Client:	Copperwood Resources, Inc.	Project ID.:	17C050
Project:	Air Permit Application Emissions Calculations - Version 2		
Prepared by:	CED1	Date:	06/25/18
Checked by:	AKM	Date:	07/02/18

Table of Contents

Client: Copperwood Resources, Inc. Project ID.: 17C050
Project: Air Permit Application Emissions Calculations - Version 2
Prepared by: CED1 Date: 06/25/18
Checked by: AKM Date: 07/02/18

Facility and Operational Basis for Emissions Calculations

1. Thruput and Production Rates for Mine Excavation/Ore Production

Actual thruput / process rates:	6,000	Mtpd Design production rate
	1.1	convert to English units (1 Mt = 1.1 ton)
	6,600	tons per day actual production rate
	350	day/year actual operations
	2,310,000	tons/year normal production rate
	330	tons per hour
Ore moisture content:	**5**	%
Daily and Hourly Rates:	**20**	hours/day operations: 2 @ 10 hour shifts
	1	hours/day for each blasting operation: 2 @ 10 hour shifts
	350	day/year actual operations
	7000	hours / year actual operations
	350	individual hours / year actual blasting operations
Maximum thruput / process rates:	10%	additional daily rate representing maximum
	7,260	tons per day maximum production rate
	365	day/year maximum operations
	2,649,900	tons/year maximum ore production rate
	363	tons per hour
Daily and Hourly Rates:	20	hours/day operations: 2 @ 10 hour shifts
	1	hours/day for each blasting operation: 2 @ 10 hour shifts
	365	day/year maximum operations
	7,300	hours / year maximum operations
	365	individual hours / year maximum blasting operations

2. Thruput and Production Rates for Concentrate Production

Actual Concentrate Production Rate:	18.2	tons/hour wet concentrate, normal production rate
	7,992	hr/yr normal/actual: 24 hours/day x 333 days per year
	145,454	tons/year concentrate normal production rate
	8%	moisture content of concentrate
Maximum Concentrate Production Rate:	15%	additional rate representing maximum
	20.9	tons/hour concentrate maximum production rate
	8,760	hr/year maximum operations: 24 hours/day x 365 days/year
	183,347	tons/year concentrate maximum production rate

3. Particle Size Distribution for Particulate Matter Emissions

AP-42 Appendix B,2, Table B.2.2, page B.2-13 Mechanically Generated Aggregate, Unprocessed Ores, September, 1990.

% cumulative size		Proportion to PMtot	
PM-2.5 =	15.0 %	PMtot =	100 %
PM-10 =	51.0 %	PM-10 =	51 %
Ratio PM-2.5 / PM-10 =	0.29	PM-2.5 =	15.0 %

4. Ventilation Exhaust Volume

Year	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	Maximum	Minimum
Portal Exhaust (cubic feet per minute)	85,000	255,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000	180,000			255,000	85,000
West Exhaust Vent Raise (cubic feet per minute)			415,000	670,000	585,000	415,000	330,000	160,000	75,000	75,000	75,000			670,000	75,000
East Exhaust Vent Raise (cubic feet per minute)						170,000	340,000	425,000	425,000	425,000	595,000	595,000	425,000	595,000	170,000
Air Intake (cubic feet per minute)	85,000	255,000	595,000	850,000	765,000	765,000	850,000	765,000	680,000	680,000	850,000	595,000	425,000	850,000	85,000

6. Ore Stockpile Metrics

Capacity	620,000	Metric tons
	682,000	tons
Area of footprint	13	Acres
Fill Rate	6,000	Mtpd Design production rate
	6,600	tons per day fill rate

7. Tailings Facility Metrics

Tailings Footprint Area	316	acres
Tailings Area for wind exposure	230	acres
Dry Beach Area	9.4	
Solids content slurry:	32%	

Client: Copperwood Resources, Inc. Project ID.: 17C050
Project: Air Permit Application Emissions Calculations - Version 2
Prepared by: CED1 Date: 06/25/18
Checked by: AKM Date: 07/02/18

Maximum Facility Emissions for Criteria Pollutants[1]

Criteria Pollutant Emissions in ton/year

Stack	Emission Source	NOx	SO2	CO	VOC	Lead	PM	PM10	PM2.5
Stack Emissions									
SV-001	West Mine Exhaust Vent	20.04	0.90	35.10	1.00	4.03E-05	3.67	1.91	0.85
SV-002	East Mine Exhaust Vent	20.65	0.93	36.16	1.03	4.15E-05	3.78	1.97	0.87
SV-003	Portal Mine Exhaust Vent	10.93	0.49	19.14	0.55	2.20E-05	2.00	1.04	0.46
SV-004	Emergency Generator No. 1 (1000 kW)	3.22	0.004	0.54	0.06		0.09	0.09	0.09
SV-005	Emergency Generator No. 2 (500 kW)	1.95	0.002	0.12	0.04		0.02	0.02	0.02
SV-006	Emergency Generator No. 3 (500 kW)	1.95	0.00	0.12	0.04		0.02	0.02	0.02
	Total Stack Emissions	58.76	2.34	91.19	2.73	1.04E-04	9.57	5.06	2.31
Fugitive Emissions									
Surface Ore Transfer									
	F001 - Ore Transfer from Portal to First Transfer Point					4.37E-06	0.40	0.15	0.02
	F002 - Surplus Ore Transfer to Ore Stockpile					1.03E-05	0.94	0.43	0.07
	F003 - Transfer Points at Ore Bins/Reclaim Area					8.73E-06	0.79	0.29	0.04
	F004 - Management of Ore within Ore Stockpile Area					2.31E-05	2.10	0.99	0.15
	F005 - Transfer Points at SAG Mill					5.24E-07	0.05	0.02	0.003
	F006 - Concentrate Handling Operations					5.15E-07	0.05	0.02	0.003
Other Fugitive Emission Sources									
	F007 - Wind Erosion at Ore Stockpile					5.50E-05	5.00	1.00	0.25
	F008 - Wind Erosion at TDF					4.32E-05	3.40	1.77	0.90
	F009 - Reagent Mixing Area				8.92E-03		5.98E-04	2.19E-04	2.19E-04
	F010 - Space Heaters - Process Plant Building	0.90	0.01	0.52	0.07		0.05	0.05	0.05
	HR-01 - Vehicle Travel on Ore Stockpile [5]					1.86E-04	16.89	3.61	0.36
	HR-02 - Conct Truck Travel on Access Road [5]					3.96E-05	2.58	0.55	0.06
	HR-03 - Water Truck Travel on Access Road [5]					4.16E-05	2.71	0.58	0.06
	HR-04 - Reagents/Grinding Media Truck Travel on Access Road [5]					3.22E-06	0.21	0.04	0.004
	HR-05 - Explosives Truck Travel on Access Road [5]					4.03E-07	0.03	0.01	0.001
	Total Fugitive Emissions	0.90	0.01	0.52	0.08	0.0004	35.20	9.51	1.96
	Maximum Controlled Facility Emissions [1]	59.66	2.34	91.71	2.81	5.20E-04	44.77	14.57	4.27
	Potential to Emit [2, 3, 4]	58.76	2.34	91.19	2.73	1.04E-04	9.57	5.06	2.31

Normal/Actual Facility Emissions for Criteria Pollutants[1]

Criteria Pollutant Emissions in ton/year

Stack	Emission Source	NOx	SO2	CO	VOC	Lead [6]	PM	PM10	PM2.5
Stack Emissions									
SV-001	West Mine Exhaust Vent	12.62	0.76	27.80	0.50	4.03E-05	2.66	1.24	0.49
SV-002	East Mine Exhaust Vent	13.00	0.78	28.64	0.52	4.15E-05	2.74	1.28	0.50
SV-003	Portal Mine Exhaust Vent	6.88	0.41	15.16	0.27	2.20E-05	1.45	0.68	0.27
SV-004	Emergency Generator No. 1 (1000 kW)	0.81	0.001	0.14	0.014		0.02	0.02	0.02
SV-005	Emergency Generator No. 2 (500 kW)	0.49	0.001	0.03	0.011		0.005	0.005	0.005
SV-006	Emergency Generator No. 3 (500 kW)	0.49	0.001	0.03	0.01		0.005	0.005	0.005
	Total Stack Emissions	34.31	1.96	71.80	1.33	1.04E-04	6.89	3.22	1.29
Fugitive Emissions									
Surface Ore Transfer									
	F001 - Ore Transfer from Portal to First Transfer Point					4.37E-06	0.35	0.13	0.02
	F002 - Surplus Ore Transfer to Ore Stockpile					1.03E-05	0.82	0.38	0.06
	F003 - Transfer Points at Ore Bins/Reclaim Area					8.73E-06	0.69	0.25	0.04
	F004 - Management of Ore within Ore Stockpile Area					2.31E-05	1.83	0.87	0.13
	F005 - Transfer Points at SAG Mill					5.24E-07	0.04	0.02	0.002
	F006 - Concentrate Handling Operations					5.15E-07	0.05	0.02	0.003
Other Fugitive Emission Sources									
	F007 - Wind Erosion at Ore Stockpile					5.50E-05	5.00	1.00	0.25
	F008 - Wind Erosion at TDF					4.32E-05	3.40	1.77	0.90
	F009 - Reagent Mixing Area								
	F010 - Space Heaters - Process Plant Building	0.45	0.003	0.26	0.03		0.024	0.024	0.024
	HR-01 - Vehicle Travel on Ore Stockpile					1.86E-04	14.72	3.15	0.32
	HR-02 - Vehicle Travel on Access Road					3.96E-05	2.05	0.44	0.04
	HR-03 - Water Truck Travel on Access Road [5]					4.16E-05	2.47	0.53	0.05
	HR-04 - Reagents/Grinding Media Truck Travel on Access Road [5]					3.22E-06	0.18	0.04	0.004
	HR-05 - Explosives Truck Travel on Access Road [5]					4.03E-07	0.02	0.005	0.0005
	Total Fugitive Emissions	0.45	0.00	0.26	0.03	4.16E-04	31.45	8.57	1.83

Greenhouse Gas Summary

Emergency Generators	798 tons/year CO2e
Mine Heaters	32658 tons/year CO2e
Space Heaters	886 tons/year CO2e
Blasting	409 tons/year CO2e
Total	34,750 tons/year CO2e

Notes:

1. Maximum controlled facility emissions are all site emissions (including fugitive emissions) after applying collection and control efficiencies on maximum operating schedle. Normal/actual emissions are based on the nomral/acutal operating schedule and basis.
2. Potential to Emit (PTE) for criteria pollutants at this facility is the stack emissions with no fugitives. While underground material handling and transfer points would normally be considered to be fugitive emission sources, emissions are directed through mine vents, which serve as stacks and point sources of emissions.
3. New Source Performance Standards (NSPS). 40 CFR 60 Subpart LL (NSPS) for metallic minerals processing is applicable to this facility. This NSPS (metallic mining) was developed after 1980 and since this facility is not subject to federal Maximum Achievable Control Technology (MACT) standards, fugitive dust is not part of PTE.
4. PTE is based on controlled emissions since operation of emission control equipment will be a legally enforceable requirement of the operation. PTE for hazardous air pollutants (HAPs) is based on both stack and fugitive emissions per R 336.1116 (m).
5. On-Site Road emissions include fugitive emissions from surface roadway travel, no tailpipe emissions. It includes emissions from loaders moving ore at the Ore Stockpile and trucks moving produced concentrate along the access road from the concentrate storage area to the main gate. All on-site vehicle travel will be on unpaved roads.
6. Note that maximum controlled emissions for lead have not been adjusted or recalculated for normal/actual conditons in that emissions are very low. Therefore, normal/actual emissions for lead are the same as maximum controlled emissions.
7. Only 4 of the 5 operate at a given time, however, the total emissions of the 4 operating generators have been proportioned across the 5 stacks for modeling purposes and presentation above.

