Report number: 2019/34
Project Number: 19004

Land and Water Science
61 Leet Street
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Stephen Parry
Chief Executive
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1st October 2019

Dear Stephen

**RE: $NH_3$ Monitoring Report 01 – 30 September 2019**

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) from April 2018. GDC require emission values to comply with consent conditions that specify a limit of 5 ppm $NH_3$ discharged to air. In March 2017, Photonic Innovations (PI) installed two $NH_3$ sensors for comparison of the indoor and outdoor ammonia levels. Measurements are recorded continuously and reported as a 5-minute average for both the outdoor and indoor sensors.

Weekly summaries of the indoor and outdoor emission results from monitoring between 01 September and 30 September are presented in this report. During this period the maximum $NH_3$ concentration detected by the indoor sensor was 4.6 ppm (Figure 1 and Table 1) and 5.7 ppm for the outdoor sensor (Figure 2 and Table 2). Mean and median $NH_3$ concentrations during this period were 2.7 and 2.8 ppm for the indoor sensor and were both 0.9 ppm for the outdoor sensor. The maximum ammonia concentration for the outdoor sensor exceeded the consented amount of 5 ppm on multiple occasions.

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. Elevated $NH_3$ concentrations were detected by the outdoor sensor when minimum temperatures were below or near zero indicating the likelihood of very still atmospheric conditions, such as frost or fog, preventing the $NH_3$ from dissipating. 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 September – 30 September 2019. $NH_3$ measured in parts per million (ppm).

| Date | 01- 07 Sept | 08 - 14 Sept | 15 - 21 Sept | 22 - 28 Sept | 29 - 30 Sept |
|---|---|---|---|---|---|
| **Mean** | 2.7 | 1.9 | 2.0 | 2.2 | 3.0 |
| **Standard deviation** | 0.6 | 0.6 | 0.7 | 0.7 | 0.6 |
| **Median** | 2.8 | 1.9 | 1.9 | 2.2 | 3.0 |
| **Minimum** | 0.8 | 0.4 | 0.0 | 0.5 | 1.4 |
| **Maximum** | 4.6 | 3.4 | 4.1 | 4.5 | 4.3 |

Table 2. Summary statistics for the outdoor $NH_3$ sensor, 01 September – 30 September 2019. $NH_3$ measured in parts per million (ppm).

| Date | 01- 07 Sept | 08 - 14 Sept | 15 - 21 Sept | 22 - 28 Sept | 29 - 30 Sept |
|---|---|---|---|---|---|
| **Mean** | 0.9 | 0.8 | 0.8 | 0.8 | 1.0 |
| **Standard deviation** | 0.5 | 0.4 | 0.5 | 0.4 | 0.4 |
| **Median** | 0.8 | 0.7 | 0.7 | 0.8 | 0.9 |
| **Minimum** | 0.4 | 0.3 | 0.3 | 0.4 | 0.5 |
| **Maximum** | 5.7 | 4.8 | 4.7 | 5.5 | 2.5 |

**01 - 07 Sept 2019**

During this week, the indoor $NH_3$ concentration showed consistent diurnal variation for most of the week. Maximum indoor concentration was 4.6 ppm for this period. Mean and median values were 2.7 and 2.8 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 5.7 ppm for this period. Mean and median values were 0.9 and 0.8 ppm.

**08 – 14 Sept 2019**

During this week, indoor $NH_3$ concentration showed consistent diurnal variation for most of the week. Maximum indoor concentration was 3.4 ppm for this period. Mean and median values were both 1.9 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 4.8 ppm for this period. Mean and median values were both 0.8 and 0.7 ppm.

**15 – 21 Sept 2019**

During this week, indoor $NH_3$ concentration showed consistent diurnal variation for most of the week. Maximum indoor concentration was 4.1 ppm for this period. Mean and median values were 2.0 and 1.9 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 4.7 ppm for this period. Mean and median values were 0.8 and 0.7 ppm.

**22 – 28 Sept 2019**

During this week, indoor $NH_3$ concentration showed consistent diurnal variation for most of the week. Maximum indoor concentration was 4.5 ppm for this period. Mean and median values were both 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 5.5 ppm for this period. Mean and median values were both 0.8 ppm.

**29 – 30 Sept 2019**

During this week, indoor $NH_3$ concentration showed consistent diurnal variation for most of the week. Maximum indoor concentration was 4.3 ppm for this period. Mean and median values were both 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 2.5 ppm for this period. Mean and median values were 1.0 and 0.9 ppm.

