APPENDIX F-2

Emissions Calculations

This page intentionally
left blank.

Herd Breakout

	Existing	Proposed
Milking Cow	2,650	4,170
Dry Cow	550	550
Heifer (15-24 mo)	797	797
Heifer (7-14 mo)	800	800
Calves (4-6 mo)	400	400
Calf (under 3 mo)	400	400
Bulls	0	0
Totals	5,597	7,117
Increase		1,520

The estimated VOC emissions used in this analysis are from the SJVAPCD dairy emissions calculator dated January 2020 and estimates from CalEEMod v.2020.4.0

VOC Emissions from Harvested Acres in Merced County

	tons/day	lbs/year	lbs/acre/yr
Merced Farm	0.81	591,300	1.189
Harvested Acres	497,467		
		lbs/year	**tons/year**
Acres Existing	1,538	1,828	**0.914**
Acres Proposed	1,540	1,830	**0.915**

Farm Equipment emissions were calculated using an emissions factor of 1.19 lbs/acre/year of VOC based on an estimated 0.81 tons/day VOC emitted from farming equipment in the County, with 497,467 acres harvested. This emission factor is based on 2017 inventory data, the latest available, and would represent a conservative estimate of emissions.

This emission factor was applied to the existing 1,538 acres harvested (fields are harvested multiple times a year with double-cropping and triple-cropping patterns) and to the proposed 1,540 acres harvested (fields would be harvested multiple times a year with double-cropping patterns).

California Air Resources Board. CEPAM2019V1.03 Emission Projection Data. 2017 Estimated Annual Average Emissions. Merced County. Accessed on March 29, 2023 at <https://ww2.arb.ca.gov/applications/emissions-county>

United States, Department of Agriculture (USDA). 2017. 2017 Census of Agriculture – County Data: Total Cropland - Harvested Cropland, Acres. Merced County. Accessed on March 24, 2023 at < https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Census_by_State/California/ >

VOC Emissions

Emission Source	Existing VOC/ ROG Emissions (tons/yr)	Proposed VOC/ROG Emissions (tons/yr)	Increment of Increase with Proposed Expansion
Traffic and Onsite Off-road Equipment			0.035
Farm Equipment	0.914	0.915	0.001
Feed and Manure Management	46.48	55.16	8.68
	47.40	56.08	8.71

VOC emissions from traffic and onsite off-road equipment such as feed loaders were estimated using CalEEMod Version 2020.4.0. VOC emissions from feed and manure management (including cow housing, liquid manure, and solid manure) were estimated using the SJVAPCD dairy emissions calculator. See Appendix F for calculator emissions and CalEEMod results.

Herd Breakout

	Existing	Proposed
Milking Cow	2,650	4,170
Dry Cow	550	550
Heifer (15-24 mo)	797	797
Heifer (7-14 mo)	800	800
Heifer (4-6 mo)	400	400
Calf (under 3 mo)	400	400
Bulls	0	0
Totals	5,597	7,117

PM Emissions from Cow Housing

	Existing PM_{10} Emissions	Proposed PM_{10} Emissions	PM_{10} Increment of Increase	$PM_{2.5}$ Increment of Increase
Totals (lbs/yr)	20,891	17,864	-3,027	-345
Tons/Year	**10.45**	**8.93**	**-1.51**	**-0.17**

See SJVAPCD Calculator for PM_{10} Calculation Worksheets and Controls. To generate $PM_{2.5}$ emissions, the PM_{10} emission results were multiplied by the $PM_{2.5}$ fraction from the livestock fugitive dust profile in the California Emission Inventory Data and Reporting System (CEIDARS) developed by the California Air Resources Board.

