



Air Quality Annual Monitoring Report 2021

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Approvals

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Executive Summary

This report provides a review of the air quality monitoring programme carried out by OceanaGold New Zealand Limited (OGNZL) in and around Waihi, and related matters. The report is produced annually to provide a continuing record of the air quality performance of OGNZL. This report covers the 2021 calendar year and is produced in accordance with the Martha, Favona, Trio and Correnso Mines Air Quality Management Plan, 2019.

The information presented mainly relates to OGNZL's routine ambient air monitoring programme, which has been underway since 1982. The 2021 routine monitoring included measurements of total suspended particulate (TSP) and deposited particulate (DP) at 13 sites. There are 6 monitors for TSP and 9 monitors for DP.

Also included in this report are quality assurance measures, the results of any additional air quality monitoring and complaints received, as required by the consent conditions.

The conclusions of the 2021 review are the following:

- No exceedances of the threshold limits or breaches of the trigger levels occurred for TSP or DP during the year.
- OGNZL received three air quality complaints during 2021 (*cf.* one in 2020), however none were deemed to be mine related.

1 Introduction

Surface and underground mining operations can generate dust from drilling, blasting, ripping, grading, loading, haulage, tipping, crushing, conveying, and general vehicle movements. Dust can also be generated from exposed areas and stockpiles. Other mining air emissions include combustion gases (carbon monoxide and dioxide, nitrogen oxides and sulphur dioxide), directly from blasting and via exhaust emissions from machinery.

Several Discharge to Air consents (Consent 109741 for the Favona Mine, Consent 121697 for the Trio Mine, and Consent 124859 for the Golden Link Project Area) regulate the site air emissions. The requirement to provide an annual written report is a condition in each of the consents and the condition states:

The consent holder shall provide to the Waikato Regional Council a written annual report each year that addresses at least the following:

- (a) A summary of the results of the monitoring required by this consent.*
- (b) Any environmentally important trends arising from the monitoring programme.*
- (c) Comments on compliance with all conditions.*
- (d) Any reasons for non-compliance or difficulties in achieving compliance with the conditions of this resource consent.*
- (e) Any works that have been undertaken to improve environmental performance or that are proposed to be undertaken in the up-coming year to improve environmental performance in relation to the activities included in this consent.*

This report is prepared to satisfy that requirement. In particular, it gives a review of the air quality monitoring programme carried out by OGNZL at Waihi. The review covers the 2021 calendar year with reference to earlier years as appropriate.

This report also covers other air quality activities including other (non-routine) air quality monitoring, quality assurance measures and any complaints received.

2 Air Resource Consent & Air Quality Management Plan

The site's Discharge to Air resource consent (Golden Link Project Area consent 124859) authorises OGNZL to discharge contaminants to the air from the surface project area, mine portal, and vent shafts. This consent requires that OGNZL develops an Air Quality Management Plan (discussed below) to address air quality objectives, management and monitoring and which is reviewed and updated at least once every three years. This report is in accordance with the 2019 Air Quality Management Plan which was approved by Waikato Regional Council (WRC) in September 2020; the 2019 Plan is the latest approved version.

The Air Quality Management Plan is the guiding document for air quality management at OGNZL, the contents of which are defined in the consent. If there is a conflict or inconsistency

between the conditions of the consent and the provisions of the Air Quality Management Plan, the Discharge to Air resource consent shall prevail.

The Discharge to Air resource consent prescribes various process-type measures to reduce atmospheric emissions and assessments of environmental impacts. The resource consent also sets down the required content of this report.

A requirement of the Air Quality Management Plan is to specify air quality control measures. To meet this requirement OGNZL have adopted the concept of “trigger levels” as being ambient concentrations of air pollutants of concern, rather than ambient air quality guidelines that were more commonly used previously in air quality management. The trigger levels are set at about two-thirds the level of previous limits, and they are recorded in the Air Quality Management Plan.

When the trigger levels are exceeded, OGNZL is required to investigate and report on the reason for the elevated result and identify corrective action(s) to prevent a repeat occurrence where possible. The ambient air “trigger levels” specified in the Air Quality Management Plan are displayed in Table 1.

Table 1. Air Quality Parameters and Trigger Levels

	Total suspended particulate	Deposited particulate
Sample period	7-day average	30-day average
Unit of measure	$\mu\text{g}/\text{m}^3$	$\text{g}/\text{m}^2/\text{month}$
OGNZL trigger level	45	4

3 Routine Monitoring Programme

There are two types of dust measurement included in the routine ambient air monitoring programme: total suspended particulate and deposited particulate.

Although not part of the routine monthly/weekly monitoring programme, PM_{10} and silica monitoring has in the past been done biennially. After years of data collection by both OGNZL and WRC (with results within accepted limits), monitoring for PM_{10} and silica has been suspended, with a provision to reinstate a programme if/when considered necessary.

3.1 Monitoring Sites

Details of all 2021 dust monitoring sites are given in Table 2. During the calendar year, there have been a total of 13 sites in use for the routine monitoring programme (Figure 1).

Table 2. Description of 2021 Permanent Monitoring Sites

Site No	Description	Location	Air Monitor Type(s)
6.59	Alexander's, Golden Valley	N of Devt Site	DP
6.60	Torrens, Golden Valley	N of Mill	DP
6.61	Leaches, Grey St	NE of Pit	TSP, DP and Real-time TSP
6.63	Met Station, Barry Rd	SE of Pit	TSP, DP and Real-time TSP
6.64	Courthouse, Haszard Street	S of Pit	TSP
6.65	Moresby Avenue	SW of Pit	TSP
6.66	Waihi College, Rata Street	W of Pit	TSP and DP
6.71	Morrison's Farm, Trig Road	SE of Devt Site	DP
6.72	Ruddock's Farm, Baxter Road	W of Devt Site	DP
6.73	TSF East	E of Devt Site	DP
6.74	Bulltown Road	N of Pit	DP and Real-time TSP
6.78	Cnr Grey & Slevin Streets	E of Pit	TSP

