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Dear Stephen

RE: Weekly NH_3 Monitoring Report 01 – 31 December 2018

In April 2018 Gore District Council (GDC) engaged Land and Water Science to conduct continuous monitoring of ammonia (NH_3) gas emissions from the Mataura Mill dross storage site (121 Kana Street, Mataura). GDC require emission values to comply with consent conditions that specify a limit of 5 ppm NH_3 discharged to air. In December 2017, Photonic Innovations (PI) installed two NH_3 sensors for comparison of the indoor and outdoor ammonia levels. The outdoor sensor has been out of service since 18 March 2018. PI have since rectified connectivity issues and the sensor has been re-installed. Measurements are reported for both the outdoor and indoor sensors for the month of December.

Weekly summaries of the indoor and outdoor emission results from monitoring between 01 December and 31 December are presented in this report. During this period the maximum NH_3 concentration detected by the indoor sensor was 14.3 ppm (Figure 1 and Table 1) and 5.1 ppm for the outdoor sensor (Figure 2 and Table 2). Mean and median NH_3 concentrations during this period were 7.0 and 6.4 ppm for the indoor sensor and 0.9 and 0.8 ppm for the outdoor sensor. The maximum ammonia concentration for both the indoor and outdoor sensors exceeded the consented amount of 5 ppm. An increase in NH_3 concentration is expected during the spring and summer months due to higher air temperatures.

Daily (diurnal) variation in NH_3 concentration shows a consistent pattern in the data. Specifically, NH_3 concentration is strongly correlated with air temperature, reaching maximum values as air temperatures peak during the day and minimum values at night when air temperatures are at their lowest. Although diurnal variation is evident in the data, average air temperature is a greater control over the absolute concentration with maximum concentrations recorded during the warmest months of the year and minimum concentrations recorded during the coolest months of the year. The correlation between air temperature and NH_3 concentration for this reporting period is displayed in Figure 1 and Figure 2.

Table 1. Summary statistics for the indoor NH_3 sensor, 01 December – 31 December 2018. NH_3 measured in parts per million (ppm).

Date	01 Dec	02 - 08 Dec	09 - 15 Dec	16 - 22 Dec	23 - 29 Dec	30 - 31 Dec
Mean	7.0	4.7	4.9	5.1	4.7	5.4
Standard deviation	2.0	2.7	1.8	2.1	2.1	1.6
Median	6.4	1.2	2.2	2.6	2.0	3.0
Minimum	4.2	1.2	2.2	2.6	2.0	3.0
Maximum	11.2	14.3	10.0	13.1	12.6	10.9

Table 2. Summary statistics for the outdoor NH_3 sensor, 01 December – 31 December 2018. NH_3 measured in parts per million (ppm).

Date	01 Dec	02 - 08 Dec	09 - 15 Dec	16 - 22 Dec	23 - 29 Dec	30 - 31 Dec
Mean	0.9	0.7	0.7	0.6	0.7	0.7
Standard deviation	0.6	0.3	0.3	0.3	0.5	0.6
Median	0.8	0.7	0.6	0.6	0.6	0.6
Minimum	0.4	0.3	0.3	0.3	0.3	0.5
Maximum	5.0	3.0	4.3	4.0	5.1	5.0

01 December 2018

During this day, maximum indoor concentration was 11.2 ppm for this period. Mean and median values were 7.0 and 6.4 ppm respectively. The outdoor NH_3 concentration levels showed consistent variation for most of the day with higher concentrations consistent with warmer temperatures. Maximum outdoor concentration was 5.0 ppm for this period. Mean and median values were 0.9 and 0.8 ppm.

02 – 08 December 2018

During this week, indoor NH_3 concentration showed consistent diurnal variation for most of the week. Maximum indoor concentration was 14.3 ppm for this period. Mean and median values were 4.7 and 1.2 ppm. The outdoor NH_3 concentration levels showed consistent variation for most of the week with higher concentrations consistent with warmer temperatures. Maximum outdoor concentration was 3.0 ppm for this period. Mean and Median values were 0.7 ppm.

09 – 15 December 2018

During this week, indoor NH_3 concentration showed consistent diurnal variation for most of the week. Maximum indoor concentration was 10.0 ppm for this period. Mean and median values were 4.9 and 2.2 ppm. The outdoor NH_3 concentration levels showed consistent variation for most of the week with higher concentrations consistent with warmer temperatures. Maximum outdoor concentration was 4.3 ppm for this period. Mean and Median values were 0.7 and 0.6 ppm.

16 – 22 December 2018

During this week, indoor NH_3 concentration showed consistent diurnal variation for most of the week. Maximum indoor concentration was 13.1 ppm for this period. Mean and median values were 5.1 and 2.6 ppm. The outdoor NH_3 concentration levels showed consistent variation for

most of the week with higher concentrations consistent with warmer temperatures. Maximum outdoor concentration was 4.0 ppm for this period. Mean and Median values were 0.6 ppm.

