PRAMP Technical Working Group

Canister Sampling Program: Methane-Based Trigger
Recommendation Report

September 26, 2018

As heavy oil process improvements and vapor mitigation measures were implemented in the Three Creeks area, PRAMP's air monitoring network showed a marked decline in the ambient concentration of hydrocarbons. A key component of the regional monitoring network is the triggered canister *'whole air'* sampling program. Results from canister analysis have historically been used to assess potential odours and emissions profiles from different sources.

The canister sampling program collects a 1-hour sample of air when the continuously measured non-methane hydrocarbon (NMHC) concentration reaches a trigger point; the current trigger point for all stations is 0.3 parts per million (ppm) averaged over a 5-minute period. As the ambient concentration of hydrocarbons declined, fewer canisters were collected over time.

In theory, the NMHC component of the continuous hydrocarbon measurement is inclusive of all non-methane gases. However, due to the way in which the continuous sensor is calibrated, there may be some species that are not detected. To address this, PRAMP would like to implement a second trigger point based on methane. Methane is often used as a surrogate performance indicator for fugitive emissions management in areas of oil and gas production. The rationale for implementing a methane-based trigger is that when methane concentrations are elevated, there may also be other non-methane species present, even when the continuous analyzer shows low or sub-detection limit NMHC concentrations.

As a first step to recommending a suitable methane-based trigger, different percentile values for 5-minute average data were examined. Percentiles provide some insight of data spread, particularly in environmental monitoring when most values are either near zero or the regional background. The initial screening of monitoring data showed that the Reno Station had a greater frequency of elevated 5-minute average data compared to Stations 842 and 986 (Table 1). Given this observation, subsequent analysis focused on using the historical monitoring data from Reno to determine a budget-limited network-wide methane-based trigger recommendation.

	986			842			Reno		
	2015	2016	2017	2015	2016	2017	2015	2016	2017
P90	1.99	2.02	2.07	1.98	2.03	2.03	2.09	2.10	2.11
Count > Percentile	8869	8883	9531	8831	8454	8958	8326	7990	9741
P95	2.03	2.06	2.17	2.02	2.07	2.06	2.26	2.26	2.30
Count > Percentile	4430	4563	4837	4252	4759	4431	4061	3946	4900
P97	2.06	2.09	2.28	2.05	2.12	2.09	2.40	2.39	2.50
Count > Percentile	2352	2916	2984	2621	2683	2789	2450	2427	2997
P98	2.07	2.12	2.40	2.07	2.16	2.13	2.53	2.55	2.70
Count > Percentile	1848	1941	1967	1924	1836	1858	1646	1606	1998
P99	2.11	2.17	2.63	2.14	2.27	2.2	2.79	2.85	3.10
Count > Percentile	881	930	995	953	954	952	833	797	993
P99.5	2.16	2.23	2.90	2.21	2.37	2.32	3.09	3.18	3.50
Count > Percentile	478	488	502	472	488	491	420	405	499
P99.95%	2.34	2.48	3.74	2.47	2.57	3.05	4.11	4.16	4.58
Count	84	97	100	99	92	97	83	81	100
P99.99%	2.43	3.03	5.14	3.00	2.74	4.29	6.81	8.15	5.98
Count > Percentile	9	8	10	10	6	10	9	9	11

Table 1: 5-minute average methane percentile summary and count of observations above given percentiles for each station in the PRAMP network in 2015, 2016, 2017.

The 2017 percentile data for Reno suggest that there are 100 measurements above 4.58 ppm and 11 measurements above 5.98 ppm (the 99.95 and 99.99 percentiles, respectively). The 2017-28 PRAMP budget allows for the collection of 30 paired canister samples and blanks; this budget is inclusive of the existing NMHC-based trigger program. Given the current collection rate of the NMHC-based canisters, the budget-constrained number of methane-based triggered canisters is in the 10-20 range. Therefore, using 2017 data, a methane-based trigger will be between 5ppm and 6ppm, averaged over a 5-minute period. Table 2 summarizes the number of times the 5-minute average was above or equal to 5.0 ppm, 5.5 ppm, 6.0 ppm.

	986			842			Reno		
	2015	2016	2017	2015	2016	2017	2015	2016	2017
Count > 5.0 ppm	0	0	14	0	0	5	38	39	57
Count > 5.5 ppm	0	0	9	0	0	5	24	29	28
Count > 6.0 ppm	0	0	2	0	0	3	18	20	9

Table 2: Summary of 5-minute average counts above or equal to 5.0 ppm, 5.5 ppm, 6.0 ppm at each station in the PRAMP network in 2015, 2016, 2017.

A closer examination of the counts calculated and summarized in Table 2 reveals that not each 5-minute concentration above the respective threshold (5.0 ppm, 5.5 ppm, and 6.0 ppm) is a discrete occurrence. Oftentimes, elevated concentrations occur as events that last for several adjacent or nearly-adjacent 5-minute segments. Table 3 presents two examples of this; seven occurrences of methane concentrations above 5.0 ppm are listed with their respective timestamps. Given that these concentrations are adjacent or clustered within an hour, the

seven 5-minute average concentrations above 5.0 ppm represent two events that can be sampled.

		Methane	Non-Methane Hydrocarbons
		ppm	*ppm*
example 1	**2017-10-12 2:55**	5.08	0.00
	2017-10-12 3:10	5.46	0.00
	2017-10-12 3:30	7.62	0.00
example 2	**2017-11-03 2:40**	5.61	0.00
	2017-11-03 2:45	5.13	0.00
	2017-11-03 3:10	6.18	0.00
	2017-11-03 3:30	5.75	0.00

Table 3: Example of 'clustered' 5-minute average data.

In order to approximate the effect of *clustering* during events, Table 4 provides a summary of the manual review for each count presented in Table 2; the manual review considers adjacent and near adjacent 5-minute average segments at or above a given threshold. Therefore, counts presented in Table 4 indicate the expected number of canisters collected in 2015, 2016, and 2017 (and 2018 year-to-date for Reno only) for methane-based triggers set at 5.0 ppm, 5.5 ppm, and 6.0 ppm.

	986			842			Reno			
	2015	**2016**	**2017**	**2015**	**2016**	**2017**	**2015**	**2016**	**2017**	***2018*** *(ytd)*
5.0 ppm Trigger	0	0	8	0	0	1	8	10	27	*14*
5.5 ppm Trigger	0	0	5	0	0	1	8	8	15	*11*
6.0 ppm Trigger	0	0	2	0	0	1	7	4	7	*9*

Table 4: Expected count of canisters collected in the PRAMP network using methane-based 5-minute average triggers set at 5.0 ppm, 5.5 ppm, and 6.0 ppm.

Based on the analysis of historical data, it is recommended that PRAMP implement a 5-minute methane-based trigger of 5.5 ppm to supplement its existing canister sampling program. A trigger based on this concentration should produce 10-20 samples during elevated methane events over the course of a year (this assumes a continuation of the methane concentration patterns observed in the network over the last three years). This number of samples is within budget given the lower number of canisters being collected using the existing NMHC-based trigger.