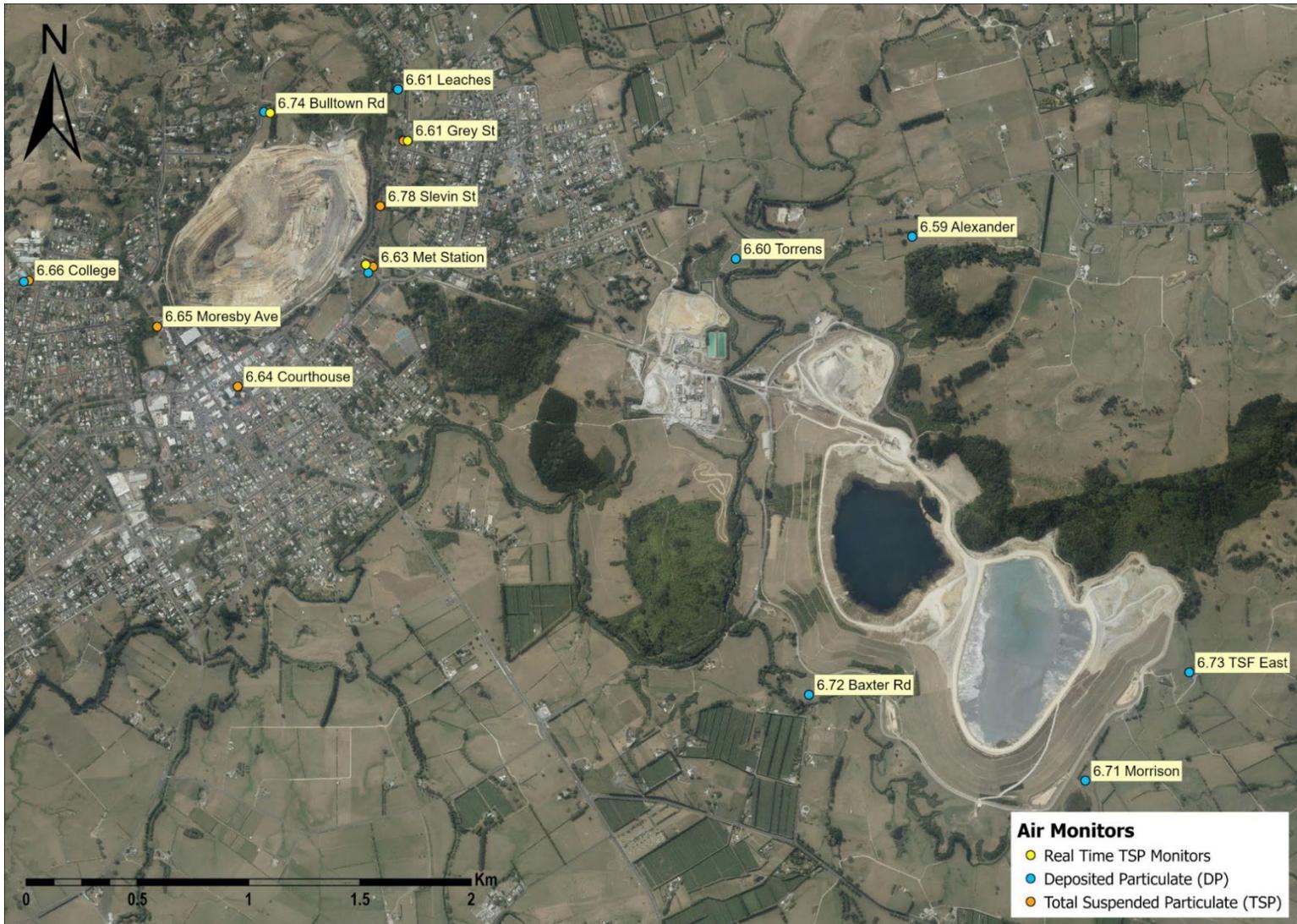


Figure 1. Waihi Dust Monitoring Sites

3.2 Quality Assurance

There are two key aspects of the quality assurance programme – gas meter calibrations and balance calibrations.

- The TSP gas meters at the suspended particulate monitoring sites were replaced with new calibrated units in June 2021.
- OGNZL's Precisa XT220A balance was calibrated on 24 June 2021. The "best accuracy" level was determined for the balance of up to 0.0006g in the 0-40g calibration range. This is considered satisfactory.

3.3 Quality Control

Two TSP monitors were affected with damaged filters during 2021, at different monitoring intervals. The TSP samples from 6.64 Courthouse and 6.65 Moresby Ave were both void for weeks ending 5 March and 17 September 2021, respectively.

One DP sample was contaminated during 2021. The sample from 6.74 Bulltown Rd was unable to be filtered for the January monitoring period, due to contamination of the sample with organic material.

3.4 Impacts of COVID-19 on TSP and DP Monitoring

During the 2021 reporting period, monitoring for TSP was disrupted due to the lockdown period from August to September 2021. All TSP sites were switched off and unsampled from 20 August to 3 September 2021 due to the lockdown restrictions. From 12 October to 5 November 2021, all TSP sites were switched off again as no filters were available due to supply issues. Monitoring of TSP sites resumed as scheduled for week ending 12 November 2021.

There were no COVID-19 related disruptions to DP monitoring.

4 Summary of Results

4.1 Total Suspended Particulate

The results of the weekly TSP monitoring for 2021 are given in Figure 2 and Appendix A.

