ quarry noise contribution for comparison against the relevant criteria. Where the quarry was inaudible, the contribution is estimated to be at least 10dB below the ambient noise level.

FIGURE 1
LOCALITY PLAN
REF: MAC180611-07



KEY

-  RECEIVER LOCATION
-  SITE LOCATION



©Imagery Source: reamaps

4 Results

4.1 Assessment Results - Location R1

The monitored noise level contributions and observed meteorological conditions for R1 are presented in **Table 2**.

Table 2 Operator-Attended Noise Survey Results – Location R1						
Date	Time (hrs)	Descriptor (dBA re 20 μ Pa)			Meteorology	Description and SPL, dBA
		L _{Amax}	L _{Aeq}	L _{A90}		
20/08/2019	13:55	71	46	34	WD: SE WS: 1.5m/s Rain: Nil	Resident's Car 50-65 Aircraft 38-43 Birds 38-45 Quarry briefly audible
Dunloe Quarry L _{Aeq} (15min) Contribution						<25

4.2 Assessment Results - Location R2

The monitored noise level contributions and observed meteorological conditions for R2 are presented in **Table 3**.

Table 3 Operator-Attended Noise Survey Results – Location R2						
Date	Time (hrs)	Descriptor (dBA re 20 μ Pa)			Meteorology	Description and SPL, dBA
		L _{Amax}	L _{Aeq}	L _{A90}		
20/08/2019	13:28	76	57	47	WD: SE WS: 1.5-2m/s Rain: Nil	Traffic 50-87 Tractor in field 36-41 Quarry Inaudible
Dunloe Quarry L _{Aeq} (15min) Contribution						<37

4.3 Assessment Results - Location R3

The monitored noise level contributions and observed meteorological conditions for R3 are presented in **Table 4**.

Table 4 Operator-Attended Noise Survey Results – Location R3						
Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L _{Amax}	L _{Aeq}	L _{A90}		
20/08/2019	14:21	69	47	41	WD: SE WS: 1.5-2m/s Rain: Nil	Local Traffic 55-67
						Dog Bark 44-48
						Wind in Trees 35-40
						Quarry truck just audible ~38-40 (5 secs)
Dunloe Quarry L _{Aeq} (15min) Contribution						<35

4.4 Assessment Results - Location R4

The monitored noise level contributions and observed meteorological conditions for R4 are presented in **Table 5**.

Table 5 Operator-Attended Noise Survey Results – Location R4						
Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L _{Amax}	L _{Aeq}	L _{A90}		
20/08/2019	14:42	69	47	38	WD: SE WS: 1.5-2m/s Rain: Nil	Aircraft 46-49
						Birds 40-52
						Quarry Inaudible
Dunloe Quarry L _{Aeq} (15min) Contribution						<30

5 Noise Compliance Assessment

The compliance assessment for each residential receiver R1, R2, R3 and R4 are presented in **Table 6** for the day assessment period.

Table 6 Daytime Noise Compliance Summary			
Receiver No.	Quarry Noise Contribution	Quarry Noise Criteria	Compliant
	dB LAeq(15min)	dB LAeq(15min)	
R1	<25	48	✓
R2	<37	48	✓
R3	<35	48	✓
R4	<30	48	✓

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6 Discussion

6.1 Discussion of Results - Location R1

Quarry noise emissions were briefly audible during noise monitoring conducted on Tuesday 20 August 2019 at location R1 however satisfied the relevant daytime noise limit of 48dB LAeq(15min). Extraneous noise sources included birds, local residential noise and aircraft.

6.2 Discussion of Results - Location R2

Quarry noise emissions were inaudible during noise monitoring conducted on Tuesday 20 August 2019 at location R2, satisfying the relevant daytime noise limit of 48dB LAeq(15min). Extraneous noise sources included the continuous operation of farm vehicles in adjacent paddock and local traffic noise.

6.3 Discussion of Results - Location R3

Quarry noise emissions were just audible for a very short period (<5 seconds) during noise monitoring conducted on Tuesday 20 August 2019 at location R3, with the contribution estimated to be <35dB LAeq(15min), satisfying the relevant daytime noise limit of 48dB LAeq(15min). Extraneous noise sources included local traffic, dogs barking and wind in trees. All extraneous noises were generally constant during the 15 minute measurement at R3.

6.4 Discussion of Results - Location R4

Quarry noise emissions were inaudible during noise monitoring conducted on Tuesday 20 August 2019 at location R4, satisfying the relevant daytime noise limit of 48dB LAeq(15min). Extraneous noise sources included aircraft and birds throughout the measurement.

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7 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed a Noise Monitoring Assessment (NMA) on behalf of Holcim (Australia) Pty Ltd at Dunloe Quarry, Pottsville, NSW. The assessment was completed to determine the quarry's compliance with the relevant criteria outlined in their Project Approval for relevant surrounding residential receivers for the Quarter 3, ending September 2019.

Attended noise monitoring was undertaken on Tuesday 20 August 2019 at representative monitoring locations, with quarry noise contributions compared against the relevant criteria. The assessment has identified that noise emissions generated by Dunloe Quarry complies with the relevant noise criteria specified in the Project Approval at all assessed residential receivers.

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Appendix A - Glossary of Terms

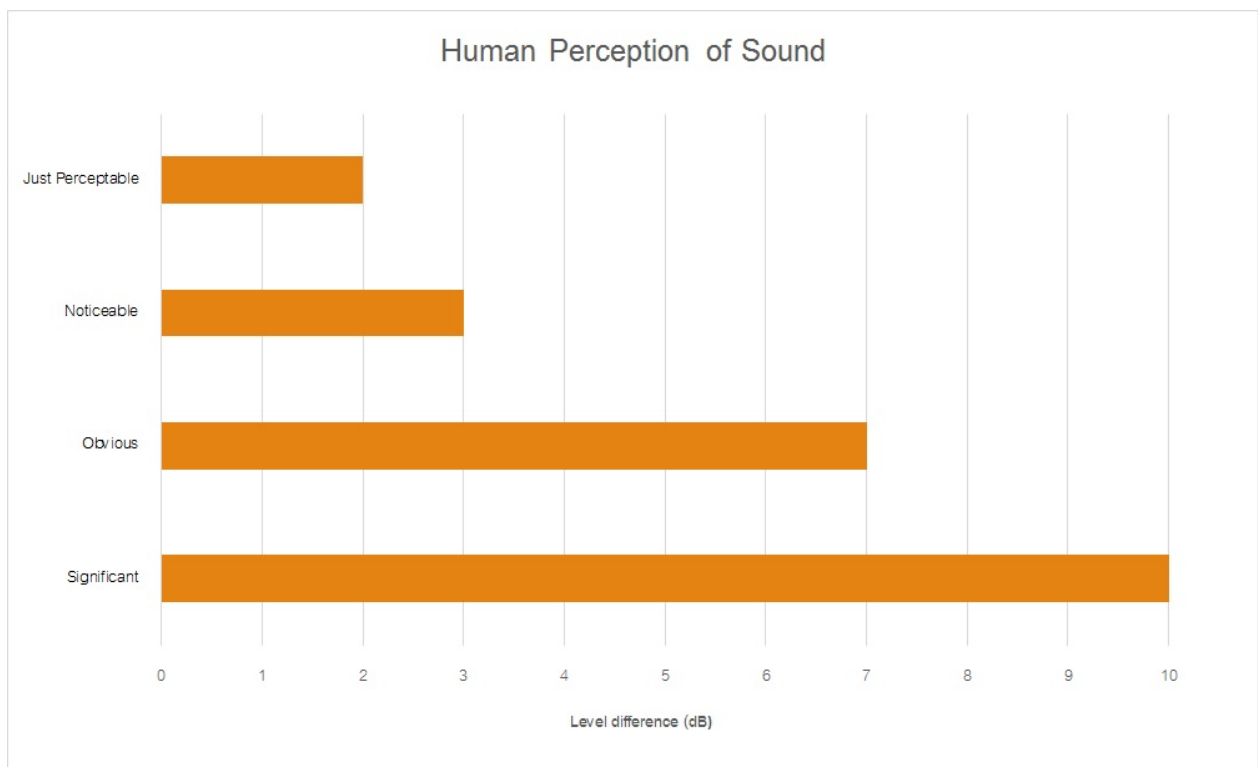
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Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the NPI as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured LA90 statistical noise levels.
Adverse Weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient Noise	The noise associated with a given environment. Typically a composite of sounds from many sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dB(Z), dB(L)	Decibels Linear or decibels Z-weighted.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
LA10	A noise level which is exceeded 10 % of the time. It is approximately equivalent to the average of maximum noise levels.
LA90	Commonly referred to as the background noise, this is the level exceeded 90 % of the time.
LAeq	The summation of noise over a selected period of time. It is the energy average noise from a source, and is the equivalent continuous sound pressure level over a given period.
LAm _{ax}	The maximum root mean squared (rms) sound pressure level received at the microphone during a measuring interval.
RBL	The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the ABL's.
Sound power level (LW)	This is a measure of the total power radiated by a source. The sound power of a source is a fundamental location of the source and is independent of the surrounding environment. Or a measure of the energy emitted from a source as sound and is given by : $= 10 \cdot \log_{10} (W/W_0)$ Where : W is the sound power in watts and W ₀ is the sound reference power at 10-12 watts.

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Threshold of pain	140
Jet engine	130
Hydraulic hammer	120
Chainsaw	110
Industrial workshop	100
Lawn-mower (operator position)	90
Heavy traffic (footpath)	80
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
Bedroom (night with windows closed)	20
Threshold of hearing	0

Figure A1 – Human Perception of Sound



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Noise Monitoring Assessment

Dunloe Quarry, Pottsville, NSW
Quarter 4 Ending December 2019.



Document Information

Noise Monitoring Assessment

Dunloe Quarry, Pottsville, NSW

Quarter 4 Ending December 2019

Prepared for: Holcim (Australia) Pty Ltd



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APPENDIX A - GLOSSARY OF TERMS

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1 Introduction

Muller Acoustic Consulting Pty Ltd (MAC) has been commissioned by Holcim (Australia) Pty Ltd (Holcim) to complete a Noise Monitoring Assessment (NMA) for the quarterly period ending December 2019 for Dunloe Quarry (the 'quarry'), Pottsville, NSW.

The monitoring has been conducted in accordance with the Dunloe Project Approval (2008) and Noise Management Plan at four representative monitoring locations. This assessment represents the operations undertaken during Quarter 4, ending December 2019 and forms part of the annual noise monitoring program to address conditions of the project approval.

The assessment has been conducted in accordance with the following documents:

- NSW Environment Protection Authority (EPA), Noise Policy for Industry (NPI), 2017;
- Dunloe Noise Management Plan (NMP), 2016; and
- Australian Standard AS 1055:2018- Acoustics - Description and measurement of environmental noise - General Procedures.

A glossary of terms, definitions and abbreviations used in this report is provided in **Appendix A**.

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2 Noise Criteria

Schedule 3 Section 2 of the Project Approval outlines the applicable noise criteria for residential receivers surrounding the quarry site.

The noise criteria are applicable when the site undertakes quarrying operations within the permitted operating hours Monday to Friday 7am – 5pm, Saturday 7am – 12pm with no operations on Sunday.

Table 1 presents the noise criteria for each of the receivers as outlined in the Project Approval.

Table 1 Noise Criteria	
Location	Day Criteria dB LAeq(15min) ²
All privately-owned receivers ¹	48

Note 1: Receiver locations are shown in Figure 1.

Note 2: Criteria applicable between Monday to Friday 7am – 5pm, Saturday 7am – 12pm with no operations on Sunday as the Table 2 of the Project Approval.

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3 Methodology

3.1 Locality

The quarry is approximately 2.5km south west of Pottsville, NSW. Receivers surrounding the quarry are primarily rural/residential situated in coastal bushland with elevated and undulating topography. The monitoring locations with respect to the quarry and assessed receivers are presented in the locality plan shown in **Figure 1**.

3.2 Noise Monitoring Locations

Four monitoring locations have been selected as part of the NMA and are listed below:

- R1 is located at the property on Kellehers Road situated north of the quarry;
- R2 is located west of the quarry on the boundary of 574 Pottsville Road;
- R3 is located to the south-west of the quarry at the address of 122 Warwick Park Road; and
- R4 is located at 265 Warwick Park Road, south of the quarry.

3.3 Assessment Methodology

Attended noise surveys were conducted in general accordance with the procedures described in Australian Standard AS 1055:2018, "Acoustics - Description and Measurement of Environmental Noise and Dunloe Quarry's Project Approval. Measurements were carried out using a Svantek Type 1, 971 noise analyser on Thursday 28 November 2019. Acoustic instrumentation used carries current NATA calibration and complies with AS/NZS IEC 61672.1-2019-Electroacoustics - Sound level meters - Specifications. Calibration of all instrumentation was checked prior to and following measurements. Drift in calibration did not exceed ± 0.5 dBA.

One measurement was conducted at each monitoring location during the daytime period. Measurements were of 15 minutes in duration and where possible, throughout each survey the operator quantified the contribution of each significant noise source.

Extraneous noise sources were excluded from the analysis to determine the $L_{Aeq}(15min)$ quarry noise contribution for comparison against the relevant criteria. Where the quarry was inaudible, the contribution is estimated to be at least 10dB below the ambient noise level.

FIGURE 1
LOCALITY PLAN
REF: MAC180611-07



KEY

 RECEIVER LOCATION

 SITE LOCATION



*Imagery Source: reamaps

4 Results

4.1 Assessment Results - Location R1

The monitored noise level contributions and observed meteorological conditions for R1 are presented in **Table 2**.

Table 2 Operator-Attended Noise Survey Results – Location R1						
Date	Time (hrs)	Descriptor (dBA re 20 μ Pa)			Meteorology	Description and SPL, dBA
		L _{Amax}	L _{Aeq}	L _{A90}		
28/11/2019	11:44	82	57	33	WD: E	Birds 34-39
					WS: 2m/s	Insects <34
					Rain: Nil	Traffic 33-82
Dunloe Quarry L _{Aeq} (15min) Contribution						Quarry inaudible
						<30

4.2 Assessment Results - Location R2

The monitored noise level contributions and observed meteorological conditions for R2 are presented in **Table 3**.

Table 3 Operator-Attended Noise Survey Results – Location R2						
Date	Time (hrs)	Descriptor (dBA re 20 μ Pa)			Meteorology	Description and SPL, dBA
		L _{Amax}	L _{Aeq}	L _{A90}		
28/11/2019	12:08	85	64	46	WD: E	Traffic 46-76
					WS: 0.5m/s	Birds <46
					Rain: Nil	Local residential noise 46-60
Dunloe Quarry L _{Aeq} (15min) Contribution						Quarry inaudible
						<30

4.3 Assessment Results - Location R3

The monitored noise level contributions and observed meteorological conditions for R3 are presented in **Table 4**.

Table 4 Operator-Attended Noise Survey Results – Location R3						
Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L _{Amax}	L _{Aeq}	L _{A90}		
28/11/2019	12:32	62	43	37	WD: E WS: 1m/s Rain: Nil	Aircraft 38-44
						Birds 36-62
						Wind 36-44
						Traffic <38
						Insects <38
						Quarry inaudible
Dunloe Quarry L _{Aeq} (15min) Contribution						<30

4.4 Assessment Results - Location R4

The monitored noise level contributions and observed meteorological conditions for R4 are presented in **Table 5**.

Table 5 Operator-Attended Noise Survey Results – Location R4						
Date	Time (hrs)	Descriptor (dBA re 20 µPa)			Meteorology	Description and SPL, dBA
		L _{Amax}	L _{Aeq}	L _{A90}		
28/11/2019	13:00	57	44	40	WD: E WS: 2m/s Rain: Nil	Traffic <36
						Wind 34-44
						Birds 36-57
						Quarry inaudible
Dunloe Quarry L _{Aeq} (15min) Contribution						<30

5 Discussion

5.1 Discussion of Results - Location R1

Quarry noise emissions were inaudible during noise monitoring conducted on Thursday 28 November 2019 at location R1. Quarry noise contributions were estimated to satisfy the relevant daytime noise limit of 48dB LAeq(15min). Extraneous noise sources include birds, insects and traffic during the monitoring period.

5.2 Discussion of Results - Location R2

Quarry noise emissions were inaudible during noise monitoring conducted on Thursday 28 November 2019 at location R2. Quarry noise contributions were estimated to satisfy the relevant daytime noise limit of 48dB LAeq(15min). Extraneous noise sources include traffic, birds and local residential noise during the monitoring period.

5.3 Discussion of Results - Location R3

Quarry noise emissions were inaudible during noise monitoring conducted on Thursday 28 November 2019 at location R3. Quarry noise contributions were estimated to satisfy the relevant daytime noise limit of 48dB LAeq(15min). Extraneous noise sources include aircraft, birds, wind in trees, traffic and insects during the monitoring period.

5.4 Discussion of Results - Location R4

Quarry noise emissions were inaudible during noise monitoring conducted on Thursday 28 November 2019 at location R4. Quarry noise contributions were estimated to satisfy the relevant daytime noise limit of 48dB LAeq(15min). Extraneous noise sources include traffic, wind in trees and birds during the monitoring period.

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6 Conclusion

Muller Acoustic Consulting Pty Ltd (MAC) has completed a Noise Monitoring Assessment (NMA) on behalf of Holcim (Australia) Pty Ltd at Dunloe Quarry, Pottsville, NSW. The assessment was completed to determine the quarry's compliance with the relevant criteria outlined in their Project Approval for relevant surrounding residential receivers for the Quarter 4, ending December 2019.

Attended noise monitoring was undertaken on Thursday 28 November 2019 at representative monitoring locations, with quarry noise contributions compared against the relevant criteria. The assessment has identified that noise emissions generated by Dunloe Quarry complies with the relevant noise criteria specified in the Project Approval at all assessed residential receivers.

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Appendix A - Glossary of Terms

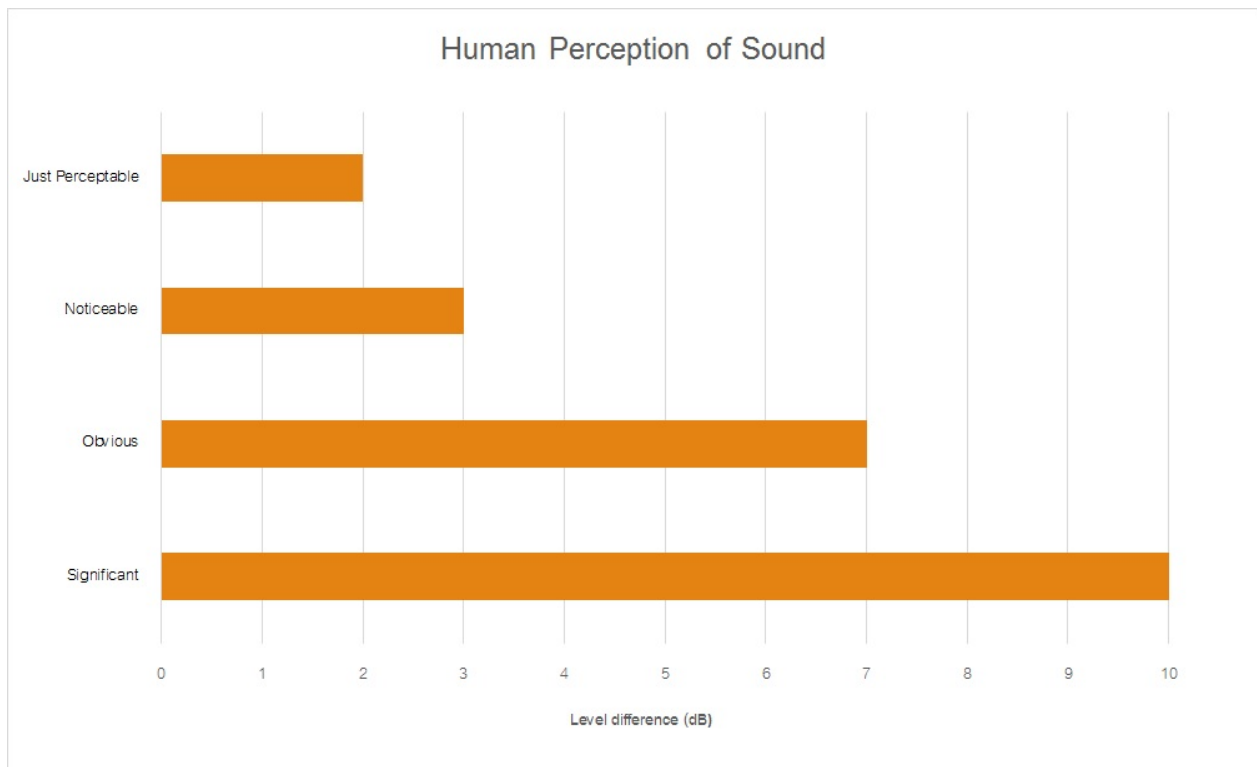
Table A1 provides a number of technical terms have been used in this report.

Table A1 Glossary of Terms	
Term	Description
1/3 Octave	Single octave bands divided into three parts
Octave	A division of the frequency range into bands, the upper frequency limit of each band being twice the lower frequency limit.
ABL	Assessment Background Level (ABL) is defined in the NPI as a single figure background level for each assessment period (day, evening and night). It is the tenth percentile of the measured LA90 statistical noise levels.
Adverse Weather	Weather effects that enhance noise (that is, wind and temperature inversions) that occur at a site for a significant period of time (that is, wind occurring more than 30% of the time in any assessment period in any season and/or temperature inversions occurring more than 30% of the nights in winter).
Ambient Noise	The noise associated with a given environment. Typically a composite of sounds from many sources located both near and far where no particular sound is dominant.
A Weighting	A standard weighting of the audible frequencies designed to reflect the response of the human ear to noise.
dBA	Noise is measured in units called decibels (dB). There are several scales for describing noise, the most common being the 'A-weighted' scale. This attempts to closely approximate the frequency response of the human ear.
dB(Z), dB(L)	Decibels Linear or decibels Z-weighted.
Hertz (Hz)	The measure of frequency of sound wave oscillations per second - 1 oscillation per second equals 1 hertz.
LA10	A noise level which is exceeded 10 % of the time. It is approximately equivalent to the average of maximum noise levels.
LA90	Commonly referred to as the background noise, this is the level exceeded 90 % of the time.
LAeq	The summation of noise over a selected period of time. It is the energy average noise from a source, and is the equivalent continuous sound pressure level over a given period.
LAm _{ax}	The maximum root mean squared (rms) sound pressure level received at the microphone during a measuring interval.
RBL	The Rating Background Level (RBL) is an overall single figure background level representing each assessment period over the whole monitoring period. The RBL is used to determine the intrusiveness criteria for noise assessment purposes and is the median of the ABL's.
Sound power level (LW)	This is a measure of the total power radiated by a source. The sound power of a source is a fundamental location of the source and is independent of the surrounding environment. Or a measure of the energy emitted from a source as sound and is given by : $= 10 \cdot \log_{10} (W/W_0)$ Where : W is the sound power in watts and W ₀ is the sound reference power at 10-12 watts.