Foth

Client: Copperwood Resources, Inc. Project ID.: 17C050
Project: Air Permit Application Emissions Calculations - Version 2
Prepared by: CED1 Date: 06/25/18
Checked by: AKM Date: 07/02/18

Ore
Concentrate
Native Soil
Tailings

Maximum Facility Emissions for Criteria Pollutants[1]

						HAP/TAC Concentrations (all in weight percent)																
						Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Magnesium	Manganese [9]	Mercury	Molybdenum	Nickel	Phosphorus	Selenium	Silver	Sulfur	Tin
						Sb	As	Ba	Be	Cd	Cr	Co	Cu	Pb	Mg	Mn	Hg	Mo	Ni	P	Se	Ag	S	Sn
					Ore [2]	4.75E-05	1.80E-04	0.07559	2.60E-04	1.75E-04	0.011	0.003	1.460	1.10E-03	0.00	0.17	0.0	5.06E-05	0.007	0.00	1.413E-04	4.387E-04	0.61	0.0003
					Concentrate [3]	0.00020	0.00100	0.01860	0.0	0.00370	0.006	0.0016	29.170	1.00E-03	1.45	0.09	0.00	0.0005	0.0073	2.48	0.0000	0.0040	8.80	0.0000
					Native Soil [4]	2.10E-05	0.0003	0.0188	0.0001	0.00005	0.004	0.0016	0.002	1.54E-03	0.45	0.22	0.00	9.10E-05	0.002	0.07	1.10E-04	1.68E-05	0.04	0.0001
					Tailings [5]	0.00005	0.0006	0.0535	0.0002	0.00003	0.0284	0.0036	0.4675	0.001	0.00	0.16	0.00	2.70E-03	0.02	0.00	1.00E-04	2.20E-04	0.23	2.50E-04
	PM	PM10	PM2.5																				
Underground Mine Emissions (Point) (EUMINEVENT) [7]																							
SV-001 (West Mine Exhaust Vent)	4.092	2.114	0.298	lb/hr	Ore	1.94E-06	7.36E-06	3.09E-03	1.06E-05	7.16E-06	4.44E-04	1.36E-04	5.97E-02	4.50E-05	0.00E+00	3.54E-03	4.26E-07	2.07E-06	2.68E-04	0.00E+00	5.78E-06	1.80E-05	2.51E-02	1.18E-05
	3.666	1.914	0.845	ton/yr		1.74E-06	6.60E-06	2.77E-03	9.53E-06	6.42E-06	3.98E-04	1.22E-04	5.35E-02	4.03E-05	0.00E+00	3.21E-03	3.81E-07	1.86E-06	2.40E-04	0.00E+00	5.18E-06	1.61E-05	2.25E-02	1.05E-05
SV-002 (East Mine Exhaust Vent)	4.22	2.18	0.31	lb/hr	Ore	2.00E-06	7.59E-06	3.19E-03	1.10E-05	7.38E-06	4.57E-04	1.40E-04	6.15E-02	4.63E-05	0.00E+00	3.65E-03	4.38E-07	2.13E-06	2.76E-04	0.00E+00	5.96E-06	1.85E-05	2.59E-02	1.21E-05
	3.78	1.97	0.87	ton/yr		1.79E-06	6.80E-06	2.86E-03	9.82E-06	6.61E-06	4.10E-04	1.26E-04	5.52E-02	4.15E-05	0.00E+00	3.30E-03	3.93E-07	1.91E-06	2.47E-04	0.00E+00	5.34E-06	1.66E-05	2.32E-02	1.09E-05
SV-003 (Portal Exhaust Vent)	2.232	1.153	0.162	lb/hr	Ore	1.06E-06	4.02E-06	1.69E-03	5.80E-06	3.91E-06	2.42E-04	7.43E-05	3.26E-02	2.45E-05	0.00E+00	1.93E-03	2.32E-07	1.13E-06	1.46E-04	0.00E+00	3.15E-06	9.79E-06	1.37E-02	6.42E-06
	2.000	1.044	0.461	ton/yr		9.50E-07	3.60E-06	1.51E-03	5.20E-06	3.50E-06	2.17E-04	6.65E-05	2.92E-02	2.20E-05	0.00E+00	1.75E-03	2.08E-07	1.01E-06	1.31E-04	0.00E+00	2.83E-06	8.77E-06	1.23E-02	5.75E-06
Total Underground Mine Emissions (Point)	10.54	5.45	0.77	lb/hr	Ore	5.01E-06	1.90E-05	7.97E-03	2.74E-05	1.84E-05	1.14E-03	3.51E-04	1.54E-01	1.16E-04	0.00E+00	9.13E-03	1.10E-06	5.33E-06	6.90E-04	0.00E+00	1.49E-05	4.62E-05	6.47E-02	3.03E-05
	9.44	4.93	2.18	ton/yr		4.49E-06	1.70E-05	7.14E-03	2.46E-05	1.65E-05	1.02E-03	3.14E-04	1.38E-01	1.04E-04	0.00E+00	8.26E-03	9.82E-07	4.78E-06	6.18E-04	0.00E+00	1.33E-05	4.14E-05	5.80E-02	2.72E-05
					lb per year toxics	0.009	0.034	14.277	0.049	0.033	2.049	0.628	275.751	0.208	0.000	16.52	0.00	0.010	1.24	0.00	0.027	0.083	115.92	0.054
Haul Road Fugitive Emissions (Volume Source Fugitives) [6]																							
HR-01 Haul Road on Ore Stockpile (EUHAULROADS)	4.63	0.99	0.099	lb/hr	Ore	2.20E-06	8.33E-06	3.50E-03	1.20E-05	8.10E-06	5.02E-04	1.54E-04	6.76E-02	5.08E-05	0.00E+00	1.66E-03	4.81E-07	2.34E-06	3.03E-04	0.00E+00	6.54E-06	2.03E-05	2.84E-02	1.33E-05
	16.89	3.61	0.36	ton/yr		8.02E-06	3.04E-05	1.28E-02	4.39E-05	2.96E-05	1.83E-03	5.62E-04	2.47E-01	1.86E-04	0.00E+00	6.06E-03	1.76E-06	8.55E-06	1.11E-03	0.00E+00	2.39E-05	7.41E-05	1.04E-01	4.86E-05
HR-02 Concentrate Transfer Along On-Site Access Road (EUHAULROADS)	1.74	0.37	0.037	lb/hr	Native Soil	3.66E-07	5.57E-06	3.27E-04	1.85E-06	8.01E-07	6.39E-05	2.77E-05	3.43E-05	2.67E-05	7.83E-03	8.30E-04	1.55E-07	1.58E-06	4.16E-05	1.24E-03	1.91E-06	2.92E-07	6.96E-04	2.09E-06
	2.58	0.55	0.06	ton/yr		5.41E-07	8.25E-06	4.85E-04	2.73E-06	1.19E-06	9.46E-05	4.10E-05	5.08E-05	3.96E-05	1.16E-02	1.23E-03	2.29E-07	2.35E-06	6.16E-05	1.83E-03	2.84E-06	4.33E-07	1.03E-03	3.09E-06
HR-03 - Water Truck Transport Along On-Site Access Road (EUHAULROADS)	2.24	0.48	0.05	lb/hr	Native Soil	4.71E-07	7.18E-06	4.22E-04	2.38E-06	1.03E-06	8.23E-05	3.57E-05	4.42E-05	3.44E-05	1.01E-02	1.07E-03	2.00E-07	2.04E-06	5.36E-05	1.59E-03	2.47E-06	3.77E-07	8.98E-04	2.69E-06
	2.71	0.58	0.06	ton/yr		5.69E-07	8.66E-06	5.09E-04	2.87E-06	1.25E-06	9.94E-05	4.30E-05	5.33E-05	4.16E-05	1.22E-02	1.29E-03	2.41E-07	2.46E-06	6.47E-05	1.92E-03	2.98E-06	4.55E-07	1.08E-03	3.25E-06
Reagent/Grind Media Truck Transport Along On-Site Access Road (EUHAULROADS)	1.78	0.38	0.04	lb/hr	Native Soil	3.74E-07	5.70E-06	3.35E-04	1.89E-06	8.20E-07	6.54E-05	2.83E-05	3.51E-05	2.74E-05	8.02E-03	8.50E-04	1.59E-07	1.62E-06	4.26E-05	1.27E-03	1.96E-06	2.99E-07	7.13E-04	2.14E-06
	0.21	0.04	0.004	ton/yr		4.40E-08	6.71E-07	3.94E-05	2.22E-07	9.64E-08	7.69E-06	3.33E-06	4.13E-06	3.22E-06	9.43E-04	1.00E-04	1.87E-08	1.91E-07	5.01E-06	1.49E-04	2.31E-07	3.52E-08	8.38E-05	2.51E-07
HR-05 - Explosives Truck Transport Along On-Site Access Road (EUHAULROADS)	1.77	0.38	0.04	lb/hr	Native Soil	3.71E-07	5.65E-06	3.32E-04	1.87E-06	8.13E-07	6.48E-05	2.81E-05	3.48E-05	2.71E-05	7.95E-03	8.43E-04	1.57E-07	1.61E-06	4.22E-05	1.25E-03	1.94E-06	2.97E-07	7.07E-04	2.12E-06
	0.03	0.01	0.001	ton/yr		5.51E-09	8.40E-08	4.94E-06	2.78E-08	1.21E-08	9.64E-07	4.17E-07	5.17E-07	4.03E-07	1.18E-04	1.25E-05	2.34E-09	2.39E-08	6.28E-07	1.86E-05	2.89E-08	4.41E-09	1.05E-05	3.15E-08
Total Haul Road Fugitive Emissions	12.16	2.60	0.26	lb/hr		3.78E-06	3.24E-05	4.91E-03	2.00E-05	1.16E-05	7.79E-04	2.74E-04	6.77E-02	1.66E-04	3.39E-02	5.25E-03	1.15E-06	9.20E-06	4.83E-04	5.35E-03	1.48E-05	2.16E-05	3.14E-02	2.23E-05
	22.41	4.79	0.48	ton/yr		9.18E-06	4.81E-05	1.38E-02	4.98E-05	3.21E-05	2.04E-03	6.50E-04	2.47E-01	2.70E-04	2.48E-02	8.69E-03	2.25E-06	1.36E-05	1.24E-03	3.92E-03	2.99E-05	7.50E-05	1.06E-01	5.52E-05
					lb per year toxics	0.0184	0.0961	27.6127	0.0995	0.0642	4.0707	1.2995	493.4533	0.5407	49.6898	17.3783	0.0045	0.0271	2.4747	7.8400	0.0599	0.1501	211.7617	0.1104
Surface Ore Transfer & Handling (Volume Source Fugitive) (EUFUGITIVES)																							
F001 - Portal to Transfer Tower	0.11	0.04	0.006	lb/hr	Ore	5.17E-08	1.96E-07	8.23E-05	2.83E-07	1.91E-07	1.18E-05	3.62E-06	1.59E-03	1.20E-06	0.00E+00	6.69E-05	1.13E-08	5.51E-08	7.13E-06	0.00E+00	1.54E-07	4.78E-07	6.68E-04	3.13E-07
	0.40	0.15	0.02	ton/yr		1.89E-07	7.15E-07	3.00E-04	1.03E-06	6.96E-07	4.31E-05	1.32E-05	5.80E-03	4.37E-06	0.00E+00	2.44E-04	4.13E-08	2.01E-07	2.60E-05	0.00E+00	5.62E-07	1.74E-06	2.44E-03	1.14E-06
F002 - Surplus Ore Transfer at Ore Stockpile	0.26	0.119	0.018	lb/hr	Ore	1.22E-07	4.64E-07	1.95E-04	6.70E-07	4.51E-07	2.79E-05	8.57E-06	3.76E-03	2.83E-06	0.00E+00	1.99E-04	2.68E-08	1.30E-07	1.69E-05	0.00E+00	3.64E-07	1.13E-06	1.58E-03	7.40E-07
	0.940	0.434	0.066	ton/yr		4.46E-07	1.69E-06	7.11E-04	2.44E-06	1.64E-06	1.02E-04	3.13E-05	1.37E-02	1.03E-05	0.00E+00	7.27E-04	9.78E-08	4.76E-07	6.15E-05	0.00E+00	1.33E-06	4.12E-06	5.77E-03	2.70E-06
F003 - Transfer Point at Ore Bins/Reclaim Area	0.22	0.08	0.01	lb/hr	Ore	1.03E-07	3.92E-07	1.65E-04	5.66E-07	3.81E-07	2.36E-05	7.25E-06	3.18E-03	2.39E-06	0.00E+00	1.34E-04	2.27E-08	1.10E-07	1.43E-05	0.00E+00	3.08E-07	9.55E-07	1.34E-03	6.26E-07
	0.8	0.3	0.0	ton/yr		3.78E-07	1.43E-06	6.01E-04	2.07E-06	1.39E-06	8.63E-05	2.64E-05	1.16E-02	8.73E-06	0.00E+00	4.88E-04	8.27E-08	4.02E-07	5.20E-05	0.00E+00	1.12E-06	3.49E-06	4.88E-03	2.29E-06
F004 - Management of Ore within Ore Stockpile	0.58	0.27	0.04	lb/hr	Ore	2.73E-07	1.04E-06	4.35E-04	1.50E-06	1.01E-06	6.25E-05	1.92E-05	8.41E-03	6.33E-06	0.00E+00	4.56E-04	5.99E-08	2.91E-07	3.77E-05	0.00E+00	8.14E-07	2.53E-06	3.53E-03	1.66E-06
	2.10	1.0	0.2	ton/yr		9.98E-07	3.78E-06	1.59E-03	5.46E-06	3.68E-06	2.28E-04	6.99E-05	3.07E-02	2.31E-05	0.00E+00	1.67E-03	2.19E-07	1.06E-06	1.38E-04	0.00E+00	2.97E-06	9.22E-06	1.29E-02	6.04E-06
F005 - Transfer Points at SAG Mill	0.011	0.0040	0.0006	lb/hr	Ore	5.17E-09	1.96E-08	8.23E-06	2.83E-08	1.91E-08	1.18E-06	3.62E-07	1.59E-04	1.20E-07	0.00E+00	6.69E-06	1.13E-09	5.51E-09	7.13E-07	0.00E+00	1.54E-08	4.78E-08	6.68E-05	3.13E-08
	0.048	0.017	0.003	ton/hr		2.27E-08	8.59E-08	3.61E-05	1.24E-07	8.35E-08	5.18E-06	1.59E-06	6.96E-04	5.24E-07	0.00E+00	2.93E-05	4.96E-09	2.41E-08	3.12E-06	0.00E+00	6.74E-08	2.09E-07	2.93E-04	1.37E-07
F006 - Concentrate Packaging Operations	0.012	0.004	0.0006	lb/hr	Concentrate	2.35E-08	1.18E-07	2.19E-06	0.00E+00	4.35E-07	7.52E-07	1.88E-07	3.43E-03	1.18E-07	1.70E-04	3.78E-06	5.76E-09	5.88E-08	8.58E-07	2.92E-04	0.00E+00	4.70E-07	1.03E-03	0.00E+00
	0.051	0.019	0.0028	ton/yr		1.03E-07	5.15E-07	9.58E-06	0.00E+00	1.91E-06	3.30E-06	8.24E-07	1.50E-02	5.15E-07	7.47E-04	1.66E-05	2.52E-08	2.57E-07	3.76E-06	1.28E-03	0.00E+00	2.06E-06	4.53E-03	0.00E+00
Total fugitive emissions associated with Surface Ore Handling and Handling	1.18	0.52	0.08	lb/hr		5.80E-07	2.23E-06	8.87E-04	3.04E-06	2.48E-06	1.28E-04	3.91E-05	2.05E-02	1.30E-05	1.70E-04	8.67E-04	1.28E-07	6.51E-07	7.75E-05	2.92E-04	1.65E-06	5.61E-06	8.22E-03	3.37E-06
	4.3	1.9	0.3	ton/yr		2.14E-06	8.22E-06	3.25E-03	1.11E-05	9.40E-06	4.68E-04	1.43E-04	7.75E-02	4.76E-05	7.47E-04	3.17E-03	4.71E-07	2.42E-06	2.84E-04	1.28E-03	6.05E-06	2.08E-05	3.08E-02	1.23E-05
					lb per year toxics	4.27E-03	1.64E-02	6.49E+00	2.23E-02	1.88E-02	9.36E-01	2.87E-01	1.55E+02	9.51E-02	1.49E+00	6.34E+00	9.41E-04	4.85E-03	5.68E-01	2.55E+00	1.21E-02	4.17E-02	6.16E+01	2.46E-02
Wind Erosion Stockpiles (Area Source Fugitives) (EUWINDEROSION)																							
F007 - Ore Stockpile (EUFUGITIVES)	1.14	0.23	0.06	lb/hr	Ore	5.43E-07	2.06E-06	8.64E-04	2.97E-06	2.00E-06	1.24E-04	3.80E-05	1.67E-02	1.26E-05	0.00E+00	3.83E-04	1.19E-07	5.78E-07	7.48E-05	0.00E+00	1.61E-06	5.01E-06	7.01E-03	3.29E-06
	5.00	1.00	0.25	ton/yr		2.38E-06	9.01E-06	3.78E-03	1.30E-05	8.76E-06	5.43E-04	1.67E-04	7.31E-02	5.50E-05	0.00E+00	1.68E-03	5.20E-07	2.53E-06	3.28E-04	0.00E+00	7.07E-06	2.20E-05	3.07E-02	1.44E-05
					lb per year toxics	4.75E-03	1.80E-02	7.57E+00	2.60E-02	1.75E-02	1.09E+00	3.33E-01	1.46E+02	1.10E-01	0.00E+00	3.35E+00	1.04E-03	5.06E-03	6.55E-01	0.00E+00	1.41E-02	4.39E-02	6.14E+01	2.88E-02
F008 - Tailings Disposal Facility (EUFUGITIVES)	0.78	0.40	0.21	lb/hr	Tailings	3.88E-07	4.66E-06	4.15E-04	1.55E-06	2.33E-07	2.21E-04	2.80E-05	3.63E-03	9.86E-06	0.00E+00	6.49E-04	1.32E-08	2.10E-05	1.45E-04	0.00E+00	7.76E-07	1.71E-06	1.75E-03	1.94E-06
	3.40	1.77	0.90	ton/yr		1.70E-06	2.04E-05	1.82E-03	6.80E-06	1.02E-06	9.66E-04	1.22E-04	1.59E-02	4.32E-05	0.00E+00	2.84E-03	5.78E-08	9.18E-05	6.36E-04	0.00E+00	3.40E-06	7.48E-06	7.65E-03	8.50E-06
					lb per year toxics	3.40E-03	4.08E-02	3.64E+00	1.36E-02	2.04E-03	1.93E+00	2.45E-01	3.18E+01	8.64E-02	0.00E+00	5.69E+00	1.16E-04	1.84E-01	1.27E+00	0.00E+00	6.80E-03	1.50E-02	1.53E+01	1.70E-02