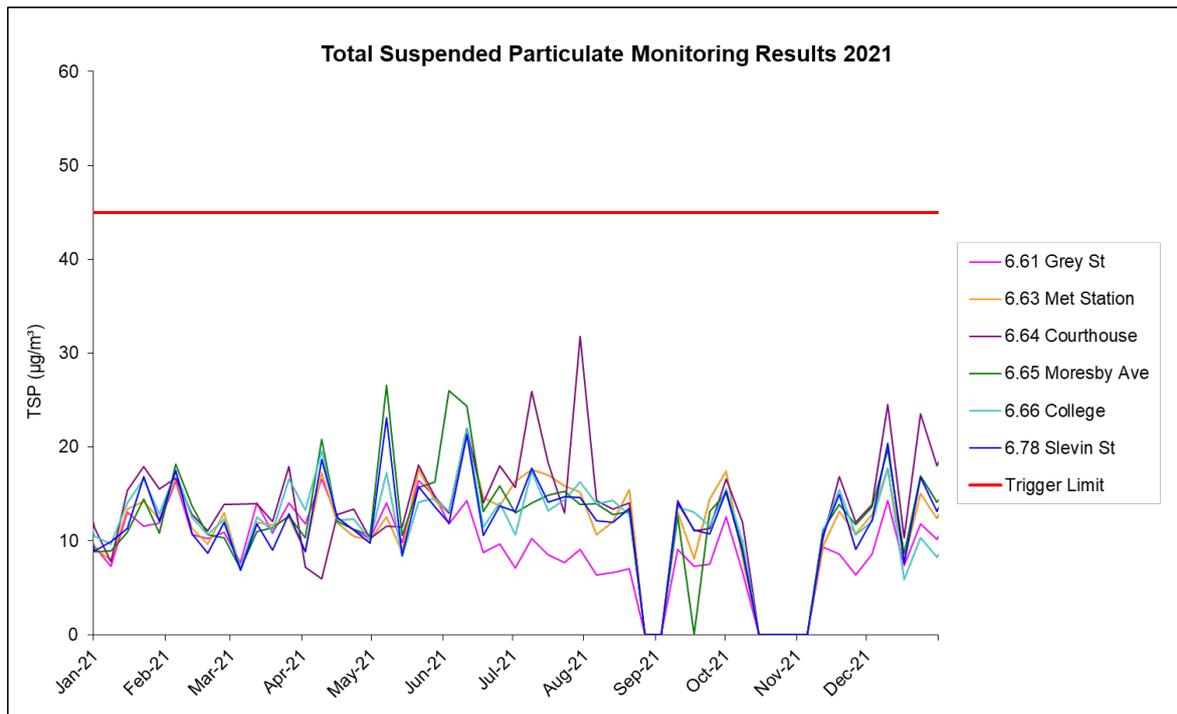


Figure 2. Total Suspended Particulate Results for 2021

No results exceeded the OGNZL TSP trigger limit of $45 \mu\text{g}/\text{m}^3$, seven-day average during 2021. The highest recording during the year was $31.8 \mu\text{g}/\text{m}^3$ at the 6.64 Courthouse monitor for the week ending 30 July (no other monitor exceeded $30 \mu\text{g}/\text{m}^3$ during the week concerned). This result may be related to a decrease in temperature compared to the previous month (mean monthly temperature 12.0°C in June and 9.8°C in July), which could have led to an increase in household heating and therefore higher TSP results. Previous year's results show a general trend of higher TSP concentrations during autumn and winter months. The average weekly reading across all sites was $13.0 \mu\text{g}/\text{m}^3$ (c.f. $13.9 \mu\text{g}/\text{m}^3$ in 2020).

4.2 Deposited Particulate

The results of the monthly DP monitoring for 2021 are given in Figure 3 and Appendix B.

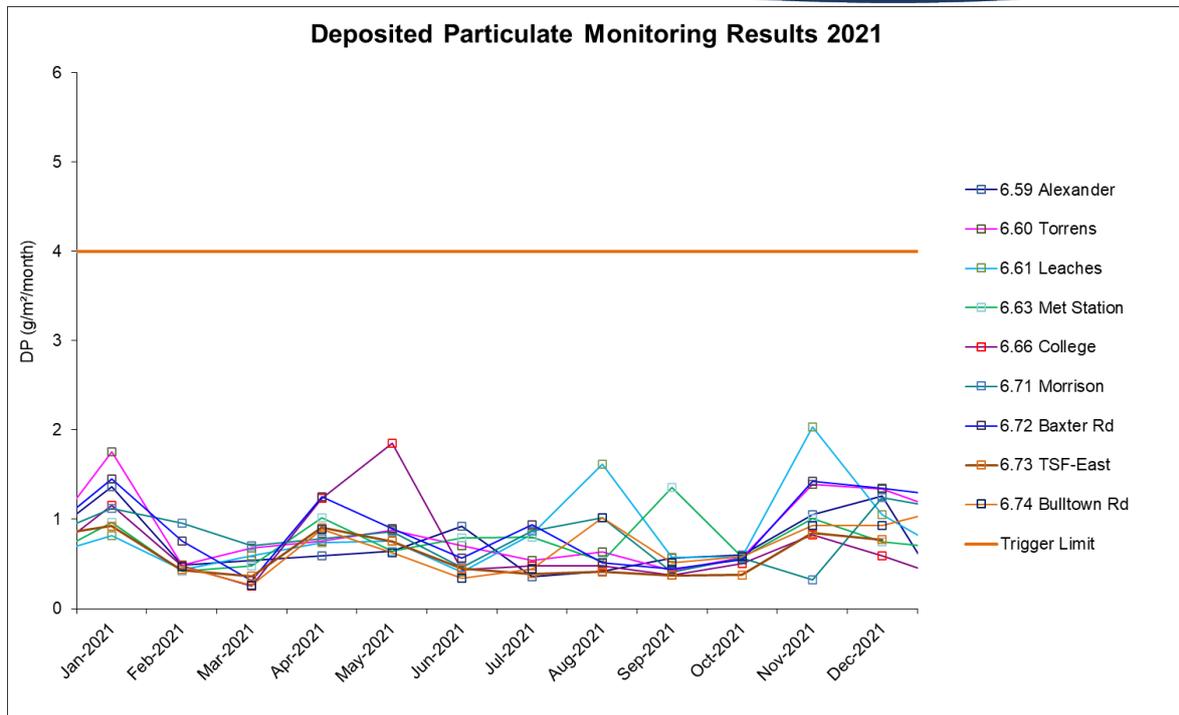


Figure 3. Deposited Particulate Results for 2021

No results exceeded the OGNZL DP trigger limit of 4 g/m²/month during 2021. The highest recording during the year was 2 g/m²/month at the 6.61 Leaches monitor for the month of November. This slightly higher result was likely due to fertiliser contamination from the surrounding farmland. No other site exceeded 2.0 g/m²/month for the reporting period. The average monthly reading across all sites was 0.8 g/m²/month (*c.f.* 0.7 g/m²/month in 2020).

4.3 Trends

The criteria of air quality trigger levels have applied for 24 years, and the dust concentrations appear to be below those trigger levels most of the time. It can be concluded that the air quality in and around Waihi is not deteriorating.

Figure 4 shows the long-term results of the TSP monitoring. The phases of active mining activities do not seem to have been reflected in corresponding changes in TSP levels, indicating that control measures during mining have been effective.