Table A2 provides a list of common noise sources and their typical sound level.

Table A2 Common Noise Sources and Their Typical Sound Pressure Levels (SPL), dBA	
Source	Typical Sound Level
Threshold of pain	140
Jet engine	130
Hydraulic hammer	120
Chainsaw	110
Industrial workshop	100
Lawn-mower (operator position)	90
Heavy traffic (footpath)	80
Elevated speech	70
Typical conversation	60
Ambient suburban environment	40
Ambient rural environment	30
Bedroom (night with windows closed)	20
Threshold of hearing	0

Figure A1 – Human Perception of Sound



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APPENDIX 2

DUNLOE SAND QUARRY LONGTERM ENVIRONMENTAL MONITORING

Longterm Depositional Dust Monitoring at Dunloe Sands Quarry

Data located	Date	Location	D1	D2	D3	D4
			g/m2/month	g/m2/month	g/m2/month	g/m2/month
Appendix of 2015 AEMR	17-07-2015	Dunloe Sands	0.3	0.2	0.7	0.4
Appendix of 2015 AEMR	19-08-2015	Dunloe Sands	0.3	0.3	0.2	0.2
Appendix of 2015 AEMR	17-09-2015	Dunloe Sands	0.5	1.6	0.4	0.5
Appendix of 2015 AEMR	21-10-2015	Dunloe Sands	0.1	0.6	0.2	0.1
Appendix of 2015 AEMR	25-11-2015	Dunloe Sands	0.3	1.7	0.6	0.5
Appendix of 2015 AEMR	16-12-2015	Dunloe Sands	0.7	0.8	0.4	0.6
2016 AEMR	Jan-16	Dunloe Sands	0.3	0.4	0.5	0.6
2016 AEMR	Feb-16	Dunloe Sands	0.4	0.6	0.5	0.5
2016 AEMR	Mar-16	Dunloe Sands	0.2	4.7	0.3	0.5
2016 AEMR	Apr-16	Dunloe Sands	0.2	1.6	0.2	0.8
2016 AEMR	May-16	Dunloe Sands	0.3	1.2	0.3	1.6
2016 AEMR	Jun-16	Dunloe Sands	0.3	1.1	1.6	0.5
2016 AEMR	Jul-16	Dunloe Sands	0.13	0.52	0.41	0.39
2016 AEMR	Aug-16	Dunloe Sands	0.6	0.5	0.3	0.4
2016 AEMR	Sep-16	Dunloe Sands	0.8	0.5	0.4	0.3
2016 AEMR	Oct-16	Dunloe Sands	0.8	0.5	0.4	0.3
2016 AEMR	Nov-16	Dunloe Sands	0.4	1.9	0.3	0.4
2016 AEMR	Dec-16	Dunloe Sands	0.5	1.7	0.6	0.5
2017 Q1 Env Mon report	30-01-2017	Dunloe Sands	0.3	0.2	0.5	0.3
2017 Q1 Env Mon report	27-02-2017	Dunloe Sands	0.3	0.2	0.2	0.3
2017 Enviro Monitoring	22-03-2017	Dunloe Sands	0.2	0.1	2.4	0.3
2017 Enviro Monitoring	19-04-2017	Dunloe Sands	0.2	0.9	1	0.3
2017 Enviro Monitoring	17-05-2017	Dunloe Sands	0.8	0.8	1.4	0.7
2017 Enviro Monitoring	14-06-2017	Dunloe Sands	0.2	0.2	0.2	0.2
2017 Enviro Monitoring	12-07-2017	Dunloe Sands	0.3	0.1	0.2	0.3
2017 Enviro Monitoring	09-08-2017	Dunloe Sands	0.1	0.1	0.2	0.5
2017 Enviro Monitoring	06-09-2017	Dunloe Sands	0.5	0.2	0.5	0.5
2017 Enviro Monitoring	04-10-2017	Dunloe Sands	0.7	0.6	2.4	0.9
2017 Enviro Monitoring	01-11-2017	Dunloe Sands	0.5	0.3	0.8	0.5
2017 Enviro Monitoring	29-11-2017	Dunloe Sands	0.1	0.2	0.3	0.1
2017 Enviro Monitoring	28-12-2017	Dunloe Sands	0.4	0.3	0.2	0.2
2018 Enviro Monitoring	24-01-2018	Dunloe Sands	0.1	0.1	0.1	0.1
2018 Enviro Monitoring	21-02-2018	Dunloe Sands	2.7	0.7	1.6	0.6
2018 Enviro Monitoring	21-03-2018	Dunloe Sands	0.4	4.9c	11.8c	7.1c
2018 Enviro Monitoring	18-04-2018	Dunloe Sands	0.4	0.1	0.3	0.2
2018 Enviro Monitoring	16-05-2018	Dunloe Sands	0.2	0.4	0.6	0.3
2018 Enviro Monitoring	13-06-2018	Dunloe Sands	0.3	0.2	5.2c	0.4
2018 Enviro Monitoring	11-07-2018	Dunloe Sands	0.5	0.4	0.5	0.2
2018 Enviro Monitoring	08-08-2018	Dunloe Sands	0.4	0.5	0.3	0.2
2018 Enviro Monitoring	05-09-2018	Dunloe Sands	NS	NS	NS	NS
2018 Enviro Monitoring	05-10-2018	Dunloe Sands	0.1	0.4	0.3	0.7
2018 Enviro Monitoring	06-11-2018	Dunloe Sands	0.1	0.1	1.5	0.7
2018 Enviro Monitoring	07-12-2018	Dunloe Sands	1	0.2	1.6	0.3
2019 Enviro Monitoring	08-01-2019	Dunloe Sands	0.5	0.6	0.5	0.3
2019 Enviro Monitoring	05-02-2019	Dunloe Sands	0.2	0.2	0.2	0.2
2019 Enviro Monitoring	08-03-2019	Dunloe Sands	1.1	1	1.2	0.9
2019 Enviro Monitoring	05-04-2019	Dunloe Sands	0.5	0.2	0.2	0.9
2019 Enviro Monitoring	07-05-2019	Dunloe Sands	0.1	0.4	0.2	1.2
2019 Enviro Monitoring	04-06-2019	Dunloe Sands	0.2	0.4	0.7	0.2
2019 Enviro Monitoring	04-07-2019	Dunloe Sands	0.3	0.3	0.2	1.1
2019 Enviro Monitoring	29-08-2019	Dunloe Sands	0.5	0.5	0.4	1.8
2019 Enviro Monitoring	26-09-2019	Dunloe Sands	0.7	0.6	0.5	1.5
2019 Enviro Monitoring	24-10-2019	Dunloe Sands	1.2	0.7	0.5	1.4
2019 Enviro Monitoring	22-11-2019	Dunloe Sands	0.8	0.5	0.8	0.5
2019 Enviro Monitoring	20-12-2019	Dunloe Sands	1.8	1.8	1.6	1
Minimum			0.1	0.1	0.1	0.1
Maximum			2.7	4.7	2.4	1.8
Average			0.48	0.66	0.62	0.55

Longterm Surrounding Surface Water Quality Monitoring at Dunloe Sands Quarry

Data located	Date	Location	pH	EC	DO (membrane electrode)	Turbidity	TSS	Total Phosphorus-P	Total-N	Calcium	Magnesium	Potassium	Sulfur as Sulfate	Arsenic (Total)	Iron (Total)	Manganese (Total)
			pH	µScm-1	mg/L	NTU	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
2011/2012 AEMR	Dec-11	SW3	6	253	8.4		8	0.03	0.05							
2011/2012 AEMR	Mar-12	SW3	5.4	227	5.5		11	0.02	0.96							
2011/2012 AEMR	Jun-12	SW3	6	314	7.8	36	12	0.05	0.7	8.2						
2011/2012 AEMR	27-09-2012	SW3	6.7	17676	7.6	10	5.2	0.03	0.52							
2012/2013 AEMR	Dec-12	SW3	6.7	25765	6		14	0.04	0.7							
2012/2013 AEMR	Mar-13	SW3	6.7	3489	6.8		8.4	0.03	0.53							
2012/2013 AEMR	Jun-13	SW3	6	692	7.2		48									
2012/2013 AEMR	Sep-13	SW3	7	17686	7.3		14	0.02	0.38							
2013/2014 AEMR	12-12-2013	SW3	7.1	25681	5.8		13	0.02	0.34							
2013/2014 AEMR	Mar-14	SW3	3.7	1753	2.9		42	0.05	1.54							
2013/2014 AEMR	31-03-2014	SW3	3.7	1753	2.9	77	42	0.05	1.54							
2013/2014 AEMR	25-06-2014	SW3	5.7	19911	8.9	14	9	<0.02	0.76							
2013/2014 AEMR	Aug-14	SW3	7.9	41455	8.4		5.8	<0.02	0.2							
2013/2014 AEMR	29-09-2014	SW3	7.9	41455	8.4	6.2	5.8	<0.02	0.2	123	16	7	505	<0.005	11	106
Appendix of 2015 AEMR	15-12-2014	SW3	7.7	30732	7.9	9.9	35	0.03	0.36							
Appendix of 2015 AEMR	26-03-2015	SW3	3.7	1834	4.8	54	23	0.04	1.32							
Appendix of 2015 AEMR	24-04-2015	SW3	6.5	12467	7.2	7.8	4.0	0.15	0.46							
Appendix of 2015 AEMR	17-09-2015	SW3	6.7	15704	7.3	33	20	0.02	0.45							
Appendix of 2015 AEMR	11-12-2015	SW3	6.5	15038	6.8	13	24	<0.02	0.41							
Appendix of 2016 AEMR	24-03-2016	SW3	3.8	2548	3.6	54	24	0.06	1.16							
Appendix of 2016 AEMR	30-06-2016	SW3	5.5	1501.6	6.8	31	25	0.03	0.87							
Appendix of 2016 AEMR	29-09-2016	SW3	6.7	38914	6.1		5.6	0.02	0.23							
Appendix of 2016 AEMR	20-12-2016	SW3	7.4	36425	7.1		6.2	<0.02	0.31							
AEMR 2019	08-03-2019	SW3	6.92	41	2.97	0	5									
AEMR 2019	04-06-2019	SW3	6.84	30600	7.8	14	6									
AEMR 2019	29-08-2019	SW3	6.36	6310	9.9	17.5	10									
AEMR 2019	22-11-2019	SW3	6.79	43000	108	5.6	6									
Number of Samples			27	27	27	16	27	17	22	2	1	1	1	0	1	1
Minimum			3.7	41	2.9	0	4	0.02	0.05	8.2	16	7	505	0	11	106
Maximum			7.9	43000	108	77	48	0.15	1.54	123	16	7	505	0	11	106
Average			6.22	16045.36	10.38	23.94	16.00	0.04	0.64	65.60	16.00	7.00	505.00	#DIV/0!	11.00	106.00
2011/2012 AEMR	Dec-11	SW4	6.4	1504	5.3		12	0.03	0.63							
2011/2012 AEMR	Mar-12	SW4	6	458	6.8		6.7	0.03	0.81							
2011/2012 AEMR	Jun-12	SW4	6.2	805	8.6	26	7.7	0.04	0.78	10						
2011/2012 AEMR	27-09-2012	SW4	7	23790	7	5.1	10	<0.02	0.27							
2012/2013 AEMR	Dec-12	SW4	7	30543	5.7		9.4	<0.02	0.39							
2012/2013 AEMR	Mar-13	SW4	7.6	29821	7		9.6	0.02	0.54							
2012/2013 AEMR	Jun-13	SW4	5.9	890	7.4		16									
2012/2013 AEMR	Sep-13	SW4	6.8	16825	7.2		8.8	0.02	0.41							
2013/2014 AEMR	12-12-2013	SW4	6.7	17021	5.5		15	0.03	0.51							
2013/2014 AEMR	Mar-14	SW4	3.8	1354	2.5		41	0.04	1.43							
2013/2014 AEMR	31-03-2014	SW4	3.8	1354	2.5	76	41	0.04	1.43							
2013/2014 AEMR	25-06-2014	SW4	6.5	25363	8.4	12	8	<0.02	0.5							
2013/2014 AEMR	Aug-14	SW4	7.1	22190	8.4		6	<0.02	0.31							
2013/2014 AEMR	29-09-2014	SW4	7.1	22190	8.4	9.8	6	<0.02	0.31							
Appendix of 2015 AEMR	15-12-2014	SW4	8	29257	10	11	33	0.05	0.86							
Appendix of 2015 AEMR	26-03-2015	SW4	3.7	1426	4.7	48	24	0.1	1.15							
Appendix of 2015 AEMR	24-04-2015	SW4	6.4	12416	7.4	22	18	0.02	0.45							
Appendix of 2015 AEMR	17-09-2015	SW4	6.7	8008	7.3	19	11	0.02	0.48							
Appendix of 2015 AEMR	11-12-2015	SW4	7.7	39859	7.5	4.2	9.5	0.02	0.24							
Appendix of 2016 AEMR	24-03-2016	SW4	3.8	2721	5.5	54	25	0.06	1.15							
Appendix of 2016 AEMR	30-06-2016	SW4	6.5	3468.2	8.4	14	10	0.02	0.7							
Appendix of 2016 AEMR	29-09-2016	SW4	6.9	37551	9.6		66	0.02	0.34							
Appendix of 2016 AEMR	20-12-2016	SW4	6.9	17005	6.9		8.5	0.03	0.49							
AEMR 2019	08-03-2019	SW4	7.59	51	4.67	0	5									
AEMR 2019	04-06-2019	SW4	6.99	40700	9	2.3	6									
AEMR 2019	29-08-2019	SW4	6.9	7140	8.5	6.6	8									
AEMR 2019	22-11-2019	SW4	7.23	45300	103	2.6	5									
Number of Samples			27	27	27	16	27	17	22	1						
Minimum			3.7	51	2.5	0	5	0.02	0.24	10						
Maximum			8	45300	103	76	66	0.1	1.43	10						

Longterm Surrounding Surface Water Quality Monitoring at Dunloe Sands Quarry

Average			6.42	16259.64	10.49	19.54	15.79	0.03	0.64	10.00					
2011/2012 AEMR	Dec-11	SW9	6.4	657	7.8		13	0.03	0.53						
2011/2012 AEMR	Mar-12	SW9	6.1	704	6.5		36	0.09	1.31						
2011/2012 AEMR	Jun-12	SW9	6.1	575	5.4	25	10	0.04	0.6	32					
2011/2012 AEMR	27-09-2012	SW9	7.3	13557	9.4	4.8	13	0.02	0.53						
2012/2013 AEMR	Dec-12	SW9	6.8	17219	6.9		9.4	0.04	0.76						
2012/2013 AEMR	Mar-13	SW9	6.7	3708	7.3		6.8	0.03	0.43						
2012/2013 AEMR	Jun-13	SW9	4.9	305	6.5		27								
2012/2013 AEMR	Sep-13	SW9	7	2753	9.9		29	0.13	1.34						
2013/2014 AEMR	12-12-2013	SW9	6.8	10096	5.2		20	0.05	0.81						
2013/2014 AEMR	Mar-14	SW9	4.6	1431	2.1		40	0.13	1.64						
2013/2014 AEMR	31-03-2014	SW9	4.6	1431	2.1	30	40	0.13	1.64						
2013/2014 AEMR	25-06-2014	SW9	6.6	18376	7.9	60	16	0.05	0.67						
2013/2014 AEMR	Aug-14	SW9	7.1	10705	9.3		20	0.03	0.6						
2013/2014 AEMR	29-09-2014	SW9	7.1	10705	9.3	36	20	0.03	0.6						
Appendix of 2015 AEMR	15-12-2014	SW9	8	26966	10	33	37	0.05	1.52						
Appendix of 2015 AEMR	26-03-2015	SW9	4.2	763	5.2	16	5.8	0.02	1.04						
Appendix of 2015 AEMR	24-04-2015	SW9	6.2	4344	6.8	29	14	0.03	0.86						
Appendix of 2015 AEMR	17-09-2015	SW9	6.6	7381	6.8	34	14	0.03	0.83						
Appendix of 2015 AEMR	11-12-2015	SW9	7.1	5694	5.2	22	28	0.05	0.81						
Appendix of 2016 AEMR	24-03-2016	SW9	6.1	4157	6.5	13	10	0.04	0.88						
Appendix of 2016 AEMR	30-06-2016	SW9	6.6	2577.4	7.6	19	6.3	0.02	0.78						
Appendix of 2016 AEMR	29-09-2016	SW9	6.8	35815	7.4		35	<0.02	0.26						
Appendix of 2016 AEMR	20-12-2016	SW9	6.9	21421	6.9		6.4	0.04	0.82						
AEMR 2019	08-03-2019	SW9	7.46	49	3.6	0	5								
AEMR 2019	04-06-2019	SW9	6.93	38	8	3	5								
AEMR 2019	29-08-2019	SW9	6.82	7240	8.7	3.4	5								
AEMR 2019	22-11-2019	SW9	7.07	44300	71.1	2.1	10								
Number of Samples			27	27	27	16	27		22	1					
Minimum			4.2	38	2.1	0	5		0.26	1					
Maximum			8	44300	71.1	60	40		1.64	32					
Average			6.37	9369.16	9.24	20.64	17.84		0.88	32.00					
2011/2012 AEMR	Dec-11	SW10	6.2	492	7.5		23	0.04	0.54						
2011/2012 AEMR	Mar-12	SW10	5.7	546	4.3		31	0.03	0.73						
2011/2012 AEMR	Jun-12	SW10	6.4	805	6.7	45	22	0.07	0.86	35					
2011/2012 AEMR	27-09-2012	SW10	7.4	12749	9.4	7.7	14	0.04	0.84						
2012/2013 AEMR	Dec-12	SW10	6.7	19403	6.9		7.4	0.03	0.71						
2012/2013 AEMR	Mar-13	SW10	6.8	1025	5.6		16	0.05	0.77						
2012/2013 AEMR	Jun-13	SW10	4.8	302	5.7		30								
2012/2013 AEMR	Sep-13	SW10	7.8	2870	15		45	0.29	2.15						
2013/2014 AEMR	12-12-2013	SW10	6.8	15775	5		10	0.03	0.56						
2013/2014 AEMR	Mar-14	SW10	4.6	1454	2.2		40	0.13	1.63						
2013/2014 AEMR	31-03-2014	SW10	4.6	1454	2.2	32	40	0.13	1.63						
2013/2014 AEMR	25-06-2014	SW10	6.5	17312	7.6	37	15	0.04	0.72						
2013/2014 AEMR	Aug-14	SW10	7.2	9164	11		30	0.11	1.06						
2013/2014 AEMR	29-09-2014	SW10	7.2	9164	11	46	30	0.11	1.06						
Appendix of 2015 AEMR	15-12-2014	SW10	7.6	26936	12	33	44	0.07	1.38						
Appendix of 2015 AEMR	26-03-2015	SW10	4.2	779	5.6	14	8.0	0.06	1.08						
Appendix of 2015 AEMR	24-04-2015	SW10	6.2	4381	6.5	25	15	0.03	0.87						
Appendix of 2015 AEMR	17-09-2015	SW10	6.5	6756	7	37	21	0.04	0.98						
Appendix of 2015 AEMR	11-12-2015	SW10	6.8	17660	5.7	5.4	9	<0.02	0.33						
Appendix of 2016 AEMR	24-03-2016	SW10	5.3	2967	7.1	7.4	4.8	0.04	0.77						
Appendix of 2016 AEMR	30-06-2016	SW10	6.7	4893.3	7.1	7.1	4.8	0.02	0.61						
Appendix of 2016 AEMR	29-09-2016	SW10	6.9	35928	6.9		36	0.02	0.58						
Appendix of 2016 AEMR	20-12-2016	SW10	6.9	7210	7.8		10	0.04	0.81						
AEMR 2019	08-03-2019	SW10	6.93	42	4.29	20	8								
AEMR 2019	04-06-2019	SW10	5.76	18800	4.8	16.4	15								
AEMR 2019	29-08-2019	SW10	6.6	3010	9.2	19.6	8								
AEMR 2019	22-11-2019	SW10	7.02	38700	54.8	10.5	9								
Number of Samples			27	27	27	16	27		22	1					
Minimum			4.2	42	2.2	5.4	4.8		0.33	35					
Maximum			7.8	38700	54.8	46	45		2.15	35					
Average			6.37	9651.01	8.85	22.69	20.22		0.94	35.00					