23 – 29 December 2018

During this week, indoor NH_3 concentration showed consistent diurnal variation for most of the week. Maximum indoor concentration was 12.6 ppm for this period. Mean and median values were 5.4 and 3.0 ppm. The outdoor NH_3 concentration levels showed consistent variation for most of the week with higher concentrations consistent with warmer temperatures. Maximum outdoor concentration was 5.1 ppm for this period. Mean and Median values were 0.7 and 0.6 ppm.

30 – 31 December 2018

During these two days, indoor NH_3 concentration showed consistent diurnal variation for most of the week. Maximum indoor concentration was 10.9 ppm for this period. Mean and median values were 5.4 and 3.0 ppm. The outdoor NH_3 concentration levels showed consistent variation for most of the week with higher concentrations consistent with warmer temperatures. Maximum outdoor concentration was 5.0 ppm for this period. Mean and Median values were 0.7 and 0.6 ppm.

Summary

During the monitoring period (01 – 31 December) indoor NH_3 concentrations reached a maximum of 14.3 ppm, while mean and median concentrations were 7.0 and 6.4 ppm. These values are consistent with that expected of warmer weather conditions. Outdoor concentrations were a maximum of 5.1 ppm, while mean and median concentrations were at 0.9 and 0.8 ppm. The higher values of NH_3 concentrations were recorded on days with higher maximum temperatures. Based on this data, temperature continues to be the most dominant control over NH_3 concentration.

Kind regards

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Dr Clint Rissmann
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For public access to the real-time data go to: ***http://35.189.3.224:3000/login***
Log in email: gcc@photonicinDecations.com and use the **password:** Pa5%w0rd