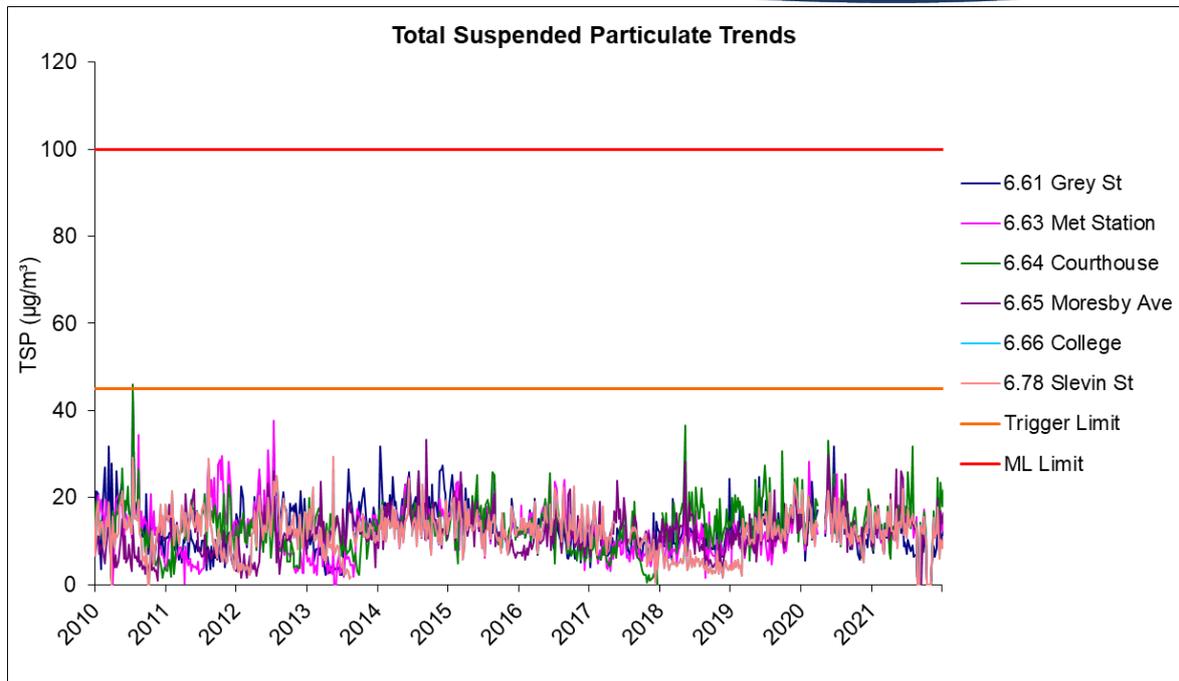


Figure 4. Total Suspended Particulate Trends from 2010 to 2021

Figure 5 shows the long-term DP results from the Waihi monitors. The 2021 results show a stable trend and compare well with results from the previous years.

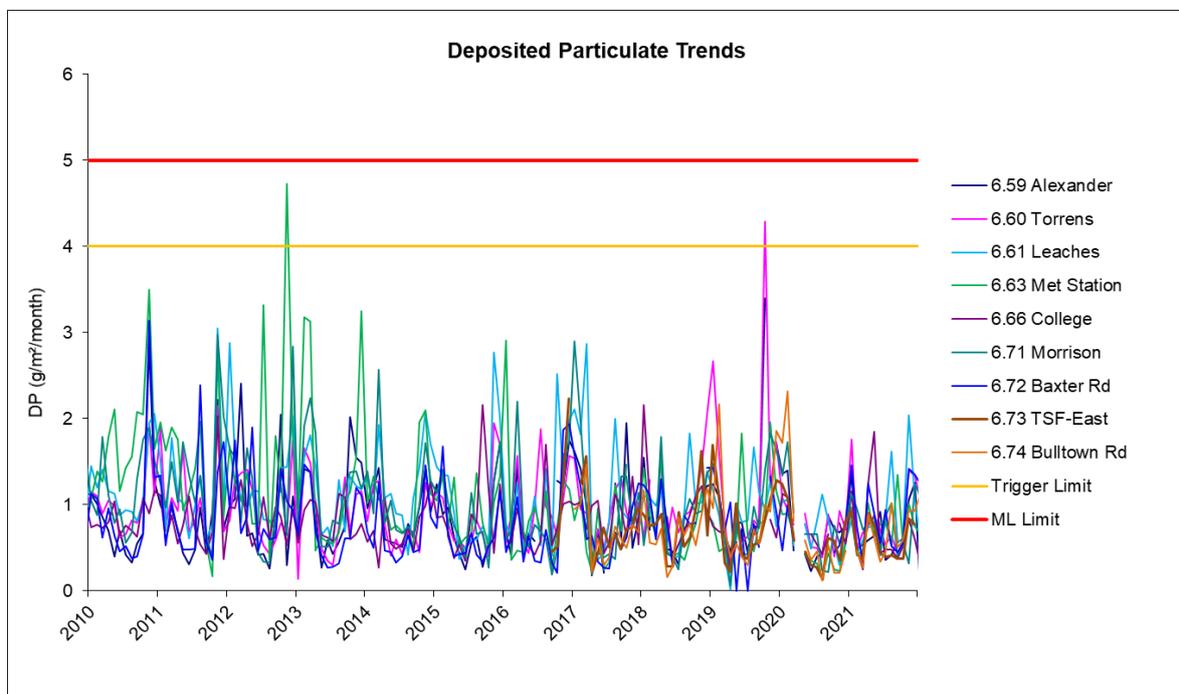


Figure 5. Deposited Particulate Trends from 2010 to 2021

4.4 Discretionary Deposited Particulate Monitoring

No discretionary deposited particulate monitoring was undertaken in 2021.

5 Compliance with Consent Conditions

5.1 General Operations 2021

Mining activities in 2021 remained as normal for most of the site's operations. Ore stockpiling continued as normal but experienced lower levels of activity compared with previous years. The Favona waste stockpile continues to be utilised to store waste rock from the Martha Underground since early 2020 (after being empty for 8 years). At the Development Site, earthworks were undertaken to raise the crest of TSF1A by 1.3 m in early 2021. The Martha pit remains in abeyance.

5.2 Complaints

Complaints about dust, smoke and blasting odour coming from the site's operations are matters of concern to OGNZL. No complaints were received in relation to the above parameters; however, three complaints in relation to air quality were received in 2021.

The first related to WRC receiving several complaints from the Russell St area regarding fires being lit at night. A staff member from WRC contacted OGNZL in April to find out if the mine was burning anything at night, however these fires were not related to the mine as material is not burnt on site at night.

The second complaint related to dust covering a resident's solar panels on the roof of their house in November. After inspection by a member of the environmental team, it was found that the solar panels had a film of pollen covering them. As a gesture of goodwill, it was decided that the panels would be soft washed at the company's expense.

In December, a third complaint was received where the complainant was concerned about weed spraying on the pit rim walkway. As a mitigating action for future works, extra signage will be used, and a notice issued via Facebook to ensure the public are aware of spraying in the area.