Wind Erosion Cropped Fields

	PM Emission Factor (tons/acre/yr)	PM10/PM2.5 Emission Factor (tons/acre/yr)	Emission Factor (lbs/acre/yr)	Existing Acreage	Existing Emissions (tons/year)	Proposed Acreage	Proposed Emissions (tons/year)
PM10	0.013659	0.0061466	12.3	1,538	9.45	1,540	9.47
PM2.5*		0.0010594	2.12	1,538	1.629	1,540	1.631
	Note: PM2.5 Emissions Factor estimated from a comparison of Annual Average Emissions of both PM10 and PM2.5 as found in CARB Almanac Emission Projection Data (Published in 2013). 2012 Estimated Annual Average Emissions. 2012 Emissions Data for Merced County, Dust from Agricultural Lands (Non-Pasture). http://www.arb.ca.gov/ei/emissiondata.htm						
	PM Emission Factor found in Methodology for California Air Resources Board, Section 7.12, Windblown Dust - Agricultural Lands, Revised July 1997. http://www.arb.ca.gov/ei/areasrc/index7.htm						

PM 10 Emissions from Mobile Sources

Emissions	Emissions (lbs/day)	Emissions (tons/yr)	Increment of Increase (tons/year)
Traffic & Onsite Mobile Source (Tractors)			0.0618
Onsite Diesel PM			0.0000535
Truck Travel	0.000197	0.0000360	
	0.0000391	0.0000071	
	0.0000495	0.0000090	

Emissions	Emissions (lbs/day)	Emissions (tons/yr)	Increment of Increase (tons/year)
Truck Idling	0.00000522	0.0000010	
	0.00000174	0.0000003	
	0.000000477	0.0000001	
Tons/Year			**0.062**
Emission from area sources, traffic, and onsite off-road equipment such as feed loaders were estimated using CalEEMod			
Version 2020.4.0, Appendix F-1.			
See Appendix G for Onsite Diesel PM.			

Land Preparation and Harvesting

	Crop Type	PM10 Emission Factor (lbs/acre/year)	PM2.5 Emission Factor (lbs/acre/year)	Existing Acreage	Existing PM10 Emissions (tons/year)	Existing PM2.5 Emissions (tons/year)	Proposed Acreage	Proposed PM10 Emissions (tons/year)	Proposed PM2.5 Emissions (tons/year)
Land Preparation	Oats	3.70	0.55	582	1.08	0.16	770	1.42	0.21
	Corn, silage	6.90	0.10	582	2.01	0.03	582	2.01	0.03
	Sudangrass	4.00	0.06	374	0.75	0.01	0	0.00	0.00
Total Land Preparation					**3.83**	**0.20**		**3.43**	**0.24**
Harvesting	Oats	5.80	0.87	582	1.69	0.25	582	1.69	0.25
	Corn, silage	0.17	0.00	582	0.05	0.00	582	0.05	0.00
	Sudangrass	0.00	0.00	374	0.00	0.00	374	0.00	0.00
Total Harvesting					**1.74**	**0.25**		**1.74**	**0.25**
Total Farming Operations					**5.57**	**0.46**		**5.17**	**0.50**

	Crop Type	PM10 Emission Factor (lbs/acre/year)	PM2.5 Emission Factor (lbs/acre/year)	Existing Acreage	Existing PM10 Emissions (tons/year)	Existing PM2.5 Emissions (tons/year)	Proposed Acreage	Proposed PM10 Emissions (tons/year)	Proposed PM2.5 Emissions (tons/year)
	Notes: CARB PM10 emission factors based on 2012 crop acreage. PM2.5 Emissions Factor estimated from CARB speciation profiles included in resource below.								
	California Air Resources Board, Section 7.4, Agricultural Land Preparation Operations, Revised and updated, April 2016. Section 7.5, Agricultural Harvest Operations, Updated April 2016, Revised March 2017. http://www.arb.ca.gov/ei/areasrc/index7.htm								
	Based on double-cropping, several fields would undergo land preparation twice in a year, and therefore the acreage was considered for each occurrence. Harvesting operations would occur multiple times for project fields. Cropping patterns obtained from existing and proposed NMPs.								

Dry Manure Application PM Emissions

	Emission Factor (lbs/acre/yr)	Existing Acreage	Existing Emissions (tons/year)	Proposed Acreage	Proposed Emissions (tons/year)
PM10	5.07	0	0.00	0	0.00
PM2.5	3.042	0	0.00	0	0.00
	To generate $PM_{2.5}$ emissions, the PM_{10} emission results were multiplied by the $PM_{2.5}$ fraction from the livestock waste profile in the California Emission Inventory Data and Reporting System (CEIDARS) developed by the California Air Resources Board.				