Longterm Pond Water Quality Monitoring at Dunloe Sands Quarry

Data located	Date	Location	pH	EC	DO (membrane electrode)	*Redox Potential	Alkalinity as CaCO3	Bicarbonate as CaCO3	Chloride	Turbidity	TSS	Chlorophyll 'a'	Oil and Grease	Total Phosphorus-P	Total-N	Ammonia	Calcium	Magnesium	Sodium	Potassium	Sulfur as Sulfate	Aluminium (Total)	Arsenic (Total)	Iron (Total)	Manganese (Total)
			pH	µScm-1	mg/L	mV	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	µg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
2011/2012 AEMR	30-05-2012	Lake	5.8	133	8.9					190	84		<2	0.09	0.66										
2011/2012 AEMR	27-06-2012	Lake	6	143	9.4		3	2	8	34	23		4	0.04	0.38		13	1.5	6.3	<5	41	1.21	<0.005	1.01	0.03
2011/2012 AEMR	26-07-2012	Lake	7	164	9.4					18	15		<2	0.02	0.33										
2011/2012 AEMR	27-08-2012	Lake	5.7	188	9.3	168				100	70		2	0.04	0.44										
2011/2012 AEMR	27-09-2012	Lake 1	4.6	214	8.2		<1	<1	10	7.8	11		<2	0.02	0.44		22	1.9	9	<5	65	0.47	<0.005	0.41	0.05
2011/2012 AEMR	29-10-2012	Lake	4.2	246	8.5					2.9	4		<2	<0.02	0.09										
2012/2013 AEMR	25-11-2013	Lake	5.9	478	7					18	26		<2	0.04	0.33										
2013/2014 AEMR	12-12-2013	Lake	4.7	568	7.7	160	2	1	22	33	54		<2	0.06	0.48		75	8.6	15	5	244	8.92	<0.005	3.49	0.64
2013/2014 AEMR	30-01-2014	Lake	4.4	650	7.9					31	41		<2	0.03	0.37										
2013/2014 AEMR	24-02-2014	Lake	4.4	780	7.7					40	45		<2	0.04	0.25										
2013/2014 AEMR	31-03-2014	Lake	4.9	800	7.5					70	63		<2	0.04	0.55										
2013/2014 AEMR	28-04-2014	Lake	4.4	874						33	30		<2	0.03	0.17										
2013/2014 AEMR	28-05-2014	Lake	4.1	895	9.2					42	30		<2	<0.02	0.27										
2013/2014 AEMR	25-06-2014	Lake	3.8	916	9.4		<1	<1	35	72	53		<2	0.08	0.37		109	16	23	6	413	26	<0.005	12	1.05
2013/2014 AEMR	30-07-2014	Lake	4.3	917						79	44		<2	0.02	0.44										
2013/2014 AEMR	29-08-2014	Lake	4.5	960						138	187		5	0.05	0.81										
2013/2014 AEMR	29-09-2014	Lake	3.8	971	8		<1	<1		68	58			0.03	0.58										
Appendix of 2015 AEMR	28-11-2014	Lake	4	998	8.3					70	101		<2	0.07	0.5										
Appendix of 2015 AEMR	15-12-2014	Lake	4.4	1005	8		NP	<1	40	119	167		<2	0.14	0.31		159	18	29	7	394	33	0.008	11	1.23
Appendix of 2015 AEMR	22-01-2015	Lake 1	4.4	1029	7.4	204				78	96		<2	0.05	0.32										
Appendix of 2015 AEMR	25-02-2015	Lake 1	4.2	960	7					85	89		<2	0.08	0.6										
Appendix of 2015 AEMR	26-03-2015	Lake 1	4.1	853	7.5		NP	NP	38	34	55		<2	0.25	0.42		92	12	22	6	369	24.2	0.003	5.61	1.03
Appendix of 2015 AEMR	24-04-2015	Lake	4.3	963	8.5					59	95		<2	0.1	0.73										
Appendix of 2015 AEMR	28-05-2015	Lake	4.4	927	9					52	85		<2	0.22	0.44										
Appendix of 2015 AEMR	17-09-2015	Lake	4.5	928	8.9		NP		35	56	61	6	<2	0.1	0.43	0.08	117	13	25	8	361	19.3	0.003	6.7	0.953
Appendix of 2015 AEMR	21-10-2015	Lake	4.4	955	7.8					56	100		<2	0.08	0.28										
Appendix of 2015 AEMR	25-11-2015	Lake	3.7	996	7.7					5.1	4		<2	0.03	0.16										
Appendix of 2015 AEMR	11-12-2015	Lake 1	4.2	956	6.8		<1	<1	45	20	39		<2	0.39	0.57		111	13	29	9	429	14.3	0.004	2.54	0.896
Appendix of 2016 AEMR	25-01-2016	Pond	3.9	1002	7.3					7.9			6												
Appendix of 2016 AEMR	24-02-2016	Pond	4	1021	7.4					6.1			2												
Appendix of 2016 AEMR	24-03-2016	Pond	3.9	1060	7.9					7.2			2	0.07	0.12		112.71	14.14	43.28	9.32	382.38	10.93	0.002	1.24	0.88
Appendix of 2016 AEMR	29-04-2016	Pond	4.4	1037	8.6					7.7			2												
Appendix of 2016 AEMR	24-05-2016	Pond	4.9	1029	8.4								4												
Appendix of 2016 AEMR	30-06-2016	Pond	4.7	518.9	9.8					4		16	2	0.02	0.31	<0.02	57.45	7.218	24.38	5.39	185.14	4.51	0.002	0.41	0.56
Appendix of 2016 AEMR	21-07-2016	Pond	4.5	546.4	9.3					1.2			0												
Appendix of 2016 AEMR	31-08-2016	Pond	4	618	9.1					2			2												
Appendix of 2016 AEMR	29-09-2016	Pond	4.1	651	8.7					2.6		10	2			<0.02		7.9	27	6	220	2.83	0.002	0.41	0.39
Appendix of 2016 AEMR	27-10-2016	Pond	4	684	8.4					7.2			2												
Appendix of 2016 AEMR	29-11-2016	Pond	3.8	714	8					1.7			2												
Appendix of 2016 AEMR	20-12-2016	Pond	3.5	742	7.3					2.8		2	2	<0.02	0.19	0.03		9.3	29	7	251	4.01	0.001	0.71	0.48
2017 Q1 Env Mon report	30-01-2017	Pond	3.6	758	7.2					2.6			<2												
2017 Q1 Env Mon report	27-02-2017	Pond	3.5	858	7.7					2.4			<2												
2017 Env Monitoring	22-03-2017	Pond	3.4	979	8.2		<5		67	2.2			<5.0	<0.05	0.01	0.013		10	46	7	260	5.6	<0.001	1.7	0.57
2017 Env Monitoring	19-04-2017	Pond	6.5	84	7.6					400			<5.0												
2017 Env Monitoring	17-05-2017	Pond	5.9	101	8.1					230			<5.0												
2017 Env Monitoring	14-06-2017	Pond	4.8	115	9.5		<5		8	100			<5.0	0.07	0.07	0.03		2	7	2	25	0.17	<0.001	0.04	0.12
2017 Env Monitoring	12-07-2017	Pond	4.3	153	9.2					5.5			<5.0												
2017 Env Monitoring	09-08-2017	Pond	4.2	171	9.9					3.4			<5.0												
2017 Env Monitoring	06-09-2017	Pond	4.2	183	6.6		<5		11	3.2			<5.0	<0.05	0.3	<0.005		2	8	2	47	0.35	<0.001	0.085	0.18
2017 Env Monitoring	04-10-2017	Pond	4.3	229	8.6					1.6			<5.0												
2017 Env Monitoring	01-11-2017	Pond	4.1	271	8					2.9			<5.0												
2017 Env Monitoring	29-11-2017	Pond	4.3	303	7.6					4			<5.0												
2017 Env Monitoring	28-12-2017	Pond	4.1	339	7.8		<5		16	1			<5.0	<0.05	<0.1	<0.005		3.7	11	3	84	0.6	<0.001	0.12	0.23
2018 Env Monitoring	24-01-2018	Dam 1	4.02	361	8.3					2.1		<1	<5												
2018 Env Monitoring	21-02-2018	Dam 1	3.96	367	8.74					2.1		<1	<5												
2018 Env Monitoring	21-03-2018	Dam 1	4.05	395	8.61		<5		21	2.42		<1	<5	<0.05	<0.1	<0.005		5	14	3.6	99	0.88	<0.001	0.088	0.25
2018 Env Monitoring	18-04-2018	Dam 1	4.6	373	8.18					4.64		1	<5												
2018 Env Monitoring	16-05-2018	Dam 1	4.12	346	8.38					2.27		<1	<5												
2018 Env Monitoring	13-06-2018	Dam 1	4.21	366	9.18				21	2.87		<1	<5	<0.05	<0.1	<0.005		4.9	14	3.6	110	0.62	<0.001	0.1	0.25
2018 Env Monitoring	11-07-2018	Dam 1	4.13	324	9.69		<5			4.17		<1	<5												
2018 Env Monitoring	08-08-2018	Dam 1	4.08	384	9.38					5.3		<1	<5												
2018 Env Monitoring	05-09-2018	Dam 1	6.73	382	99.2	138				21		<1	<5	0.02		0.04									
2018 Env Monitoring	05-10-2018	Dam 1																							
2018 Env Monitoring	06-11-2018	Dam 1	4.25	560	104	3520				0.2	<5														
2018 Env Monitoring	07-12-2018	Dam 1	4.42	540	99.8	350	1		86	1.4		<1	<5	0.18		0.01		9	45	4	135	0.72	<0.002	0.07	0.243

Longterm Pond Water Quality Monitoring at Dunloe Sands Quarry

Data located	Date	Location	pH	EC	DO (membrane electrode)	*Redox Potential	Alkalinity as CaCO3	Bicarbonate as CaCO3	Chloride	Turbidity	TSS	Chlorophyll 'a'	Oil and Grease	Total Phosphorus-P	Total-N	Ammonia	Calcium	Magnesium	Sodium	Potassium	Sulfur as Sulfate	Aluminium (Total)	Arsenic (Total)	Iron (Total)	Manganese (Total)	
			pH	µScm-1	mg/L	mV	mg/L	mg/L	mg/L	mg/L	NTU	mg/L	µg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
2019 Env Monitoring	08-01-2019	Dredge Pond Dam 1	4.45	613	103					0.7			NR													
2019 Env Monitoring	05-02-2019	Dredge Pond Dam 1	4.41	680	7.44					0			5													
2019 Env Monitoring	08-03-2019	Dredge Pond Dam 1	4.12	625	5.63			1	81	0		2	5					10	47	5	164	0.84	0.001	0.23	0.278	
2019 Env Monitoring	05-04-2019	Dredge Pond Dam 1	4.24	603	8.1					3.4			5													
2019 Env Monitoring	07-05-2019	Dredge Pond Dam 1	4.18	127	1.2					50.8			5													
2019 Env Monitoring	04-06-2019	Dredge Pond Dam 1	4.06	547	9.3			1	74	1.8		1	5					10	44	5	170	0.76	0.001	0.21	0.235	
2019 Env Monitoring	04-07-2019	Dredge Pond Dam 1	4.15	436	12.8					1.8			5													
2019 Env Monitoring	29-08-2019	Dredge Pond Dam 1	4.35	120	11.4			1	66	1.9		1	NR					9	37	4	174	0.68	0.001	0.2	0.259	
2019 Env Monitoring	26-09-2019	Dredge Pond Dam 1	5.54	620	8					8			5													
2019 Env Monitoring	24-10-2019	Dredge Pond Dam 1	4.42	663	60.3					NR			5													
2019 Env Monitoring	22-11-2019	Dredge Pond Dam 1	3.95	722	116			1	95	1.1		1	5					11	53	5	171	0.92	0.003	0.55	0.26	
2019 Env Monitoring	20-12-2019	Dredge Pond Dam 1	5.13	783	85.4					12.7			5													
Minimum			3.4	84	1.2	138	1	1	8	0	4	1	0	0.02	0.01	0.01	13	1.5	6.3	2	25	0.17	0.001	0.04	0.03	
Maximum			7	1060	116	3520	3	2	95	400	187	16	6	0.39	33	0.08	159	18	53	9.32	429	33	0.008	12	1.23	
Average			4.44	599.62	16.62	756.67	2.00	1.17	41.00	34.47	61.79	4.44	3.56	0.08	1.36	0.03	86.82	8.66	26.43	5.38	208.41	7.04	0.00	2.13	0.48	
2019 Env Monitoring	08-01-2019	Silt Pond Dam 2	8.21	578	111.28					2.76			NR													
2019 Env Monitoring	05-02-2019	Silt Pond Dam 2	6.76	653	7.74					0			5													
2019 Env Monitoring	08-03-2019	Silt Pond Dam 2	9.85	612	5.97			8	71	0		3	5					10	43	4	158	0.03	0.001	0.05	0.076	
2019 Env Monitoring	05-04-2019	Silt Pond Dam 2	6.8	587	8.2					15			5													
2019 Env Monitoring	07-05-2019	Silt Pond Dam 2	3.94	592	0.5					0.6			5													
2019 Env Monitoring	04-06-2019	Silt Pond Dam 2	6.08	501	9.6			5	72	8.8		1	5					10	42	4	164	0.01	0.001	0.05	0.164	
2019 Env Monitoring	04-07-2019	Silt Pond Dam 2	6.7	420	9.5					7.6			8													
2019 Env Monitoring	29-08-2019	Silt Pond Dam 2	6.91	148	10			11	65	14.1		2	NR					9	36	4	164	0.02	0.001	0.05	0.203	
2019 Env Monitoring	26-09-2019	Silt Pond Dam 2	6.81	130	9.3					15.5			5													
2019 Env Monitoring	24-10-2019	Silt Pond Dam 2	7.3	652	84.5					NR			5													
2019 Env Monitoring	22-11-2019	Silt Pond Dam 2	NRR	NRR	NRR			22	80	NRR		8	5					11	46	5	164	0.58	0.003	0.05	0.126	
2019 Env Monitoring	20-12-2019	Silt Pond Dam 2	6.99	719	110					57.3			5													
Minimum			3.94	130	0.5	0	0	5	65	0	0	1	5	0	0	0	0	9	36	4	158	0.01	0.001	0.05	0.076	
Maximum			9.85	719	111.28	0	0	22	80	57.3	0	8	8	0	0	0	0	11	46	5	164	0.58	0.003	0.05	0.203	
Average			6.94	508.36	33.33	0	0	5	65	12.17	0.00	0.00	5.30	0	0	0	0	11	46	5	164	0.58	0.003	0.05	0.203	

Longterm Pond Water Layer Monitoring at Dunloe Sands Quarry

Data located	Date	Location	pH	EC	DO (membrane electrode)	*Redox Potential	Turbidity	TSS	Total Phosphorus-P	Total-N
			pH	µScm-1	mg/L	mV	NTU	mg/L	mg/L	mg/L
2011/2012 AEMR	27-06-2012	Lake 2m	6.1	144	9.4	257				
2011/2012 AEMR	27-09-2012	Lake 2m	4.6	214	8.2		2.2	4.5	0.02	
Appendix of 2015 AEMR	26-03-2015	Lake 2m	4.0	859	7.6	280				
Appendix of 2015 AEMR	17-09-2015	Lake 2m	4.5	915	8.8	185				
Appendix of 2015 AEMR	11-12-2015	Lake 2m	4.2	952	7.2		19	44	0.13	0.13
Appendix of 2016 AEMR	24-03-2016	Lake 2m	4.3	1011	8					
Appendix of 2016 AEMR	30-06-2016	Lake 2m	4.8	527.6	9.9					
Appendix of 2016 AEMR	29-09-2016	Lake 2m	4.1	647	8.8					
Appendix of 2016 AEMR	20-12-2016	Lake 2m	3.5	742	7.4					
No of Samples			9	9	9	3	2	2	2	1
Minimum			3.5	144	7.2	185	2.2	4.5	0.02	0.13
Maximum			6.1	1011	9.9	280	19	44	0.13	0.13
Average			4.46	667.96	8.37	240.67	10.60	24.25	0.08	0.13
2011/2012 AEMR	27-06-2012	Lake 3m	6.1	144	9.5	267				
2011/2012 AEMR	27-09-2012	Lake 3m	4.6	214	8.2		14	30	0.03	
Appendix of 2015 AEMR	26-03-2015	Lake 3m	4.0	859	7.5	297				
Appendix of 2015 AEMR	17-09-2015	Lake 3m	4.5	915	8.7	200				
Appendix of 2015 AEMR	11-12-2015	Lake 3m	4.2	949	7.2		19	96	0.07	0.07
Appendix of 2016 AEMR	24-03-2016	Lake 3m	4.4	1014	8.1					
Appendix of 2016 AEMR	30-06-2016	Lake 3m	4.9	510.8	9.8					
Appendix of 2016 AEMR	29-09-2016	Lake 3m	4.1	650	8.8					
Appendix of 2016 AEMR	20-12-2016	Lake 3m	3.6	742	7.7					
No of Samples			9	9	9	3	2	2	2	1
Minimum			3.6	144	7.2	200	14	30	0.03	0.07
Maximum			6.1	1014	9.8	297	19	96	0.07	0.07
Average			4.49	666.42	8.39	254.67	16.50	63.00	0.05	0.07
2011/2012 AEMR	27-06-2012	Lake 4m	6.2	144	9.6	264				
2011/2012 AEMR	27-09-2012	Lake 4m	4.6	213	8.2		5.8	9.2	0.02	
Appendix of 2015 AEMR	26-03-2015	Lake 4m	4.0	860	7.5	312				
Appendix of 2015 AEMR	17-09-2015	Lake 4m	4.5	915	8.7	200				
Appendix of 2015 AEMR	11-12-2015	Lake 4m	4.2	952	7.5		16	102	0.06	0.06
Appendix of 2016 AEMR	24-03-2016	Lake 4m	4.3	1.11	7.9					
Appendix of 2016 AEMR	30-06-2016	Lake 4m	4.8	517.4	9.9					
Appendix of 2016 AEMR	29-09-2016	Lake 4m	4	648	8.8					
Appendix of 2016 AEMR	20-12-2016	Lake 4m	3.6	742	7.7					
No of Samples			9	9	9	3	2	2	2	1
Minimum			3.6	1.11	7.5	200	5.8	9.2	0.02	0.06
Maximum			6.2	952	9.9	312	16	102	0.06	0.06
Average			4.47	554.72	8.42	258.67	10.90	55.60	0.04	0.06
2011/2012 AEMR	27-06-2012	Lake 5m	6.5	144	9.5	261				
Appendix of 2015 AEMR	26-03-2015	Lake 5m	4.0	864	7.5	316				
Appendix of 2015 AEMR	17-09-2015	Lake 5m	4.4	913	8.7	210				
Appendix of 2015 AEMR	11-12-2015	Lake 5m	4.1	954	7.7		12	22	0.06	0.06
Appendix of 2016 AEMR	24-03-2016	Lake 5m	4.7	1019	8.1					
Appendix of 2016 AEMR	30-06-2016	Lake 5m	4.8	515.5	9.9					
Appendix of 2016 AEMR	29-09-2016	Lake 5m	4	647	8.8					
Appendix of 2016 AEMR	20-12-2016	Lake 5m	3.6	742	7.6					
No of Samples			8	8	8	3	1	1	1	1
Minimum			3.6	144	7.5	210	12	22	0.06	0.06
Maximum			6.5	1019	9.9	316	12	22	0.06	0.06
Average			4.51	724.81	8.48	262.33	12.00	22.00	0.06	0.06
Appendix of 2016 AEMR	30-06-2016	Lake 6m	5.2	516.6	9.9					
Appendix of 2016 AEMR	29-09-2016	Lake 6m	4.5	627	8.4					
Appendix of 2016 AEMR	20-12-2016	Lake 6m	3.6	740	7.4					
No of Samples			3	3	3					
Minimum			3.6	516.6	7.4					
Maximum			5.2	740	9.9					
Average			4.43	627.87	8.57					