Details of any complaints or concerns received by OGNZL are recorded in a complaints/concerns register, along with information about any follow-up action. The register covers complaints on all operational matters, not just air quality, and has been in use since 1987. The number of complaints received about air quality each year are recorded in the register and listed in Table 3.

Table 3. Air Quality Complaints¹ Recorded in the Company's Register

Year	Number	Year	Number
1987	15	2005	2
1988	6	2006	3
1989	0	2007	8
1990	0	2008	7
1991	2	2009	5
1992	4	2010	6
1993	5	2011	26
1994	6	2012	11
1995	1	2013	10
1996	0	2014	5
1997	0	2015	7
1998	1	2016	4
1999	5	2017	5
2000	10	2018	2
2001	2	2019	0
2002	10	2020	1
2003	5	2021	3
2004	18		

5.3 Mitigation

The 2021 annual rainfall (1560 mm) was significantly less than the historical average of 2110 mm (Figure 6). The dry periods require OGNZL to be proactive with mitigating any dust emissions occurring from operating areas. Actions taken to mitigate dust emissions, particularly during dry summer periods, included the use of the sprinklers and watering roads in high activity areas. Speed restrictions on unsealed roads also reduced dust generation.

¹ Not all complaints were deemed to be mine-related.

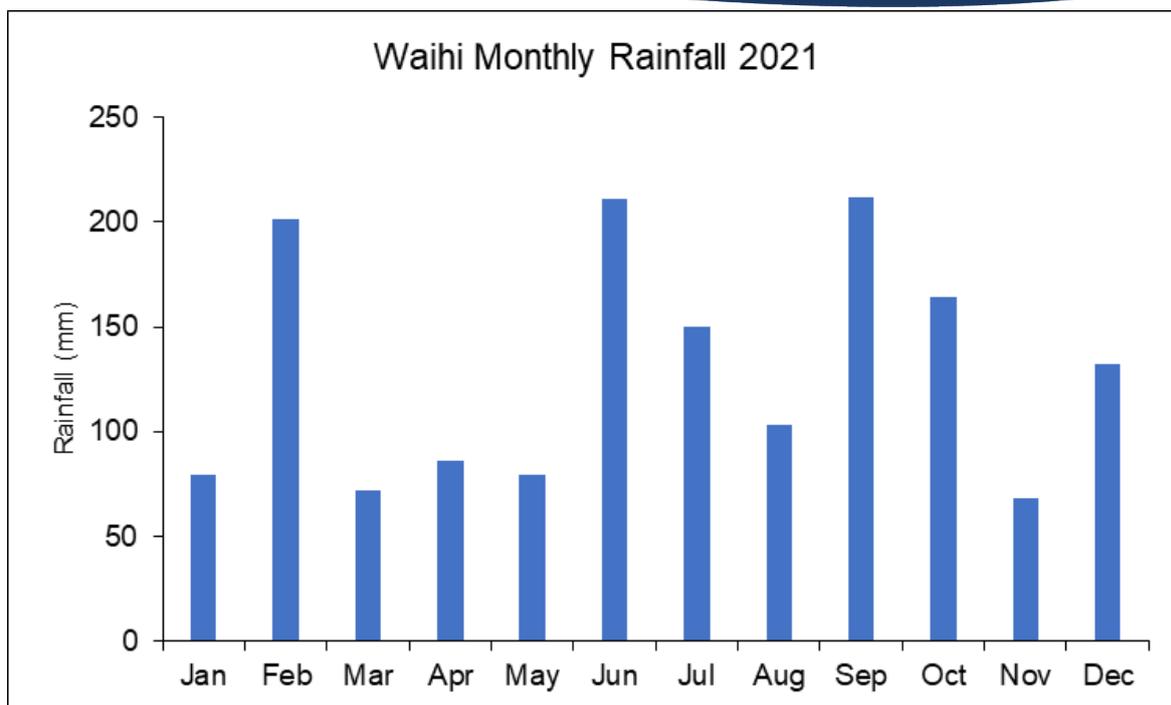


Figure 6. Waihi Monthly Rainfall 2021

Wind speed and direction followed typical seasonal patterns in 2021, with predominantly northeast and southwest winds. There were mostly light winds in summer and early autumn, while the strongest winds occurred in June and November (westerlies). The 2021 monthly wind roses for Waihi are displayed in Appendix C and compare well with data from the previous year.

5.4 Hydro-seeding, Tarsealing and Rehabilitation

Hydro-seeding and pasture establishment is normally carried out in response to new earthworks (e.g. pit cutbacks, TSF crest raising). No new hydro-seeding or pasture planting was undertaken during the year.

In 2021, the Development Site Southern Perimeter Road was re-sheeted, and minor tarseal repairs occurred on the access road and around the mill; no significant new areas were sealed.

6 Other Monitoring

6.1 PM₁₀ and Silica Monitoring

PM₁₀ and silica community monitoring was not conducted in 2021. Along with the suspension of production mining in the open pit, it has been agreed with WRC that PM₁₀ and silica monitoring can be suspended until such time that it is considered necessary.

6.2 Gold Room Stack Testing

To quantify emissions for the purposes of internal and corporate reporting, and to ensure workplace safety, occasional testing of specific emission sources is undertaken. Watercare Services Ltd was commissioned to undertake selected metals emission testing on the electrowinning and gold room furnace stack in February 2021.

6.3 Real-time TSP Monitoring

Three 'real-time' TSP monitors around the open pit were installed in 2021 to provide prompt feedback on TSP levels, ensuring that future earthworks in the open pit will have an established real-time system ready in advance. The monitors can also analyse for specific dust fractions (PM_{10} , $PM_{2.5}$, using special cyclones), should the need arise in the future.

The real-time TSP monitors were installed at 6.61 Grey St, 6.63 Met Station, and 6.74 Bulltown Rd (Figure 1), however, the Bulltown Rd monitor (6.74) wasn't operational until early 2022.

The Grey St monitor (6.61) developed a fault towards the end of October 2021 and was unable to be repaired immediately due to COVID-19 travel restrictions. Maintenance, instrument faults and power outages caused some issues with the continuous running of the Met Station monitor (6.63) and there are gaps in the dataset between June and September 2021 as a result.

The real-time TSP monitoring results for 2021 are given in Figure 7; currently there are no set trigger limits.