Aggregate PM10 and PM2.5

Emission Source	Existing PM_{10} Emissions (tons/year)	Proposed PM_{10} Emissions (tons/year)	Project Increase PM10 Emissions	Existing $PM_{2.5}$ Emissions (tons/year)	Proposed $PM_{2.5}$ Emissions (tons/year)	Project Increase PM2.5 Emissions
Wind Erosion	9.453	9.466	0.012	1.63	1.63	0.002
Farming Operations	5.57	5.17	-0.40	0.46	0.50	0.04
Traffic & On-Site Mobile Source	-	-	0.06			0.02
Animal Movement	10.45	8.93	-1.51	1.19	1.02	-0.17

Emission Source	Existing PM_{10} Emissions (tons/year)	Proposed PM_{10} Emissions (tons/year)	Project Increase PM10 Emissions	Existing $PM_{2.5}$ Emissions (tons/year)	Proposed $PM_{2.5}$ Emissions (tons/year)	Project Increase PM2.5 Emissions
Dry Manure Application	0.00	0.00	0.00	0.00	0.00	0.00
Total	**25.47**	**23.57**	**-1.84**	**3.28**	**3.15**	**-0.11**

Existing Cropped Fields			
Field	**Acres Planted**	**Acres Harvested**	**Crop**
Williams 3	32	32	Oats
	32	32	Corn
	32	32	Sudangrass
Geer 1	15	15	Oats
	15	15	Corn
	15	15	Sudangrass
Geer 2	25	25	Oats
	25	25	Corn
	25	25	Sudangrass
Faith Home 4	32	32	Oats
	32	32	Corn
	32	32	Sudangrass
Faith Home 5	18	18	Oats
	18	18	Corn
	18	18	Sudangrass
Prairie Flower 6	18	18	Oats
	18	18	Corn
	18	18	Sudangrass
Williams 8	72	72	Oats
	72	72	Corn
	72	72	Sudangrass
Williams 7	72	72	Oats
	72	72	Corn
	72	72	Sudangrass
Williams 9	32	32	Oats
	32	32	Corn
	32	32	Sudangrass
Mitchell 10	58	58	Oats
	58	58	Corn
	58	58	Sudangrass
Turner 11/12	68	68	Oats
	68	68	Corn

Total Planted Acres	**Total Harvested Acres**	**Crop Type**
582	582	oats
582	582	corn
	0	Alfalfa, hay
	0	earlage
374	374	Sudangrass, silage
		Almond
		Wheat
		Sorghum Sudan
		Pistachios
1,538	**1,538**	
Summary of overall cropping pattern		
374		Oats/Corn/Sudangrass
208		Oats/Corn

Existing Cropped Fields			
Field	**Acres Planted**	**Acres Harvested**	**Crop**
Riverside 14	84	84	Oats
	84	84	Corn
Washington 13	56	56	Oats
	56	56	Corn
Total Acres	**1,538**	**1,538**	

Total Planted Acres	**Total Harvested Acres**	**Crop Type**

Proposed Cropped Fields			
Field	**Acres Planted**	**Acres Harvested**	**Crop**
Williams 3	17	17	Oats
	17	17	Corn
Geer 1	15	15	Oats
	15	15	Corn
Geer 2	25	25	Oats
	25	25	Corn
Faith Home 4	52	52	Oats
	52	52	Corn
Faith Home 5	37	37	Oats
	37	37	Corn
Prairie Flower 6	18	18	Oats
	18	18	Corn
Williams 8	72	72	Oats
	72	72	Corn
Williams 7	72	72	Oats

Total Planted Acres	**Total Harvested Acres**	**Crop Type**
770	770	oats
770	770	corn
	0	Alfalfa, hay
	0	earlage
0	0	Sudangrass, silage
		Almond
		Wheat
		Sorghum Sudan
		Pistachios
1,540	**1,540**	
Summary of overall cropping pattern		
		Oats/Corn/Sudangrass
770		Oats/Corn