Foth

Client: Copperwood Resources, Inc. Project ID.: 17C050
Project: Air Permit Application Emissions Calculations - Version 2
Prepared by: CED1 Date: 06/25/18
Checked by: AKM Date: 07/02/18

Ore
Concentrate
Native Soil
Tailings

Totals for all Emissions Sources				Antimony	Arsenic	Barium	Beryllium	Cadmium	Chromium	Cobalt	Copper	Lead	Magnesium	Manganese	Mercury	Molybdenum	Nickel	Phosphorus	Selenium	Silver	Sulfur	Tin
	5.11.E+00	lb/hr																				
Total TACs=	20735	lb/year	total lb/hr	1.03E-05	6.03E-05	1.50E-02	5.50E-05	3.47E-05	2.39E-03	7.29E-04	2.62E-01	3.18E-04	3.41E-02	1.63E-02	2.51E-06	3.67E-05	1.47E-03	5.64E-03	3.38E-05	8.01E-05	1.13E-01	6.12E-05
	10.4	ton/year	decimal format lb/hr	0.00001	0.0001	0.015	0.00005	0.00003	0.002	0.0007	0.262	0.0003	0.0341	0.016	0.000	0.0000	0.0015	0.006	0.00003	0.00008	0.113	0.00006
			lb/yr	0.04	0.21	59.59	0.21	0.14	10.07	2.79	1102.20	1.04	51.18	49.29	0.01	0.23	6.21	10.39	0.12	0.33	466.04	0.24
				TAC	TAC	TAC	TAC	TAC	TAC	TAC	TAC	TAC	TAC	TAC	TAC	TAC	TAC	TAC	TAC	TAC		TAC
Federal HAPS: marked as HAP →				HAP	HAP		HAP	HAP	HAP	HAP		HAP		HAP	HAP		HAP		HAP			

Emergency Generators (SV-004, SV-005, SV-006) [7]	0.52	0.52	0.52	lb/hr
EUGENERATORS	0.08	0.08	0.08	ton/yr
Reagents (F009) and Space Heaters (F010) (Fugitive)				
EUFUGITIVES	0.0112	0.0112	0.0112	lb/hr
	0.049	0.0489	0.0489	ton/yr
Stack Emissions - Total	11.06	5.97	1.29	lb/hr
	9.5	5.0	2.3	ton/yr
Fugitive Emissions - Total	8.3	2.3	0.4	lb/hr
	27.3	7.9	1.7	ton/yr
Total Maximum Controlled Facility Emissions	36.8	12.9	3.9	ton/yr

Notes:

1. Maximum facility emissions are all site emissions (including fugitive emissions) after applying collection and control efficiencies.
2. Ore data are the maximum average from sampled parting shales. Copper and silver concentrations are from Orvana Minerals, Corp. Feasibility Study Results Announcement, 02/07/2012.
3. Concentrate data are from *Orvana Minerals Corporation, Copperwood Technical Project, NI 43-01-0 Technical Report, April 30, 2010, Table 16-3;* except silver concentrations are from *Q431-03-028-Orvan Resources Copperwood Project Prefeasbility Study Final 08-03-2011, page 5* .
4. Native soil data is the greatest maximum value from *Orvana EIA, Table 202.2.2-5, Summary of Soil Chemistry* .
5. Talings data are the maximum values from sampled composite talings. Derived from Orvana EIA, Table 203.3.4-5, Bulk Chemical Composition Composite Tailings from metalllurgical testing compared to unprocessed copper bearing sequence.
6. Roadway emissions only include fugitive emissions from surface roadway travel.
7. Potential to Emit (PTE) for this facility is the stack emissions with no fugitives. The New Source Performance Standards (NSPS) for metallic minerals processing is applicable to this facility
   This NSPS (metallic mining) was developed after 1980 and since this facility is not subject to federal Maximum Achievable Control Technology (MACT) standards, fugitive dust is not part of PTE.
   PTE is based on controlled emissions since operation of emission control equipment will be a legally enforceable requirement of the operation. PTE for hazardous air pollutants (HAPs)
   is based on both stack and fugitive emissions per R 336.1116 (m).
8. Toxics from combustion appear on sheets for these emissions units.
9. Calculation of manganese TAC emissions is based on Note 29 in the MDEQ Table 2 List of Screening Levels. Note 29 states that the ITSL for manganese is most appropriately applied to PM10-Mn rather than TSP-Mn data. Therefore, all TAC calculations for Mn were based on PM-10 data.

Client: Copperwood Resources, Inc. Project ID.: 17C050
Project: Air Permit Application Emissions Calculations - Version 2
Prepared by: CED1 Date: 06/25/18
Checked by: AKM Date: 07/02/18

Underground Emissions (Point Sources) SV-001, SV-002, SV-003)
EUMINEVENT
SV-001 = West Mine Exhaust Vent
SV-002 = East Mine Exhaust Vent
SV-003 = Portal Exhaust Vent

Underground emissions are comprised from the following activities:
1 Drill
2 Blast
3 Material Handling (muck pile, rock breaker, and conveyor transfer points)

1 Drilling

Additional particle size ratios are based on AP-42 Appendix B.2 Generalized Particle Size Distributions

Drilling Emissions PM	PM-10	PM-2.5	
E factor	0.00008		lb/ton processed AP-42 11.19.2-2 E factor
1	0.51	0.15	Particle size proportion[1]
0.00016	0.00008	2.35E-05	Adjusted E Factor - lb/ton processed
			Maximum Emissions
7,260	7,260	7,260	tons ore through put per day[2]
1.14	0.58	0.17	lb/day
0.06	0.03	0.01	lb/hr based on 20 hrs/day [3]
416	212	62	lb/year at 365 days per year [3]
0.208	0.106	0.031	ton/year maximum emissions
			Actual Emisssions
6600	6600	6600	tons ore through put per day[2]
1.04	0.53	0.16	lb/day
0.05	0.03	0.01	lb/hr based on 20 hrs/day [3]
362	185	54	lb/year at 350 days per year [3]
0.18	0.09	0.03	ton/year actual emissions

1. See Facility Basis sheet, item 3.
2. See Facility Basis sheet, item 1.
3. Maximum and Actual operational hours are shown on Facility Basis sheet, item 1.

2 Blasting PM Emissions

Based on AP-42, Chapter 11.9 Western Surface Coal Mining
(Best fit for this estimate)

$$E = 0.000014(A)^{1.5}$$ Emission factor equation from Table 11.9-1 for Blasting lb PM/blast

Drill hole depth: 10 feet
Wet Bulk Density Ore: 128 lb/ft3
Source: PFS Design Criteria, Document KD Engineering, No. KDE Q431-03-010

$$E_{PM10} = (0.52)(0.000014)(A)^{1.5}$$ 0.52 = PM10 factor Table 11.9-1

$$E_{PM\,2.5} = (0.03)(0.000014)(A)^{1.5}$$ 0.03 = PM2.5 factor Table 11.9-1

Where: E is emissions factor Area A is estimated by the volume of ore.
Area Calculation
Area is estimated from blasted volume per day divided by the drill hole depth (10 ft)
From mine plan:

	tons/year	lb/ft3	lb/ton	ft3/yr			
Maximum Ore Production Rate:	2,649,900	128	2000	41,404,688	4,140,469	ft2	Area blasted per year
					10	ft	depth of blast
					11,344	ft2	area for 365 day/year
					A= 11,344	ft2	daily blast area

Using formulae above, Emission factors E:

Emissions PM	Emissions PM-10	Emissions PM-2.5	
16.9	8.8	0.5	lb/blast per day
1	1	1	hr/day maximum
16.9	8.8	0.51	lb/hr maximum
8.46	4.40	0.254	lb/hr (50% Control as Settling Emission Factor for PM)
1.54	0.80	0.046	ton/yr maximum production
0.13	0.07	0.004	ton/yr normal production

A= 11,344 ft2 daily blast area
Maximum Operating days per year: 365
Normal Operating days per year: 350
Assumed Settling Emission Factor: 50% (Assume portion of PM will settle underground and not be vented to surface)
Max. Individual Blasting hours per year: **365** hr/yr
Normal Individual Blasting hours per year: **350** hr/yr

1. A settling efficiency and subsequently a settling factor can be calculated if the dimensions of underground working areas (e.g., stopes, declines, etc.) are known. At the time emission calculations were prepared, this information was not available. Based on previous emission calculations for another underground mine in Michigan, a settling emission factor of 0.43 was calculated for underground stope areas. Given this information, an approximate settling factor of 50% will be applied to this facility.

