9.3. Annual Air Quality Report 2023

Prepared for: Environmental Science and Policy Comm

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Activity: Environmental: Air

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PURPOSE

[1] This annual report discusses the results of the State of the Environment (SOE) monitoring for air quality for the year 2023.

EXECUTIVE SUMMARY

[2] Monitoring of PM_{10} (particulate matter with a diameter of less than 10 micrometres) was undertaken in the Alexandra, Arrowtown, Central Dunedin and Mosgiel airsheds during 2023.

[3] Alexandra, Arrowtown and Mosgiel recorded exceedances of the NESAQ (National Environmental Standards for Air Quality) during the winter months. The limit for PM_{10} is 50 µg/m³ over a 24-hour average and there were a total of 17 exceedances. These results are consistent with the results reported in previous years.

[4] $PM_{2.5}$ (particulate matter with a diameter of less than 2.5 micrometres) was monitored at Arrowtown, Central Dunedin, Clyde, Cromwell, Milton and Wanaka. Arrowtown followed by Milton had the highest annual and winter average concentrations. This data cannot currently be compared to existing guidelines or the proposed NESAQ for $PM_{2.5,}$ due to the following: Arrowtown and Central Dunedin need to be tested for equivalence (currently ongoing), the other four sites' monitoring methods are not suitable under the NESAQ to compare with limits.

RECOMMENDATION

That the Council:

1) ***Notes** this report.*

BACKGROUND

[5] Otago has several towns where air quality is considered degraded during winter, namely Alexandra, Arrowtown, Clyde, Cromwell and Milton. Under the Resource Management Act (RMA), regional councils are required to monitor air quality, and to improve it where necessary. The main pollutant of concern is particulate matter (PM) which is a product of combustion. In Otago the main source of PM is home heating emissions in winter (Wilton, 2019). Long term exposure to PM_{10} and $PM_{2.5}$ contribute to the risks of developing and exacerbating existing cardiovascular and respiratory conditions, which

makes fine particulates a serious threat to human health. Furthermore, recent research provides evidence that air pollution is dangerous at lower concentrations than previously thought, and supports the lowering of existing guidelines (WHO, 2021).

[6] ORC operates an SOE monitoring network for PM_{10} and is required to report[1] exceedances of the NESAQ (50 µg/m³, 24-hour average). The SOE network is currently being upgraded to include monitoring for $PM_{2.5}$. The upgrade process includes a period of co-location and subsequent equivalence testing of the new instruments compared to the existing ones. Further comparison data is still required to be able to correct for the new instruments and accurately report some of their data.

AIR QUALITY ASSESSMENT FRAMEWORK

[7] Under the RMA, councils are required to monitor air quality and work towards meeting the standards of the NESAQ. The NESAQ is currently being updated to include limits for $PM_{2.5}$, and proposed limits were released in 2020. In 2021 the World Health Organization (WHO) released updated guidelines which recommend new and stricter limits for pollutants (WHO 2021). The standard that ORC must report against is the NESAQ; for context, other guidelines are given below (Table 1).

Table 1 Standards and guidelines for PM_{10} and $PM_{2.5}$

Pollutant	Averaging Time	NESAQ 2004		Proposed NESAQ 2020		WHO 2021	
		Value (µg/m³)	Allowable exceedances	Value (µg/m³)	Allowable exceedances	Value (µg/m³)	Allowable exceedances
PM_{10}	24-hour	50	1 per annum	50	1 per annum	45	3-4[b]
	Annual	20[a]	NA	NA	NA	15	NA
$PM_{2.5}$	24-hour			25	3 per annum	15	3-4[b]
	Annual			10	NA	5	NA

[a]AAQG (Ambient Air Quality Guideline, 2002) limit and NESAQ Guideline

[b]99th percentile, there can be 3-4 exceedances per year

[8] The air quality results can also be categorised according to the MfE (Ministry for Environment) Environmental Performance Indicators (EPI), outlined in the Ambient Air Quality Guidelines (AAQG) (2002). The EPI categories indicate an appropriate action according to the concentrations (Table 2). How the results measure against the MfE EPI is set out below in paragraph 10.

[1] Currently ORC reports exceedances by way of public notice in the ODT, as well as on the ORC website every month exceedances occur.