Proposed Cropped Fields			
Field	**Acres Planted**	**Acres Harvested**	**Crop**
	72	72	Corn
Williams 9	32	32	Oats
	32	32	Corn
Mitchell 10	58	58	Oats
	58	58	Corn
Turner 11/12	68	68	Oats
	68	68	Corn
Riverside 14	84	84	Oats
	84	84	Corn
Washington 13	56	56	Oats
	56	56	Corn
Prairie Flower 17	70	70	Oats
	70	70	Corn
River 16	76	76	Oats
	76	76	Corn
Turner 15	18	18	Oats
	18	18	Corn
Total Acres	**1,540**	**1,540**	

Total Planted Acres	**Total Harvested Acres**	**Crop Type**

Dry Manure Applied - Existing	
Field Name	**Acres**
Total Acres	**0**

Dry Manure Applied - Proposed	
Field Name	**Acres**
	0
	0
Total Acres	**0**

Farming Equipment: NOx Emissions from Harvested Acres in Merced County

	tons/day	lbs/year	lbs/acre/yr	tons/year	Increment of Increase
Merced Farm	4.59	3,350,700	6.736		
Total Harvested Acres	497,467				
Harvested Acres Existing	1,538	10,359.23		**5.180**	
Harvested Acres Proposed	1,540	10,372.70		**5.186**	**0.007**

Farm Equipment emissions were calculated using an emissions factor of 6.74 lbs/acre/year of NO_X based on an estimated 4.59 tons/day NO_X emitted from farming equipment in Merced County, with 497,467 acres harvested. This emission factor is based on 2017 inventory data, the latest available, and would represent a conservative estimate of emissions.
This emission factor was applied to the existing 1,538 acres harvested (fields are harvested multiple times a year with double-cropping and triple-cropping patterns) and to the proposed 1,540 acres harvested (fields would be harvested multiple times a year with double-cropping patterns).

California Air Resources Board. CEPAM2019V1.03 Emission Projection Data. 2017 Estimated Annual Average Emissions. Merced County. Accessed on March 24, 2023 at <https://ww2.arb.ca.gov/applications/emissions-county>
United States, Department of Agriculture (USDA). 2017. 2017 Census of Agriculture – County Data: Total Cropland - Harvested Cropland, Acres. Merced County. Accessed on March 24, 2023 at < https://www.nass.usda.gov/Publications/AgCensus/2017/Full_Report/Census_by_State/California/ >

Total NOx Emissions

	Increment of Increase
	tons/yr
Traffic and Onsite Mobile Source	0.293
Farming Equipment	0.007
Soil Emissions	0.209
Total	**0.508**

Vehicle Trips estimated using CalEEMod v.2020.4.0

Table 1. **County Summary Highlights: 2017** (continued)

[For meaning of abbreviations and symbols, see introductory text.]

Item	Merced	Modoc	Mono	Monterey	Napa	Nevada	Orange
Farms ..... number	2,337	423	65	1,104	1,866	673	193
Land in farms ..... acres	946,385	571,191	73,031	1,340,142	255,778	52,061	32,401
Average size of farm ..... acres	405	1,350	1,124	1,214	137	77	168
Median size of farm ..... acres	40	239	36	80	11	10	4
Estimated market value of land and buildings:							
Average per farm ..... dollars	5,299,308	2,640,981	2,158,060	8,944,364	6,052,361	574,346	3,205,502
Average per acre ..... dollars	13,086	1,956	1,921	7,368	44,154	7,425	19,094
Estimated market value of all machinery and equipment $1,000	782,567	82,713	9,143	889,335	175,969	23,051	31,350
Average per farm ..... dollars	334,860	195,540	140,666	805,557	94,303	34,251	162,436
Farms by size:							
1 to 9 acres	384	41	12	276	843	295	130
10 to 49 acres	867	65	24	227	555	253	31
50 to 179 acres	465	81	6	148	256	74	14
180 to 499 acres	284	66	6	138	103	34	11
500 to 999 acres	165	52	2	92	57	11	4
1,000 acres or more	172	118	15	223	52	6	3
Total cropland ..... farms	1,851	319	36	789	1,788	377	147
acres	546,460	159,907	7,913	366,709	67,701	4,816	9,564
Harvested cropland ..... farms	1,777	283	30	704	1,753	318	142
acres	497,467	115,640	7,591	299,378	60,978	3,313	5,803
Irrigated land ..... farms	1,975	310	47	638	1,749	465	138
acres	493,726	142,138	41,736	294,590	60,945	4,952	4,214

CEPAM2019v1.03 Emission Projection Data by EIC

2017 Annual Average Emissions (Tons/Day)

MERCED COUNTY
MISCELLANEOUS PROCESSES
650-FUGITIVE WINDBLOWN DUST

Download these results (as a comma delimited file).
Start a new query.