Blasting - Additional Pollutants

AP-42 Section 13.3 Explosives Detonation Table 13.3-1 version: 2/80 (reformatted 1/95)

Emulsion Powder Factor 0.80 kg emulsion/tonne (GMining, 2017)
1.6 lb emulsion/ton rock blast
7,260 tons per day of maximum ore production
6600 tons per day of normal ore production

ANFO maximum emissions - Based on maximum production rate

Maximum daily production rate: 7,260 ton/day
Maximum operating days/year 365 day/yr
Average annual blasting rate: 2,649,900 ton/yr blasted rock
Emulsion Powder Factor 1.60 lb emulsion/ton rock blasted
Annual emulsion usage 4,239,840 lb emulsion/yr
2120 ton emulsion /yr

	NOx	SOx	CO
AP-42 factor lb emissions/ton ANFO	17	2	67
Emissions (lb/yr)	36039	4240	142035
Emissions (lb/hr)	98.7	11.6	389.1
Emissions (tpy)	18.0	2.1	71.0

ANFO maximum emissions - Based on normal production rate

Normal production rate: 6600 ton/day
Normal operating days/year: 350 days/yr
Average annual blasting rate: 2,310,000 ton/yr blasted rock
Emulsion Powder Factor: 1.60 lb. emulsion/ton rock blasted
Annual emulstion usage: 3,696,000 lb. emulsion/yr
1848 ton emulsion /yr

NOx	SOx	CO	
17	2	67	AP-42 factor lb emissions/ton ANFO
31416	3696	123816	Emissions (lb/yr)
89.8	10.6	353.8	Emissions (lb/hr)
15.7	1.8	61.9	Emissions (tpy)

3 Material Handling

Emissions Calculations:

	Process thru-put ton/hr	E factor PM lb/ton	E factor PM-10 lb/ton	E-Factor PM-2.5 [1] lb/ton	Efficiency capture	Efficiency % note 2b PC equip	Efficiency % note 2a Enclosure	Emissions PM lb/hr	Emissions PM-10 lb/hr	Emissions PM-2.5 (lb/hr)	Efactor Reference
Remove Broken Ore from Muck Pile	363	0.003	0.0011	0.000165				1.089	0.399	0.0599	11.19-2 Conveyor Transfer Point (Uncontrolled)
Use Rolls/Rock Breaker to Reduce Ore Size	363	0.0054	0.0024	0.00036		90%		0.196	0.087	0.0131	11.19-2 Tertiary Crushing (Uncontrolled)
Transfer Ore to Feed Hopper	363	0.003	0.0011	0.000165		90%		0.109	0.040	0.0060	11.19-2 Conveyor Transfer Point (Uncontrolled)
Feed Hopper to Side Conveyor	363	0.003	0.0011	0.000165		90%		0.109	0.040	0.0060	11.19-2 Conveyor Transfer Point (Uncontrolled)
Side Conveyor to Main Conveyor	363	0.003	0.0011	0.000165		90%		0.109	0.040	0.0060	11.19-2 Conveyor Transfer Point (Uncontrolled)
Fugitive Emissions from Underground Material Handling								1.612	0.606	0.091	lb/hr maximum
maximum hours based on:								7300	7300	7300	hr/yr maximum
								11766	4425	664	lb/yr maximum
								5.883	2.213	0.332	ton/yr maximum
								5.641	2.122	0.318	ton/yr actual

Foth

Client: Copperwood Resources, Inc. Project ID.: 17C050
Project: Air Permit Application Emissions Calculations - Version 2
Prepared by: CED1 Date: 06/25/18
Checked by: AKM Date: 07/02/18

1. Particle size distribution is provided on Facility Basis sheet, item 3.
2. Capture & control efficiencies applied:

(b) Emission source has a wet spray. Efficiency applied is: 90%

4 Mine Heaters
Emissions Calculations:

All mine heaters will be positioned at the mine ventilation intake with propane combustion emissions exhausted through the three mine exhaust vents.

Emission Factors

AP-42 Table 1.5-1 Emission Factors for LPG Combustion (Updated 07/08)

Pollutant	Emission Factor - lb/1000 gal	
NOx	13	
CO	7.5	
TOC	1.0	
PM	0.7	(Assume all PM10)
SO2	0.10S	S=sulfur content expressed in gr/100 ft3 gas vapor (see calc at bottom)
SO2	0.0812	at S=10 ppm

Potential to Emit - Traditional Approach, uncontrolled running all year round

No. heaters:	1		ACI-CANEFCO - The heater will use 6 Maxon APX burners rated at 9 mmBTU/hour.
No. burners/heater:	6		ACI-CANEFCO -
Load per burner:	9	mmBtu/hr	ACI-CANEFCO
Operating time:	8760	hr/yr	
1000 gal LPG=	91.5	mmBtu	AP-42 Chapter 1.5
Total burner fuel usage=	0.590	- 1000 gal/hr	

Uncontrolled	NOx	SOx	PM10	CO	VOC
Emissions (lb/hr)	7.67	4.8E-02	0.41	4.43	0.59
Emissions (lb/yr)	67208	420	3619	38774	5170
Emissions (tpy)	33.6	2.1E-01	1.8	19.4	2.6

Normal/Actual Emissions

No. heaters running:	6		
Load per heater:	9	mmBtu/hr	
Days/year requiring mine heat:	182.5	day/yr	Based on data from National Weather Service Forecast Office,
Operating time:	4380	hr/yr	there are 148 days/year with average temperature less than 32 F.

Uncontrolled	NOx	SOx	PM10	CO	VOC
Emissions (lb/hr)	7.67	4.8E-02	0.41	4.43	0.59
Emissions (lb/yr)	33604	210	1809	19387	2585
Emissions (tpy)	16.8	1.0E-01	0.9	9.7	1.3

Calculation of S

S= gr S/100 ft3 vapor 7000 gr=1 lb

sulfur content	10	ppm	Platt's Petrochemicals Guide to Specifications - LPG
ɒane vapor density at 1 atm, 70F	0.116	lb/ft3	
sulfur content of vapor at 10 ppm	0.00000116	lb/ft3	
convert to gr/100ft3:			
S=	0.812	gr S/100 ft3 vapor	

Allocation of Emissions to Ventilation System:

Ventilation Summary is shown on Facility Basis sheet, item 4.
Use Maximum Ventilation Rates to Estimate Allocation of Emissions (Mine Year 2025)

	CFM	Allocation
	330,000	0.388
SV-001 (West Mine Exhaust Vent)		
	340,000	0.400
SV-002 (East Mine Exhaust Vent)		
	180,000	0.21
SV-003 (Portal Mine Exhaust Vent)		
	850,000	

Emissions Summary:

	Maximum Underground Emissions:							Normal Underground Emissions:							
	Emissions NOx	**Emissions** SOx	**Emissions** CO	**Emissions** PM	**Emissions** PM-10	**Emissions** PM-2.5	Emissions VOC	**Emissions** NOx	**Emissions** SOx	**Emissions** CO	**Emissions** PM	**Emissions** PM-10	**Emissions** PM-2.5	**Emissions** VOC	
Total lb/hr	106.4	11.7	393.6	10.54	5.45	0.77	0.59	97.4	10.6	358.2					
Total ton/yr	51.6	2.3	90.4	9.44	4.93	2.18	2.6	32.5	2.0	71.6	6.86	3.19	1.25	1.3	
	Ventilation Raise Allocated Maximum Emissions							Ventilation Raise Allocated Normal Emissions							
SV-001 (West Mine Exhaust	41.31	4.53	152.79	4.09	2.11	0.298	0.229	37.83	4.12	139.06					lb/hr
	20.04	0.90	35.10	3.67	1.91	0.85	1.00	12.62	0.76	27.80	2.66	1.24	0.49	0.50	ton/yr
SV-002 (East Mine Exhaust	42.56	4.67	157.42	4.22	2.18	0.307	0.236	38.97	4.24	143.27					lb/hr
	20.65	0.93	36.16	3.78	1.97	0.87	1.03	13.00	0.78	28.64	2.74	1.28	0.50	0.52	ton/yr
SV-003 (Portal Mine Exhaust	22.53	2.47	83.34	2.23	1.15	0.162	0.125	20.63	2.25	75.85					lb/hr
	10.93	0.49	19.14	2.00	1.04	0.46	0.55	6.88	0.41	15.16	1.45	0.68	0.27	0.27	ton/yr

Client: Copperwood Resources, Inc. Project ID.: 17C050
Project: Air Permit Application Emissions Calculations - Version 2
Prepared by: CED1 Date: 06/25/18
Checked by: AKM Date: 07/02/18

Process Plant Building Space Heaters (F010)
Fugitive Emissions Source (Characterized as Volume Source for Air Dispersion Modeling)
Emissions Calculations:

All space heaters will be located in the process plant, including the grinding/flotation plant, concentrate area, and reagent area. It will be assumed that propane combustion emissions will be exhausted throughout the process plant building and will be considered a volume source from an air dispersion modeling standpoint.

Emission Factors

	AP-42 Table 1.5-1 Emission Factors for LPG Combustion (Updated 07/08)	
Pollutant	Emission Factor - lb/1000 gal	
NOx	13	
CO	7.5	
TOC	1.0	
PM	0.7	(Assume all PM10)
SO2	0.10S	S=sulfur content expressed in gr/100 ft3 gas vapor (see calc at bottom)
SO2	0.0812	at S=10 ppm

Potential to Emit - Traditional Approach, uncontrolled running all year round

Required Heat Input Rate:	1.452	mmBtu/hr	This is net load load required based on heat load calculations prepared by Gmining. The heat load was determined after taking into account the heat gain from electric motors in the building.
Operating time:	8760	hr/yr	
1000 gal LPG=	91.5	mmBtu	AP-42 Chapter 1.5
Total burner fuel usage=	0.016	- 1000 gal/hr	

Uncontrolled	NOx	SOx	PM10	CO	VOC
Emissions (lb/hr)	0.21	1.3E-03	0.01	0.12	0.02
Emissions (lb/yr)	1807	11	97	1043	139
Emissions (tpy)	0.9	5.6E-03	0.05	0.5	0.1

Normal/Actual Emissions

Days/year requiring mine heat:	182.5	day/yr	Based on data from National Weather Service Forecast Office, there are 148 days/year with average temperature under 32 F.
Operating time:	4380	hr/yr	

Uncontrolled	NOx	SOx	PM10	CO	VOC
Emissions (lb/hr)	0.21	1.3E-03	0.01	0.12	0.02
Emissions (lb/yr)	904	6	49	521	70
Emissions (tpy)	0.5	2.8E-03	0.02	0.26	0.03

Calculation of S

S= gr S/100 ft3 vapor		7000	gr=1 lb
sulfur content	10	ppm	Platt's Petrochemicals Guide to Specifications - LPG
ɔor density at 1 atm, 70F	0.116	lb/ft3	
ntent of vapor at 10 ppm	0.00000116	lb/ft3	
convert to gr/100ft3:			
S=	0.812	gr S/100 ft3 vapor	

Client: Copperwood Resources, Inc. Project ID.: 17C050
Project: Air Permit Application Emissions Calculations - Version 2
Prepared by: CED1 Date: 06/25/18
Checked by: AKM Date: 07/02/18

Ore handling and processing emissions are comprised from the following fugitive emissions that are characterized as Volume Sources:
1. Ore Transfer from Portal to First Transfer Point (fugitive)
2. Surplus Ore Transfer at Ore Stockpile for Temporary Storage (fugitive)
3 Transfer Points at Ore Bins/Reclaim Area (fugitive)
4 Transfer Points at SAG Mill (fugitive)
5 Concentrate Handling Operations (fugitive)

Surface Ore Handling and Processing

EUFUGITIVES

	Process thru-put ton/hr [1]	E factor PM lb/ton	E factor PM-10 lb/ton	E-Factor PM-2.5 [4] lb/ton	Capture Efficiency % note 3a	Control Efficiency % note 3b PC equip	Control Efficiency % note 3a Enclosure	Emissions PM lb/hr	Emissions PM-10 lb/hr	Emissions PM-2.5 (lb/hr)	Efactor Reference	
1. Ore Transfer from Portal to First Transfer Point (fugitive)												
Process F001												
Feed Ore Transfer Conveyor (No. 1) to Ore Transfer Conveyor (No. 2)	363	0.003	0.0011	0.000165			95%	0.054	0.020	0.0030	11.19-2 Conveyor Transfer Point (Uncontrolled)	
Feed Ore Transfer Conveyor (No. 1) to Surplus Ore Feed Conveyor (No. 4) (to Ore Stockpile)	182	0.003	0.0011	0.000165			95%	0.027	0.010	0.0015	11.19-2 Conveyor Transfer Point (Uncontrolled)	
Surplus Ore Feed Transfer (using FE) to Feed Ore Conveyor (No.1) (Return from Ore Stockpile)	182	0.003	0.0011	0.000165			95%	0.027	0.010	0.0015	11.19-2 Conveyor Transfer Point (Uncontrolled)	
						Fugitive Emissions from F001		0.109	0.040	0.006	lb/hr maximum	
						maximum hours based on:		7300	7300	7300	hr/yr maximum	(see Note No. 5)
								795	291	44	lb/yr maximum	
								0.40	0.15	0.02	ton/yr maximum	
2. Surplus Ore Transfer at Ore Stockpile for Temporary Storage (fugitive)								0.35	0.13	0.02	ton/yr actual	
Process F002												
Ore Transfer Conveyor (No. 4) Transfer to Drop Point (within Ore Stockpile)	182	0.003	0.0011	0.000165			95%	0.027	0.010	0.001	11.19-2 Conveyor Transfer Point (Uncontrolled)	
FEL removes material from Conveyor No. 4 drop point for transfer to staging area within Ore Stockpile footprint. (handling/maintaining piles) (See Note 2)	182	0.0013	0.0006	0.0001				0.230	0.109	0.016	13.2.4 Equation (1), see Calc 1	
						Fugitive Emissions from F002		0.258	0.119	0.018	lb/hr maximum	
						maximum hours based on:		7300	7300	7300	hr/yr maximum	(see Note No. 5)
								1880	868	131	lb/yr maximum	
								0.94	0.43	0.07	ton/yr maximum	
3 Transfer Points at Ore Bins/Reclaim Area (fugitive)								0.82	0.38	0.06	ton/yr actual	
Process F003												
Ore Transfer Conveyor No. 2 to Ore Bin Conveyor	363	0.003	0.0011	0.000165			95%	0.054	0.0200	0.0030	11.19-2 Conveyor Transfer Point (Uncontrolled)	
Ore Bin Conveyor Transfer to Ore Bins No. 1 to No. 4	363	0.003	0.0011	0.000165			95%	0.054	0.0200	0.0030	11.19-2 Conveyor Transfer Point (Uncontrolled)	
Ore Bins No. 1 to No. 4 Transfer to Ore Bin Feeders No. 1 to No. 4	363	0.003	0.0011	0.000165			95%	0.054	0.020	0.0030	11.19-2 Conveyor Transfer Point (Uncontrolled)	
Ore Bin Feeders No. 1 to No. 4 Transfer to SAG Mill Feed Conveyor No. 3	363	0.003	0.0011	0.000165			95%	0.054	0.020	0.0030	11.19-2 Conveyor Transfer Point (Uncontrolled)	
						Fugitive Emissions from F003		0.218	0.080	0.012	lb/hr maximum	
						maximum hours based on:		7300	7300	7300	hr/yr maximum	(see Note No. 5)
								1590	583	87	lb/yr maximum	
								0.79	0.29	0.04	ton/yr maximum	
4 Transfer Points at SAG Mill (fugitive)								0.69	0.25	0.04	ton/yr actual	
Process F005												
SAG Mill Feed Conveyor No. 3 Transfer to SAG Mill Hopper	363	0.003	0.0011	0.000165	90.0%	95%		0.0054	0.00200	0.00030	11.19-2 Conveyor Transfer Point (Uncontrolled)	
SAG Mill Hopper to SAG Mill	363	0.003	0.0011	0.000165	90.0%	95%		0.0054	0.00200	0.00030	11.19-2 Conveyor Transfer Point (Uncontrolled)	
						Fugitive Emissions from F005		0.011	0.004	0.001	lb/hr maximum	
						maximum hours based on:		8760	8760	8760	hr/yr maximum	(see Note No. 5)
								95	35	5	lb/yr maximum	
								0.048	0.017	0.003	ton/yr maximum	
								0.042	0.015	0.002	ton/yr actual	