Table 2 MfE Environmental Performance Indicators for air quality

Category	Monitoring result compared to guideline	Description
Action	Exceeds the guideline	Unacceptable and action is required to reduce emissions
Alert	66-100%	Warning level which could lead to exceedances if trends are not curbed
Acceptable	33-66%	Maximum values might be a concern in sensitive locations, urgent action is not warranted
Good	10-33%	Peak measurements not likely to affect air quality
Excellent	0-10%	Not recommended for PM_{10} monitoring, PM_{10} in this range is classified as good instead

SOE MONITORING RESULTS: PM_{10}

[9] PM_{10} was monitored continuously at four sites across the region in 2023: Alexandra, Arrowtown, Central Dunedin and Mosgiel. A summary of the key PM_{10} monitoring indicators for 2023 are given in Table 3, with a detailed table of the NESAQ exceedances in Appendix 1. Arrowtown had the most exceedances, with ten, as well as the highest maximum daily concentration of 81 µg/m³. The highest annual mean occurred at Mosgiel, followed by Alexandra with 17 and 16 µg/m³ respectively. These annual means are compliant with the NESAQ, but not with the WHO guideline of 15 µg/m³.

Table 3 Key PM_{10} indicators for 2023

Site	Annual mean (µg/m³)	Winter mean (µg/m³)	Maximum daily concentration (µg/m³)	2nd highest daily concentration (µg/m³)	Number of NESAQ exceedances	Data capture (%)
Alexandra	16	24	51	51	3	94
Arrowtown	13	24	81	80	10	95
Central Dunedin	15	16	39	39	0	99
Mosgiel	17	21	58	56	4	83

Figure 1 PM_{10} concentrations for 2023 (24-hour average)

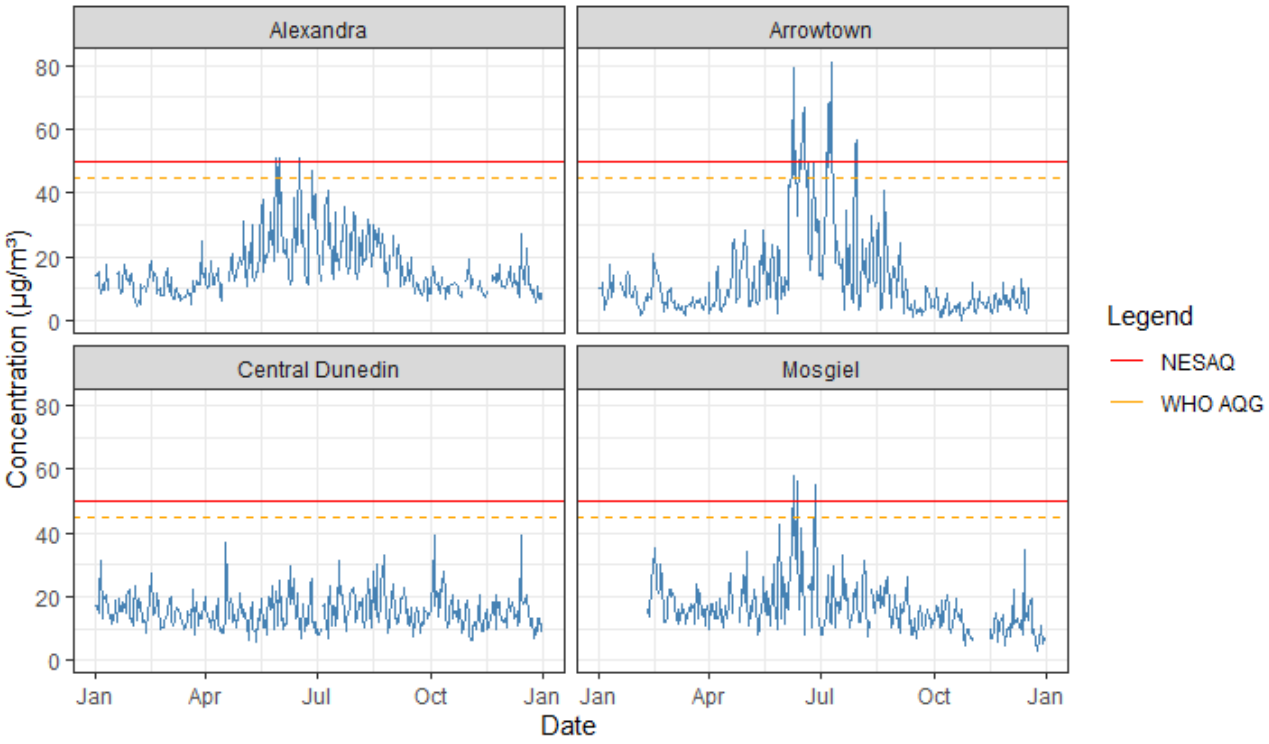
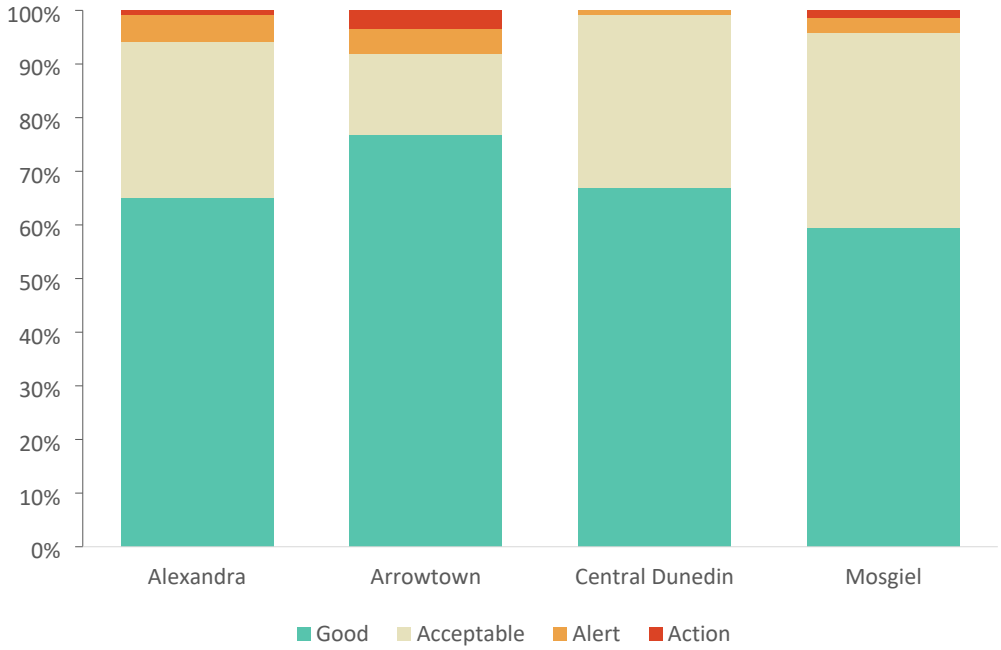