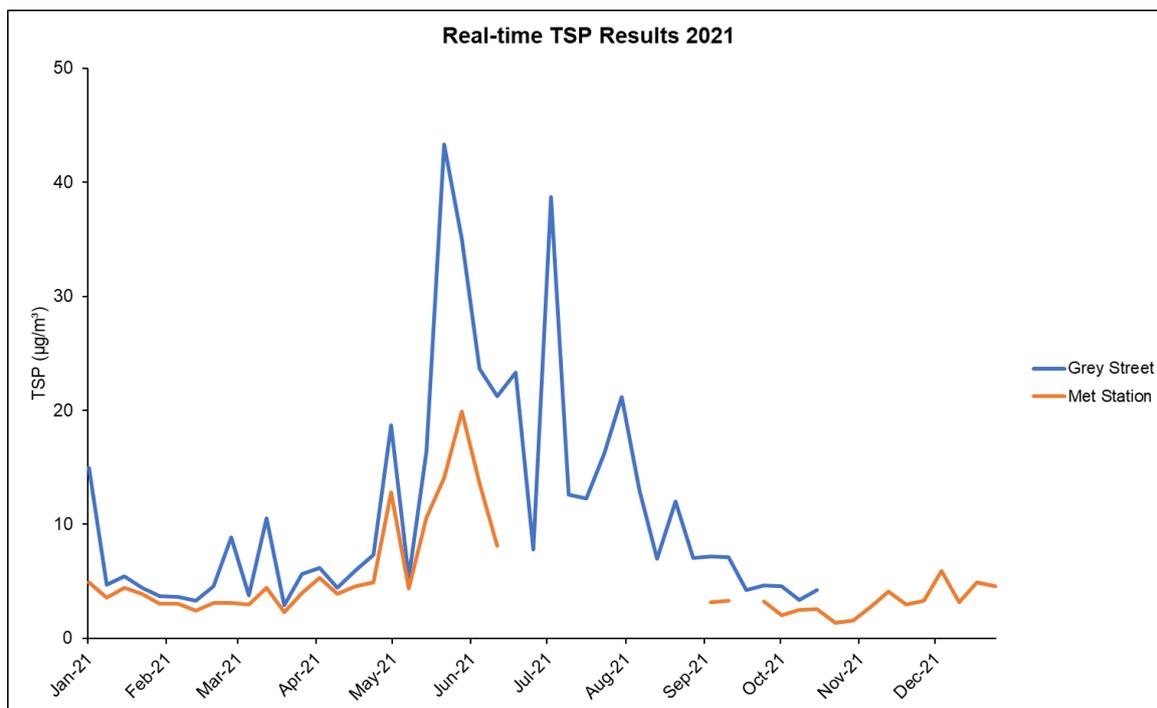


Figure 7. Real-time TSP Results for 2021

7 Future Monitoring

7.1 Deposited, Total Suspended Particulates

Ongoing operational activities followed by rehabilitation activities at Waihi will require dust control activities to be maintained and monitored for some time. At present, there is no consideration for altering the current DP and TSP programmes.

7.2 PM₁₀ and Silica

OGNZL had been undertaking biennial monitoring for PM₁₀ and silica and WRC also conducted a continuous monitoring programme for PM₁₀ from 2008 – 2011. Data has indicated that the mine is complying with standards and that Waihi is regarded as a 'complying airshed.' In consultation with WRC, it was agreed that PM₁₀ and silica monitoring can be suspended until such time that it is considered necessary. Future decisions will be based on any trends from the ongoing air quality monitoring programmes, as well as the implications of future mining activity.

8 References

- Beca Limited, March 2018: Project Martha - Assessment of Environmental Effects of Discharges to Air. Technical Report (Appendix L) for Project Martha consent application.
- Environment Waikato, November 2013: Air quality monitoring report for Hamilton, Tokoroa, Taupo, Te Kuiti, Putaruru, Matamata, Ngaruawahia and Turangi – 2012. Environment Waikato Technical Report TR-2013/33.
- Ministry for the Environment, 2009: Good Practice Guide for Air Quality Monitoring and Data Management 2009.
- Ministry for the Environment, 2016: Good Practice Guide for Assessing and Managing Dust.
- Newmont Waihi Gold, 2007: Fine Particles and Silica Concentrations in the Vicinity of Newmont Waihi Gold, October 2007. Unpublished report.
- Resource Management, 2004: (National Environmental Standards for Air Quality) Regulations 2004.
- Sinclair Knight Mertz, October 2003: Favona Underground Mine, Waihi, Report to: Environment Waikato – Assessment of Air Quality Aspects. Unpublished report for Environment Waikato.
- Watercare Services Limited, March 2021: OceanaGold Waihi Limited, Selected Metals – Electrowinning and Gold Room Furnace Stacks, February 2021. Unpublished report for OceanaGold Waihi.
- WorkSafe New Zealand, November 2020: Workplace exposure standards and biological exposure indices.

Appendix A. Total Suspended Particulate Monitoring Results 2021 ($\mu\text{g}/\text{m}^3$)

AIR QUALITY

TOTAL SUSPENDED PARTICULATE (TSP) RESULTS

Co-ordinates refer to NZMS 260 T13 Paeroa

All Measurements in $\mu\text{g}/\text{m}^3$

Above trigger limit (45)
Near trigger limit (40-45)