Client: Copperwood Resources, Inc. Project ID.: 17C050
Project: Air Permit Application Emissions Calculations - Version 2
Prepared by: CED1 Date: 06/25/18
Checked by: AKM Date: 07/02/18

5 Concentrate Handling Operations (fugitive)

Process F006	Process thru-put [1] ton/hr	E factor PM [4] lb/ton	E factor PM-10 [4] lb/ton	E-Factor PM-2.5 [4] lb/ton	Control Efficiency % note 3c PC equip	Control Efficiency % note 3a enclosure	Emissions PM lb/hr	Emissions PM-10 lb/hr	Emissions PM-2.5 (lb/hr)	Efactor Reference
Copper Concentrate Filter Press to Copper Concentrate Stockpile	20.9	0.003	0.0011	0.000165	25.0%	95%	0.002	0.00086	0.00013	11.19-2 Conveyor Transfer Point (Uncontrolled)
Copper Concentrate Stockpile to Concentrate Loadout Hopper	20.9	0.003	0.0011	0.000165	25.0%	95%	0.002	0.00086	0.00013	11.19-2 Conveyor Transfer Point (Uncontrolled)
Concentrate Loadout Hopper to Concentrate Feeder	20.9	0.003	0.0011	0.000165	25.0%	95%	0.002	0.00086	0.00013	11.19-2 Conveyor Transfer Point (Uncontrolled)
Concentrate Feeder to Truck Loading Conveyor	20.9	0.003	0.0011	0.000165	25.0%	95%	0.002	0.00086	0.00013	11.19-2 Conveyor Transfer Point (Uncontrolled)
Truck Loading Conveyor to Concentrate Truck	20.9	0.003	0.0011	0.000165	25.0%	95%	0.002	0.00086	0.00013	11.19-2 Conveyor Transfer Point (Uncontrolled)
					Fugitive Emissions from F006		0.012	0.004	0.001	lb/hr maximum
					maximum hours based on:		8760	8760	8760	hr/yr maximum (see Note No. 5)
							103.0	37.8	5.7	lb/yr maximum
							0.05	0.02	0.003	ton/yr maximum
							0.05	0.02	0.003	ton/yr actual

Notes:

1. Thruput and hours of operation are described on the Facility Basis sheet.

2. Most ore transfer will flow directly from mine portal to the process plant through the ore bins/reclaim area. However, it is assume approximately 50% of the ore will be transferred to the ore stockpile for intermediate storage. The intent is to keep the mine operations underway during times the process plant will be down for maintenance. Therefore, the tons/hour process rate for the ore stockpile is 363 tph * 0.50 = 182 tph.

3. Capture & control efficiencies applied:
(a) Emission source is indoors in an enclosed building or enclosed by cover. Efficiency applied is: 95%
(b) Emission source has a wet spray. Efficiency applied is: 90%
(c) Concentrate is 9% moisture. Additional Control Efficiency applied is: 25%

4. Particle size distribution is provided on Facility Basis sheet, item 3.

5. Mine operation basis, see Facility Basis Sheet:

	Normal/ Actual	Maximum
Mine operation hours/year:	7,000	7,300
thruput tons/day:	6,600	7,260
ore production rate tons/year:	2,310,000	2,649,900
concentrate production hours/year:	7,992	8,760
concentrate production rate tons/day:	18.2	20.9
concentrate production rate tons/year:	145,454	183,084

Calc 1
Transfer to ore pile & handling mat'l pile - AP-42 13.2.4 Eq. (1)

E= emission factor

$$E = k(0.0032)\left(\frac{U}{5}\right)^{1.3} / \left(\frac{M}{2}\right)^{1.4} (lb/ton)$$

k=particle size multiplier (dimensionless)

U= mean wind speed (mph) U= 8.3 mph (Avg wind speed using meteorological data from Ironwood, MI for 2012-2016)
M= material moisture content ore (%) M= 5.0 % for the ore

Copper Ore

E PM lb/ton	**E** PM-10 lb/ton	**E** PM-2.5 lb/ton	k PM * unitless	k PM-10 unitless	k PM-2.5 unitless	U miles/hr	M %
0.0013	0.0006	0.0001	0.74	0.35	0.053	8.3	5.0

*Assumes k factor for PM is represented by PM-30

Foth

Client: Copperwood Resources, Inc. Project ID.: 17C050
Project: Air Permit Application Emissions Calculations - Version 2
Prepared by: CED1 Date: 06/25/18
Checked by: AKM Date: 07/02/18

Ore Stockpile Material Handling

Ore Stockpile material handling emissions are comprised from the following activities
1. material handling
2 vehicle travel

1. Material Handling Activites

Process F004 (Fugitive Volume Source)	Process thru-put ton/hr	E factor PM lb/ton	E factor PM-10 lb/ton	E factor PM-2.5 lb/ton	Control Efficiency % note 2	Emissions PM lb/hr	Emissions PM-10 lb/hr	Emissions PM-2.5 lb/hr	E factor reference
Management of Ore at Staging Area within Ore Stockpile									
Surplus ore from mine operations is transferred to Ore Stockpile. FEL transfers to working area within footprint of Ore Stockpile area.	182	0.0013	0.0006	0.0001		0.230	1.09E-01	1.65E-02	13.2.4 Equation (1), see Calc 1
FEL manages piles within Ore Stockpile area (at 50% of pile mass) [1]	91	0.0013	0.0006	0.0001		0.115	5.45E-02	8.25E-03	13.2.4 Equation (1), see Calc 1
FEL transfers material from staging area within Ore Stockpile footprint for return to Conveyor No. 4. (handling/maintaining piles) (See Note 1)	182	0.0013	0.0006	0.0001		0.230	1.09E-01	1.65E-02	13.2.4 Equation (1), see Calc 1
Material handling emissions within Ore Stockpile						0.58	0.27	0.04	lb/hr
						7,300	7,300	7,300	hr/yr [2]
Process F004 Material Handling emissions:						4,203	1,988	301	lb/yr
						2.1	1.0	0.2	ton/yr

Calc 1
Transfer to ore pile & handling mat'l pile - AP-42 13.2.4 Eq. (1)

E= emission factor

$$E = k(0.0032)\left(\frac{U}{5}\right)^{1.3} / \left(\frac{M}{2}\right)^{1.4} \quad (lb/ton)$$

k=particle size multiplier (dimensionless)

U= mean wind speed (mph) U= 8.3 mph (Avg wind speed using meteorological data from Ironwood, MI for 2012-2016)

M= material moisture content ore (%) M= 5.0 % for the ore (Information from the Prefeasibility Study for the project prepared by KD Engineering in July 2011 indicates that the ore moisture content was expected to be 6.5%. Therefore, 5% moisture will be used to be conservative.)

Copper Ore

E PM lb/ton	E PM-10 lb/ton	E PM-2.5 lb/ton	k PM * unitless	k PM-10 unitless	k PM-2.5 unitless	U miles/hr	M %
0.0013	0.0006	0.0001	0.74	0.35	0.053	8.3	5.0

*Assumes k factor for PM is represented by PM-30

Notes:
1. Maximum controlled emissions for material handling within Ore Stockpile assumes that 50% of transferred ore will be managed further within Ore Stockpile.
2. Maximum and Actual Basis

		Maximum	Actual
From Facility Basis Sheet:	Operating hours/year	**7,300**	**7,000**
	Mine Thruput Rate tons/day	**7,260**	**6,600**

Ore Material Handling

PM	PM-10	PM-2.5	
0.6	0.3	0.04	lb/hr maximum
2.1	1.0	0.15	ton/yr maximum
1.8	0.9	0.13	ton/yr actual

2. Vehicle Travel on Ore Stockpile - HR01 (Fugitive Volume Source)
Unpaved roadway maximum emissions and potential to emit are based on the maximum overall production rate of the facility and the number of vehicles and trips required to handle this capacity. Based on AP-42 13.2.2 Unpaved Roads (11/06), it is used to estimate unpaved road PM, PM10, and PM2.5 emissions. The precipitation factor (factorprecip) is applied to vehicle emissions to account for the inherent control provided by the natural mitigation of rainfall and other precipitation. Additional controls are added to account for the road watering program and limitations on truck speeds.

Front End Loader CAT 988K $E = k\left(\frac{s}{12}\right)^{a} \times \left(\frac{W}{3}\right)^{b}$ lb/VMT Equation (1a) - for industrial roads

$$Factor_{precip} = \left[(365 - P)/365\right] \quad \text{(dimensionless) Equation (2)}$$

Where:
E= emissions factor calculated for each vehicle in lb/VMT
k= particle size multiplier selected from Table 13.2.2-2 for industrial roads, in lb/VMT
a & b = empirical constants selected from Table 13.2.2-2 for industrial roads.
s= surface material silt content (%) 2 % (Based on grain size distribution graph provided by Copperwood)
W= mean weight of vehicle (tons) = 56 tons (vehicle weight empty)
16 tons (weight of payload)
64 tons (Average weight of vehicle including travel to Ore Stockpile and return empty to Conveyor No. 4)
P= number of days/year with 0.01 in precipitation, selected from AP-42 Figure 13.2.2-1
P= 150 days
Precipitation Factor = 0.59 Based on equation (2) and P = 150

Control from CE = 50% from limiting truck speed to 15 mph

HR-01 (Haul Road)

	Emission Factor for the CAT 988K wheel loader						Estimated Distance						Maximum	Actual
	E lb/VMT [1]	k lb/VMT	s %	W ton	a	b	Circuit [2] feet	Payload [3] ton	Material ton/hr	Circuits per hr [4]	VMT per hr	Emissions lb/hr	Emissions ton/yr	Emissions ton/yr
PM total *	1.63	4.9	2	64.0	0.7	0.45	1200	16.0	182	12	2.8	**4.63**	**16.89**	**16.2**
PM 10	0.35	1.5	2	64.0	0.9	0.45	1200	16.0	182	12	2.8	**0.99**	**3.61**	**3.5**
PM2.5	0.035	0.15	2	64.0	0.9	0.45	1200	16.0	182	12	2.8	**0.099**	**0.36**	**0.3**

*Assumes k factor for PM is represented by PM-30

Emissions PM	Emissions PM-10	Emissions PM-2.5	
4.6	1.0	0.1	lb/hr maximum
16.9	3.6	0.4	ton/yr maximum
14.7	3.2	0.32	ton/yr actual

Ore Handling at Ore Stockpile Summary

Emissions PM	Emissions PM-10	Emissions PM-2.5	
6.5	1.9	0.2	lb/hr maximum
19.0	4.6	0.5	ton/yr maximum
16.6	4.0	0.4	ton/yr actual

Notes:
1. The emission factor has been adjusted to account for additional controls associated with limitations on vehicle speed to 15 mph.
2. One circuit is the distance from Ore Stockpile to incline at Transfer Tower, return to stockpile. Movement will be to various locations within the stockpile. To calculate emissions, it will be assumed that the estimated distance is about 600 feet from the transfer tower ramp to center of Ore Stockpile. Therefore the circuit will be 1,200 feet round-trip.
3. Payload is based on transporting rated payload.
4. Based on daily perspective

Client: Copperwood Resources, Inc. Project ID.: 17C050
Project: Air Permit Application Emissions Calculations - Version 2
Prepared by: CED1 Date: 06/25/18
Checked by: AKM Date: 07/02/18

On-Site Roadway Fugitive Dust Emissions due to Vehicle Travel, Access Road - HR-02 and HR-03

Roadway dust emissions ar comprised from the following sources:

1. Concentrate Trucks - Unpaved Road (HR-02) This estimate addresses product haul truck travel between the concentrate load-out area and the main gate access point to the mine.
2 Truck Transport of Water to Site (HR-03) This estimate addresses truck transport of water from the main gate to Off-loading Station at TDF.
3. Truck Transport of Reagents & Grinding Media (HR-04) This estimate addresses truck transport of mill reagents and grinding media from the main gate to the process plant.
4. Truck Transport of Explosives (HR-05) This estimate addresses truck transport of explosives from the main gate to the explosives magazine.

Unpaved road emissions are based on AP-42 Chapter 13.2.2 (11/06).
The precipitation factor is applied to vehicle emissions to account for the inherent control provided by the natural mitigation of rainfall and other precipitation.