Longterm Algae Monitoring at Dunloe Sands Quarry

Data located	Date	Location	Cyanophyta (Blue Green Algae)	Chlorophyta (Total Algae Count)	Diatoms (Bacillariophyta)	Dinophyta (Dinoflagellates)	Euglenophyta (Euglenoids)
			cells/mL	cells/mL	cells/mL	cells/mL	cells/mL
2011/2012 AEMR	30-11-2011	Extraction Pond	240				
2011/2012 AEMR	22-12-2012	Extraction Pond	800				
2011/2012 AEMR	02-02-2012	Extraction Pond	<100				
2011/2012 AEMR	20-02-2012	Extraction Pond	700				
2011/2012 AEMR	28-02-2012	Extraction Pond	14375				
2011/2012 AEMR	27-03-2012	Extraction Pond	1200				
2011/2012 AEMR	30-05-2012	Extraction Pond	<100				
2011/2012 AEMR	27-06-2012	Extraction Pond	130	0.01			
2011/2012 AEMR	26-07-2012	Extraction Pond	16360	2520			
2011/2012 AEMR	27-08-2012	Extraction Pond	24640	3720			
2011/2012 AEMR	27-09-2012	Extraction Pond	68000	35000			
2011/2012 AEMR	29-10-2012	Extraction Pond	<100	7900			
2012/2013 AEMR	28-11-2012	Extraction Pond	<100	80670			
2012/2013 AEMR	24-12-2012	Extraction Pond	<100				
2012/2013 AEMR	17-01-2013	Extraction Pond	<100				
2012/2013 AEMR	01-02-2013	Extraction Pond	<100				
2012/2013 AEMR	15-02-2013	Extraction Pond	<100				
2012/2013 AEMR	08-03-2013	Extraction Pond	<100	215			
2012/2013 AEMR	30-05-2013	Extraction Pond	<100	880			
2012/2013 AEMR	30-06-2013	Extraction Pond	<100				
2012/2013 AEMR	30-07-2013	Extraction Pond	<100	34000			
2012/2013 AEMR	28-08-2013	Extraction Pond	<100	205			
2012/2013 AEMR	30-09-2013	Extraction Pond	<100				
2012/2013 AEMR	25-10-2013	Extraction Pond	<100	17430			
2013/2014 AEMR	25-11-2013	Extraction Pond				480	
2013/2014 AEMR	12-12-2013	Extraction Pond	1150	39500			
2013/2014 AEMR	19-12-2013	Extraction Pond		22000			
2013/2014 AEMR	09-01-2014	Extraction Pond		123000			
2013/2014 AEMR	29-01-2014	Extraction Pond		34000			
2013/2014 AEMR	31-03-2014	Extraction Pond			295		
2013/2014 AEMR	28-04-2014	Extraction Pond		7700	45		
2013/2014 AEMR	29-05-2014	Extraction Pond	ND	7600			
2013/2014 AEMR	26-06-2014	Extraction Pond	ND	52000			
2013/2014 AEMR	31-07-2014	Extraction Pond	ND	28000			
2013/2014 AEMR	28-10-2014	Extraction Pond	ND	168000			
Appendix of 2015 AEMR	28-11-2014	Extraction Pond	ND	123000	260	60	
Appendix of 2015 AEMR	16-12-2014	Extraction Pond	ND	106500	220	35	
Appendix of 2015 AEMR	22-01-2015	Extraction Pond	ND	37000			
Appendix of 2015 AEMR	26-02-2015	Extraction Pond	ND				
Appendix of 2015 AEMR	26-03-2015	Extraction Pond	ND	8750			
Appendix of 2015 AEMR	24-04-2015	Extraction Pond	ND	8000			
Appendix of 2015 AEMR	29-05-2015	Extraction Pond	ND	76000	4200		
Appendix of 2015 AEMR	29-06-2015	Extraction Pond	ND	211000	6300		
Appendix of 2015 AEMR	21-10-2015	Extraction Pond	ND	18330	65	35	155
Appendix of 2015 AEMR	26-11-2015	Extraction Pond	ND	4850		5	
Appendix of 2015 AEMR	11-12-2015	Extraction Pond	ND	11900	30	10	
2016 AEMR	25-01-2016	Extraction Pond	ND	34000			
2016 AEMR	08-02-2016	Extraction Pond	ND	0			
2016 AEMR	24-02-2016	Extraction Pond	ND	3700			
2016 AEMR	10-03-2016	Extraction Pond	ND	1575			
2016 AEMR	24-03-2016	Extraction Pond	ND	7600			
2016 AEMR	07-04-2016	Extraction Pond	ND	9700			
2016 AEMR	29-04-2016	Extraction Pond	ND	11800			
2016 AEMR	24-05-2016	Extraction Pond	ND	5700			
2016 AEMR	30-06-2016	Extraction Pond	ND	28930			
2016 AEMR	31-08-2016	Extraction Pond	840	61500			
2016 AEMR	30-09-2016	Extraction Pond	ND	920			
2016 AEMR	04-10-2016	Extraction Pond	ND	920			
2016 AEMR	28-10-2016	Extraction Pond	ND	29000			
2016 AEMR	21-12-2016	Extraction Pond	ND	10830			
2017 Q1 Env Mon report	30-01-2017	Extraction Pond	ND	1480			
2017 Q1 Env Mon report	27-02-2017	Extraction Pond	ND	640			
2017 Env Monitoring	22-03-2017	Extraction Pond	ND	175			
2017 Env Monitoring	19-04-2017	Extraction Pond	ND	600			
2017 Env Monitoring	17-05-2017	Extraction Pond	ND	2820			
2017 Env Monitoring	14-06-2017	Extraction Pond	ND	1830			
2017 Env Monitoring	12-07-2017	Extraction Pond	ND	5260			
2017 Env Monitoring	09-08-2017	Extraction Pond	ND	41500			
2017 Env Monitoring	06-09-2017	Extraction Pond	ND	99800			
2017 Env Monitoring	04-10-2017	Extraction Pond	ND	128000			
2017 Env Monitoring	01-11-2017	Extraction Pond	ND	38600			
2017 Env Monitoring	29-11-2017	Extraction Pond	ND	8150			
2017 Env Monitoring	28-12-2017	Extraction Pond	ND	1890			
2018 Env Monitoring	24-01-2018	Extraction Pond	<5	350			
2018 Env Monitoring	21-02-2018	Extraction Pond	<5	100			
2018 Env Monitoring	21-03-2018	Extraction Pond	<5	3,960			
2018 Env Monitoring	18-04-2018	Extraction Pond	<5	4,580			
2018 Env Monitoring	16-05-2018	Extraction Pond	<5	250			
2018 Env Monitoring	13-06-2018	Extraction Pond	<5	5,820			
2018 Env Monitoring	11-07-2018	Extraction Pond	<5	16,100			
2018 Env Monitoring	08-08-2018	Extraction Pond	<5	13,800			
2018 Env Monitoring	05-09-2018	Extraction Pond	ND	ND			
2018 Env Monitoring	05-10-2018	Extraction Pond	<5	ND			
2018 Env Monitoring	06-11-2018	Extraction Pond	ND	ND			
2018 Env Monitoring	07-12-2018	Extraction Pond	ND	ND			
2019 Env Monitoring	08-03-2019	Point 1 Silt Pond (Dam 2)	<0.001	<5			
2019 Env Monitoring	04-06-2019	Point 1 Silt Pond (Dam 2)	<0.001	500			
2019 Env Monitoring	29-08-2019	Point 1 Silt Pond (Dam 2)	<0.001	525			
2019 Env Monitoring	22-11-2019	Point 1 Silt Pond (Dam 2)	2.13	10800			
2019 Env Monitoring	08-03-2019	Point 2 Dredge Pond (Dam 1)	<0.001	<5			
2019 Env Monitoring	04-06-2019	Point 2 Dredge Pond (Dam 1)	<0.001	550			
2019 Env Monitoring	29-08-2019	Point 2 Dredge Pond (Dam 1)	0.002	30900			
2019 Env Monitoring	22-11-2019	Point 2 Dredge Pond (Dam 1)	0.002	900			
		Minimum	0.002	0	30	5	155
		Maximum	68000	211000	6300	480	155
		Average	9174.1	26700.4	1426.9	104.2	155.0

Longterm Groundwater Quality Monitoring at Dunloe Sands Quarry

Data located	Date	Location	pH	EC	DO (membrane electrode)	*Redox Potential	Alkalinity as CaCO3	Bicarbonate as CaCO3	Chloride	Total Phosphorus-P	Total-N	Ammonia	Calcium	Magnesium	Sodium	Potassium	Sulfur as Sulfate	Aluminium (Total)	Arsenic (Total)	Iron (Total)	Manganese (Total)
			pH	µScm-1	mg/L	mV	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
2011/2012 AEMR	Dec-11	DPL1							13				0.2	0.4	4	<5	3.5		<0.005	1.34	<0.01
2011/2012 AEMR	Mar-12	DPL1							17				0.2	0.4	5.4	<5	4.8		<0.005	1.32	<0.01
2011/2012 AEMR	30-05-2012	DPL1	4.2	98	3.3	435															
2011/2012 AEMR	Jun-12	DPL1	4.2	105	3.8	405	<1	<1	20				0.6	0.6	11	<5	5.3		<0.005	2.49	<0.01
2011/2012 AEMR	26-07-2012	DPL1	4.3	87	5.1	374															
2011/2012 AEMR	27-08-2012	DPL1	4.2	98	2.1	365															
2011/2012 AEMR	27-09-2012	DPL1	4.2	94	2.6	305	<1	<1	15				0.5	0.3	8.4	<5	6.7		<0.005	3.25	<0.01
2011/2012 AEMR	29-10-2012	DPL1	4.6	96	5.8	208															
2012/2013 AEMR	Dec-12	DPL1							36				1	0.7	6.3	<5	4.9		<0.005	4.32	<0.01
2012/2013 AEMR	Mar-13	DPL1							12				0.2	0.1	9.2	<5	7.3		<0.005	1.68	<0.01
2012/2013 AEMR	Jun-13	DPL1							19				0.1	<0.1	0.1	<5	5.9		<0.005	1.5	<0.01
2012/2013 AEMR	Sep-13	DPL1							16				0.4	0.2	7.5	<5			<0.005	5.82	<0.01
2013/2014 AEMR	12-12-2013	DPL1	4.8	86	3.5	91	3	2	20				0.4	0.2	0.2	<5	6.2		<0.005	3.83	0.02
2013/2014 AEMR	29-01-2014	DPL1	4	279	5.7	264															
2013/2014 AEMR	24-02-2014	DPL1	4.6	76	3.8	242															
2013/2014 AEMR	31-03-2014	DPL1	4.9	72	6.3	136	3	2	15				0.6	0.1	0.1	<5	3.5		<0.005	2.44	<0.01
2013/2014 AEMR	24-04-2014	DPL1	4	75		204															
2013/2014 AEMR	28-05-2014	DPL1	4.2	95		307															
2013/2014 AEMR	25-06-2014	DPL1	4.1	98	2	350	<1	<1	16				0.5	0.3	9.7	<5	6.4		<0.005	0.76	<0.01
2013/2014 AEMR	30-07-2014	DPL1	4.1	112	3.9	174	<1	<1	19				0.4	0.2	11	<5	7.7	0.77	<0.005	0.62	<0.01
2013/2014 AEMR	29-08-2014	DPL1	4.4	97	4.3	185	NP	NP	20				0.2	<0.1	9.6	<5	4.3		<0.005	3.93	<0.01
2013/2014 AEMR	29-09-2014	DPL1	4	108	3.5	177															
Appendix of 2015 AEMR	28-11-2014	DPL1	4.7	81	3.3	110															
Appendix of 2015 AEMR	15-12-2014	DPL1	4.6	94	1.5	160	NP	<1	15				1.6	0.4	10	<5	6.1	0.32	<0.005	2.55	0.02
Appendix of 2015 AEMR	22-01-2015	DPL1	4.8	80	3.8	110															
Appendix of 2015 AEMR	25-02-2015	DPL1	4.2	110	1.1	160															
Appendix of 2015 AEMR	26-03-2015	DPL1	4	109	4	245	NP	NP													
Appendix of 2015 AEMR	24-04-2015	DPL1	4.1	131	2.7	253															
Appendix of 2015 AEMR	28-05-2015	DPL1	3.8	164	2	256															
Appendix of 2015 AEMR	17-09-2015	DPL1	4.1	135	3.9	195	NP		18			<0.02	0.7	0.8	12	<5	10	0.64	<0.001	0.95	0.017
Appendix of 2015 AEMR	21-10-2015	DPL1	4.3	116	2.9	217															
Appendix of 2015 AEMR	25-11-2015	DPL1	4.2	102	6.1	170															
Appendix of 2015 AEMR	11-12-2015	DPL1	4.6	86	2.4	232	1	1	14				0.3	0.2	11	<5	10	0.32	<0.001	3.21	0.009
Appendix of 2016 AEMR	25-01-2016	DPL1	4.7	95	1.6	165															
Appendix of 2016 AEMR	24-02-2016	DPL1	4.8	98	5.7	138															
Appendix of 2016 AEMR	24-03-2016	DPL1	4.6	104	3.8	268	2	2	17				0.37	0.23	10.21	<5	9.403	0.727	0.001	4.224	0.007
Appendix of 2016 AEMR	29-04-2016	DPL1	4.3	96	6.4	388															
Appendix of 2016 AEMR	24-05-2016	DPL1	4.2	106	2.7	255															
Appendix of 2016 AEMR	30-06-2016	DPL1	4.9	101.1	3.6	283							3.503	0.353	10.561	<5	9.636	0.471	0.001	2.508	0.14
Appendix of 2016 AEMR	21-07-2016	DPL1	3.9	142.2	6.8	384															
Appendix of 2016 AEMR	31-08-2016	DPL1	4	140	6.5	321															
Appendix of 2016 AEMR	29-09-2016	DPL1	3.9	151	2.5	366															
Appendix of 2016 AEMR	27-10-2016	DPL1	4	151	2.5	366															
Appendix of 2016 AEMR	29-11-2016	DPL1	4.7	116	1.9	108															
Appendix of 2016 AEMR	20-12-2016	DPL1	4.7	131	5.2	307.1															
Q1 2017 Env mon report	30-01-2017	DPL1	4.2	121																	
Q1 2017 Env mon report	27-02-2017	DPL1	4.6	103																	
2017 Env Monitoring	22-03-2017	DPL1	4.4	116			<5		18	0.09	1.1	0.056		<0.5	12	1	12	0.48	<0.001	4.8	0.018
2017 Env Monitoring	19-04-2017	DPL1	4.2	180																	
2017 Env Monitoring	17-05-2017	DPL1	4.4	135																	
2017 Env Monitoring	14-06-2017	DPL1	4.3	197			<5		22	<0.05	0.5	0.039		1	14	1	39	1.6	<0.001	13	0.039
2017 Env Monitoring	12-07-2017	DPL1	4.1	137																	
2017 Env Monitoring	09-08-2017	DPL1	4.3	123																	
2017 Env Monitoring	06-09-2017	DPL1	4	124			<5		18	<0.05	1.2	0.031		<0.5	11	1	10	0.73	<0.001	3.4	0.017
2017 Env Monitoring	04-10-2017	DPL1	4.3	123																	
2017 Env Monitoring	01-11-2017	DPL1	4.4	121																	
2017 Env Monitoring	29-11-2017	DPL1	4.5	129																	
2017 Env Monitoring	28-12-2017	DPL1	4.5	130			<5		21	<0.05	0.4	0.071		0.6	12	2.1	44	0.53	<0.001	5	0.02
2018 Env Monitoring	24-01-2018	DPL1	4.49	138.4																	
2018 Env Monitoring	21-02-2018	DPL1	4.46	120.5																	
2018 Env Monitoring	21-03-2018	DPL1	4.35	159			<5		21	0.06	0.2	0.062		0.8	13	1.5	44	0.76	<0.001	5.5	0.028
2018 Env Monitoring	18-04-2018	DPL1	4.49	153																	
2018 Env Monitoring	16-05-2018	DPL1	4.4	146.3																	
2018 Env Monitoring	13-06-2018	DPL1	4.33	167.1			<5		19	<0.05	0.4	0.057		0.7	14	1.4	28	0.76	<0.001	6.2	0.024
2018 Env Monitoring	11-07-2018	DPL1	4.31	146.3																	
2018 Env Monitoring	08-08-2018	DPL1	3.91	204																	
2018 Env Monitoring	05-09-2018	DPL1	4.12	114	4.52		<1		18			0.07		<1	22	1	26	1.08	<0.001	0.05	0.001
2018 Env Monitoring	05-10-2018	DPL1	4.53	143	7																
2018 Env Monitoring	06-11-2018	DPL1	4.51	142	4.8																
2018 Env Monitoring	07-12-2018	DPL1	4.49	120	4.8	44.3	<1		17					1	11	<1	36	0.88	0.001	10.7	0.003
2019 Env Monitoring	08-01-2019	DPL1	4.4	178.36	3.52	-2.5															
2019 Env Monitoring	05-02-2019	DPL1	4.48	142.5	0.26	-64.1															
2019 Env Monitoring	08-03-2019	DPL1	4.12	224	0.11	1.6		<1					4	2	13	1	68	2.58	<0.001	19.5	0.05
2019 Env Monitoring	05-04-2019	DPL1	4.14	122	0.2	NR		<1						1					<0.001		0.038
2019 Env Monitoring	07-05-2019	DPL1	6.6	3570	0.3	0.1		<1											<0.001		0.033
2019 Env Monitoring	04-06-2019	DPL1	4.14	126	0.5	31.9		<1					2	1	11	1	38	1.27	<0.001	10.9	0.034
2019 Env Monitoring	04-07-2019	DPL1	6.6	3570	0.3	0.1															
2019 Env Monitoring	01-08-2019	DPL1	4.32	94	8.1	54.1		<1					2	<1	10	<1	20	1.1	<0.001	8.63	0.033
2019 Env Monitoring	26-09-2019	DPL1	5.01	38	9.6	-29.4		<1													0.034
2019 Env Monitoring	24-10-2019	DPL1	5.01	138	1.8	<0.1		<1													
2019 Env Monitoring	22-11-2019	DPL1	4.59	94	15.6	71.1															

Longterm Groundwater Quality Monitoring at Dunloe Sands Quarry

2019 Env Monitoring		20-12-2019	DPL1	4.86	84	15.5	110															
No of Samples				76	76	53	50	4	4	25	2	6	8	22	24	30	9	29	18	3	30	21
Minimum				3.8	38	0.11	-64.1	1	1	12	0.06	0.2	0.031	0.1	0.1	0.1	1	3.5	0.32	0.001	0.05	0.001
Maximum				6.6	3570	15.6	435	3	2	36	0.09	1.2	0.071	4	2	22	2.1	68	2.58	0.001	19.5	0.14
Average				4.42	213.01	4.07	197.93	2.25	1.75	18.24	0.08	0.63	0.06	0.99	0.57	9.68	1.22	17.50	0.89	0.00	4.76	0.03
2011/2012 AEMR	Dec-11	DPL3								2300				72	119	842	72	136		<0.005	0.74	0.53
2011/2012 AEMR	Mar-12	DPL3								2400				66	109	1081	<5	126		<0.005	1.25	0.51
2011/2012 AEMR	30-05-2012	DPL3	6.6	7074	2.3	317																
2011/2012 AEMR	Jun-12	DPL3	6.7	7057	6.6	315	150	94	2220					70	112	1119	48	143		<0.005	1.94	0.53
2011/2012 AEMR	26-07-2012	DPL3	6.6	7093	3.6	284																
2011/2012 AEMR	27-08-2012	DPL3	6.7	7343	1.8	193																
2011/2012 AEMR	27-09-2012	DPL3	6.4	7130	2.4	249	120	75	2280					63	100	1060	50	147		<0.005	2.11	0.51
2011/2012 AEMR	29-10-2012	DPL3	6.3	7177	4.8	146																
2012/2013 AEMR	Dec-12	DPL3								2270				68	103	946	61	132		<0.005	2.46	0.52
2012/2013 AEMR	Mar-13	DPL3								2280				74	115	1296	48	149		<0.005	1.78	0.58
2012/2013 AEMR	Jun-13	DPL3								2310				66	105	66	44	169		<0.005	1.63	0.52
2012/2013 AEMR	Sep-13	DPL3								2280				60	93	1003	38			<0.005	3.05	0.52
2013/2014 AEMR	12-12-2013	DPL3	6.2	7140	2.4	116	120	73	2340					66	104	104	43	168		<0.005	3.16	0.57
2013/2014 AEMR	29-01-2014	DPL3	6.3	6964	4.4	201																
2013/2014 AEMR	24-02-2014	DPL3	6.3	6677	3.6	245																
2013/2014 AEMR	31-03-2014	DPL3	6.4	7234	4.2	118	120	74	120					63	109	109	43	175		<0.005	2.86	0.56
2013/2014 AEMR	24-04-2014	DPL3	6.5	7448		136																
2013/2014 AEMR	28-05-2014	DPL3	6.6	7484		318																
2013/2014 AEMR	25-06-2014	DPL3	6.6	7370	5.9	260	110	70	2290					82	125	1320	44	180		<0.005	6.47	0.93
2013/2014 AEMR	30-07-2014	DPL3	6.6	7431	4.9	122	110	66	2420					74	114	1200	46	177	0.03	<0.005	3.97	0.58
2013/2014 AEMR	29-08-2014	DPL3	6.5	7643	3.9	184	110	68	2370					71	110	1140	43	168		<0.005	4.22	0.56
2013/2014 AEMR	29-09-2014	DPL3	6.1	7558	3	188																
2013/2014 AEMR	28-11-2014	DPL3	6.1	7491	4.2	100																
Appendix of 2015 AEMR	15-12-2014	DPL3	6.2	7280	2.6	130	130	77	2370					82	118	1240	48	146	0.04	<0.005	3.53	0.59
Appendix of 2015 AEMR	22-01-2015	DPL3	6.1	7473	2.2	136																
Appendix of 2015 AEMR	25-02-2015	DPL3	6.4	7478	3.2	150																
Appendix of 2015 AEMR	26-03-2015	DPL3	6.1	7542	2.9	195	130	128														
Appendix of 2015 AEMR	24-04-2015	DPL3	6.6	7540	4.8	246																
Appendix of 2015 AEMR	28-05-2015	DPL3	6.5	7483	5.2	182																
Appendix of 2015 AEMR	17-09-2015	DPL3	6.4	7422	3.7	150	120			2380		0.04		68	102	1220	41	152	0.22	<0.001	3.09	0.641
Appendix of 2015 AEMR	21-10-2015	DPL3	6.2	7310	2.4	157																
Appendix of 2015 AEMR	25-11-2015	DPL3	6.2	7562	6.9	205																
Appendix of 2015 AEMR	11-12-2015	DPL3	6.3	7321	2.6	182	120	120	2370					68	108	1220	40	181	0.13	0.001	2.99	6.23
Appendix of 2016 AEMR	25-01-2016	DPL3	6.1	7395	2.8	147																
Appendix of 2016 AEMR	24-02-2016	DPL3	6.2	7372	5.7	58																
Appendix of 2016 AEMR	24-03-2016	DPL3	6.4	7406	3.5	155	123	123	2650					78.03	117.11	1284.98	44.19	176.114	0.07	0.001	2.183	0.625
Appendix of 2016 AEMR	29-04-2016	DPL3	6.4	7417	6.4	196																
Appendix of 2016 AEMR	24-05-2016	DPL3	6.5	7394	5.4	180																
Appendix of 2016 AEMR	30-06-2016	DPL3	6.6	7250.2	6.4	180																
Appendix of 2016 AEMR	21-07-2016	DPL3	6.5	6868.2	6.6	262																
Appendix of 2016 AEMR	31-08-2016	DPL3	6.5	7281	5.8	170	121			2650				78	121	1350	46	170		0.001	3.33	0.541
Appendix of 2016 AEMR	29-09-2016	DPL3	6.1	7313	2.5	221																
Appendix of 2016 AEMR	27-10-2016	DPL3	6.1	7313	3.99	1738																
Appendix of 2016 AEMR	29-11-2016	DPL3	6.1	7376	1.8	67																
Appendix of 2016 AEMR	20-12-2016	DPL3	6	7673	4	315.9	121			2700												
Q1 2017 Env mon report	30-01-2017	DPL3	6.1	7119																		
Q1 2017 Env mon report	27-02-2017	DPL3	6.1	7013																		
2017 Env Monitoring	22-03-2017	DPL3	5.9	7570			130			2300	0.1	4.1	2.9		130	1500	54	230	0.04	<0.001	15	0.67
2017 Env Monitoring	19-04-2017	DPL3	5.9	7660																		
2017 Env Monitoring	17-05-2017	DPL3	5.9	7410																		
2017 Env Monitoring	14-06-2017	DPL3																				
2017 Env Monitoring	12-07-2017	DPL3	6.2	7060																		
2017 Env Monitoring	09-08-2017	DPL3	6.2	7490																		
2017 Env Monitoring	06-09-2017	DPL3	6.1	7490			140			2000	<0.05	3	2		120	1600	55	140	0.04	<0.001	2.8	0.6
2017 Env Monitoring	04-10-2017	DPL3	6	7530																		
2017 Env Monitoring	01-11-2017	DPL3	5.9	7970																		
2017 Env Monitoring	29-11-2017	DPL3	5.9	7680																		
2017 Env Monitoring	28-12-2017	DPL3	6	7570			130			2400	0.05	3.8	2.8		130	1700	53	190	0.09	<0.001	13	0.62
2018 Env Monitoring	24-01-2018	DPL3	5.94	7640																		
2018 Env Monitoring	21-02-2018	DPL3	5.94	7240																		
2018 Env Monitoring	21-03-2018	DPL3	5.87	8230			140			2500	<0.05	3.7	2.9		150	1400	53	200	0.09	<0.001	9.9	0.64
2018 Env Monitoring	18-04-2018	DPL3	5.94	7580																		
2018 Env Monitoring	16-05-2018	DPL3	5.97	7670</																		