EMISSIONS INVENTORY CATEGORY	TOG	ROG	CO	NOX	SOX	PM	PM10	PM2.5	NH3
650-650-5400-0000 Methodology 650-DUST FROM AGRICULTURAL LANDS (NON-PASTURE) 5400-DUST 0000-SUB-CATEGORY UNSPECIFIED	-	-	-	-	-	12.25	5.57	0.96	-
650-651-5400-0000 Methodology 651-DUST FROM PASTURE LANDS 5400-DUST 0000-SUB-CATEGORY UNSPECIFIED	-	-	-	-	-	2.73	1.24	0.21	-
650-652-5400-0000 Methodology 652-DUST FROM UNPAVED ROADS AND ASSOCIATED AREAS 5400-DUST 0000-SUB-CATEGORY UNSPECIFIED	-	-	-	-	-	0.78	0.46	0.06	-
TOTAL	-	-	-	-	-	15.75	7.26	1.24	-
FARM EQUIPMENT	0.94	0.81	4.91	4.59	0.00	0.29	0.29	0.26	0.00

CEPAM2019v1.03 Emission Projection Data by EIC

2017 Annual Average Emissions (Tons/Day)

MERCED COUNTY
MISCELLANEOUS PROCESSES
620-FARMING OPERATIONS

Download these results (as a comma delimited file).
Start a new query.

EMISSIONS INVENTORY CATEGORY	TOG	ROG	CO	NOX	SOX	PM	PM10	PM2.5	NH3
620-614-5400-0000 Methodology 614-TILLING DUST 5400-DUST 0000-SUB-CATEGORY UNSPECIFIED	-	-	-	-	-	9.31	4.23	0.63	-
620-615-5400-0000 Methodology 615-HARVEST OPERATIONS - DUST 5400-DUST 0000-SUB-CATEGORY UNSPECIFIED	-	-	-	-	-	11.17	5.08	0.76	-

NOx Emissions from Mobile Sources

Emissions	Emissions (lbs/ day)	Emissions (tons/ yr)	Increment of Increase (tons/ year)
Traffic & Onsite Mobile Source (Tractors)			0.2898
Onsite NOx			0.0030105
Truck Travel	0.00341	0.0006223	
	0.00203	0.0003705	
	0.0094	0.0017155	

Emissions	Emissions (lbs/ day)	Emissions (tons/ yr)	Increment of Increase (tons/ year)
Truck Idling	0.000552	0.0001007	
	0.000552	0.0001007	
	0.000552	0.0001007	
Tons/Year			**0.293**

Emission from traffic and onsite off-road equipment such as feed loaders were estimated using CalEEMod Version 2020.4.0, Appendix F-1.

See Appendix G for Onsite NOx emissions from onsite truck travel and idling.

NOx Emissions from Agricultural Activities

	Acres	N2O Annual Average (Metric Tons CO_2e/Acre/ Year)	N2O Annual Average (tons/ acre/year)	Total Emissions (tons/yr)	
Existing Cropping					
Corn/Oats	208	0.32	0.0012	0.2462	
Corn/Oats/Sudangrass Silage	374	0.33	0.0012	0.4565	
Total				*0.7027*	
Proposed Cropping					
Corn/Oats	770	0.32	0.0012	*0.9114*	
Increment of Increase				**0.2087**	

The Michigan State University's US Cropland Greenhouse Gas Calculator accounts for different cropping systems using USDA county-specific data considering crop type, tillage, fertilizer, and environmental variables to calculate greenhouse gas emissions. Michigan State University's US Cropland Greenhouse Gas Calculator. Accessed on March 30, 2023 at <http://carboncalculator.kbs.msu.edu/>