

APPENDIX B

Emission Reduction Analysis For Proposed Amendments to Rule 4311

November 25, 2020

SAN JOAQUIN VALLEY UNIFIED AIR POLLUTION CONTROL DISTRICT

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**EMISSION REDUCTION ANALYSIS FOR
REVISED PROPOSED RULE 4311 (FLARES)**

I. SUMMARY

The purpose of this rule project is to obtain as much reductions of nitrogen oxides (NO_x) emissions from the source category as expeditiously practical, technologically feasible, and economically reasonable. The District committed to amending Rule 4311 as part of the District's *2016 Plan for the 2008 8-Hour Ozone Standard* and the *2018 Plan for the 1997, 2006 and 2012 PM_{2.5} Standards (2018 PM_{2.5} Plan)*. In the *2018 PM_{2.5} Plan*, the District estimated an amendment to Rule 4311 would contribute 0.05 tons per day toward an aggregate commitment to reduce 1.88 tons per day of NO_x. This appendix details the calculations and assumptions used to estimate the NO_x emission reductions associated with the proposed amendments to Rule 4311. The District estimated emission reductions using permit conditions and annually reported throughput of individual flares, and the proposed rule's emission and throughput limits.

In order to determine the emission reductions associated with the changes, District staff queried the District Permit Services Database for all flares, and then sorted the flares into categories based on the types of operations. Categories were oil and gas operations, digester operations, landfill operations, organic liquid loading operations, and other operations. The District further divided digester operations into flares at major source facilities and those at non-major source facilities, and landfill operations into open and closed landfills to be consistent with SCAQMD Rule 1118.1 requirements.

The District identified 266 flares in total. Based on the three-year average of throughput data reported to the District in annual emissions inventory submissions, 31 flares are estimated to exceed the proposed rule threshold limits and would be required to be replaced or modified to meet proposed ULN emissions limits. This includes 19 flares at oil and gas producers, 2 flares at digester operations, and 10 flares at landfill operations.

District staff estimates that the proposed changes in the rule limits and new annual throughput thresholds would lead to approximately 0.19 tons per day (tpd) of NO_x emission reductions. Flare operators may opt to reduce the use of their flares to comply with Rule 4311 requirements, and such reductions will often result in more than 50% to 75% throughput reductions and in those cases more overall NO_x reductions than installing new flares. Although District staff expects proposed Rule 4311 will result in more emissions reductions than what is calculated here, this rule project will not attempt to quantify or take credits for these additional reductions.

A summary of the emission reduction analysis results is shown in Table 1 and details of the calculations are explained later in this appendix.

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Table 1 – Summary of NOx Reductions Based on Average Flare Annual Throughputs

Facility Category	Total Permitted Flares	Number Replacing Flares	Annual Throughput of Affected Flares (MMBtu/yr)	Estimated NOx Reductions (tpd)	Percent NOx Reductions
Oil and Gas Facilities	161	19	1,299,587	0.089	46.4%
Landfill Facilities	28	10	2,576,069	0.095	47.9%
Wastewater Treatment	22	2	334,500	0.018	47.1%
Other Facilities	55	0	0	0	—
Totals	266	31	4,361,417	0.203	37.2%

II. BACKGROUND

District staff estimates there are 266 flares that are currently under permit with the District and are subject to the proposed Rule 4311. Flares act as a safety device during unforeseeable and unpreventable situations, and as an emission control device for air toxics and VOCs.

Effective technologies to reduce NOx emissions for flares rely on precise combustion controls achieved with careful air/fuel mixing and specially tuned burners to ensure complete combustion with appropriate residence times in the combustion zones. In order to be effective the systems are designed to match the input gas heating values and flow rates, or installed with sensors and controls to accommodate variations on these parameters in real time.