Figure 2 PM_{10} concentrations as air quality indicator categories for 2023 (24-hour average)



[10] When the PM_{10} data is sorted into the MfE indicator categories, all sites have over 60% data in the "good" category, with much of the rest of it within the "acceptable" category. All sites have less than 10% of their data in the "alert" category (Figure 2). The seasonality of Arrowtown's air quality is shown in this graph in particular,

highlighting both very low concentrations along with the most extreme high pollution days.

SOE MONITORING RESULTS: $PM_{2.5}$

[11] $PM_{2.5}$ was monitored continuously at six locations across the region in 2023: Arrowtown, Central Dunedin, Clyde, Cromwell, Milton and a new site that was installed in Wanaka at the beginning of winter. $PM_{2.5}$ was monitored using non-reference methods[2] at Clyde, Cromwell, Milton, and Wanaka. The instruments at Arrowtown and Central Dunedin are considered equivalent to reference methods and as such, can be compared to the proposed NESAQ, however a twelve-month period of co-location needs to be undertaken in order to establish a correction factor. As this has not been undertaken yet, none of the $PM_{2.5}$ data have been compared to limits or guidelines.

[12] A summary of the key $PM_{2.5}$ monitoring indicators for 2023 are given in Table 4. Central Dunedin recorded the lowest annual and winter means for 2023, and the Wanaka site recorded the second lowest winter mean. Unlike the other four monitoring locations these two appear to have the least seasonal variation. The sites with the highest concentrations were Milton (126 µg/m³ maximum daily concentration) followed by Arrowtown (116 µg/m³ maximum daily concentration).