**Summary**

During the monitoring period (01 – 30 September) indoor $NH_3$ concentrations reached a maximum of 4.6 ppm, while mean and median concentrations were both 2.7 and 2.8 ppm. Outdoor concentrations were a maximum of 5.7 ppm, while mean and median concentrations were both 0.9 ppm. Elevated $NH_3$ concentrations were detected by the outdoor sensor when minimum temperatures were below or near zero indicating the likelihood of very still atmospheric conditions, such as frost or fog, preventing the $NH_3$ from dissipating. The outdoor sensor exceeded the consent conditions of 5.0 ppm twice during the month of September. The indoor sensor did not exceed 5.0 ppm for September. These values are significantly lower than reported for the summer months and consistent with cooler, wintertime temperatures. Overall, temperature continues to be the most dominant control over $NH_3$ concentration.

Kind regards

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Land and Water Science Ltd

Dr Clint Rissmann
Director
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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@photonicinnovations.com and use the **password:** Pa5%w0rd

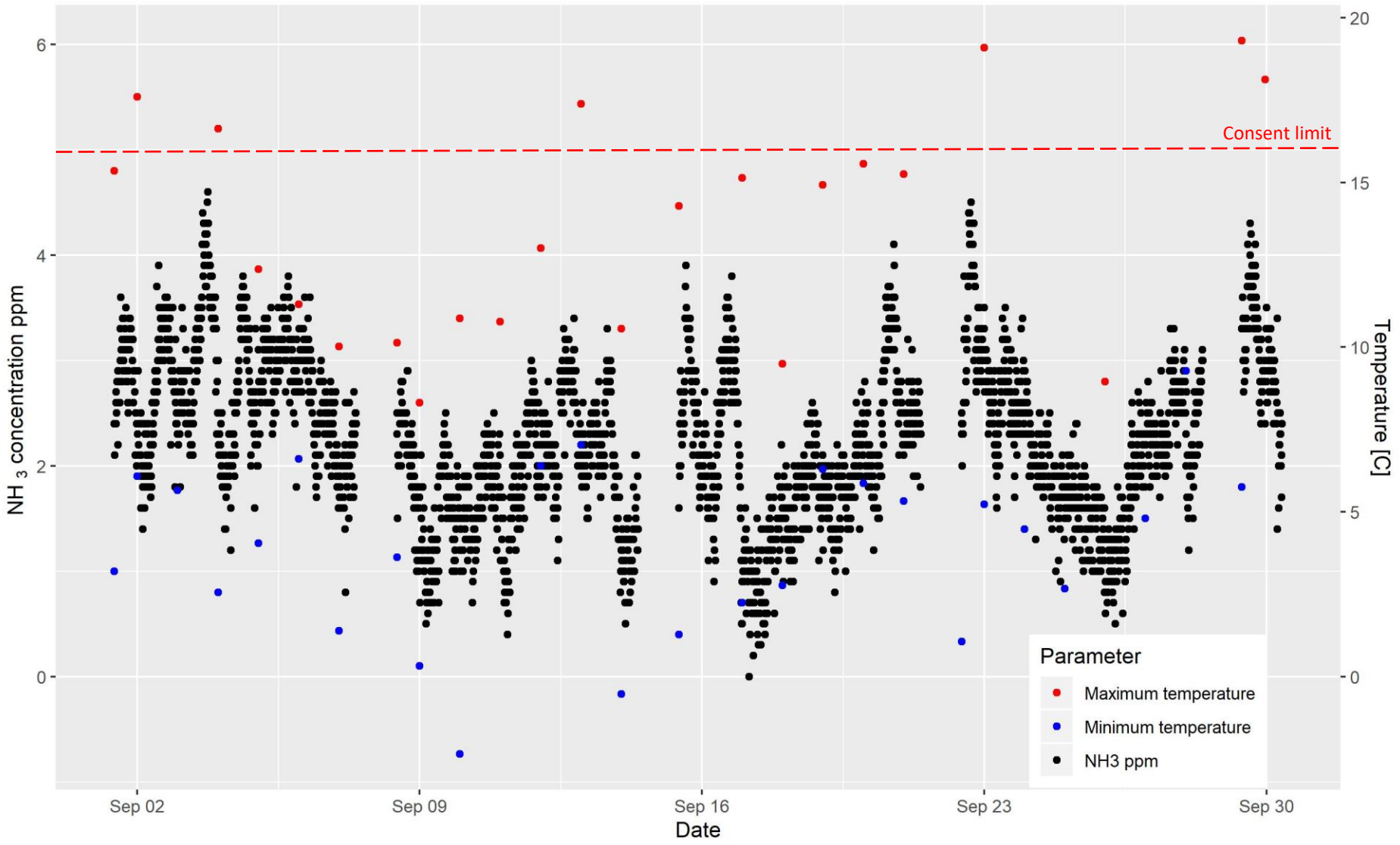


Figure 1: Continuous indoor $NH_3$ concentration and maximum daily temperature.