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2019 Env Monitoring	22-11-2019	DPL3	6.03	9480	19.9	<0.1		115	3840				150	236	1910	64		0.21	<0.001	17.6	1.11
2019 Env Monitoring	20-12-2019	DPL3	6.26	10400	40.4	<0.1															
No of Samples			75	75	52	49	21	15	30	2	5	8	23	30	30	29	25	16	5	30	30
Minimum			3.88	568	0.27	-88.9	110	66	120	0.05	3	0.04	60	93	1.28	38	126	0.03	0.001	0.74	0.51
Maximum			6.7	10400	399	1738	151	138	3840	0.1	4.1	2.9	150	236	1910	72	230	0.66	0.002	24	6.23
Average			6.09	7252.94	14.27	200.41	126.67	98.27	2416.33	0.08	3.74	2.26	78.44	123.47	1102.74	48.80	166.64	0.17	0.00	6.71	0.83
2011/2012 AEMR	Dec-11	DPL5																			
2011/2012 AEMR	Mar-12	DPL5							14				0.5	1	9.1	<5	5.9		<0.005	2.51	<0.01
2011/2012 AEMR	30-05-2012	DPL5	4.7	92	4.6	386															
2011/2012 AEMR	Jun-12	DPL5	4.8	81	6.6	347	2	1	17				0.6	1.3	9.2	<5	4.3		<0.005	1.01	<0.01
2011/2012 AEMR	26-07-2012	DPL5	4.7	92	3.7	313															
2011/2012 AEMR	27-08-2012	DPL5	4.6	103	3.4	292															
2011/2012 AEMR	27-09-2012	DPL5	4.5	102	2.6	266	<1	<1	19				0.7	1.4	10	<5	8.5		<0.005	0.89	<0.01
2011/2012 AEMR	29-10-2012	DPL5	4.4	108	2.2	288															
2012/2013 AEMR	Dec-12	DPL5							18				0.6	1.2	5.9	<5	3.5		<0.005	2.16	<0.01
2012/2013 AEMR	Mar-13	DPL5							12				0.5	1.3	8.2	<5	4		<0.005	0.09	<0.01
2012/2013 AEMR	Jun-13	DPL5							30				0.7	1.9	0.7	<5	8.2		<0.005	0.31	<0.01
2012/2013 AEMR	Sep-13	DPL5							640				13	40	243	9			<0.005	15	0.14
2013/2014 AEMR	12-12-2013	DPL5	4.8	334	2.3	106	3	2	89				2.3	7.2	7.2	<5	15		<0.005	4.81	0.04
2013/2014 AEMR	29-01-2014	DPL5	4.9	314	4.2	161															
2013/2014 AEMR	24-02-2014	DPL5	4.1	337	4.1	255															
2013/2014 AEMR	31-03-2014	DPL5	5	359	3.3	107	2	1	110				2.4	6.3	6.3	<5	12		<0.005	3.52	<0.01
2013/2014 AEMR	24-04-2014	DPL5	4.7	110		84															
2013/2014 AEMR	28-05-2014	DPL5	4	239		313															
2013/2014 AEMR	25-06-2014	DPL5	3.6	566	2.1	375	<1	<1	140				4.2	9.9	64	<5	9.8		<0.005	1.73	0.05
2013/2014 AEMR	30-07-2014	DPL5	3.7	639	4.6	238	<1	<1	140				13	11	69	<5	47	3.96	<0.005	2	0.11
2013/2014 AEMR	29-08-2014	DPL5	3.9	678	2.7	215	NP	NP	170				4.9	12	75	<5	16		<0.005	11	0.03
2013/2014 AEMR	29-09-2014	DPL5	3.8	942	1.8	247															
Appendix of 2015 AEMR	28-11-2014	DPL5	4.9	706	2.7	105															
Appendix of 2015 AEMR	15-12-2014	DPL5	5.2	801	2	115	5	3	220				6.2	15	110	<5	11	0.3	<0.005	14	0.08
Appendix of 2015 AEMR	22-01-2015	DPL5	5	811	3.8	160															
Appendix of 2015 AEMR	25-02-2015	DPL5	4	433	6.2	178															
Appendix of 2015 AEMR	26-03-2015	DPL5	4.8	1066	3.9	144	2	2													
Appendix of 2015 AEMR	24-04-2015	DPL5	3.7	963	4.8	257															
Appendix of 2015 AEMR	28-05-2015	DPL5	3.8	611	2.5	325															
Appendix of 2015 AEMR	17-09-2015	DPL5	3.9	844	2.4	205	NP		220			0.18	5.5	9.6	113	<5	23	0.67	<0.001	1.4	0.055
Appendix of 2015 AEMR	21-10-2015	DPL5	4.3	676	5.4	189															
Appendix of 2015 AEMR	25-11-2015	DPL5	5.2	390	6	135															
Appendix of 2015 AEMR	11-12-2015	DPL5	5.4	310	2.3	151	7	7	80				2.2	3.9	41	<5	12	0.13	<0.001	7.21	0.027
Appendix of 2016 AEMR	25-01-2016	DPL5	5.6	376	3.1	113															
Appendix of 2016 AEMR	24-02-2016	DPL5	5.6	335	2.9	76															
Appendix of 2016 AEMR	24-03-2016	DPL5	5.3	412	2.4	186	6	6	112				2.99	3.88	42.05	<5	13.372	0.148	<0.001	4.597	0.022
Appendix of 2016 AEMR	29-04-2016	DPL5	4.6	285	6.2	259															
Appendix of 2016 AEMR	24-05-2016	DPL5	4.5	300	4.7	195															
Appendix of 2016 AEMR	30-06-2016	DPL5	4.3	385.7	2.9	271															
Appendix of 2016 AEMR	21-07-2016	DPL5	4.4	321.5	5.2	297															
Appendix of 2016 AEMR	31-08-2016	DPL5	4.4	348	4.4	230	<1		89				2.2	2.8	57	<5	28		0.001	11.2	0.012
Appendix of 2016 AEMR	29-09-2016	DPL5	4.4	399	2.5	285															
Appendix of 2016 AEMR	27-10-2016	DPL5	4.4	399	2.5	285															
Appendix of 2016 AEMR	29-11-2016	DPL5	5.4	5.4	1.6	74															
Appendix of 2016 AEMR	20-12-2016	DPL5	5.2	298	3.3	244.5	5		50				2.3	2.8	47	<5	21		0.001	4.55	0.012
Q1 2017 Env mon report	30-01-2017	DPL5	5.2	260																	
Q1 2017 Env mon report	27-02-2017	DPL5	5.5	244																	
2017 Env Monitoring	22-03-2017	DPL5	5.1	300			<5		63	0.1	1	0.1		2	55	1	22	0.2	<0.001	1.5	0.009
2017 Env Monitoring	19-04-2017	DPL5	5.1	203																	
2017 Env Monitoring	17-05-2017	DPL5	5.1	226																	
2017 Env Monitoring	14-06-2017	DPL5																			
2017 Env Monitoring	12-07-2017	DPL5	5.2	189																	
2017 Env Monitoring	09-08-2017	DPL5	5.1	200																	
2017 Env Monitoring	06-09-2017	DPL5	5.2	179			8		26	<0.05	1.3	0.055		<0.5	35	0.7	18	0.54	<0.001	0.23	<0.005
2017 Env Monitoring	04-10-2017	DPL5	5.3	188																	
2017 Env Monitoring	01-11-2017	DPL5	5.3	197																	
2017 Env Monitoring	29-11-2017	DPL5	5	480																	
2017 Env Monitoring	28-12-2017	DPL5	4.5	2200			<5		640	<0.05	0.6	0.24		41	450	6.8	79	2.4	<0.001	7.2	0.11
2018 Env Monitoring	24-01-2018	DPL5	4.42	2470																	
2018 Env Monitoring	21-02-2018	DPL5	4.53	1392																	
2018 Env Monitoring	21-03-2018	DPL5	4.58	1461			11		370	<0.05	0.4	0.14		25	230	5.1	59	1.2	<0.001	4.2	0.066
2018 Env Monitoring	18-04-2018	DPL5	4.88	266																	
2018 Env Monitoring	16-05-2018	DPL5	4.78	486																	
2018 Env Monitoring	13-06-2018	DPL5	4.69	406			<5		96	<0.05	0.4	0.098									

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			3.2	3.8	0.19	-45.9	3	2	14	0.1	1.3	0.25	21	29	1.5	4	30	3.21	0.001	9.48	0.02
Minimum			5.78	10190	35.9	464	10	6	790	11	2.5	1.13	134	33	24	11	1520	147	0.026	580	3.75
Maximum			4.06	1361.10	4.18	175.26	6.50	4.00	49.61	6.37	1.67	0.50	20.12	11.36	11.78	7.89	492.86	34.57	0.00	149.39	0.93
Average																					
2011/2012 AEMR	Dec-11	DPL7							680				16	24	451	36	207		<0.005	0.34	0.04
2011/2012 AEMR	Mar-12	DPL7							710				16	24	649	28	210		<0.005	0.28	0.03
2011/2012 AEMR	30-05-2012	DPL7	7.4	3451	3.6	241															
2011/2012 AEMR	Jun-12	DPL7	7.5	3446	5	249	550	336	700				17	36	561	30	214		<0.005	0.32	0.05
2011/2012 AEMR	26-07-2012	DPL7	7.4	3434	3.4	-15															
2011/2012 AEMR	27-08-2012	DPL7	7.6	3492	2.5	24															
2011/2012 AEMR	27-09-2012	DPL7	7.4	3385	2.1	154	430	256	730				15	32	530	28	226		<0.005	1.11	0.02
2011/2012 AEMR	29-10-2012	DPL7	7.2	3416	1.7	52															
2012/2013 AEMR	Dec-12	DPL7							730				16	34	673	29	203		<0.005	0.56	0.02
2012/2013 AEMR	Mar-13	DPL7							750				18	38	610	27	223		<0.005	0.72	0.05
2012/2013 AEMR	Jun-13	DPL7							740				16	36	16	25	274		<0.005	1.56	0.03
2012/2013 AEMR	Sep-13	DPL7							750				16	34	543	23			<0.005	1.2	0.05
2013/2014 AEMR	12-12-2013	DPL7	7.2	3341	4.1	52	390	238	750				18	38	38	26	249		<0.005	1.33	0.08
2013/2014 AEMR	29-01-2014	DPL7	7.3	3243	3.9	154															
2013/2014 AEMR	24-02-2014	DPL7	7.2	3151	2.4	231															
2013/2014 AEMR	31-03-2014	DPL7	7.2	3358	2.8	-2	410	250	720				19	39	39	26	253		<0.005	1.52	0.04
2013/2014 AEMR	24-04-2014	DPL7	7.5	3452		116															
2013/2014 AEMR	28-05-2014	DPL7	7.3	3468		297															
2013/2014 AEMR	25-06-2014	DPL7	4.6	69	2.3	320	1	<1	15			0.3	0.2	9.9	<5	4.2		<0.005	0.85	<0.01	
2013/2014 AEMR	30-07-2014	DPL7	7.5	3414	3.5	126	390	240	760				19	41	656	27	261	0.41	<0.005	1.42	0.02
2013/2014 AEMR	29-08-2014	DPL7	7.5	3477	2.8	128	400	245	740				17	37	611	25	236		<0.005	1.88	0.01
2013/2014 AEMR	29-09-2014	DPL7	7.2	3436	4.9	173															
Appendix of 2015 AEMR	28-11-2014	DPL7	7.1	3416	4.9	75															
Appendix of 2015 AEMR	15-12-2014	DPL7	7.2	3340	2.3	100	400	243	780				22	43	685	29	211	0.34	<0.005	1.62	0.06
Appendix of 2015 AEMR	22-01-2015	DPL7	7.1	3404	2.6	77															
Appendix of 2015 AEMR	25-02-2015	DPL7	7.4	3396	4.5	30															
Appendix of 2015 AEMR	26-03-2015	DPL7	7.1	3446	3.1	78	420	423	780				18	38	651	26	250	0.51	<0.001	2.62	0.077
Appendix of 2015 AEMR	24-04-2015	DPL7	7.5	3438	5.5	53															
Appendix of 2015 AEMR	28-05-2015	DPL7	7.5	3417	6	161															
Appendix of 2015 AEMR	17-09-2015	DPL7	7.3	3323	2.8	110	380		760			0.06	18	39	644	25	250	0.62	<0.001	2.53	0.025
Appendix of 2015 AEMR	21-10-2015	DPL7	7.2	3330	3.5	144															
Appendix of 2015 AEMR	25-11-2015	DPL7	7.2	3500	5.8	100															
Appendix of 2015 AEMR	11-12-2015	DPL7	7.2	3371	2.7	214	380	380	770				17	37	644	24	272	0.04	0.0002	2.44	0.084
Appendix of 2016 AEMR	25-01-2016	DPL7	7.1	3344	1.8	-36.00															
Appendix of 2016 AEMR	24-02-2016	DPL7	7.2	3444	5.5	-60.00															
Appendix of 2016 AEMR	24-03-2016	DPL7	7.2	3399	4.1	-9.00	363	363	738				18.21	38.01	637.38	26.08	260.218	0.356	<0.001	1.772	0.084
Appendix of 2016 AEMR	29-04-2016	DPL7	7.4	3374	6.4	26.00															
Appendix of 2016 AEMR	24-05-2016	DPL7	7.4	3382	5.5	-57.00															
Appendix of 2016 AEMR	30-06-2016	DPL7	7.4	3404.7	5.7	98.00															
Appendix of 2016 AEMR	21-07-2016	DPL7	7.5	3159	6.5	-31.00															
Appendix of 2016 AEMR	31-08-2016	DPL7	7.3	3364	3.7	-22.00	369		760				24	35	604	24	217		0.001	2.07	0.082
Appendix of 2016 AEMR	29-09-2016	DPL7	7.2	3558	2.4	44.00															
Appendix of 2016 AEMR	27-10-2016	DPL7	7.2	3558	2.4	44.00															
Appendix of 2016 AEMR	29-11-2016	DPL7	7.1	3371	2.4	20.00															
Appendix of 2016 AEMR	20-12-2016	DPL7	6.9	3527	4.5	229.3	372		372				18	38	648	25	263		0.001	1.85	0.082
Q1 2017 Env mon report	30-01-2017	DPL7	6.9	3471																	
Q1 2017 Env mon report	27-02-2017	DPL7	7.1	3174																	
2017 Env Monitoring	22-03-2017	DPL7	7	3430			350		360	0.1	2.1	0.19		36	830	29	710	0.33	<0.001	1.8	0.076
2017 Env Monitoring	19-04-2017	DPL7																			
2017 Env Monitoring	17-05-2017	DPL7	6.9	3440																	
2017 Env Monitoring	14-06-2017	DPL7																			
2017 Env Monitoring	12-07-2017	DPL7	7	3360																	
2017 Env Monitoring	09-08-2017	DPL7	7	3480																	
2017 Env Monitoring	06-09-2017	DPL7	7	3380			390		640	0.1	2.9	0.67		38	940	31	350	0.33	<0.001	1.3	0.065
2017 Env Monitoring	04-10-2017	DPL7	7	3450																	
2017 Env Monitoring	01-11-2017	DPL7	6.9	3440																	
2017 Env Monitoring	29-11-2017	DPL7	6.8	344																	
2017 Env Monitoring	28-12-2017	DPL7	6.9	3410			380		720	0.1	3.6	2.4		38	930	30	250	0.33	<0.001	1.4	0.063
2018 Env Monitoring	24-01-2018	DPL7	6.84	3450																	
2018 Env Monitoring	21-02-2018	DPL7	6.83	3310																	
2018 Env Monitoring	21-03-2018	DPL7	6.78	3650			400		710	0.2	3.7	2.3		41	750	30	250	0.37	<0.001	1.3	0.065
2018 Env Monitoring	18-04-2018	DPL7	6.88	3500																	
2018 Env Monitoring	16-05-2018	DPL7	6.89	3480																	
2018 Env Monitoring	13-06-2018	DPL7	6.89	3570			380		680	0.1	3.9	2.3		37	840	31	260	0.35	<0.001	1.6	0.072
2018 Env Monitoring	11-07-2018	DPL7	7.08	3220																	
2018 Env Monitoring	08-08-2018	DPL7	7.01	3510																	
2018 Env Monitoring	05-09-2018	DPL7	3.9	2680	57.6	391	393		783			2.06		40	651	26	232	0.49	<0.001		0.074
2018 Env Monitoring	05-10-2018	DPL7	6.88	3340	7.5																
2018 Env Monitoring	06-11-2018	DPL7	6.73	3530	4																
2018 Env Monitoring	07-12-2018	DPL7	6.76	3310	2.3	-112.6	395		749			2.08		39	635	25	278	0.5	<0.001	1.7	0.659
2019 Env Monitoring	08-01-2019	DPL7	6.75	3329.4	14.2	-90.7															
2019 Env Monitoring	05-02-2019	DPL7	6.74	3571.4	0.18	-1620															
2019 Env Monitoring	08-03-2019	DPL7	5.09	367	0.22	3.2		415					755	39	675	25	267	0.44	<0.01	1.63	0.072
2019 Env Monitoring	05-04-2019	DPL7	6.74	3460	0.6	NR															
2019 Env Monitoring	07-05-2019	DPL7	4.4	2320	0.7	0.1															
2019 Env Monitoring	04-06-2019	DPL7	6.68	3480	0.4	0.1		380					671	40	656	25	316	0.34	<0.001	1.57	0.078
2019 Env Monitoring	04-07-2019	DPL7	4.4	2320	0.7	0.1															
2019 Env Monitoring	01-08-2019	DPL7	6.88	3220	7.2	<0.1		393					639	38	607	22	265	0.51	<0.001	1.8</	

Longterm Groundwater Quality Monitoring at Dunloe Sands Quarry

Minimum		3.9	7.1	0.18	-1620	1	238	15	0.1	2.1	0.06	0.3	0.2	9.9	22	4.2	0.04	0.0002	0.28	0.01
Maximum		7.6	3820	57.6	391	550	423	783	0.2	3.9	2.4	803	43	940	36	710	0.62	0.001	2.62	0.659
Average		6.94	3207.18	4.67	50.09	378.24	325.00	680.63	0.12	3.24	1.51	133.60	35.68	582.30	26.90	257.51	0.40	0.00	1.45	0.08

Longterm Groundwater Depth Monitoring at Dunloe Sands Quarry

Date	DPL1	DPL3	DPL5	DPL6	DPL7
Nov-13	0.61	0.57	0.67	0.59	0.61
Apr-14	0.61	0.58	0.68	0.61	0.62
Nov-14	1.30	1.90	1.20	1.40	1.90
Dec-14	1.20	1.80	1.20	1.40	1.80
Jan-15	1.10	1.40	0.90	1.20	1.40
Feb-15	0.30	1.00	0.20	0.80	1.50
Mar-15	0.70	1.00	0.40	1.00	1.20
Apr-15	0.90	1.00	0.80	1.20	1.40
May-15	1.10	1.70	0.80	1.40	1.20
Jun-15	1.40	1.40	0.80	1.20	1.30
Jul-15	1.00	1.50	1.10	1.10	1.00
Aug-15	1.30	1.50	0.90	1.10	1.60
Sep-15	1.30	1.80	1.30	1.20	1.70
Oct-15	1.40	1.70	1.10	1.20	1.80
Nov-15	1.20	1.40	1.20	1.30	1.70
Dec-15	1.10	1.20	0.90	1.20	1.60
22-03-2017	1.58	1.28	1.38	1.95	1.20
19-04-2017	1.53	1.46	1.51	1.26	
17-05-2017	1.64	1.44	1.54	1.51	1.51
14-06-2017	0.89			1.08	
12-07-2017	1.69	1.52	1.60	1.54	1.47
09-08-2017	1.83	1.60	1.68	1.77	1.69
06-09-2017	1.90	1.61	1.67	1.85	1.80
04-10-2017	1.91	1.54	1.61	1.81	1.69
01-11-2017	1.92	1.64	1.72	1.81	1.72
29-11-2017	1.93	1.65	1.74	1.81	1.77
28-12-2017	1.94	1.66	1.74	1.97	1.78
24-01-2018	2.03	1.70	1.77	1.88	1.9
21-02-2018	1.94	1.52	1.62	1.87	1.89
21-03-2018	1.68	1.38	1.49	1.62	1.4
18-04-2018	1.6	1.33	1.41	1.52	1.24
16-05-2018	1.62	1.23	1.36	1.65	1.37
13-06-2018	1.74	1.42	1.56	1.78	1.55
11-07-2018	1.78	1.48	1.56	1.71	1.62
08-08-2018	1.98	1.72	1.80	1.78	1.78
05-09-2018		1.36	1.74	1.6	1.78
05-10-2018	1.73	1.39	1.39	1.73	1.64
06-11-2018	1.74	1.74	1.54	1.62	1.52
07-12-2018		1.39	1.46	1.58	1.34
08-01-2019	1.75	1.63	1.60	1.91	1.8
05-02-2019	1.99	1.64	1.71	2.1	1.93
08-03-2019	1.97	1.83	1.88	1.51	1.59
05-04-2019	1.58	1.35	1.39	1.48	1.56
07-05-2019	NA	NA	NA	NA	NA
04-06-2019	1.75	1.35	1.75	1.64	1.6
04-07-2019	1.68	1.26	1.42	1.49	1.31
01-08-2019	1.85	1.49	1.59	1.58	1.61
26-09-2019	2.45	2.74	2.77	1.64	2.75
24-10-2019	NR	NR	NR	NR	NR
22-11-2019	2.03	2.02	1.81	2.01	1.99
20-12-2019	2.13	1.79	1.83	1.68	2.01
Minimum	0.3	0.57	0.2	0.59	0.61
Maximum	2.45	2.74	2.77	2.1	2.75
Average	1.54	1.49	1.39	1.50	1.58