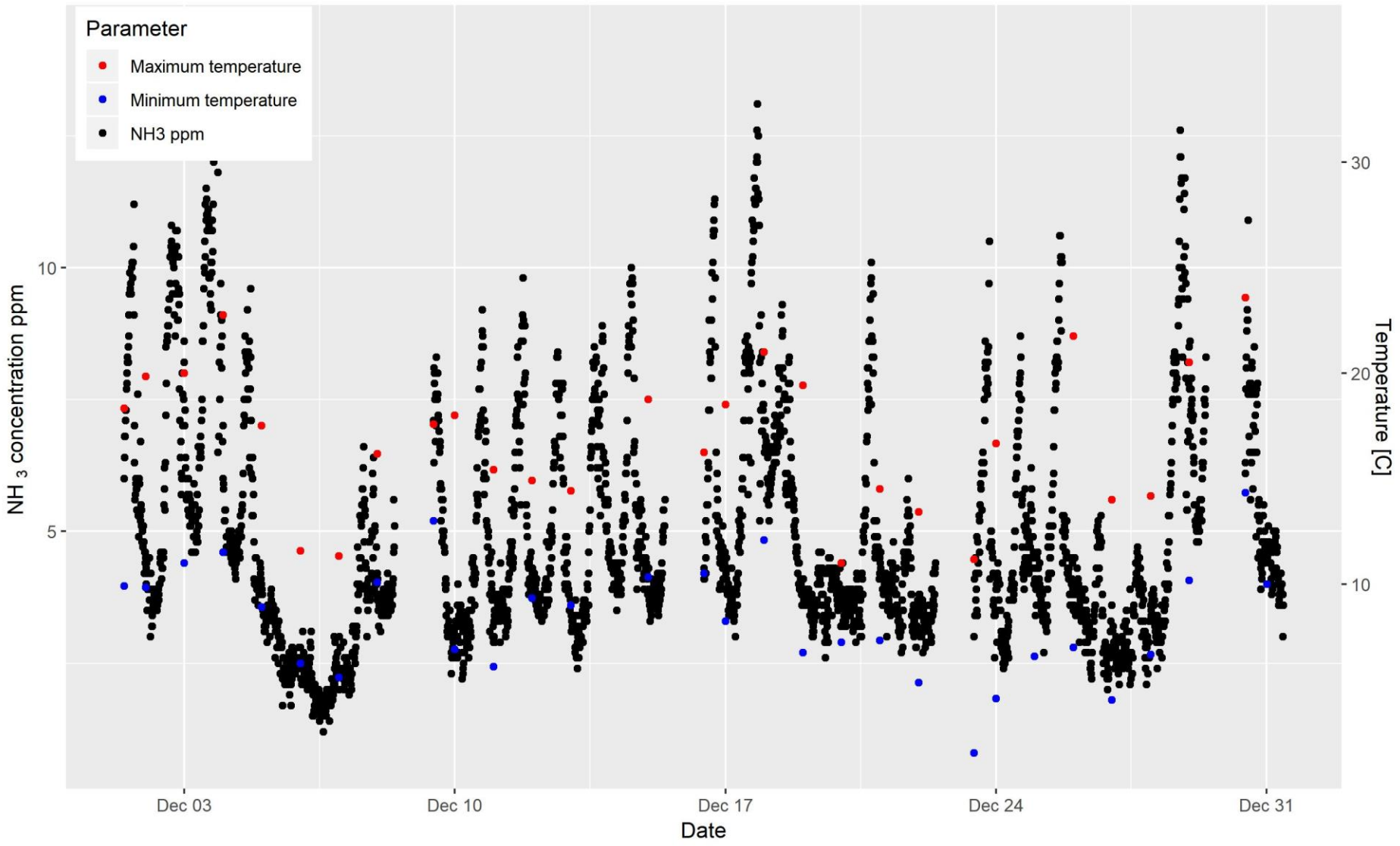

Figure 1: Continuous indoor NH_3 concentration, maximum daily temperature

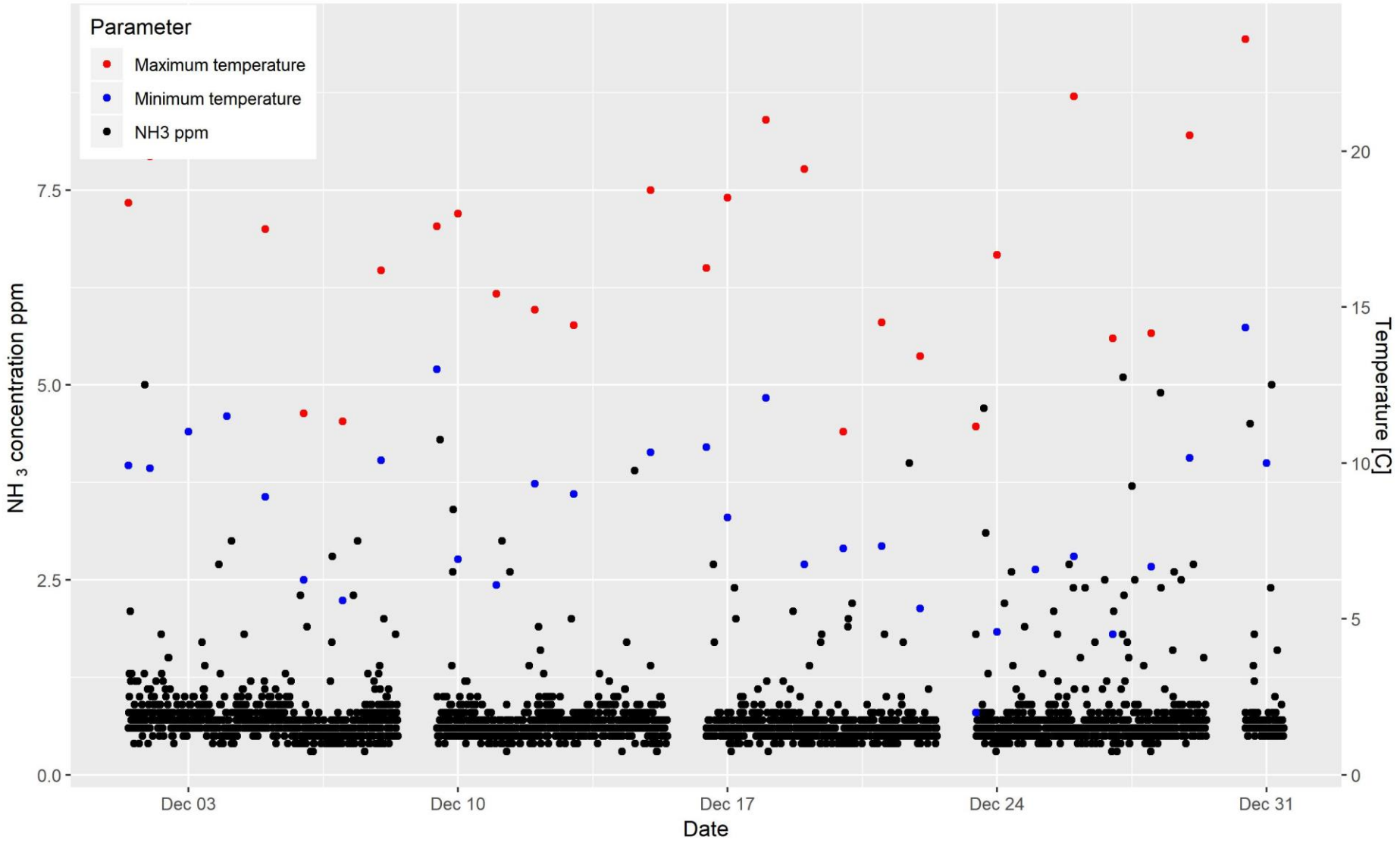

Figure 2: Continuous outdoor NH_3 concentration, maximum daily temperature