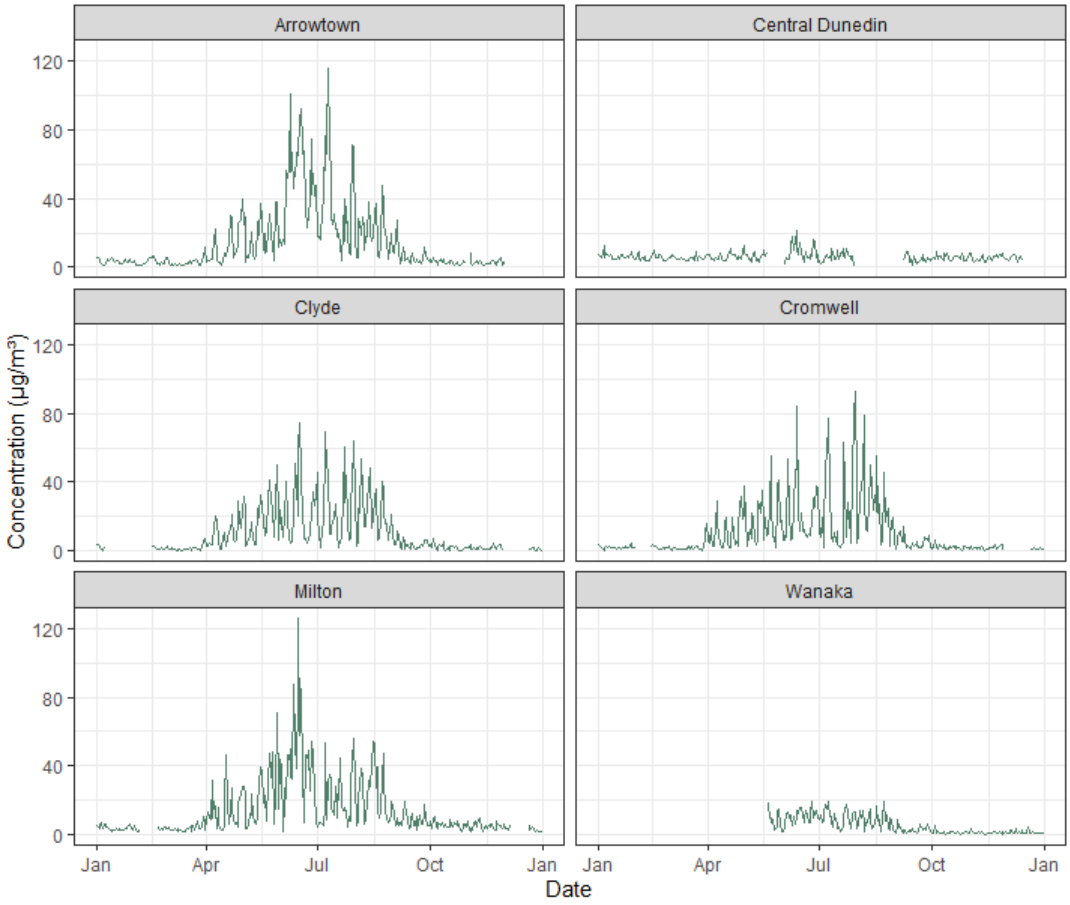
[13] For the Arrowtown site, all key indicators for $PM_{2.5}$ are higher than the ones for PM_{10}, which should not be possible. This is an example of why this data needs a correction factor.

Table 4 Key $PM_{2.5}$ indicators for 2023

Site	Annual mean (µg/m³)	Winter (May to August) mean (µg/m³)	Maximum daily concentration (µg/m³)	2nd highest daily concentration (µg/m³)	Data capture (%)
Arrowtown	15	31	116	101	91
Central Dunedin	6	7	21	18	81
Clyde	11	23	74	69	83
Cromwell	11	23	92	84	90
Milton	14	27	126	88	92
Wanaka	-	9	20	19	61

[2] Under the NESAQ only reference method instruments may be compared to standard limits

Figure 3 $PM_{2.5}$ concentrations for 2023 (24-hour average)



CONSIDERATIONS

Strategic Framework and Policy Considerations

[14] The work outlined in this paper contributes to the following elements of ORC's Strategic Direction:

- Monitoring air quality in the region and investigate pollution sources
- Provide best available information on Otago's air quality

Financial Considerations

[15] The air quality monitoring is a funded activity in both the Science and Environmental Monitoring areas.

Significance and Engagement

[16] N/A

Legislative and Risk Considerations

[17] Managing air quality is a regional council requirement in accordance with the NESAQ.

Climate Change Considerations

[18] N/A

Communications Considerations

[19] Air quality communications will continue during 2024.

NEXT STEPS

[20] Monitoring network upgrades will continue in 2024.

[21] This information will be used to inform the Air Plan review as it continues to be developed.

REFERENCES

ORC, 2021. *State and Trends of Air Quality in the Otago Region 2010-2019*. https://orc.govt.nz/plans-policies-reports/reports-and-publications/air

Wilton, E., 2019. *Wanaka, Cromwell and Clyde Air Emission Inventory – 2019*. Environet Ltd.

World Health Organization, 2021. *WHO global air quality guidelines: particulate matter (PM2.5 and PM10), ozone, nitrogen dioxide, sulfur dioxide and carbon monoxide.* https://iris.who.int/handle/10665/345329

APPENDIX: PM_{10} Exceedance table for 2023

Site	Alexandra	Arrowtown	Central Dunedin	Mosgiel
Date	**Concentration (µg/m³) 24-hour average**			
28/05/2023	51			
31/05/2023	51			
8/06/2023		80		58
10/06/2023		54		
11/06/2023				56
14/06/2023		56		
16/06/2023	51	64		
26/06/2023				55
27/06/2023				55
6/07/2023		68		
8/07/2023		56		
9/07/2023		81		
10/07/2023		55		
29/07/2023		55		
30/07/2023		57		
Total number of exceedances	**3**	**10**	**0**	**4**

ATTACHMENTS

Nil