APPENDIX 3

DUNLOE SAND QUARRY TRUCK MOVEMENT SUMMARY

Jan-19						
Day	Date	Total truck movements per day	Max Visits Per Hour	Operational hours	Max visits per day	
Monday		0	4	10	40	
Tuesday	01-01-2019	0	4	10	40	
Wednesday	02-01-2019	0	4	10	40	
Thursday	03-01-2019	0	4	10	40	
Friday	04-01-2019	0	4	10	40	
Saturday	05-01-2019	0	4	5	20	
Sunday	06-01-2019	0	0	0	0	
Monday	07-01-2019	21	4	10	40	
Tuesday	08-01-2019	19	4	10	40	
Wednesday	09-01-2019	15	4	10	40	
Thursday	10-01-2019	18	4	10	40	
Friday	11-01-2019	13	4	10	40	
Saturday	12-01-2019	0	4	5	20	
Sunday	13-01-2019	0	0	0	0	
Monday	14-01-2019	19	4	10	40	
Tuesday	15-01-2019	20	4	10	40	
Wednesday	16-01-2019	14	4	10	40	
Thursday	17-01-2019	21	4	10	40	
Friday	18-01-2019	18	4	10	40	
Saturday	19-01-2019	0	4	5	20	
Sunday	20-01-2019	0	0	0	0	
Monday	21-01-2019	26	4	10	40	
Tuesday	22-01-2019	27	4	10	40	
Wednesday	23-01-2019	23	4	10	40	
Thursday	24-01-2019	17	4	10	40	
Friday	25-01-2019	18	4	10	40	
Saturday	26-01-2019	0	4	5	20	
Sunday	27-01-2019	0	0	0	0	
Monday	28-01-2019	0	4	10	40	
Tuesday	29-01-2019	22	4	10	40	
Wednesday	30-01-2019	15	4	10	40	
Thursday	31-01-2019	15	4	10	40	

Feb-19						
Day	Date	Total truck movements per day	Max Visits Per Hour	Operational hours	Max visits per day	
Friday		43497	19	4	10	40
Saturday	02-02-2019		0	4	5	20
Sunday	03-02-2019		0	0	0	0
Monday	04-02-2019		25	4	10	40
Tuesday	05-02-2019		21	4	10	40
Wednesday	06-02-2019		7	4	10	40
Thursday	07-02-2019		21	4	10	40
Friday	08-02-2019		15	4	10	40
Saturday	09-02-2019		0	4	5	20
Sunday	10-02-2019		0	0	0	0
Monday	11-02-2019		28	4	10	40
Tuesday	12-02-2019		24	4	10	40
Wednesday	13-02-2019		24	4	10	40
Thursday	14-02-2019		23	4	10	40
Friday	15-02-2019		23	4	10	40
Saturday	16-02-2019		0	4	5	20
Sunday	17-02-2019		0	0	0	0
Monday	18-02-2019		19	4	10	40
Tuesday	19-02-2019		30	4	10	40
Wednesday	20-02-2019		17	4	10	40
Thursday	21-02-2019		24	4	10	40
Friday	22-02-2019		29	4	10	40
Saturday	23-02-2019		0	4	5	20
Sunday	24-02-2019		0	0	0	0
Monday	25-02-2019		21	4	10	40
Tuesday	26-02-2019		13	4	10	40
Wednesday	27-02-2019		23	4	10	40
Thursday	28-02-2019		19	4	10	40

Mar-19						
Day	Date	Total truck movements per day	Max Visits Per Hour	Operational hours	Max visits per day	
Friday	01-03-2019	13	4	4	10	40
Saturday	02-03-2019	0	4	4	5	20
Sunday	03-03-2019	0	0	0	0	0
Monday	04-03-2019	32	4	4	10	40
Tuesday	05-03-2019	23	4	4	10	40
Wednesday	06-03-2019	16	4	4	10	40
Thursday	07-03-2019	26	4	4	10	40
Friday	08-03-2019	28	4	4	10	40
Saturday	09-03-2019	0	4	4	5	20
Sunday	10-03-2019	0	0	0	0	0
Monday	11-03-2019	25	4	4	10	40
Tuesday	12-03-2019	27	4	4	10	40
Wednesday	13-03-2019	19	4	4	10	40
Thursday	14-03-2019	29	4	4	10	40
Friday	15-03-2019	14	4	4	10	40
Saturday	16-03-2019	0	4	4	5	20
Sunday	17-03-2019	0	0	0	0	0
Monday	18-03-2019	11	4	4	10	40
Tuesday	19-03-2019	13	4	4	10	40
Wednesday	20-03-2019	20	4	4	10	40
Thursday	21-03-2019	24	4	4	10	40
Friday	22-03-2019	20	4	4	10	40
Saturday	23-03-2019	0	4	4	5	20
Sunday	24-03-2019	0	0	0	0	0
Monday	25-03-2019	20	4	4	10	40
Tuesday	26-03-2019	25	4	4	10	40
Wednesday	27-03-2019	16	4	4	10	40
Thursday	28-03-2019	11	4	4	10	40
Friday	29-03-2019	17	4	4	10	40
Saturday	30-03-2019	0	4	4	5	20
Sunday	31-03-2019	0	0	0	0	0

Apr-19						
Day	Date	Total truck movements per	Max Visits Per Hour	Operational hours	Max visits per day	
Monday	01-04-2019	26	4	4	10	40
Tuesday	02-04-2019	22	4	4	10	40
Wednesday	03-04-2019	20	4	4	10	40
Thursday	04-04-2019	17	4	4	10	40
Friday	05-04-2019	27	4	4	10	40
Saturday	06-04-2019	0	4	4	5	20
Sunday	07-04-2019	0	0	0	0	0
Monday	08-04-2019	19	4	4	10	40
Tuesday	09-04-2019	18	4	4	10	40
Wednesday	10-04-2019	21	4	4	10	40
Thursday	11-04-2019	21	4	4	10	40
Friday	12-04-2019	21	4	4	10	40
Saturday	13-04-2019	0	4	4	5	20
Sunday	14-04-2019	0	0	0	0	0
Monday	15-04-2019	18	4	4	10	40
Tuesday	16-04-2019	12	4	4	10	40
Wednesday	17-04-2019	16	4	4	10	40
Thursday	18-04-2019	16	4	4	10	40
Friday	19-04-2019	0	4	4	10	40
Saturday	20-04-2019	0	4	4	5	20
Sunday	21-04-2019	0	0	0	0	0
Monday	22-04-2019	0	4	4	10	40
Tuesday	23-04-2019	12	4	4	10	40
Wednesday	24-04-2019	34	4	4	10	40
Thursday	25-04-2019	23	4	4	10	40
Friday	26-04-2019	0	4	4	10	40
Saturday	27-04-2019	20	4	4	5	20
Sunday	28-04-2019	0	0	0	0	0
Monday	29-04-2019	15	4	4	10	40
Tuesday	30-04-2019	26	4	4	10	40

May-19						
Day	Date	Total truck movements per		Operational		
		day	Max Visits Per Hour	hours	Max visits per day	
Wednesday	01-05-2019	28	4	4	10	40
Thursday	02-05-2019	18	4	4	10	40
Friday	03-05-2019	16	4	4	10	40
Saturday	04-05-2019	0	4	4	5	20
Sunday	05-05-2019	0	0	0	0	0
Monday	06-05-2019	18	4	4	10	40
Tuesday	07-05-2019	23	4	4	10	40
Wednesday	08-05-2019	19	4	4	10	40
Thursday	09-05-2019	18	4	4	10	40
Friday	10-05-2019	20	4	4	10	40
Saturday	11-05-2019	0	4	4	5	20
Sunday	12-05-2019	0	0	0	0	0
Monday	13-05-2019	20	4	4	10	40
Tuesday	14-05-2019	18	4	4	10	40
Wednesday	15-05-2019	14	4	4	10	40
Thursday	16-05-2019	19	4	4	10	40
Friday	17-05-2019	11	4	4	10	40
Saturday	18-05-2019	0	4	4	5	20
Sunday	19-05-2019	0	0	0	0	0
Monday	20-05-2019	13	4	4	10	40
Tuesday	21-05-2019	19	4	4	10	40
Wednesday	22-05-2019	20	4	4	10	40
Thursday	23-05-2019	17	4	4	10	40
Friday	24-05-2019	28	4	4	10	40
Saturday	25-05-2019	0	4	4	5	20
Sunday	26-05-2019	0	0	0	0	0
Monday	27-05-2019	24	4	4	10	40
Tuesday	28-05-2019	20	4	4	10	40
Wednesday	29-05-2019	20	4	4	10	40
Thursday	30-05-2019	25	4	4	10	40
Friday	31-05-2019	15	4	4	10	40

Jun-19						
Day	Date	Total truck movements per day	Max Visits Per Hour	Operational hours	Max visits per day	
Saturday	01-06-2019	1	4	4	5	20
Sunday	02-06-2019	0	0	0	0	0
Monday	03-06-2019	39	4	4	10	40
Tuesday	04-06-2019	26	4	4	10	40
Wednesday	05-06-2019	17	4	4	10	40
Thursday	06-06-2019	28	4	4	10	40
Friday	07-06-2019	23	4	4	10	40
Saturday	08-06-2019	0	4	4	5	20
Sunday	09-06-2019	0	0	0	0	0
Monday	10-06-2019	0	4	4	10	40
Tuesday	11-06-2019	28	4	4	10	40
Wednesday	12-06-2019	18	4	4	10	40
Thursday	13-06-2019	12	4	4	10	40
Friday	14-06-2019	15	4	4	10	40
Saturday	15-06-2019	0	4	4	5	20
Sunday	16-06-2019	0	0	0	0	0
Monday	17-06-2019	25	4	4	10	40
Tuesday	18-06-2019	17	4	4	10	40
Wednesday	19-06-2019	19	4	4	10	40
Thursday	20-06-2019	26	4	4	10	40
Friday	21-06-2019	24	12	12	10	120
Saturday	22-06-2019	7	12	12	5	120
Sunday	23-06-2019	0	0	0	0	0
Monday	24-06-2019	17	12	12	10	120
Tuesday	25-06-2019	7	12	12	10	120
Wednesday	26-06-2019	2	12	12	10	120
Thursday	27-06-2019	8	12	12	10	120
Friday	28-06-2019	15	12	12	10	120
Saturday	29-06-2019	0	12	12	5	60
Sunday	30-06-2019	0	0	0	0	0

Jul-19						
Day	Date	Total truck movements per day	Max Visits Per Hour	Operational hours	Max visits per day	
Monday	01-07-2019	36	12	12	10	120
Tuesday	02-07-2019	14	12	12	10	120
Wednesday	03-07-2019	20	12	12	10	120
Thursday	04-07-2019	16	12	12	10	120
Friday	05-07-2019	15	12	12	10	120
Saturday	06-07-2019	0	12	12	5	60
Sunday	07-07-2019	0	0	0	0	0
Monday	08-07-2019	11	12	12	10	120
Tuesday	09-07-2019	20	12	12	10	120
Wednesday	10-07-2019	14	12	12	10	120
Thursday	11-07-2019	20	12	12	10	120
Friday	12-07-2019	30	12	12	10	120
Saturday	13-07-2019	0	12	12	5	60
Sunday	14-07-2019	0	0	0	0	0
Monday	15-07-2019	21	12	12	10	120
Tuesday	16-07-2019	20	12	12	10	120
Wednesday	17-07-2019	13	12	12	10	120
Thursday	18-07-2019	18	12	12	10	120
Friday	19-07-2019	26	12	12	10	120
Saturday	20-07-2019	0	12	12	5	60
Sunday	21-07-2019	0	0	0	0	0
Monday	22-07-2019	21	12	12	10	120
Tuesday	23-07-2019	15	12	12	10	120
Wednesday	24-07-2019	22	12	12	10	120
Thursday	25-07-2019	22	12	12	10	120
Friday	26-07-2019	14	12	12	10	120
Saturday	27-07-2019	0	12	12	5	60
Sunday	28-07-2019	0	0	0	0	0
Monday	29-07-2019	18	12	12	10	120
Tuesday	30-07-2019	22	12	12	10	120
Wednesday	31-07-2019	22	12	12	10	120

Aug-19						
Day	Date	Total truck movements per		Operational		
		day	Max Visits Per Hour	hours	Max visits per day	
Thursday	01-08-2019	31	12	12	10	120
Friday	02-08-2019	20	12	12	10	120
Saturday	03-08-2019	0	12	12	5	60
Sunday	04-08-2019	0	0	0	0	0
Monday	05-08-2019	17	12	12	10	120
Tuesday	06-08-2019	16	12	12	10	120
Wednesday	07-08-2019	19	12	12	10	120
Thursday	08-08-2019	21	12	12	10	120
Friday	09-08-2019	20	12	12	10	120
Saturday	10-08-2019	0	12	12	5	60
Sunday	11-08-2019	0	0	0	0	0
Monday	12-08-2019	27	12	12	10	120
Tuesday	13-08-2019	20	12	12	10	120
Wednesday	14-08-2019	16	12	12	10	120
Thursday	15-08-2019	17	12	12	10	120
Friday	16-08-2019	25	12	12	10	120
Saturday	17-08-2019	0	12	12	5	60
Sunday	18-08-2019	0	0	0	0	0
Monday	19-08-2019	21	12	12	10	120
Tuesday	20-08-2019	22	12	12	10	120
Wednesday	21-08-2019	14	12	12	10	120
Thursday	22-08-2019	18	12	12	10	120
Friday	23-08-2019	26	12	12	10	120
Saturday	24-08-2019	0	12	12	5	60
Sunday	25-08-2019	0	0	0	0	0
Monday	26-08-2019	18	12	12	10	120
Tuesday	27-08-2019	20	12	12	10	120
Wednesday	28-08-2019	29	12	12	10	120
Thursday	29-08-2019	28	12	12	10	120
Friday	30-08-2019	9	12	12	10	120
Saturday	31-08-2019	0	12	12	5	60

Sep-19						
Day	Date	Total truck movements per		Operational		
		day	Max Visits Per Hour	hours	Max visits per day	
Sunday	01-09-2019	0		0	0	0
Monday	02-09-2019	25		12	10	120
Tuesday	03-09-2019	23		12	10	120
Wednesday	04-09-2019	24		12	10	120
Thursday	05-09-2019	29		12	10	120
Friday	06-09-2019	23		12	10	120
Saturday	07-09-2019	0		12	5	60
Sunday	08-09-2019	0		0	0	0
Monday	09-09-2019	21		12	10	120
Tuesday	10-09-2019	19		12	10	120
Wednesday	11-09-2019	18		12	10	120
Thursday	12-09-2019	21		12	10	120
Friday	13-09-2019	19		12	10	120
Saturday	14-09-2019	0		12	5	60
Sunday	15-09-2019	0		0	0	0
Monday	16-09-2019	26		12	10	120
Tuesday	17-09-2019	20		12	10	120
Wednesday	18-09-2019	21		12	10	120
Thursday	19-09-2019	26		12	10	120
Friday	20-09-2019	34		12	10	120
Saturday	21-09-2019	0		12	5	60
Sunday	22-09-2019	0		0	0	0
Monday	23-09-2019	21		12	10	120
Tuesday	24-09-2019	20		12	10	120
Wednesday	25-09-2019	21		12	10	120
Thursday	26-09-2019	22		12	10	120
Friday	27-09-2019	21		12	10	120
Saturday	28-09-2019	0		12	5	60
Sunday	29-09-2019	0		0	0	0
Monday	30-09-2019	13		12	10	120

Oct-19						
Day	Date	Total truck movements per day	Max Visits Per Hour	Operational hours	Max visits per day	
Tuesday	01-10-2019	33	12	12	10	120
Wednesday	02-10-2019	16	12	12	10	120
Thursday	03-10-2019	73	12	12	10	120
Friday	04-10-2019	59	12	12	10	120
Saturday	05-10-2019	0	12	12	5	60
Sunday	06-10-2019	0	0	0	0	0
Monday	07-10-2019	0	12	12	10	120
Tuesday	08-10-2019	22	12	12	10	120
Wednesday	09-10-2019	24	12	12	10	120
Thursday	10-10-2019	26	12	12	10	120
Friday	11-10-2019	18	12	12	10	120
Saturday	12-10-2019	0	12	12	5	60
Sunday	13-10-2019	0	0	0	0	0
Monday	14-10-2019	21	12	12	10	120
Tuesday	15-10-2019	23	12	12	10	120
Wednesday	16-10-2019	23	12	12	10	120
Thursday	17-10-2019	24	12	12	10	120
Friday	18-10-2019	15	12	12	10	120
Saturday	19-10-2019	0	12	12	5	60
Sunday	20-10-2019	0	0	0	0	0
Monday	21-10-2019	21	12	12	10	120
Tuesday	22-10-2019	19	12	12	10	120
Wednesday	23-10-2019	18	12	12	10	120
Thursday	24-10-2019	23	12	12	10	120
Friday	25-10-2019	25	12	12	10	120
Saturday	26-10-2019	0	12	12	5	60
Sunday	27-10-2019	0	0	0	0	0
Monday	28-10-2019	30	12	12	10	120
Tuesday	29-10-2019	20	12	12	10	120
Wednesday	30-10-2019	49	12	12	10	120
Thursday	43769	28	12	12	10	120

Nov-19						
Day	Date	Total truck movements per day	Max Visits Per Hour	Operational hours	Max visits per day	
Friday	01-11-2019	23		12	10	120
Saturday	02-11-2019	0		12	5	60
Sunday	03-11-2019	0		0	0	0
Monday	04-11-2019	21		12	10	120
Tuesday	05-11-2019	17		12	10	120
Wednesday	06-11-2019	20		12	10	120
Thursday	07-11-2019	17		12	10	120
Friday	08-11-2019	24		12	10	120
Saturday	09-11-2019	0		12	5	60
Sunday	10-11-2019	0		0	0	0
Monday	11-11-2019	26		12	10	120
Tuesday	12-11-2019	33		12	10	120
Wednesday	13-11-2019	30		12	10	120
Thursday	14-11-2019	24		12	10	120
Friday	15-11-2019	23		12	10	120
Saturday	16-11-2019	0		12	5	60
Sunday	17-11-2019	0		0	0	0
Monday	18-11-2019	29		12	10	120
Tuesday	19-11-2019	23		12	10	120
Wednesday	20-11-2019	22		12	10	120
Thursday	21-11-2019	33		12	10	120
Friday	22-11-2019	18		12	10	120
Saturday	23-11-2019	10		12	5	60
Sunday	24-11-2019	0		0	0	0
Monday	25-11-2019	34		12	10	120
Tuesday	26-11-2019	32		12	10	120
Wednesday	27-11-2019	21		12	10	120
Thursday	28-11-2019	24		12	10	120
Friday	29-11-2019	11		12	10	120
Saturday	30-11-2019	0		12	5	60

Dec-19						
Day	Date	Total truck movements per day	Max Visits Per Hour	Operational hours	Max visits per day	
Sunday	01-12-2019	0		0	0	0
Monday	02-12-2019	28		12	10	120
Tuesday	03-12-2019	25		12	10	120
Wednesday	04-12-2019	19		12	10	120
Thursday	05-12-2019	25		12	10	120
Friday	06-12-2019	13		12	10	120
Saturday	07-12-2019	0		12	5	60
Sunday	08-12-2019	0		0	0	0
Monday	09-12-2019	21		12	10	120
Tuesday	10-12-2019	23		12	10	120
Wednesday	11-12-2019	23		12	10	120
Thursday	12-12-2019	23		12	10	120
Friday	13-12-2019	16		12	10	120
Saturday	14-12-2019	0		12	5	60
Sunday	15-12-2019	0		0	0	0
Monday	16-12-2019	31		12	10	120
Tuesday	17-12-2019	24		12	10	120
Wednesday	18-12-2019	28		12	10	120
Thursday	19-12-2019	27		12	10	120
Friday	20-12-2019	13		12	10	120
Saturday	21-12-2019	0		12	5	60
Sunday	22-12-2019	0		0	0	0
Monday	23-12-2019	0		12	10	120
Tuesday	24-12-2019	0		12	10	120
Wednesday	25-12-2019	0		12	10	120
Thursday	26-12-2019	0		12	10	120
Friday	27-12-2019	0		12	10	120
Saturday	28-12-2019	0		12	5	60
Sunday	29-12-2019	0		0	0	0
Monday	30-12-2019	0		12	10	120
Tuesday	31-12-2019	0		12	10	120

APPENDIX 4

DUNLOE SAND QUARRY ACID SULPHATE SOIL MONITORING RESULTS

Acid Sulphate test sample 2019

DUNLOE SANDS

Acid sulphate tests

ass

Daniel Dwyer



Construction Sciences

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CHROMIUM-SUITE TEST REPORT

Client: Holcim (Australia)
Client Address: Level 2, 18 Little Cribb Street, Milton QLD 4064
Project: Ballina NSW - Holcim Duntlooe Sands
Sub Project: Supplied Sample
Location: Supplied Sample
Component: Supplied Sample
Area Description: Construction Sciences - Ballina
Sampled by: Tested as Received
Sampling Method: Tested as Received
Test Procedures: AS 4689.0, 1, 2, 4, 7, 6, 15, 13, 14

Report Number: 3740/S/124880CRS
Project No: 3740/P/1333
Lot Number: -
Internal Test Request: 3740/T/23979
Client Reference: 22373/CC/280
Purchase Order No: -
Date Sampled: 29/01/2019
Date Tested: 8/02/2019
Report Date: 8/02/2019

Laboratory Number	Sample Location	pH _{KCl} units: LOR: 0.1	TAA (H ⁺ meq/l)	TAA (% B)	S _{KCl} (% B) ^a	S _{Cr} (% B)	S _{NAS} (% B)	ANC _{BT} (%CO ₂) ^a	ANC _{BT} (%B) ^a	Net Acidity (H ⁺ meq/l)	Net Acidity (% B)	Recommended Limiting Rate (kg of lime per cubic metre)
3740/S/124880	Concrete Sand #1	8.5	0	0.000	<0.007	0.021	nr	0.45	0.14	-47	-0.076	No Limiting Required
3740/S/124881	Concrete Sand #2	8.6	0	0.000	0.008	0.029	nr	0.33	0.10	-26	-0.041	No Limiting Required
3740/S/124882	Sand #1	5.3	6	0.009	<0.007	<0.02	nr	nr	nr	6	0.009	No Limiting Required
3740/S/124883	Sand #2	5.4	9	0.014	<0.007	<0.02	nr	nr	nr	9	0.014	No Limiting Required
3740/S/124884	Sand	6.7	0	0.000	<0.007	<0.02	nr	0.16	0.05	-21	-0.034	No Limiting Required
Blank		5.7	1.6	0.003								

Notes:

- nr: not required, pH trigger not met.
- LOR: Limit of Reporting
- ^a If pH_{KCl} < 6.5 it must be assumed that effective ANC is zero.
- Effective ANC is ANC_{BT}/Fitness Factor of 1.5.
- ^b S_{KCl} determined as sulfate by turbidimetric method.
- Where liming is specified, lime should be fine grained agricultural lime of at least 90% purity.
- Any liming rate provided is a recommended rate only, and is based on the total of TAA Equivalent % Oxidisable Sulphur plus Potential Acidity (S_{Cr}) plus Retained Acidity (S_{NAS}) minus effective ANC; with a factor of safety of 1.5.
- Any recommended liming rate is based on the 0.03% action criteria.
- A placed dry density of 1.7 tonnes/cubic metre has been used in calculating liming rate/s.
- The recommended liming rate is derived from a mathematical equation and will need to be field validated.
- Construction Sciences accepts no responsibility for any loss associated with use of the calculated liming rate/s.
- Results apply to the sample(s) as received.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/National standards. Accredited for compliance with ISO/IEC 17025 - Testing.