Period Ending Date	6.61 Grey St	6.63 Met Station	6.64 Courthouse	6.65 Moresby Ave	6.66 College	6.78 Slevin St
1-Jan-21	9.4	9.2	11.4	8.8	10.5	8.9
8-Jan-21	7.3	7.9	7.8	9.0	9.6	9.9
15-Jan-21	13.0	13.4	15.3	10.9	14.1	11.3
22-Jan-21	11.6	14.2	17.9	14.5	16.6	16.9
29-Jan-21	11.9	12.3	15.5	10.9	12.9	12.1
5-Feb-21	16.4	16.6	16.6	18.2	17.3	17.5
12-Feb-21	10.6	11.3	12.8	13.7	12.5	10.8
19-Feb-21	10.2	9.7	11.1	10.7	10.6	8.6
26-Feb-21	10.9	12.9	13.8	10.3	12.3	12.0
5-Mar-21	7.7	7.1	F	7.0	7.1	6.9
12-Mar-21	14.0	11.9	14.0	11.0	12.5	11.8
19-Mar-21	10.8	11.6	12.1	11.4	11.1	9.0
26-Mar-21	14.0	12.5	17.9	12.6	16.6	12.9
2-Apr-21	11.8	8.9	7.2	10.3	13.3	8.8
9-Apr-21	16.6	17.3	6.0	20.8	19.6	18.7
16-Apr-21	12.5	11.9	12.8	12.1	12.3	12.5
23-Apr-21	11.2	10.5	13.3	11.3	12.3	11.2
30-Apr-21	10.2	10.1	10.2	10.6	10.2	9.7
7-May-21	14.1	12.5	11.6	26.6	17.2	23.1
14-May-21	9.9	8.8	11.5	10.6	8.4	8.4
21-May-21	16.4	17.7	18.1	15.7	14.1	15.8
28-May-21	14.8	14.3	14.7	16.2	14.5	13.6
4-Jun-21	11.8	13.0	13.0	26.0	13.1	11.9
11-Jun-21	14.3	21.6	22.0	24.3	22.0	21.3
18-Jun-21	8.8	14.7	14.0	13.1	11.5	10.6
25-Jun-21	9.6	13.7	18.0	15.9	14.0	13.7
2-Jul-21	7.1	16.3	15.7	13.0	10.6	13.2
9-Jul-21	10.3	17.6	26.0	14.0	17.4	17.7
16-Jul-21	8.5	17.0	18.3	14.9	13.2	14.1
23-Jul-21	7.7	15.8	13.0	15.2	14.4	14.7
30-Jul-21	9.0	15.2	31.8	13.9	16.3	14.6
6-Aug-21	6.4	10.7	14.2	14.0	13.9	12.1
13-Aug-21	6.6	12.0	13.4	12.8	14.3	11.9
20-Aug-21	7.1	15.5	14.0	13.1	12.8	13.5
27-Aug-21	Unsampled due to COVID-19 lockdown					
3-Sep-21	Unsampled due to COVID-19 lockdown					
10-Sep-21	9.1	13.0	14.3	12.6	13.6	14.1
17-Sep-21	7.3	8.1	11.1	F	13.0	11.1
24-Sep-21	7.5	14.4	11.3	13.2	11.6	10.7
1-Oct-21	12.5	17.4	16.6	15.1	15.5	15.2
8-Oct-21	6.7	8.2	12.0	9.2	9.9	8.8
15-Oct-21	Unsampled due to no filters being available					
22-Oct-21	Unsampled due to no filters being available					
29-Oct-21	Unsampled due to no filters being available					
5-Nov-21	Unsampled due to no filters being available					
12-Nov-21	9.3	9.4	10.3	11.1	10.9	10.7
19-Nov-21	8.6	13.2	16.8	13.9	15.4	15.0
26-Nov-21	6.4	10.8	12.0	11.8	10.7	9.1
3-Dec-21	8.6	12.8	13.9	13.7	12.0	12.2
10-Dec-21	14.3	17.7	24.5	19.8	17.7	20.4
17-Dec-21	7.4	7.9	10.4	8.6	5.9	7.6
24-Dec-21	11.8	15.1	23.5	17.0	10.3	16.7
31-Dec-21	10.1	12.4	18.0	14.1	8.3	13.2

CODE	DEFINITION
F	Filter damaged

Appendix B. Deposited Particulate Monitoring Results 2021 (g/m²/month)

AIR QUALITY

DEPOSITED PARTICULATE (DP) RESULTS

All measurements in g/m²/month

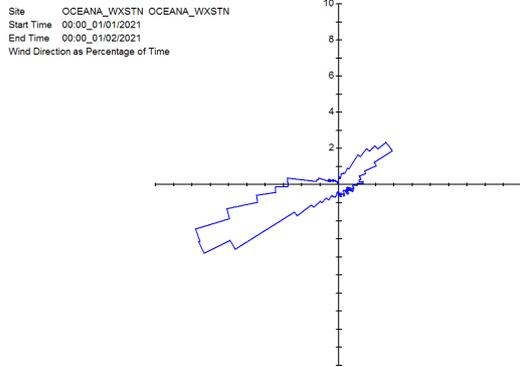
4 g/m ² /month	Above trigger limit
>3 g/m ² /month	Near trigger limit

YEAR		6.59	6.60	6.61	6.63	6.66	6.71	6.72	6.73	6.74
		Alexander	Torrens	Leaches	Met Station	College	Morrison	Baxter Rd	TSF East	Bulltown Rd
2021	Jan-21	1.4	1.8	0.8	1.0	1.2	1.1	1.5	0.9	O
	Feb-21	0.5	0.5	0.4	0.4	0.5	1.0	0.8	0.4	0.5
	Mar-21	0.5	0.7	0.6	0.5	0.2	0.7	0.3	0.4	0.3
	Apr-21	0.6	0.8	0.7	1.0	1.2	0.8	1.2	0.9	0.9
	May-21	0.6	0.9	0.8	0.6	1.9	0.9	0.9	0.8	0.6
	Jun-21	0.9	0.7	0.4	0.8	0.4	0.5	0.6	0.4	0.3
	Jul-21	0.4	0.5	0.8	0.8	0.5	0.9	0.9	0.4	0.4
	Aug-21	0.4	0.6	1.6	0.5	0.5	1.0	0.5	0.4	1.0
	Sep-21	0.6	0.4	0.6	1.4	0.4	0.4	0.4	0.4	0.5
	Oct-21	0.6	0.6	0.6	0.6	0.5	0.6	0.5	0.4	0.6
	Nov-21	1.1	1.4	2.0	1.0	0.8	0.3	1.4	0.8	0.9
	Dec-21	1.3	1.3	1.1	0.7	0.6	1.2	1.4	0.8	0.9

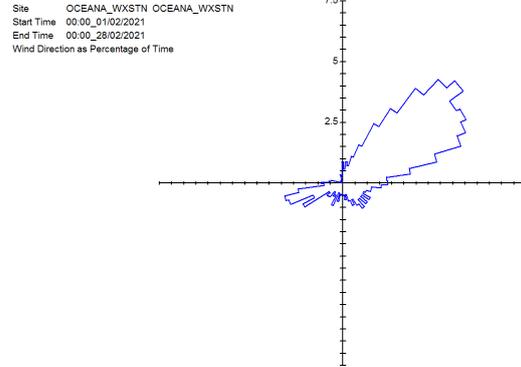
CODE	DEFINITION
O	Organics, unable to filter