Unpaved Road Emission Factor Calculations
AP-42 Chapter 13.2.2 Unaved Roads 11/06

$$E = [k\ (s/12)^{a}\ (W/3)^{b}]$$ lb/VMT Equation (1a)

$$E = \mathrm{E}\ [(365 - \mathrm{P})/365]$$ (dimensionless) Equation (2)

Where:
E= size specific emissions factor calculated for each vehicle (lb/VMT)
k= empirical constant selected from Table 13.2.2-2 (for industrial roads) (lb/VMT)
a & b= empirical constants selected from Table 13.2.2-2 (for industrial roads)

Constant	PM*	PM-10	PM-2.5
k (lb/VMT)	4.9	1.5	0.15
a	0.7	0.9	0.9
b	0.45	0.45	0.45

*Assumes PM is represented by PM-30

s= surface material silt content (%)
s= 2 % silt content of aggregate mat'l used for on-site access road (Assumes regular road maintenance such as grading & replacing with fresh mat'l.)

HR-02 - Concentrate Haul Truck

Maximum hours per year for truck travel = 4.85 miles per round trip
0.323 hours/trip (assume 15 mph speed limit)
2,962 hours/year for truck travel

W= "fleet" average weight of vehicle (tons) - varies for each vehicle "fleet"
20 tons (vehicle weight empty)
W Concentrate truck= 20 tons (weight of payload to meet Wisconsin 20 ton/truck load limit)
30 tons (Average weight of vehicle including travel from concentrate load-out to main gate and return empty)
P= number of days/year with 0.01 in precipitation, selected from AP-42 Figure 13.2.2-1
P= 150
VMT= vehicle miles traveled per year, calculated separately for each vehicle fleet (see below)
Precipitation factor= 0.59 Based on equation (2) and P=150

	PM	PM-10	PM-2.5	
E conc't truck traffic=	2.32	0.50	0.05	lb/VMT

HR-03 - Water Transport Truck

Maximum hours per year for truck travel = 3.54 miles per round trip
0.236 hours/trip (assume 15 mph speed limit)
2,413 hours/year for truck travel

W= "fleet" average weight of vehicle (tons) - varies for each vehicle "fleet"
23.5 tons (vehicle weight empty)
58.5 tons (weight of payload - in Michigan only)
52.75 tons (Average weight of vehicle including travel from main gate to off-load location at TDF
P= number of days/year with 0.01 in precipitation, selected from AP-42 Figure 13.2.2-1
P= 150
VMT= vehicle miles traveled per year, calculated separately for each vehicle fleet (see below)
Precipitation factor= 0.59 Based on equation (2) and P=150

	PM	PM-10	PM-2.5	
E water truck traffic=	2.99	0.64	0.06	lb/VMT

Vehicle Miles Traveled (VMT)
Concentrate Product Haul Trucks Unpaved Road (HR-02)

25,590 ft (round trip distance on unpaved road between concentrate load-out area and main gate)
5,280 feet/mile
183,347 tons/year maximum concentrate production rate
20 ton/truck
9,168 truck trips/year
VMT ore truck = 44,434 miles/yr unpaved
speed check 15.0 miles/hr

Water Transport Trucks Unpaved Road (HR-03)

VMT Water Truck = 18,700 ft (round trip distance on unpaved road between water off-load area and main gate)
5,280 feet/mile
28 trucks per day (B. Stimac, 1/30/18)
365 days per year
10,220 truck trips per year
VMT water truck = 36,196 miles/yr unpaved
speed check 15.0 miles/hr

Emissions from Concentrate Truck Movement Along Access Road (HR-02)

$$Emissions = (E)(VMT)(1 - CE\%)$$

Concentrate Product Haul Trucks Unpaved Road

Unpaved vehicle miles traveled, VMT 44,434 VMT/yr
15.00 VMT/hr
CE= 90% from roadway watering program
CE= 50% from limiting truck speed to 15 mph

	Emissions PM	Emissions PM-10	Emissions PM-2.5	
Unpaved Road Emission Factor EF	2.32	0.50	0.05	lb/VMT
Emissions	1.74	0.37	0.037	lb/hr maximum
Emissions	5,156	1,103	110	lb/yr maximum
Emissions	2.6	0.6	0.06	ton/yr maximum
Emissions	2.0	0.4	0.04	ton/yr actual

Emissions from Water Transport Truck Movement Along Access Road (HR-03)

$$Emissions = (E)(VMT)(1 - CE\%)$$

Water Transport Trucks Unpaved Road

Unpaved vehicle miles traveled, VMT 36,196 VMT/yr
15.0 VMT/hr
CE= 90% from roadway watering program
CE= 50% from limiting truck speed to 15 mph

	Emissions PM	Emissions PM-10	Emissions PM-2.5	
Unpaved Road Emission Factor EF	2.99	0.64	0.06	lb/VMT
Emissions	2.24	0.48	0.05	lb/hr maximum
Emissions	5,415	1,158	116	lb/yr maximum
Emissions	2.7	0.6	0.06	ton/yr maximum
Emissions	2.5	0.5	0.1	ton/yr actual

HR-04 - Reagent and Grinding Media Haul Trucks

Maximum hours per year for truck travel = 4.85 miles per round trip
0.323 hours/trip (assume 15 mph speed limit)
235.2 hours/year for truck travel

W= "fleet" average weight of vehicle (tons) - varies for each vehicle "fleet"
20 tons (vehicle weight empty)
Weight Delivery truck= 23.2 tons (weight of payload)
32 tons (Average weight of vehicle including travel from process plant to main gate and return empty)
P= number of days/year with 0.01 in precipitation, selected from AP-42 Figure 13.2.2-1
P= 150
VMT= vehicle miles traveled per year, calculated separately for each vehicle fleet (see below)
Precipitation factor= 0.59 Based on equation (2) and P=150

	PM	PM-10	PM-2.5	
E delivery truck traffic=	2.38	0.51	0.05	lb/VMT

HR-05 - Explosives Haul Truck

Maximum hours per year for truck travel = 4.29 miles per round trip
0.286 hours/trip (assume 15 mph speed limit)
29.7 hours/year for truck travel

W= "fleet" average weight of vehicle (tons) - varies for each vehicle "fleet"
20 tons (vehicle weight empty)
22 tons (weight of payload)
31 tons (Average weight of vehicle including travel from main gate to off-load location at explosives magazine)
P= number of days/year with 0.01 in precipitation, selected from AP-42 Figure
P= 150
VMT= vehicle miles traveled per year, calculated separately for each vehicle fleet (see below)
Precipitation factor= 0.59 Based on equation (2) and P=150

	PM	PM-10	PM-2.5	
E delivery truck traffic=	2.36	0.50	0.05	lb/VMT

Vehicle Miles Traveled (VMT)
Reagent & Grinding Media Haul Trucks Unpaved Road (HR-04)

25,590 ft (round trip distance on unpaved road between process plant and main gate)
5,280 feet/mile
14 trucks per week (Gmining 6/19/18)
52 weeks/year
728 truck trips/year
VMT ore truck = 3,528 miles/yr unpaved
speed check 15 miles/hr

Explosives Haul Truck (HR-05)

VMT Water Truck = 22,638 ft (round trip distance on unpaved road between explosives magazine and main gate)
5,280 feet/mile
2 trucks per week (GMining, 6/19/18)
52 weeks per year
104 truck trips per year
VMT water truck = 446 miles/yr unpaved
speed check 15 miles/hr

Emissions from Reagent & Grinding Media Truck Movement Along Access Road (HR-04)

$$Emissions = (E)(VMT)(1 - CE\%)$$

Reagent and Grinding Media Haul Trucks Unpaved Road

Unpaved vehicle miles traveled, VMT 3,528 VMT/yr
15.00 VMT/hr
CE= 90% from roadway watering program
CE= 50% from limiting truck speed to 15 mph

	Emissions PM	Emissions PM-10	Emissions PM-2.5	
Unpaved Road Emission Factor EF	2.38	0.51	0.05	lb/VMT
Emissions	1.78	0.38	0.038	lb/hr maximum
Emissions	419	90	9	lb/yr maximum
Emissions	0.2	0.04	0.004	ton/yr maximum
Emissions	0.2	0.04	0.004	ton/yr actual

Emissions from Explosives Truck Movement Along Access Road (HR-05)

$$Emissions = (E)(VMT)(1 - CE\%)$$

Explosives Haul Trucks Unpaved Road

Unpaved vehicle miles traveled, VMT 446 VMT/yr
15.0 VMT/hr
CE= 90% from roadway watering program
CE= 50% from limiting truck speed to 15 mph

	Emissions PM	Emissions PM-10	Emissions PM-2.5	
Unpaved Road Emission Factor EF	2.36	0.50	0.05	lb/VMT
Emissions	1.77	0.38	0.04	lb/hr maximum
Emissions	53	11	1	lb/yr maximum
Emissions	0.03	0.01	0.001	ton/yr maximum
Emissions	0.02	0.005	0.0005	ton/yr actual

Client: Copperwood Resources, Inc. Project ID.: 17C050
Project: Air Permit Application Emissions Calculations - Version 2
Prepared by: CED1 Date: 06/25/18
Checked by: AKM Date: 07/02/18

Wind Erosion - Tailings Disposal Facility and Ore Stockpile

EUWINDEROSION

Fugitive emissions due to wind erosion are estimate for the following two areas:
1 Ore Stockpile (F007)
2 Tailings Disposal Facility (TDF) (F008)

1. Ore Stockpile Wind Erosion Emissions (F007) (Area Source Fugitives)

Ore stockpile dimensions and surface area based on base maps of the mine facility as provided by Copperwood

Ore Stockpile Surface Area (m^2)	51,790	
Ore Stockpile Surface Area (ft^2)	557,460	1 square meter = 10.764 square feet
Acres	13	1 acre = 43,560 ft2

Particle Size Ratios: Provided by GMining - Grain Size Distributions for Ore Stockpile

	% passing		Ratio to TSP*
TSP =	1	Assume to be TSP	1
< 10 µm =	0.20		0.20
< 2.5 µm =	0.050		0.050

*Assume TSP represents PMtotal (PM)

Emissions Calculation:

$$Emissions = 1.7kA\left(\frac{365-P}{235}\right)\left(\frac{s}{1.5}\right)\left(\frac{f}{15}\right)$$ lb/day

EPA-450/3-88-008 Control of Open Fugitive Dust Sources, Equation (4-9)

A - acreage tailings for Ore Stockpile = 12.8

k - particle size multiplier [1] =	PM	PM-10	PM-2.5	
	1	0.20	0.050	(see particle size ratios for Ore Stockpile)

D - number of days/year in storage pile=	365	
s - silt content %=	2	Based on grain size distribution graphs provided by GMining for the Ore Stockpile.
P - days/year with >0.01" precipitation=	150	Based on precipitation map in AP-42, Section 13.2.2, Unpaved Roads, Figure 13.2.2-1. Interpolate days of precipitation from contours.
f - % time wind is >12 mph at mean pile height=	15.5	Based on wind frequency distribution count for five years of wind speed data provided by the Michigan Department of Environmental Quality from Ironwood, MI for the period 2012 through 2016.
	8760	Hours of operation per year

Wind Erosion Emissions - Ore Stockpile

Emissions PM	Emissions PM-10	Emissions PM-2.5	
27.42	5.48	1.37	lb/day maximum and actual
1.14	0.229	0.057	lb/hr maximum and actual
5.00	1.00	0.250	ton/yr maximum and actual

2. TDF Wind Erosion Emissions (F008) (Area Source Fugitives)

Tailings will be deposited in slurry form at the Tailings Disposal Facility (TDF) on the east side of the facility (Figure 2). The TDF will be constructed in lifts. The berm for the tailings impoundment portion will be constructed of coarse tailings from the mill. Tailings will be pumped from the mill in a water-saturated state (approximately 80% solids) and the tailings will be generally covered with water in the TDF. Drying may occur in inactive sections of the tailings impoundment, which may form a dryer erodible tailings beach area. Based on information from GMining, the maximum exposed erodible beach area will be approximately 9.2 acres, with the overall maximum tailing footprint being 230 acres.

Tailings Surface Area	930,769	m2	1 square meter = 10.764 square feet
Tailings Surface Area	10,018,800	ft2	This information was provided by Copperwood on the TDF tailings surface area.
Tailings Surface Area	230	acres	1 acre = 43,560 ft2
Wet Beach Area (75% of Exposed Beach Area) (Acres)	25.25	acres	Information from GMining, tailings surface area over the life of the mine. The wet beach and dry beach surface areas are based on the maximum surface near the end of the project.
Dry Beach Area (25% of Exposed Beach Area)	409,883	ft2	A graph provided by Copperwood shows the total square feet of dry beach area at maximum TDF size.
Dry Beach Area (25% of Exposed Beach Area)	9.4	acres	
Dry Beach Area (25% of Exposed Beach Area)	38,079	m2	

VMT conct t lb/day

EPA-450/3-88-008 Control of Open Fugitive Dust Sources, Equation (4-9)

Particle Size Ratios: Provided by GMining - Grain Size Distributions for TDF

	% passing		Ratio to TSP*
TSP =	1	Assume to be TSP	1
< 10 µm =	0.52		0.52
< 2.5 µm =	0.26		0.26

*Assume TSP represents PMtotal (PM). Note that distribution for 10 and 2.5 um particle sizes are based on a weighted average of distribution graphs for rougher and first cleaner scavenger tails.