Accreditation No.: 1986
 Corporate Site Number: 3740

Paul Mayes

APPROVED SIGNATORY: Paul Mayes
 Form Number: REP CRS-Holdim-1 28/06/17



Construction Sciences



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 Website:
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CHROMIUM SUITE TEST REPORT

Client:	Holcim (Australia)												
Client Address:	Level 2, 18 Little Cribb Street, Milton QLD 4064												
Project:	Ballina NSW - Holcim Dumlooe Sands												
Sub Project:	Supplied Sample												
Location:	Supplied Sample												
Component:	Construction Sciences - Ballina												
Area Description:	Tested as Received												
Sampled by:	AS 4880.0.1.2.4.7.8.11.13.14												
Sampling Method:	Sample Location												
Test Procedures:	AS 4880.0.1.2.4.7.8.11.13.14												
Laboratory Number	units:	LOI:	pH_{CaCl2}	TAA	TAA	S_{Cl}	S_{Cr}	S_{NaS}	ANC_{AT}	ANC_{Cr}	Net Acidity	Net Acidity	Recommended Limiting Rate
				(% B)	(% B)	(% B)	(% B)	(% B)	(% B)	(% B)	(% B)	(% B)	(kg of lime per cubic metre)
				(t/m ³)	(t/m ³)	(t/m ³)	(t/m ³)	(t/m ³)	(t/m ³)	(t/m ³)	(t/m ³)	(t/m ³)	
3740/S/128670	0.1	0.1	6.8	0	0.000	0.007	0.028	nr	0.10	0.03	4	0.006	No Limiting Required
3740/S/128671	0.1	0.1	7.3	0	0.000	0.007	0.024	nr	0.15	0.05	-6	-0.009	No Limiting Required
3740/S/128672	0.1	0.1	5.7	<1	<0.002	<0.007	0.027	nr	nr	nr	17	0.027	No Limiting Required
3740/S/128673	0.1	0.1	5.8	1	0.002	0.011	<0.02	nr	nr	nr	1	0.002	No Limiting Required
3740/S/128674	0.1	0.1	5.2	4	0.007	0.007	<0.02	nr	nr	nr	4	0.007	No Limiting Required
Blank			5.3	6.1	0.010								

Notes:
 nr: not required, pH trigger not met.
 LOR: Limit of Reporting
 * If pH_{CaCl2} < 6.5 it must be assumed that effective ANC is zero.
 Effective ANC is ANC_{Cr}/Fitness Factor of 1.5.
 * S_{NaS} determined as sulfate by turbidimetric method.
 Where liming is specified, lime should be fine grained agricultural lime of at least 80% purity.
 Any liming rate provided is a recommended rate only, and is based on the total of TAA, Equivalent % Oxidisable Sulphur plus
 Potential Acidity (S_{Cr}) plus Retained Acidity (S_{NaS}) minus effective ANC; with a factor of safety of 1.5.
 Any recommended liming rate is based on the 0.03% S action criteria.
 A placed dry density of 1.7 tonnes/cubic metre has been used in calculating liming rate/s.
 The recommended liming rate is derived from a mathematical equation and will need to be field validated.
 Construction Sciences accepts no responsibility for any loss associated with use of the calculated liming rate/s.
 Results apply to the sample(s) as received.



Paul Mayes

APPROVED SIGNATORY: Paul Mayes
 Form Number: REP-CRS-Holcim-1.29/08/17

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 Accredited for compliance with ISO/IEC 17025 - Testing
 Accreditation No.: 1898
 Corporate Site Number: 3740



Construction Sciences



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CHROMIUM SUITE TEST REPORT

Client: Holcim (Australia)
Client Address: Level 2, 18 Little Cribb Street, Milton QLD 4064
Project: Ballina NSW - Holcim Dumloo Sands
Sub Project: -
Location: Supplied Sample
Component: -
Area Description: -
Sampled by: Construction Sciences - Ballina
Sampling Method: Tested as Received

Test Procedures: AS 4680.0, 1, 2, 4, 7, 8, 11, 13, 14

Laboratory Number	Sample Location	pH _{KCl}	TAA (p ^H meq/l)	TAA (% S)	S _{KCl} (% S)	S _{Cr} (% S)	S _{MS} (% S)	ANC _{BT} (% S)	ANC _{BT} (p ^H meq/l)	Net Acidity (% S)	Net Acidity (p ^H meq/l)	Recommended Limiting Rate (kg of lime per cubic metre)
3740/S/134628	Stockpile 7285 N/A	9.2	0	0.000	0.011	0.038	n ^r	1.00	0.32	-0.175	-109	No Limiting Required
3740/S/134629	Stockpile 7286 N/A	9.2	0	0.000	0.007	0.034	n ^r	0.43	0.14	-0.058	-36	No Limiting Required
3740/S/134630	Stockpile 7287 N/A	6.8	0	0.000	0.011	<0.02	n ^r	0.21	0.07	-0.044	-28	No Limiting Required
3740/S/134631	Stockpile 7288 N/A	7.6	0	0.000	0.015	<0.02	n ^r	0.33	0.11	-0.070	-44	No Limiting Required
3740/S/134632	Stockpile 7289 N/A	7.1	0	0.000	0.022	0.023	n ^r	0.16	0.05	-0.012	-8	No Limiting Required
Blank		5.9	1.9	0.003								

Notes:

- n^r: not required, pH trigger not met.
- LOR: Limit of Reporting
- * If pH_{KCl} <6.5 it must be assumed that effective ANC is zero.
- Effective ANC is ANC_{BT}/Fineness Factor of 1.5.
- * S_{KCl} determined as sulfate by turbidimetric method.
- Where liming is specified, lime should be fine grained agricultural lime of at least 90% purity.
- Any liming rate provided is a recommended rate only, and is based on the total of TAA Equivalent % Oxidisable Sulphur plus Potential Acidity (S_C) plus Retained Acidity (S_{MS}) minus effective ANC; with a factor of safety of 1.5.
- Any recommended liming rate is based on the 0.03% S action criteria.
- A placed dry density of 1.7 tonnes/cubic metre has been used in calculating liming rate/s.
- The recommended liming rate is derived from a mathematical equation and will need to be field validated.
- Construction Sciences accepts no responsibility for any loss associated with use of the calculated liming rate/s.
- Results apply to the sample(s) as received.



The results of the tests - calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025 - Testing

Accreditation No.: 1988
Corporate Site Number: 3740

Paul Mayes

APPROVED SIGNATORY: Paul Mayes
Form Number: REP CRS-Holdim-1 29/08/17



Construction Sciences



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Facsimile:
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 Website:
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CHROMIUM SUITE TEST REPORT

Client: Holcim (Australia)
Client Address: Level 2, 18 Little Cribb Street, Milton QLD 4064
Project: Ballina NSW - Holcim Dunlop Sands
Sub Project: -
Location: Supplied Sample
Component: -
Area Description: Construction Sciences - Ballina
Sampling Method: Tested as Received

Report Number: 3740/S/134633CRS
Project No: 3740/P/1333
Lot Number: N/A
Internal Test Request: 3740/T/25936
Client Reference: 22373/CC/323
Purchase Order No: -
Date Sampled: 3/06/2019
Date Tested: 12/06/2019
Report Date: 13/06/2019

Test Procedures: AS 4689.0,-1,-2,-4,-7,-8,-11,-13,-14

Laboratory Number	Sample Location	pH _{KCl}	TAA (H ⁺ mol/L)	TAA (% S)	S _{KCl} (% S)	S _{Cr} (% S)	S _{NAS} (% S)	ANC _{BT} (% S)	ANC _{BT} (% S)	Net Acidity (H ⁺ mol/L)	Net Acidity (% S)	Recommended Limiting Rate (kg of lime per cubic metre)
3740/S/134633	Stockpile 7290 N/A	8.5	0	0.000	<0.007	0.033	n/r	0.37	0.12	-29	-0.047	No Limiting Required
3740/S/134634	Stockpile 7291 N/A	8.5	0	0.000	<0.007	0.037	n/r	0.30	0.10	-16	-0.026	No Limiting Required
3740/S/134635	Stockpile 7292 N/A	7.9	0	0.000	0.011	<0.02	n/r	0.15	0.05	-20	-0.033	No Limiting Required
3740/S/134636	Stockpile 7293 N/A	7.7	0	0.000	0.011	<0.02	n/r	0.07	0.02	-8	-0.014	No Limiting Required
3740/S/134637	Stockpile 7294 N/A	7.3	0	0.000	0.022	<0.02	n/r	0.19	0.06	-25	-0.040	No Limiting Required
Blank		5.9	1.9	0.003								

Notes:

- n/r: not required, pH trigger not met.
- LOR: Limit of Reporting
- * If pH_{KCl} <6.5 it must be assumed that effective ANC is zero.
- Effective ANC is ANC_{BT}/Fineness Factor of 1.5.
- * S_{KCl} determined as sulfate by turbidimetric method.
- Where liming is specified, lime should be fine grained agricultural lime of at least 90% purity.
- Any liming rate provided is a recommended rate only, and is based on the total of TAA Equivalent % Oxidisable Sulphur plus Potential Acidity (S_{Cr}) plus Retained Acidity (S_{NAS}) minus effective ANC; with a factor of safety of 1.5.
- Any recommended liming rate is based on the 0.03% S action criteria.
- A placed dry density of 1.7 tonnes/cubic metre has been used in calculating liming rate/s.
- The recommended liming rate is derived from a mathematical equation and will need to be field validated.
- Construction Sciences accepts no responsibility for any loss associated with use of the calculated liming rate/s.
- Results apply to the sample(s) as received.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian standards.
 Accredited for compliance with ISO/IEC 17025 - Testing



Paul Mayes

APPROVED SIGNATORY: Paul Mayes
 Form Number: REP CRS-Holdim-1 28/06/17

Accreditation No.: 1988
 Corporate Site Number: 3740

CHROMIUM SUITE TEST REPORT

Client: Holcim (Australia)
Client Address: Level 2, 18 Little Cribb Street, Milton QLD 4064
Project: Ballina NSW - Holcim Dunlop Sands
Sub Project: -
Location: Supplied Sample
Component: -
Area Description: -
Sampled by: Construction Sciences-Ballina
Sampling Method: Tested as Received

Report Number: 3740/S/142923CRS
Project No: 3740/P/1333
Lot Number: N/A
Internal Test Request: 3740/T/27489
Client Reference: 22373/CC/338
Purchase Order No: -
Date Sampled: 22/08/2019
Date Tested: 29/08/2019
Report Date: 29/08/2019

Test Procedures: AS 4989.0, .1, .2, .4, .7, .8, .11, .13, .14

Laboratory Number	Sample Location	pH _{KCl} units: LOR: 0.1	TAA (H ⁺ molt)	TAA (% S)	S _{KCl} (% S) ^a 0.007	S _{OT} (% S) 0.02	S _{NAS} (% S) 0.001	ANC _{OT} (% S) ^a 0.01	ANC _{OT} (% S) ^a 0.01	Net Acidity (H ⁺ molt)	Net Acidity (% S) 0.001	Recommended Limiting Rate (kg of lime per cubic metre)
3740/S/142923	Stockpile 7335 N/A	9.5	0	0.000	0.011	0.033	nr	0.21	0.21	-67	-0.108	No Limiting Required
3740/S/142924	Stockpile 7336 N/A	9.4	0	0.000	0.015	0.036	nr	0.60	0.19	-58	-0.093	No Limiting Required
3740/S/142925	Stockpile 7337 N/A	7.4	0	0.000	0.022	<0.02	nr	0.12	0.04	-16	-0.026	No Limiting Required
3740/S/142926	Stockpile 7338 N/A	7.3	0	0.000	0.030	<0.02	nr	0.01	0.00	-2	-0.003	No Limiting Required
3740/S/142927	Stockpile 7339 N/A	7.3	0	0.000	<0.007	<0.02	nr	0.06	0.02	-8	-0.013	No Limiting Required
Blank		5.9	2.1	0.003								

Notes:

- nr: not required, pH trigger not met.
- LOR: Limit of Reporting
- ^a If pH_{KCl} <6.5 it must be assumed that effective ANC is zero.
- Effective ANC is ANC_{OT}/Fineness Factor of 1.5.
- ^a S_{KCl} determined as sulfate by turbidimetric method.
- Where liming is specified, lime should be fine grained agricultural lime of at least 90% purity.
- Any liming rate provided is a recommended rate only, and is based on the total of TAA, Equivalent % Oxidisable Sulphur plus Potential Acidity (S_{OT}) plus Retained Acidity (S_{NAS}) minus effective ANC; with a factor of safety of 1.5.
- Any recommended liming rate is based on the 0.03%S action criteria.
- A placed dry density of 1.7 tonnes/cubic metre has been used in calculating liming rate/s.
- The recommended liming rate is derived from a mathematical equation and will need to be field validated.
- Construction Sciences accepts no responsibility for any loss associated with use of the calculated liming rate/s.
- Results apply to the sample(s) as received.

The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025 - Testing



Accreditation No.: 1886
Corporate Site Number: 3740

APPROVED SIGNATORY: Paul Mayes
Form Number: REP CRS-Holdim-1 29/08/17



CHROMIUM SUITE TEST REPORT

Client: Holcim (Australia)
Client Address: Level 2, 18 Little Cribb Street, Milton Qld 4064
Project: Ballina NSW - Holcim Dunlop Sands
Sub Project: -
Location: Supplied Sample
Component: -
Area Description: -
Sampled by: Client
Sampling Method: Tested as Received
Test Procedures: AS 4689.0.1, 2, 4, 7, 8, 11, 13, 14

Laboratory Number	Sample Location	pH _{KCl}	TAA (H ⁺ mol/l)	TAA (% S)	S _{KCl} (% S) ^a	S _{Cr} (% S)	S _{NAS} (% S)	ANC _{BT} (%CO ₂) ^b	ANC _{BT} (% S) ^c	Net Acidity (H ⁺ mol/l)	Net Acidity (% S)	Recommended Limiting Rate (kg of lime per cubic metre)
3740/S/147682	Stockpile 7375	9.0	0	0.000	0.007	0.035	nr	0.37	0.12	-28	-0.044	No Limiting Required
3740/S/147683	Stockpile 7376	8.3	0	0.000	<0.007	0.040	nr	0.28	0.09	-12	-0.020	No Limiting Required
3740/S/147684	Stockpile 7377	7.0	0	0.000	0.015	0.027	nr	0.19	0.06	-9	-0.014	No Limiting Required
3740/S/147685	Stockpile 7378	6.6	0	0.000	0.011	0.030	nr	0.06	0.02	11	0.016	No Limiting Required
3740/S/147686	Stockpile 7379	6.5	0	0.000	0.011	<0.02	nr	nr	nr	0	0.000	No Limiting Required
Blank		5.7	3.6	0.006								

Notes:
nr: not required, pH trigger not met.
LOR: Limit of Reporting
^a If pH_{KCl} < 6.5 it must be assumed that effective ANC is zero.
Effective ANC is ANC_{gr}/Fineness Factor of 1.5.
^b S_{KCl} determined as sulfate by turbidimetric method.
Where liming is specified, lime should be fine grained agricultural lime of at least 90% purity.
Any liming rate provided is a recommended rate only, and is based on the total of TAA Equivalent % Oxidisable Sulphur plus Potential Acidity (S_c) plus Retained Acidity (S_{ua}) minus effective ANC; with a factor of safety of 1.5.
Any recommended liming rate is based on the 0.03% S action criteria.
A placed dry density of 1.7 tonnes/cubic metre has been used in calculating liming rate/s.
The recommended liming rate is derived from a mathematical equation and will need to be field validated.
Construction Sciences accepts no responsibility for any loss associated with use of the calculated liming rate/s.
Results apply to the sample(s) as received.



The results of the tests, calibrations and/or measurements included in this document are traceable to Australian National Standards.
Accredited for compliance with ISO/IEC 17025 - Testing

Accreditation No.: 1988
Corporate Site Number: 3740

Paul Mayes

APPROVED SIGNATORY: Paul Mayes
Form Number: REP-CRS-Holcim-1 29/08/17



Holcim Construction Sciences testing services
 Construction Sciences phone 131 186
 Aggregate enquiries phone 1300 555 277

Laboratory: Sunshine Coast Laboratory

Construction Sciences Pty Ltd
 ABN: 74 128 806 735

Address:
 32 Hi-Tech Drive
 Kunda Park Qld 4556

Email:
sunshinecoast@constructionsciences.net

Telephone:
 (07) 5452 0100

Facsimile:
 (07) 5452 0133

Website:
www.constructionsciences.net

Determination of Chloride and Sulfate

Client:	Holcim (Australia)	Report Number:	3740/S/153225HCA
Client's Address:	Level 2, 18 Little Cribb Street, Milton QLD 4064	Project Number:	3740/P/1333
Project:	Ballina NSW - Holcim Dunloe Sands	Lot Number:	N/A
Location:	Supplied Sample	Internal Test Request:	3740/T/29338
Component:	-	Client Reference:	22373/S/68191
Area Description:	-	Purchase Order No:	-
		Report Date:	27/11/2019

Test Procedures: AS1012.20 (1992)			
Sample No:	3740/S/153225		
Sampling Method:	Tested as Received		
Date Sampled:	1/10/2019		
Sampled By:	Construction Sciences-Ballina		
Date Tested:	27/11/2019		
Material Source:	Holcim Dunloe Sands		
Material Type (Specification):	Fine Sand (DUNFS-ITPCONCSAND(01/09/11))		
Material Description:	Sand		
Sample Location:	Stockpile		
	7384		
	N/A		
	DUNFS-ITPCONCSAND(01/09/11)		
Chloride Content	Qualitative test	Positive/Negative	Negative
	Quantitative test (%m/m)	Volhard Titration	0.002
Sulphate Content	Qualitative test	Positive/Negative	Negative
	Quantitative test (%m/m)	Gravimetric Method	0.039

Remarks: Results apply to the sample as received.

	The results of the tests, calibrations and/or measurements included in this document are traceable to Australian/national standards. Accredited for compliance with ISO/IEC 17025 - Testing	Form Number:
	Accreditation No.: 1986 Corporate Site Number: 3740	REP HCA-Holcim-2 7/03/2018
APPROVED SIGNATORY: Paul Mayes		

APPENDIX 5

DUNLOE SAND QUARRY 2019 REHABILITATION AND REVEGETATION MONITORING REPORT



**Annual Report
2019 Rehabilitation and Revegetation
Monitoring Program
Dunloe Sand Quarry
Pottsville NSW**

Prepared for: Lafarge Holcim

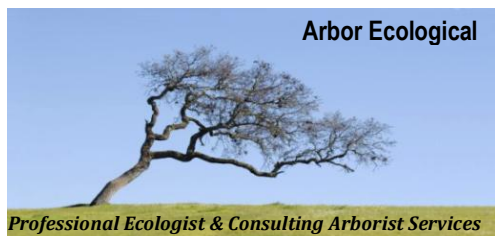
Date: 13 March 2020

Prepared By: Michael Hallinan

Bachelor of Applied Science - Environmental Resource Management

Diploma in Arboriculture (AQF Level 5)

Associate Diploma in Horticulture – Arboriculture



Introduction

This annual report for the Dunloe Sand Quarry 2019 Rehabilitation and Revegetation Monitoring Program aims to address all annual report requirements outlined in the site Rehabilitation & Revegetation Management Plan (RRMP)¹. Schedule 5 *Environmental Management and Monitoring Conditions* of the plan notes annual report requirements as follows:

- Visual monitoring results and photographs
- monitoring forms A, B, C and D
- any incidents of non-compliance with performance criteria set out in the Management Plan
- corrective actions implemented in response to performance criteria non-compliance and
- a work log of all monitoring, maintenance and corrective actions (where required) activities performed during the 2019 reporting period.