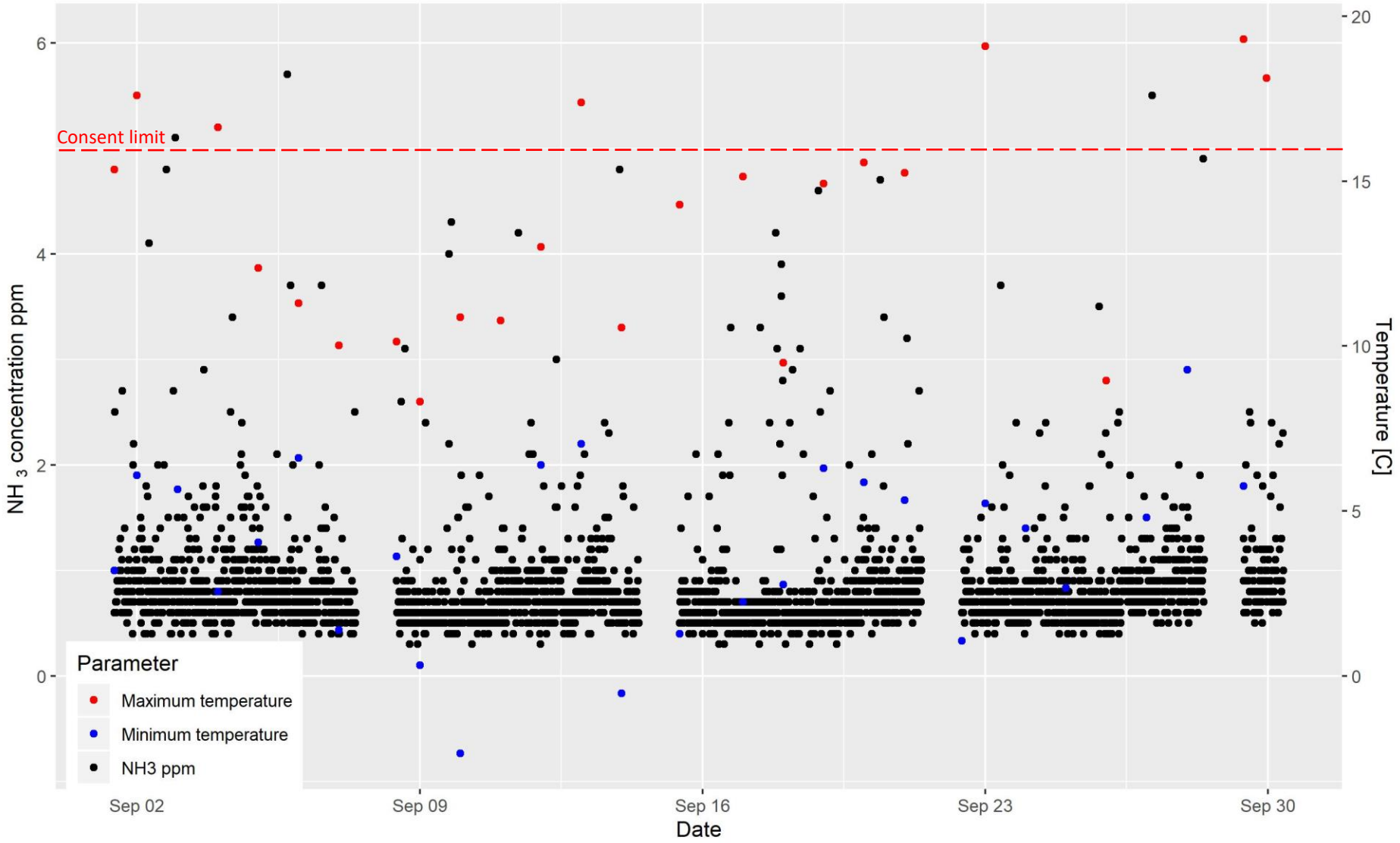


Figure 2: Continuous outdoor $NH_3$ concentration and maximum daily temperature.