A - acreage tailings for TDF= 9.4 acres

k - particle size multiplier =	PM	PM-10	PM-2.5	
	1	0.52	0.26	(see particle size ratios for TDF)

D - number of days/year in storage pile=	365	
s - silt content %=	92.42	Based on Particle Size Distribution graphs for rougher and first cleaner scavenger tails. Rougher tails are shown to be 88.14% silt content while the first cleaner scavenger tails are shown to be 99.72% silt. Copperwood indicates that 61% of the tailings will be rougher tails and 39% will be first cleaner scavenger tails. A weighted average percent silt content was calculated from this information.
P - days/year with >0.01" precipitation=	150	Based on precipitation map in AP-42, Section 13.2.2, Unpaved Roads, Figure 13.2.2-1. Interpolate days of precipitation from contours.
f - % time wind is >12 mph at mean pile height=	15.5	Based on wind frequency distribution count for five years of wind speed data provided by the Michigan Department of Environmental Quality from Ironwood, MI for the period 2012 through 2016.
Control efficiency to reflect crust layer formation on tailings:	98%	Assume 98% control due to formation of crust layer on exposed tailings area and remaining moisture in material. Exposure to wind erosion is also reduced by placing tailings in layers between waste rock layers and is below surface of a berm formed by waste rock materials.
	8760	hours per year

Wind Erosion Emissions - TDF

Emissions PM	Emissions PM-10	Emissions PM-2.5	
18.64	9.68	4.9	lb/day maximum and actual
0.78	0.40	0.205	lb/hr maximum and actual
3.40	1.77	0.90	ton/yr maximum and actual

Client: Copperwood Resources, Inc. Project ID.: 17C050
Project: Air Permit Application Emissions Calculations - Version 2
Prepared by: CED1 Date: 06/25/18
Checked by: AKM Date: 07/02/18

Emergency Generator (exempt source) - EUGENERATORS (Diesel Generators)

SV-004, SV-005, SV-006

Generators will operate during main power disruptions to support facility operations of underground mine operations, tailings slurry pump, concentrate and tailings thickeners and to supply back-up power for short durations in event there is loss of power at the power plant.

Units will be placed at three different locations: one near the mine portal, with the other two units in the location of the process plant, as shown on Fig. 3-2.
Emergency generator emission data are based on exhaust emission data sheets provided by Cummins. The unit located at the mine portal will be rated at 1,000 kW, while the other two units will be 500 kW. Cummins generator specifications are provided in Appendix A.

Emissions Factors from Cummins Data: Stand-by 1000 kW and 500 kW.

	Emission Factors for Cummins 1000DQFAD (1000 kW), Full Standby		Emission Factors for Cummins 500DFEK (500 kW), Full Standby	
Pollutant	g/hp-hr	lb/hp-hr	g/hp-hr	lb/hp-hr
NOx	3.95	0.0087	4.85	0.0107
CO	0.66	0.0015	0.31	0.0007
HC (VOC)	0.07	0.00015	0.11	0.00024
PM	0.11	0.00024	0.05	0.00011
SO2 AP-42 Table 3.4-1, where S=%sulfur in fuel		0.00809S		0.00809S
SO2 at S=0/0015		0.000012		0.0000121
Fuel Consumption @ 100% load, gal/hr		72.2		34.7

Engine Data:

Fuel Consumption @ 100% load:	141.6	Total gph, Diesel			
Heating value of diesel:	137,000	Btu/gal			
Maximum hours of operation per year:	500	hours			
Maximum Heat Input:	9.89	mmBTU/hr		4.75	mmBTU/hr

PTE calculations will be based on rated power output of the equipment.

Number of Generators:	1		2		
Power generated per Unit:	1000	kW	500	kW	Conversion: kilowatt = 1.3405 hp
Power generated per Unit:	1482	hp	732	hp	
Total Power generated:	1482	hp	1464	hp	
PTE Operating Time [1]:	500	hr/year	500	hr/year	
Actual Operating Time [2]:	126	hr/year	126	hr/year	

SV-009 (Emergency Generator No. 1 at mine portal)
Potential to Emit (1000 kW Unit)

	NOx	SOx	PM10	CO	VOC
lb/hp-hr (power output)	0.0087		0.00024	0.00145	0.00015
AP-42 E factor lb/hp-hr		0.000012			
Hourly Emission Rate (lb/hr)	12.9	0.018	0.36	2.2	0.2
Annualized Hourly Emission Rate (lb/hr) [3]	0.7				
PTE Annual Emission Rate (lb/yr)	6447.0	9.0	179.5	1077.2	114.3
PTE Annual Emission Rate (ton/yr)	3.2	0.00	0.09	0.5	0.06
Actual Annual Emission Rate (ton/yr)	0.8	0.001	0.02	0.14	0.01

SV-010, SV011 (Emergency Generators No. 2 and 3, process plant)
Potential to Emit (500 kW Units)

	NOx	SOx	PM10	CO	VOC
lb/hp-hr (power output)	0.0107		0.00011	0.0007	0.0002
AP-42 E factor lb/hp-hr		0.000012			
Hourly Emission Rate (lb/hr)	15.6	0.02	0.16	1.0	0.35
Annualized Hourly Emission Rate (lb/hr) [3]	0.9				
PTE Annual Emission Rate (lb/yr)	7819.8	8.9	80.6	499.8	177.4
PTE Annual Emission Rate (ton/yr)	3.9	0.004	0.040	0.250	0.089
Actual Annual Emission Rate (ton/yr)	1.0	0.001	0.010	0.1	0.022

Organic Pollutants	Emission Factor (lb/mmBtu)	Maximum Emissions (lb/hr)	Maximum Emissions (lb/yr)	Relative Potency Factor [4]	Maximum Hourly Emission Rate (lb/hr) [4]
Benzene	7.76E-04	0.02	7.5		
Toluene	2.81E-04	0.005	2.7		
Xylenes	1.93E-04	0.004	1.9		
Propylene	2.79E-03	0.05	27.1		
1,3-Butadiene	3.91E-05	0.0008	0.4		
Formaldehyde	7.89E-05	0.002	0.8		
Acetaldehyde	2.52E-05	0.0005	0.2		
Acrolein	7.88E-06	1.53E-04	0.1		
Polycyclic aromatic hydrocarbons (PAH)					
Naphthalene	1.30E-04	2.52E-03	1.26		
Acenaphthylene	9.23E-06	1.79E-04	0.09		
Acenaphthene	4.68E-06	9.08E-05	0.05		
Fluorene	1.28E-05	2.48E-04	0.12		
Phenanthrene	4.08E-05	7.91E-04	0.40		
Anthracene	1.23E-06	2.39E-05	0.01		
Fluoranthene	4.03E-06	7.82E-05	0.04		
Pyrene	3.71E-06	7.20E-05	0.04		
Benzo(a)anthracene *	6.22E-07	1.21E-05	0.006	0.1	1.21E-06
Chrysene *	1.53E-06	2.97E-05	0.01	0.01	2.97E-07
Benzo(b)fluoranthene *	1.11E-06	2.15E-05	0.011	0.1	2.15E-06
Benzo(k)fluoranthene *	2.18E-07	4.23E-06	0.002	0.1	4.23E-07
Benzo(a)pyrene *	2.57E-07	4.99E-06	0.002	1	4.99E-06
Indeno(1,2,3-cd)pyrene *	4.14E-07	8.03E-06	0.004	0.1	8.03E-07
Dibenz(a,h)anthracene *	3.46E-07	6.71E-06	0.003	1.1	7.38E-06
Benzo(g,h,l)perylene	5.56E-07	1.08E-05	0.005		
Total PAH	2.12E-04	4.10E-03	2.05		

Source of emission factors: AP-42, Tables 3.4-3 & 3.4-4 (October 1996 update)
* Items with an asterisk are listed PAH carcinogens.

Notes:

(1) PTE is based on EPA guidance on the maximum number of hours for an emergency generator (EPA Memorandum dated September 6, 1995).

(2) Actual operating hours based on estimated power needs.

(3) Based on verbal guidance provided by MDEQ, hourly emission rates for emergency and intermittent equipment can be annualized for NOx by multiplying the actual calculated hourly rate by annual hours / 8760 hours. For PTE, the adjustment would be 500 / 8760.

(4) Pursuant to the MDEQ PAH guidance, *Screening Levels for Polycyclic Aromatic Hydrocarbon*s, dated February 7, 2017, emissions in lb/hr have been adjusted using the Relative Potency Factors (RPF) to allow for screening using the Allowable Emission Rate Methodology under Rule 227 (1) (a).
we should cite the Feb. 7 2017 document.

Client: Copperwood Resources, Inc. Project ID.: 17C050
Project: Air Permit Application Emissions Calculations - Version 2
Prepared by: CEDI Date: 06/25/18
Checked by: AKM Date: 07/02/18

Reagent Emission Summary (exempt sources)

1 Hazardous air polutant emissions
2 Particulate emissions from handling dry materials
3 VOC emissions from material handling

1. Hazardous Air Pollutant Emissions

SDS Name Common name - form	Hazardous Component & CAS Number	Compoistion % weight	HAP Emissions		
Flomin C-3430 (SIBX) - supersac dry	Sodium isobutyl xanthate 25306-75-6	90%	0.1	lb/year	
MIBC - liquid	Methyl isobutyl carbinol 108-11-2	100%	6	lb/year	See section 3 below
Carboxymethyl Cellulose Sodium - granular	Carboxymethyl Cellulose Sodium 9004-32-4	100%	2.7E-02	lb/year	

Note : Balance of material composition is non-hazardous.
*MIBC and sodium sulfite are listed toxic air contaminants under Michigan's air pollution regulations.
+MIBC emissions calculations are provided in Section 3 on this sheet.

Reagent	Consumption		Form	Packaging	Reagent Function
Sodium Hydrosulfinde (NaHS)	1,132	ton/yr	liquid	drum or IBC	Conditioner
Sodium Isobutyl Xantante (C-3430)	560	ton/yr	granular	sack	Collector
Methyl Isobutyl Carbinol (MIBC)	90	ton/yr	liquid	drum or IBC	Frother
Dowfroth 250 (D-250)	90	ton/yr	liquid	drum or IBC	Frother
Alkylaryl Dithiophosphate (A249)	421	ton/yr	liquid	drum or IBC	Conditioner
n-Dodecyl Mercaptan (NDM)	85	ton/yr	liquid	drum or IBC	Conditioner
Sodium Silicates	542	ton/yr	liquid	drum or IBC	Conditioner
Carboxymethyl Cellulose Sodium	180	ton/yr	granular	sack	Conditioner
Hydrated Lime	7,227	ton/yr	granular	bulk	Conditioner
Flocculant (To be determined)	1.1	ton/yr	liquid	drum or IBC	Particle Attraction
Anti-Scalant (To be determined)	11,700	gal/yr	liquid	drum or IBC	Scale inhibitor

2 PM Emissions for Handling Dry Materials

Emissions are calculated for granular material handling, which will generate PM. There will be one transfer point accounted to address the material being added to the receiving tank. Once the dry material is mixed in the tank, no further PM will be generated.
(activity inside mill building, contributes to fugitive volume source)

	Max. Annual thruput ton/yr [1]	E factor PM lb/ton	E factor PM-10 lb/ton	E factor PM-2.5 lb/ton	Control Efficiency [2] %	Emissions PM lb/yr	Emissions PM-10 lb/yr	Emissions PM-2.5 lb/yr	E factor reference
SIBX	559.9	0.003	0.0011	0.0011	95%	0.1	0.03	0.03	11.19-2 Conveyor Transfer Point (Uncontrolled)
Carboxymethyl Cellulose Sodium	180.4	0.003	0.0011	0.0011	95%	0.03	0.01	0.010	11.19-2 Conveyor Transfer Point (Uncontrolled)
Hydrated Lime (received in bulk)	7227.0	0.003	0.0011	0.0011	95%	1.08	0.40	0.40	11.19-2 Conveyor Transfer Point (Uncontrolled)
				Totals =		Emissions PM	Emissions PM-10	Emissions PM-2.5	
						1.36E-04	5.00E-05	5.00E-05	lb/hr [3]
						1	0.4	0.4	lb/yr
						0.0006	0.0002	0.0002	tons/yr

1. Maximum annual throughputs were provided by Copperwood for reagent use in the process plant.
2. This emission source is indoors or enclosed. Efficiency applied is: 95%
3. The maximum operating hours for the mill in hours per year is: 8,760

3 MIBC Emissions from Volatilization from MIBC reagent storage tank

(activity inside reagent building) (exempt source)
Working Loss Equation from Section 7.1 of AP-42 for Liquid Storage Tanks:

$L_W = 0.0010 \times M_V \times P_{VA} \times Q \times K_N \times K_P$

Where:
M_V = Vapor Molecular Weight, lb/lb-mole = 102.2
P_{VA} = Vapor pressure at daily average liquid surface temperature, psia[1] = 9.67E-02
Q = Annual net throughput, bbl/year (1 bbl = 31.5 gal) = 641
K_N = Turnover factor, dimensionless = 1
K_P = Working loss product factor for most organic liquids, dimensionless = 1

S.G. = 0.802 @ 25 °C, density of H_2O = 1000 kg/m^3, thus, density of MIBC = 802 kg/m3 (6.7 lb/gal)

Annual Usage 90 tons/year
26925 gal/year
Q= 641 bbl/year

$L_W = 0.0010 \times M_V \times P_{VA} \times Q \times K_N \times K_P$

L_W = **6** lb/year MIBC Emissions
0.00072 lb/hr MIBC emissions in 7300 hr/yr

4 n-Dodecyl Mercaptan (NDM) Emissions from Volatilization from NDM reagent storage tank

(activity inside reagent building) (exempt source)
Working Loss Equation from Section 7.1 of AP-42 for Liquid Storage Tanks:

$L_W = 0.0010 \times M_V \times P_{VA} \times Q \times K_N \times K_P$

Where:
M_V = Vapor Molecular Weight, lb/lb-mole = 202.41
P_{VA} = Vapor pressure at daily average liquid surface temperature, psia[2] = 0.1
Q = Annual net throughput, bbl/year (1 bbl = 31.5 gal) = 568
K_N = Turnover factor, dimensionless = 1
K_P = Working loss product factor for most organic liquids, dimensionless = 1

S.G. = 0.845 @ 20 °C, density of H_2O = 1000 kg/m^3, thus, density of MIBC = 845 kg/m3 (7.1 lb/gal)

Annual Usage 85 tons/year
23859 gal/year
Q= 568 bbl/year

$L_W = 0.0010 \times M_V \times P_{VA} \times Q \times K_N \times K_P$

L_W = **11** lb/year NDM Emissions
0.00131 lb/hr NDM emissions in 7300 hr/yr

Notes:
1. This is the vapor pressure for MIBC at 20 °C as reported by the manufacturer. The vapor pressure is listed as 5 mmHg, the conversion is 5 X 0.019336 psia/mmHg = 0.0716 = 7.16E-02 psia.
2. The vapor pressure for NDM at 20 °C as reported by the manufacturer is < 0.1 psia.