Appendix C. 2021 Monthly Wind Roses, Waihi

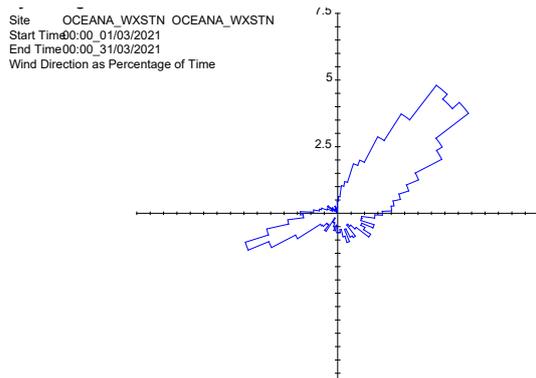
Jan 21



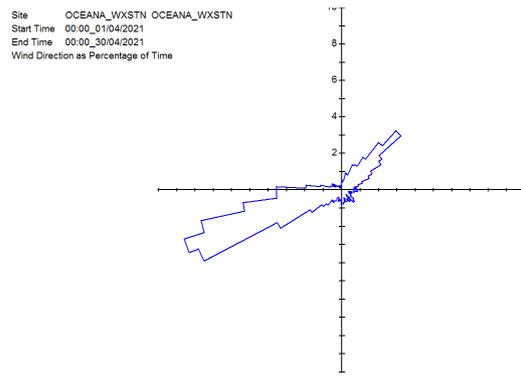
Feb 21



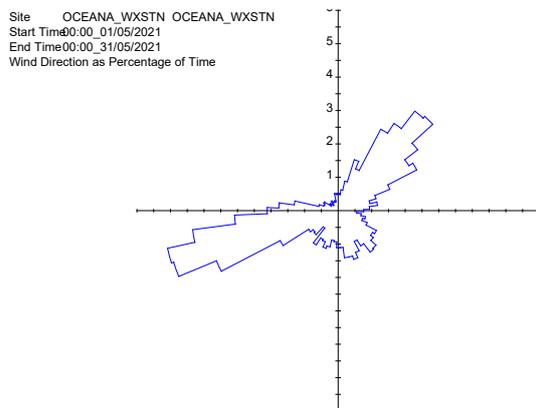
Mar 21



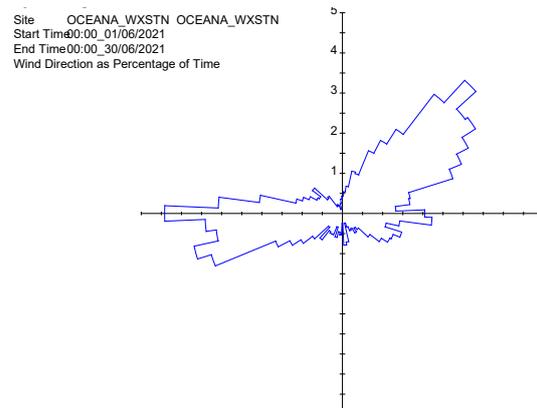
Apr 21



May 21

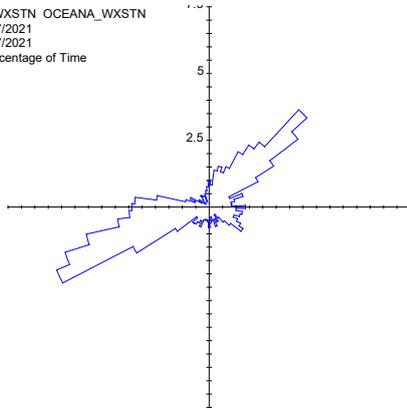


Jun 21



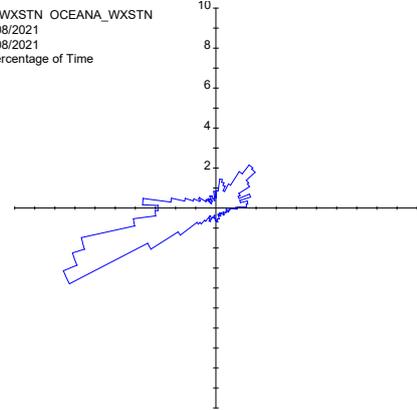
Jul 21

Site OCEANA_WXSTN OCEANA_WXSTN
Start Time0:00_01/07/2021
End Time00:00_31/07/2021
Wind Direction as Percentage of Time



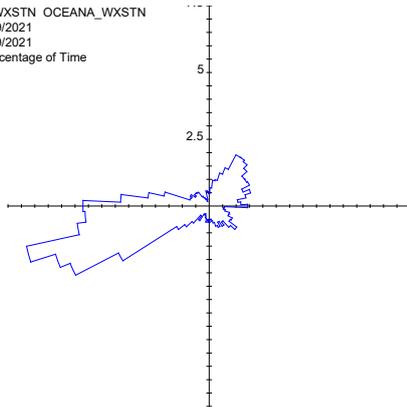
Aug 21

Site OCEANA_WXSTN OCEANA_WXSTN
Start Time0:00_01/08/2021
End Time00:00_31/08/2021
Wind Direction as Percentage of Time



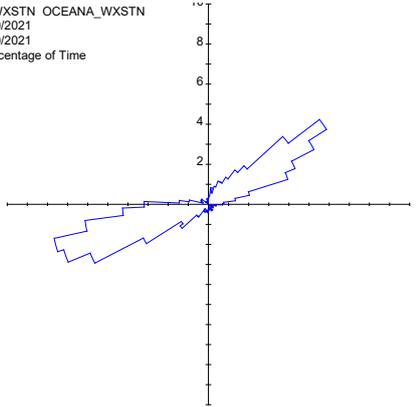
Sep 21

Site OCEANA_WXSTN OCEANA_WXSTN
Start Time0:00_01/09/2021
End Time00:00_30/09/2021
Wind Direction as Percentage of Time



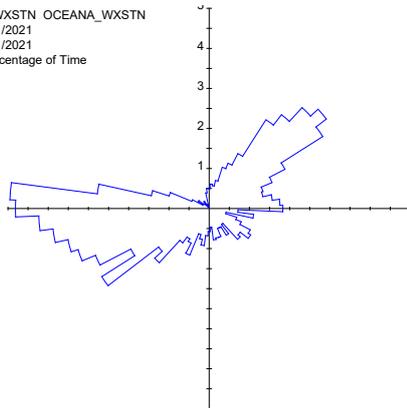
Oct 21

Site OCEANA_WXSTN OCEANA_WXSTN
Start Time0:00_01/10/2021
End Time00:00_31/10/2021
Wind Direction as Percentage of Time



Nov 21

Site OCEANA_WXSTN OCEANA_WXSTN
Start Time0:00_01/11/2021
End Time00:00_30/11/2021
Wind Direction as Percentage of Time



Dec 21

Site OCEANA_WXSTN OCEANA_WXSTN
Start Time0:00_01/12/2021
End Time00:00_01/01/2022
Wind Direction as Percentage of Time