Appendix 1 contains visual monitoring photo point photographs taken quarterly at established photo points as per the RRMP and March 2020 Forest Structure & other monitoring photos. Also appended to this report are monitoring forms completed for each rehabilitation zone at intervals outlined in the RRMP as follows:

- Form A: Routine Rehabilitation Monitoring (quarterly), **Appendix 2**
- Form B: Site Condition (six-monthly), **Appendix 3**
- Form C: Forest Structure (annually), **Appendix 4**
- Form D: Floristic Composition (annually), **Appendix 4**
- Routine Fauna Nest Box Monitoring (six-monthly), **Appendix 5**

Additionally, a 2019 work log of monitoring, maintenance and corrective actions is included as **Appendix 6**.

Rehabilitation zones and photo-point monitoring locations are shown on **Figure 1**.

¹ Planit Consulting 2009, *Rehabilitation & Revegetation Management Plan, Dunloe Park Sand Quarry*, prepared for Ramtech Pty Ltd, unpublished.





Figure 1. Rehabilitation zones and photo-point monitoring locations.

An information summary from each of the data forms is provided as follows:

Routine Rehabilitation Monitoring (Form A), refer to Appendix 2

Zone 1

General Management

No fires, rubbish dumping, plant theft, cattle grazing, stockpiling or unauthorised person or vehicle access. A record of slashing of bushfire trails is outlined in the 2019 Work Log (**Appendix 1**).

Biodiversity

The high diversity of vegetation in Zone 1 was reflected in the range of fauna observations using the site. This included birdlife (e.g. predatory Wedge-tailed Eagle and Brahminy Kite; and various frugivorous, honeyeater and insectivorous birds), a Lace Monitor, Common Eastern Froglet and signs of mammals such as bandicoots and wallabies. This adds to the range of biodiversity detected over several years using the different brackish and freshwater influenced landscape elements, vegetation types and habitats of Zone 1.

Weeds

Various weed species observed included minor infestations of Lantana, Camphor Laurel, Ground Asparagus, Winter Senna, Umbrella Tree, Bitou Bush, Pinus sp. and Corky Passionfruit. Weed infestations occur mostly along vegetation edges and fencelines (from bird perch droppings), a trend continuing from previous years.



Routine weed maintenance works identified during 2019 monitoring was scheduled to be undertaken in February 2020 and delayed due to wet weather since early February. Suitably qualified and experienced bush regenerators commenced weed control on 10/03/20 using industry best practice methods for weed control and chemical handling in line with DPI (2018)², BSRLG (1998)³, the North Coast Regional Strategic Weed Management Plan 2017-2022 (North Coast Local Land Services, 2017) and the RRMP.

Modifications

No structural modifications or illegal modifications were made within Zone 1. All fences were noted to be in a good condition with no fencing repairs required.

Vegetation Regeneration

Excellent natural regeneration/ recruitment of native plants was observed in Zone 1 despite a drought through most of the Spring/ Summer growing period. Growth continued of primary canopy species Broad-leaved Paperbark, Coast Banksia, Swamp Oak, Swamp Mahogany; and in Zone 1 C to the east Mangrove spp., Tuckeroo and Cottonwood. Height ranges of canopy species were not observed to substantially change apart from Zone 1C where an increase was observed in the reporting period.

A range of shrub and groundcover species were recorded from freshwater, marine, open forest and closed rainforest environments as shown in Routine Rehabilitation Monitoring Sheets for Zone 1A, 1B and 1C. Moderate levels of drought stress were observed and no performance criteria were exceeded in Zone 1.

Zone 2

General Management

No fires, rubbish dumping, plant theft, cattle grazing, stockpiling or unauthorised person or vehicle access.

Biodiversity

Fauna observations included birdlife such as predatory Brahminy Kite and various insectivorous and honeyeater birds; Cream-striped Shining Skink and Garden Sunskink; and signs of mammals such as bandicoots and wallabies. This adds to the range of biodiversity detected over several years using the different brackish and freshwater influenced vegetation types of Zone 2.

Weeds

Weed pressure was observed to be low in Zone two with only minor infestations of Camphor Laurel and Five-leaved Morning Glory in Zone 2C to the south. Dense vegetation groundcover was observed to exclude weed establishment.

Routine weed maintenance works identified during 2019 monitoring was scheduled to be undertaken in February 2020 and delayed due to wet weather since early February. Suitably qualified and experienced bush regenerators commenced weed control on 13/03/20 using industry best practice methods for weed control and chemical handling in line with DPI (2018), BSRLG (1998), the North Coast Regional Strategic Weed Management Plan 2017-2022 (North Coast Local Land Services, 2017) and the RRMP.

² NSW Department of Primary Industries (DPI) 2018, Weed Control Handbook – A guide to weed control in non-crop, aquatic and bushland situations 7th Edition.

³ Big Scrub Rainforest Landcare Group (BSRLG), 1998, *Common Weeds of Northern NSW Rainforest, A practical manual on their identification and control*, 2nd Ed., Big Scrub Rainforest Landcare Group, Mullumbimby NSW.



Modifications

No structural modifications or illegal modifications were made within Zone 1. All fences were noted to be in a good condition with no fencing repairs required.

Vegetation Regeneration

Natural regeneration/ recruitment of a relatively limited range of native plants was observed in Zone 2. Growth continued of primary canopy species Broad-leaved Paperbark, Coast Banksia and Swamp Oak. Height ranges of canopy species were not observed to substantially change.

A relatively simple range of understory and groundcover species were recorded in brackish water influenced environments dominated by dense cover of Swamp Oak, Rushes (*Juncus* spp.) and Common Reed. Higher plant diversity was observed in more elevated areas to the south of Zone 2 as shown in Routine Rehabilitation Monitoring Sheets. Low levels of drought stress were observed and no performance criteria were exceeded in Zone 2.

Zone 3

General Management

No fires, rubbish dumping, plant theft, cattle grazing, stockpiling or unauthorised person or vehicle access.

Biodiversity

The moderately high diversity of vegetation in Zone 3 was reflected in the range of fauna observations using the site. This included birdlife (e.g. predatory Wedge-tailed Eagle and Whistling Kite; and various honeyeater and insectivorous birds), an Eastern Small-eyed Snake, skinks and signs of bandicoots. This adds to the range of biodiversity detected over several years occupying and using vegetation in Zone 3.

Weeds

Various weed species observed included minor infestations of Lantana, Camphor Laurel, Winter Senna, Umbrella Tree, Five-leaved Morning Glory, White Passionfruit, Tobacco Bush, Blue Billygoat Weed and Corky Passionfruit. Weed infestations occur mostly along vegetation edges, a trend continuing from previous years.

Routine weed maintenance works identified during 2019 monitoring was scheduled to be undertaken in February 2020 and delayed due to wet weather since early February. Suitably qualified and experienced bush regenerators commenced weed control on 10/03/20 using industry best practice methods for weed control and chemical handling in line with DPI (2018)⁴, BSRLG (1998)⁵, the North Coast Regional Strategic Weed Management Plan 2017-2022 (North Coast Local Land Services, 2017) and the RRMP.

Modifications

No structural modifications or illegal modifications were made within Zone 3. All fences were noted to be in a good condition. A failed Banksia tree over the exclusion fence was cut to prevent fence damage.

Vegetation Regeneration

Excellent natural regeneration/ recruitment of native plants was observed in Zone 3 despite a drought through most of the Spring/ Summer growing period. Growth continued of primary

⁴ NSW Department of Primary Industries (DPI) 2018, Weed Control Handbook – A guide to weed control in non-crop, aquatic and bushland situations 7th Edition.

⁵ Big Scrub Rainforest Landcare Group (BSRLG), 1998, *Common Weeds of Northern NSW Rainforest, A practical manual on their identification and control*, 2nd Ed., Big Scrub Rainforest Landcare Group, Mullumbimby NSW.



canopy species Broad-leaved Paperbark, Coast Banksia and Swamp Oak. Height ranges of canopy species were not observed to substantially change.

A range of mostly closed rainforest understory shrub and groundcover species were recorded as shown in Routine Rehabilitation Monitoring Sheets for Zone 3. Low levels of drought stress were observed and no performance criteria were exceeded in Zone 3.

Site Condition (Form B), refer to Appendix 3

Zone 1

Very high levels of planting survival rates, native plant recruitment. Vegetation cover is variable with high levels of leaf litter and native grass and forb cover in patches. Leaf litter levels increased substantially following leaf-drop in response to Spring & Summer drought conditions. Drought-breaking rainfall in February 2020 has vastly improved growing conditions. Minor but increasing weed pressure following recent rainfall, mostly along vegetation edges. Minor infestations of Lantana, Camphor Laurel, Ground Asparagus, Winter Senna, Umbrella Tree, Bitou Bush, Pinus sp. and Corky Passionfruit. All of Zone 1 is rated as A, i.e. on track towards target but dependent on effective weed control to be undertaken.

Zone 2

High levels of planting survival rates and moderate to high levels of native plant recruitment. Vegetation cover is variable with high levels of native grass cover in some areas. Brackish conditions to the north and minor but increasing weed pressure to the south in Zone 2C where there are minor infestations of Camphor Laurel and Five-leaved Morning Glory. Drought-breaking rainfall in February 2020 has vastly improved growing conditions. All of Zone 2 is rated as A, i.e. on track towards target.

Zone 3

High levels of planting survival rates and native plant recruitment, particularly following drought-breaking rainfall in February 2020. Vegetation cover is variable with high levels of leaf litter and native grass cover. Drought-breaking rainfall in February 2020 has vastly improved growing conditions. Minor but increasing weed pressure following recent rainfall, mostly along vegetation edges. Minor infestations of Lantana, Camphor Laurel, Winter Senna, Umbrella Tree, Five-leaved Morning Glory, White Passionfruit, Tobacco Bush, Blue Billygoat Weed and Corky Passionfruit. All of Zone 3 is rated as A, i.e. on track towards target but dependent on effective weed control to be undertaken.

Forest Structure and Floristic Composition (Forms C & D), refer to Appendix 4

Monitoring undertaken annually at established, semi-permanent 50m x 20m monitoring plots in Zones 1, 2 and 3.

Zone 1

Groundcover was assessed in 1m x 1m quadrats at 5m, 25m and 45m along the established 50m transect. Leaf litter averaged 50% cover and native ferns dominated plant cover followed by native seedlings and shrubs and grasses. Native herb cover was a minor component and there was no bare soil. An assessment of coarse woody debris along the 50m transect found an increase in coarse woody debris from previous years of monitoring. Otherwise, no substantial change was noted from transect monitoring results from previous years.



Canopy foliage cover was both visually estimated and estimated against canopy cover range photographs in 10m x 10m quadrats at 5m, 25m and 45m along the established 50m transect. Canopy cover ranged between 40% and 70% and averaged 55%.

Canopy height was recorded by estimating the height of the tallest tree within each 10m x 10m quadrat at 5m, 25m and 45m along the established 50m transect. No emergent trees were noted and canopy height was visually estimated to be greater than 12m and 14m which is an increase on previous years of monitoring. This is indicative of continued canopy growth and development.

Special life forms were recorded within each 10m x 10m quadrat at 5m, 25m and 45m along the established 50m transect. Slender vines included Coastal Cynanchum, Twining Guinea Flower and Snake Vine. Ground ferns included Bracken, Gristle Fern, Bungwall and Climbing Fishbone. Blueberry Lilly as a strap-leaved life form and two Lantana plants were recorded as thorny scramblers. This extended special life form records from previous years of monitoring. Overall, the site continues to be on good track for rehabilitation.

Floristic composition assessments were made for each vegetation strata in 10m x 10m quadrats at 5m, 25m and 45m along the established 50m transect. Broad-leaved Paperbark, Swamp Oak, Coast Banksia and Swamp Mahogany were recorded as the main canopy species. A range of species were recorded in the midstory and understory/groundcover (refer to **Appendix 4**).

Excellent native recruitment and development was noted in all strata. Notable common species included Swamp Oak, Coast Banksia, Wattle spp., Celerywood, Corkwood, Macaranga, Bracken, Slender Panic Grass, Blueberry Lily, Twining Guinea Flower and Bungwall Fern.

Additional weed species were recorded from previous years of monitoring. Routine weed control commenced on 12/03/20 targeting Lantana, Camphor Laurel, Corky Passionfruit, Pinus sp., Ground Asparagus, Umbrella Tree and Senna.

Zone 2

Groundcover was assessed in 1m x 1m quadrats at 5m, 25m and 45m along the established 50m transect. Leaf litter averaged 50% cover in two of the three quadrats and native grasses and ferns dominated plant cover with native herb cover a minor component. There was no bare soil. An assessment of coarse woody debris along the 50m transect found an increase in coarse woody debris from previous years of monitoring. Otherwise, no substantial change was noted from transect monitoring results from previous years.

Canopy foliage cover was both visually estimated and estimated against canopy cover range photographs in 10m x 10m quadrats at 5m, 25m and 45m along the established 50m transect. Canopy cover ranged between 35% and 55% and averaged 42%.

Canopy height was recorded by estimating the height of the tallest tree within each 10m x 10m quadrat at 5m, 25m and 45m along the established 50m transect. No emergent trees were noted and canopy height was visually estimated to be greater than 12m which is an increase on previous years of monitoring. This is indicative of continued canopy growth and development.

Special life forms were recorded within each 10m x 10m quadrat at 5m, 25m and 45m along the established 50m transect. Slender and robust vines included Twining Guinea Flower and Silkpod. Ground ferns included Bracken and Bungwall. Blueberry Lilly as a strap-



leaved life form. This extended special life form records from previous years of monitoring. Overall, the site continues to be on good track for rehabilitation.

Floristic composition assessments were made for each vegetation strata in 10m x 10m quadrats at 5m, 25m and 45m along the established 50m transect. Broad-leaved Paperbark, Swamp Oak and Coast Banksia were recorded as the main canopy species. A range of species were recorded in the midstory and understory/ groundcover (refer to **Appendix 4**).

Excellent native recruitment and development was noted in all strata. Notable common species included Swamp Oak, Coast Banksia, Corkwood, Bracken, Slender Panic Grass, Blueberry Lily, Twining Guinea Flower, Bungwall Fern, Whiteroot and Indian Pennywort.

Additional weed species were recorded from previous years of monitoring. Routine weed control commenced on 12/03/20 targeting Camphor Laurel and Five-leaved Morning Glory.

Zone 3

Groundcover was assessed in 1m x 1m quadrats at 5m, 25m and 45m along the established 50m transect. The shade-tolerant Slender Panic Grass native grass dominated groundcover (average 68% cover) followed by leaf litter (average 13% cover) and ferns; tree seedlings and shrubs; herbs; and vines as minor components and there was no bare soil. An assessment of coarse woody debris along the 50m transect found an decrease in coarse woody debris from previous years of monitoring. Otherwise, no substantial change was noted from transect monitoring results from previous years.

Canopy foliage cover was both visually estimated and estimated against canopy cover range photographs in 10m x 10m quadrats at 5m, 25m and 45m along the established 50m transect. Canopy cover ranged between 45% and 55% and averaged 48%.

Canopy height was recorded by estimating the height of the tallest tree within each 10m x 10m quadrat at 5m, 25m and 45m along the established 50m transect. No emergent trees were noted and canopy height was visually estimated to be greater than 10m and 12m which is an increase on previous years of monitoring. This is indicative of continued canopy growth and development.

Special life forms were recorded within each 10m x 10m quadrat at 5m, 25m and 45m along the established 50m transect. Slender and robust vines included Silkpod, Twining Guinea Flower and Snake Vine. Ground ferns included Bracken, Blueberry Lilly was recorded as a strap-leaved life form and Red-fruited Saw Sedge was recorded as a thorny scrambler. This extended special life form records from previous years of monitoring. Overall, the site continues to be on good track for rehabilitation.

Floristic composition assessments were made for each vegetation strata in 10m x 10m quadrats at 5m, 25m and 45m along the established 50m transect. Broad-leaved Paperbark, Swamp Oak and Coast Banksia were recorded as the main canopy species. A range of species were recorded in the midstory and understory/ groundcover (refer to **Appendix 4**).

Excellent native recruitment and development was noted in all strata. Notable common species included Broad-leaved Paperbark, Swamp Oak, Coast Banksia, Corkwood, Bracken, Slender Panic Grass, Blueberry Lily, Twining Guinea Flower, Whiteroot, Indian Pennywort, Blady Grass, Native Peach, Cheese Tree and native Coffee Bush.



Additional weed species were recorded from previous years of monitoring. Routine weed control commenced on 12/03/20 targeting Lantana, Senna, Umbrella Tree, Camphor Laurel, Corky Passionfruit, White Passionfruit, Five-leaved Morning Glory, Tobacco Bush and Blue Billygoat weed.

Routine Fauna Nest Box Monitoring (six-monthly), refer to Appendix 5

Monitoring of fauna nest boxes was performed using a ladder and snake-eye inspection camera. A Common Brushtail Possum was detected in a Cockatoo nest box in zone 1, and fauna scratch marks were detected on another nest box. Otherwise there were no signs of fauna use of nest boxes. Nest boxes were opened where necessary to clear spiders and ants, otherwise they were found to be in good condition with no repair or maintenance requirements. The limited fauna use of nest boxes by fauna may be indicative of the availability of hollow habitat resources in mature and over-mature trees in surrounding forested areas.

Environmental Protection Zone Performance Criteria

Performance criteria are considered to have been achieved in relation to

- Existing native vegetation and areas of natural regeneration to be retained
- All rubbish/vegetation dumping, non-approved structures etc are removed from the EPZs
- Cattle and domestic animals are excluded
- A survival rate of the following minimum standards are to apply for all planted trees, shrubs and groundcovers:
 - One year following planting: 90%
 - Three years following planting: 90%
 - Five years following planting: 85%
- Planted stock to exhibit fair or healthy conditions and meet minimum growth rate standards set out in the RRMP.
- No substantial impacts have been detected in relation to:
 - Inappropriate public access
 - Litter and/or rubbish dumping
 - Stock theft
 - Bicycle/pedestrian tracks/trails
 - Soil compaction
 - Fence signage vandalism/removal
 - Cattle access and associated damage (i.e. grazing, trampling etc)
- Canopy coverage, density and diversity performance requirements for trees and shrubs
- Groundcover and natural regeneration including bare ground cover.

Note management zones contain a mosaic of variable levels of tree cover and species mixes. High levels of native recruitment and plant development and growth in all strata are considered to negate the need for any further supplementary plantings at this point in time.

Routine weed control works commenced on 12/03/20 to address isolated weed occurrences mostly along vegetation edges and ensure performance criteria are achieved, i.e:

- No declared weeds are present
- A significant reduction in the presence of weed species is evident. In practice it is noted that the removal of all individuals of all weed species for 100% of the time is unachievable. Therefore, it is considered appropriate that the following performance criteria be adopted:
 - All large weed/ornamental trees are treated
 - No weed shrubs/trees older than three months of age are present
 - Densities of such shrubs/trees is not to exceed 1 per 20m²



Arbor Ecological

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Quarry, Pottsville NSW
13/03/20

- Scattered groundcover weed species may occur but not in any covering an area greater than 5m²

All management zones are considered to consist of healthy vegetation communities and are on-track to achieving rehabilitation.



APPENDIX 6

DUNLOE SAND QUARRY 2018 – 2019 RETURN FOR EXTRACTIVE MATERIALS FORM



RETURN FOR EXTRACTIVE MATERIALS: YEAR ENDED 30 JUNE 2019

Quote RIMS ID in all correspondence

Quarry Id:	Rims ID: 401091	Inquiries please telephone: (02) 4063 6713 Completed or Nil Returns Email – mineral.royalty@planning.nsw.gov.au Postal Address (see below)
Operators Name: Address:	RAMTECH PTY LTD 30-32 LUNDBERG DR MURWILLUMBAH NSW 2484	
Email:	daniel.dwyer@lafargeholcim.com	Please amend name, postal address and location of mine or quarry if incorrect or incomplete.
Quarry Name:	DUNLOE SANDS	
Quarry Address:	'DUNLOE PARK', POTTSVILLE-MOOBALL RD POTTSVILLE NSW 2489	

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.

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.

Director, Resource Planning & Projects

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

Typical Geology _____ **BACK BEACH FLUVIATILE SAND**

Nearest Town to Quarry _____ **POTTSVILLE 2489**

Local Council Name _____ **TWEED SHIRE COUNCIL**

Deposited Plan and Lot Number/s of Quarry _____ **DP755721, DP780198, LOT 1 & LOT 2 DP78019**

Email Address of Operator _____ daniel.dwyer@lafargeholcim.com

Name of Owner or Licensee _____ **LAFARGEHOLCIM AUSTRALIA**

Postal Address of Licensee _____ **Pacific Highway 2450 Coffs Harbour Australia**

Licence/Lease Number/s (if any)
 From Mineral Resources NSW (Industry & Investment NSW) _____ **DUNLOE SANDS/ Dunloe Park**
 From Department of Lands or other Department _____ **DUNLOE SANDS/ Dunloe Park**

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 _____

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 **17/09/2019**
- CONTACT PERSON for this return _____ **Daniel Dwyer**
- NAME (Block letters) _____ **DUNLOE SANDS** Telephone _ **0411 795 060**

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	Washed Screened Sand	184,251
Manufactured Sand		
Prepared Road Base & Sub Base		
Other Unprocessed Materials		
• River Gravel		
Over 30mm		
5mm to 30mm		
Under 5mm		
• Construction Sand	Excluding Industrial	
• 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		184,251
• Gross Value (\$) of all Sales		
• Type of Material		
• Number of Full-Time Equivalent (FTE) Employees	Employees: 3	Contractors 1

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