III. EMISSION REDUCTION ANALYSIS

District staff used the Permit Database to identify the flares with type of facility, rated capacities, and permitted NOx emissions limits in the District. District staff also queried emissions inventory submittals for facilities with flares required to submit to determine the annual throughputs for most permitted flares. There are approximately 266 permitted flares that may be subject to the proposed Rule 4311.

The proposed amendment to Rule 4311 was designed to encourage flare operators to find beneficial alternative uses of gas combusted in flares. It is expected that some of the flare operators that may be required to replace flares exceeding proposed annual throughput thresholds will install equipment to make beneficial uses of the gas. These alternative uses potentially resulting in cost savings and likely greater reduction of NOx

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from flares than would occur if replaced with ultra-low NOx flares. It would be speculative, at best, to determine which flares this might occur at; therefore, the following emission reduction analysis does not include any estimate of NOx reductions for beneficial alternative uses of flare gas.

A. Affected Flares

District staff queried the Permit Services Permits Database for flare and sorted the flares by facility type. Some facility types were further sorted into closed or open landfills and major or non-major sources for facilities for those categories that may have different requirements in the proposed rule. Using collected annual throughput, permitted NOx emissions factors, and assumptions of gas heat content calculations of estimated future NOx emissions were made for all flares. Gas heat content was assumed to be 500 btu/scf for landfill gas, 650 btu/scf for digester gas, and 1000 btu/scf for other gas sources (equivalent to methane). Propane was taken as 91,000 btu/gallon.

Table 2 shows the number of each type of flare, the estimated NOx emissions, and throughputs based on a three-year average of annual throughputs for calendar years 2017, 2018, and 2019.

Table 2 – Flare NOx Emissions Based on Annual Average Throughputs

Facility Type	Number	NOx (tpy)	Throughput (MMbtu/yr)
Agriculture Related Digester - Major	4	2.29	73,512
Agriculture Related Digester - Non-major	12	1.36	48,125
Chemical Production and/or Distribution	5	0.62	18,182
Gas Plants	11	5.76	169,323
Landfill	17	72.62	2,750,093
Landfill – Closed	11	15.84	532,272
Oil and Gas Production	161	70.06	2,178,620
Other	6	1.46	68,430
Propane Backup System	6	0.01	409
Refinery	7	3.29	96,663
Wastewater Treatment - Major	6	13.66	434,537
Wastewater Treatment - NonMajor	16	8.56	264,604
Organic Liquid Handling	4	2.92	58,215
Total	266	198.43	6,692,984

B. NOx Emission Reduction Calculations

District staff reviewed each flare’s average annual throughput, as well as eligibility for exemptions, to determine which flares would be expected to exceed annual throughput

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thresholds and replace existing flares to meet proposed emissions limits. Emissions reductions for NOx were calculated for those flares by multiplying the difference in emissions from the current permit limit to the proposed rule limit by the average annual throughput.

$$ER = (EF_{Permit} - EF_{Limit}) \times Throughput_{Average} \quad (1)$$

Where:

ER = Emissions Reduction

EF_{Permit} = Emission Factor for NOx from Permit to Operate in lb/MMBtu

EF_{Limit} = Emissions Factor for NOx from proposed Rule 4311 in lb/MMBtu

$Throughput_{Average}$ = Annual Throughput averaged over the 2017, 2018, and 2019 calendar years in MMBtu/yr

NOx emissions reductions for the 31 flares expected to be required to be replaced by the proposed amendments to Rule 4311 were each calculated using Equation 1. The results of the calculations are listed in Table 4 at the end of this appendix. An example of one such calculation follows:

$$ER = (EF_{Permit} - EF_{Limit}) \times Throughput_{Average}$$
$$ER = \left(0.068 \frac{lb}{MMBtu} - 0.018 \frac{lb}{MMBtu} \right) \times 176,120 \frac{MMBtu}{yr}$$
$$ER = 8,806 \frac{lb}{yr}$$

Where:

EF_{Permit} = 0.068 lb/MMBtu

EF_{Limit} = 0.018 lb/MMBtu

$Throughput_{Average}$ = 176,120 MMBtu/yr

Using this methodology, District staff calculated the total emission reductions expected to be achieved from the replacement of flares that operate above the Rule 4311 Annual Throughput Thresholds. Comparing the total estimated NOx emissions from Table 2 to the calculated NOx emissions reductions from Table 4, 147,470 pounds per year of NOx will be reduced. This is equivalent to **72.74 tons per year** of NOx emission reductions, out of a total of 202.79 tons NOx per year. This measure is expected to reduce the flaring NOx emissions inventory in the Valley by 37.2%.

C. State Implementation Plan (SIP) Credit from Proposed Rule

The emissions reductions calculated above are based on average flare throughputs reported in 2017, 2018, and 2019. This ensures the calculation is based on the best and most current information. However, in order to determine the emissions reductions that may be applied to commitments in the SIP the reductions must be normalized to

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the planning inventory used in the analysis for the plan. The 2018 PM2.5 Plan inventory for flares is shown in Table 3.

Table 3 – Emissions Inventory from Flares¹

Pollutant	2013	2017	2019	2020	2022	2023	2024	2025	2026	2028
<i>Annual Average - Tons per day</i>										
PM2.5	0.16	0.16	0.16	0.16	0.16	0.17	0.17	0.17	0.17	0.17
NOx	0.56	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.52	0.51
<i>Winter Average - Tons per day</i>										
PM2.5	0.16	0.16	0.16	0.16	0.16	0.17	0.17	0.17	0.17	0.17
NOx	0.56	0.54	0.54	0.53	0.53	0.52	0.52	0.52	0.52	0.51

To normalize the emissions reduction expected to be achieved by the rule, District staff multiplied the percent reduction of 37.2% of the flaring inventory to the inventory included in CEPAM version 1.05 (the inventory used for the plan).

Based on CEPAM V.1.05, for calendar years of 2024 and 2025, the NOx emissions from flares is 0.52 tons per day. Reducing this inventory by 37.2% results in NOx emission reductions of 0.19 tons per day.

¹ Emissions Inventory data source is CEPAM v. 1.05.

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Table 4 – Emission Reductions from Affected Flares

SIC	Annual Throughput (MMBtu/yr)	Permitted NOx Limit (lb/MMBtu)	Proposed NOx Limit (lb/MMBtu)	NOx Reduced (lb/yr)
1311	176,120	0.068	0.018	8,806
1311	172,143	0.068	0.018	8,607
1311	161,873	0.068	0.018	8,094
1311	111,653	0.068	0.018	5,583
1311	86,467	0.068	0.018	4,323
1311	85,267	0.068	0.018	4,263
1311	64,053	0.068	0.018	3,203
1311	52,703	0.068	0.018	2,635
1311	52,514	0.068	0.018	2,626
1311	43,200	0.068	0.018	2,160
1311	37,530	0.068	0.018	1,877
1311	37,514	0.068	0.018	1,876
1311	37,210	0.068	0.018	1,860
1311	36,614	0.068	0.018	1,831
1311	34,801	0.068	0.018	1,740
1311	29,597	0.068	0.018	1,480
1311	27,644	0.068	0.018	1,382
1311	26,450	0.068	0.018	1,322
1311	26,233	0.068	0.018	1,312
4953	617,890	0.05	0.025	15,447
4953	456,837	0.057	0.025	14,619
4953	304,840	0.048	0.025	7,011
4953	290,792	0.05	0.025	7,270
4953	257,278	0.05	0.025	6,432
4953	170,667	0.06	0.025	5,973
4953	142,215	0.05	0.025	3,555
4953	142,149	0.05	0.025	3,554
4953	100,152	0.05	0.025	2,504
4953	93,250	0.06	0.025	3,264
4952	205,822	0.0606	0.025	7,329
4952	128,678	0.068	0.025	5,533
Total	4,210,156			147,470