Total Reagent VOC Emission Summary
18 lb/year VOC Emissions
0.0020 lb/hr VOC Emissions in 7300 hr/yr

Client: Copperwood Resources, Inc. Project ID.: 17C050
Project: Air Permit Application Emissions Calculations - Version 2
Prepared by: CED1 Date: 06/25/18
Checked by: AKM Date: 07/02/18

Emergency Generators EUGENERATORS - SV-004, SV-005, & SV-006
Version e-GGRT RY2013.R.01
Date: 3/19/2018

Equation C-1:

$$CO_2 = 1x10^{-3} * Fuel * HHV * EF$$

$$CH_4 \text{ or } N_2O = 1 \times 10^{-3} * Fuel * HHV * EF$$

Facility Name:	Copperwood Resources, Inc.
Reporter Name:	
Unit or Group Name/ ID:	EUGENERATORS - SV-004, SV-005, & SV-006
Configuration Type:	
Fuel/ Fuel Type:	Distillate Fuel Oil No. 2 (Diesel)
Reporting Period:	NA - PTE Calculations
Comments:	Source data should be consistent with Emergency Generators sheet.
Unit Type:	General Stationary Fuel Combustion

Fuel Input Data

[Fuel] = Mass or volume of fuel combusted per year, from company records as defined in §98.6 (express mass in short tons for solid fuel, volume in standard cubic feet for gaseous fuel, and volume in gallons for liquid fuel)	70,800.
[HHV] = Default High heat value of the fuel, from Table C-1 (mmBtu/mass or mmBtu/volume)	0.138

Gallons Distillate Fuel Oil No. 2 (Diesel) based on 3 emergency generators at a combined 141.6 gallons/hour fuel usage at peak capacity and 500 hours/year maximum operation.

Constants

[1 x 10^{-3}] = Conversion Factor from kg to metric tons (constant)	0.001

Annual CO_2 Mass Emissions For the Specific Fuel Type (metric tons) from Equation C-1

[EF] = Fuel-Specific Default CO_2 Emission Factor, from Table C-1 (kg CO_2/mmBtu)	73.96
[CO_2] = Annual CO_2 emissions from combustion of the specified fuel (metric tons)	**723**

Enter this value in e-GGRT

Annual CH_4 Mass Emissions For the Specific Fuel Type (metric tons) from Equation C-8

[EF] = Fuel-Specific Default Emission Factor for CH_4, from Table C-2 (kg CH_4/mmBtu)	0.003
[CH_4] = Annual CH_4 emissions from combustion of the specified fuel (metric tons)	**0.03**

Enter this value in e-GGRT

VMT conct truck =

Annual N_2O Mass Emissions For the Specific Fuel Type (metric tons) from Equation C-8

[EF] = Fuel-Specific Default Emission Factor for N_2O, from Table C-2 (kg N_2O/mmBtu)	0.0006
[N_2O] = Annual N_2O emissions from combustion of the specified fuel (metric tons)	**0.006**

Enter this value in e-GGRT

INFORMATION ONLY: Annual CH_4 Mass Emissions For the Specific Fuel Type Converted to Carbon Dioxide Equivalent (metric tons CO_2e)

[GWP_{CH4}] = Global Warming Potential for CH_4	25
[CH_4] = Annual CH_4 emissions from combustion of the specified fuel (metric tons CO_2e)	0.73

INFORMATION ONLY: Annual N_2O Mass Emissions For the Specific Fuel Type Converted to Carbon Dioxide Equivalent (metric tons CO_2e)

[GWP_{N2O}] = Global Warming Potential for N_2O	298
[N_2O] = Annual N_2O emissions from combustion of the specified fuel (metric tons CO_2e)	1.75

Total CO2e emissions	EUGENERATORS	725	metric tons CO2e
		798	**short tons CO2e**

Client: Copperwood Resources, Inc. Project ID.: 17C050
Project: Air Permit Application Emissions Calculations - Version 2
Prepared by: CED1 Date: 06/25/18
Checked by: AKM Date: 07/02/18

1. Thruput and Production Rates for Mine Excavation/Ore Production

Actual thruput / process rates:

EUFUGITIVES-blast
Version e-GGRT RY2013.R.01
Today's date 7/12/2018

Pounds ANFO used per year: 4,239,840

Equation C-1:

$$CO_2 = 1x10^{-3} * Fuel * HHV * EF$$

$$CH_4 \text{ or } N_2O = 1 \times 10^{-3} * Fuel * HHV * EF$$

Facility Name:	Copperwood Resources, Inc.
Reporter Name:	
Unit or Group Name/ ID:	EUFUGITIVES-blast
Configuration Type:	
Fuel/ Fuel Type:	Distillate Fuel Oil No. 2 (Diesel) - 6% of ANFO/emulsion
Reporting Period:	NA - PTE Calculations
Comments:	Source data should be consistent with Underground sheet.
Unit Type:	General Stationary Fuel Combustion

Fuel Input Data

[Fuel] = Mass or volume of fuel combusted per year, from company records as defined in §98.6 (express mass in short tons for solid fuel, volume in standard cubic feet for gaseous fuel, and volume in gallons for liquid fuel)	36,341
[HHV] = Default High heat value of the fuel, from Table C-1 (mmBtu/mass or mmBtu/volume)	0.138

Gallons Distillate Fuel Oil No. 2 (Diesel) based on 4,239,840 pounds ANFO potential usage at 6% Distillate Fuel Oil No. 2 and 7 pounds/gallon

Constants

[1 x 10^{-3}] = Conversion Factor from kg to metric tons (constant)	0.001

Annual CO_2 Mass Emissions For the Specific Fuel Type (metric tons) from Equation C-1

[EF] = Fuel-Specific Default CO_2 Emission Factor, from Table C-1 (kg CO_2/mmBtu)	73.96
[CO_2] = Annual CO_2 emissions from combustion of the specified fuel (metric tons)	**371**

Enter this value in e-GGRT

Annual CH_4 Mass Emissions For the Specific Fuel Type (metric tons) from Equation C-8

[EF] = Fuel-Specific Default Emission Factor for CH_4, from Table C-2 (kg CH_4/mmBtu)	0.003
[CH_4] = Annual CH_4 emissions from combustion of the specified fuel (metric tons)	**0.015**

Enter this value in e-GGRT

VMT conct truck =

Annual N_2O Mass Emissions For the Specific Fuel Type (metric tons) from Equation C-8

[EF] = Fuel-Specific Default Emission Factor for N_2O, from Table C-2 (kg N_2O/mmBtu)	0.0006
[N_2O] = Annual N_2O emissions from combustion of the specified fuel (metric tons)	**0.003**

Enter this value in e-GGRT

INFORMATION ONLY: Annual CH_4 Mass Emissions For the Specific Fuel Type Converted to Carbon Dioxide Equivalent (metric tons CO_2e)

[GWP_{CH4}] = Global Warming Potential for CH_4	25
[CH_4] = Annual CH_4 emissions from combustion of the specified fuel (metric tons CO_2e)	0.38

INFORMATION ONLY: Annual N_2O Mass Emissions For the Specific Fuel Type Converted to Carbon Dioxide Equivalent (metric tons CO_2e)

[GWP_{N2O}] = Global Warming Potential for N_2O	298

Client: Copperwood Resources, Inc. Project ID.: 17C050
Project: Air Permit Application Emissions Calculations - Version 2
Prepared by: CED1 Date: 06/25/18
Checked by: AKM Date: 07/02/18

1. Thruput and Production Rates for Mine Excavation/Ore Production

Actual thruput / process rates:

EUFUGITIVES-blast

[N_2O] = Annual N_2O emissions from combustion of the specified fuel (metric tons CO_2e)	0.9

Total CO2e emissions EUFUGITIVES-blast 372 metric tons CO2e
409 short tons CO2e

Mine Heaters - SV-001, SV-002, SV-003
Version e-GGRT RY2013.R.01
Date: 7/2/2018

Equation C-1: $CO_2 = 1x10^{-3} * Fuel * HHV * EF$

CH_4 or $N_2O = 1 \times 10^{-3} * Fuel * HHV * EF$

Facility Name:	Copperwood Resources, Inc.
Reporter Name:	
Unit or Group Name/ ID:	Mine Heaters - SV-001, SV-002, SV-003
Configuration Type:	
Fuel/ Fuel Type:	LPG Combustion
Reporting Period:	NA - PTE Calculations
Comments:	Source data should be consistent with Mine Heaters sheet.
Unit Type:	General Stationary Fuel Combustion

Fuel Input Data

[Fuel] = Mass or volume of fuel combusted per year, from company records as defined in §98.6 (express mass in short tons for solid fuel, volume in standard cubic feet for gaseous fuel, and volume in gallons for liquid fuel)	5,168,400.
[HHV] = Default High heat value of the fuel, from Table C-1 (mmBtu/mass or mmBtu/volume)	0.091

Gallons Liquid Petroleum Gas (LPG) based on 6 burners at a combined 590 gallons/hour fuel usage at peak capacity and 8760 hours/year maximum operation.

Constants

[1 x 10^{-3}] = Conversion Factor from kg to metric tons (constant)	0.001

Annual CO_2 Mass Emissions For the Specific Fuel Type (metric tons) from Equation C-1

[EF] = Fuel-Specific Default CO_2 Emission Factor, from Table C-1 (kg CO_2/mmBtu)	62.87
[CO_2] = Annual CO_2 emissions from combustion of the specified fuel (metric tons)	**29569**

Enter this value in e-GGRT

Annual CH_4 Mass Emissions For the Specific Fuel Type (metric tons) from Equation C-8

[EF] = Fuel-Specific Default Emission Factor for CH_4, from Table C-2 (kg CH_4/mmBtu)	0.003
[CH_4] = Annual CH_4 emissions from combustion of the specified fuel (metric tons)	**1.41**

Enter this value in e-GGRT

VMT conct truck =

Annual N_2O Mass Emissions For the Specific Fuel Type (metric tons) from Equation C-8

[EF] = Fuel-Specific Default Emission Factor for N_2O, from Table C-2 (kg N_2O/mmBtu)	0.0006
[N_2O] = Annual N_2O emissions from combustion of the specified fuel (metric tons)	**0.282**

Enter this value in e-GGRT

INFORMATION ONLY: Annual CH_4 Mass Emissions For the Specific Fuel Type Converted to Carbon Dioxide Equivalent (metric tons CO_2e)

[GWP_{CH4}] = Global Warming Potential for CH_4	25
[CH_4] = Annual CH_4 emissions from combustion of the specified fuel (metric tons CO_2e)	35.27

INFORMATION ONLY: Annual N_2O Mass Emissions For the Specific Fuel Type Converted to Carbon Dioxide Equivalent (metric tons CO_2e)

[GWP_{N2O}] = Global Warming Potential for N_2O	298
[N_2O] = Annual N_2O emissions from combustion of the specified fuel (metric tons CO_2e)	84.09

Total CO2e emissions Mine Heaters 29689 metric tons CO2e
32658 short tons CO2e

Client: Copperwood Resources, Inc. Project ID.: 17C050
Project: Air Permit Application Emissions Calculations - Version 2
Prepared by: CED1 Date: 06/25/18
Checked by: AKM Date: 07/02/18

Space Heaters - F010
Version e-GGRT RY2013.R.01
Date: 7/2/2018

Equation C-1:

$$CO_2 = 1x10^{-3} * Fuel * HHV * EF$$

$$CH_4 \text{ or } N_2O = 1 \times 10^{-3} * Fuel * HHV * EF$$

Facility Name:	Copperwood Resources, Inc.
Reporter Name:	
Unit or Group Name/ ID:	Space Heaters - F010
Configuration Type:	
Fuel/ Fuel Type:	LPG Combustion
Reporting Period:	NA - PTE Calculations
Comments:	Source data should be consistent with Space Heaters sheet.
Unit Type:	General Stationary Fuel Combustion

Fuel Input Data

[Fuel] = Mass or volume of fuel combusted per year, from company records as defined in §98.6 (express mass in short tons for solid fuel, volume in standard cubic feet for gaseous fuel, and volume in gallons for liquid fuel)	140,160.
[HHV] = Default High heat value of the fuel, from Table C-1 (mmBtu/mass or mmBtu/volume)	0.091

Gallons Liquid Petroleum Gas (LPG) based on 16 gallons/hour fuel usage at peak capacity and 8760 hours/year maximum operation.

Constants

[1 x 10^{-3}] = Conversion Factor from kg to metric tons (constant)	0.001

Annual CO_2 Mass Emissions For the Specific Fuel Type (metric tons) from Equation C-1

[EF] = Fuel-Specific Default CO_2 Emission Factor, from Table C-1 (kg CO_2/mmBtu)	62.87
[CO_2] = Annual CO_2 emissions from combustion of the specified fuel (metric tons)	**802**

Enter this value in e-GGRT

Annual CH_4 Mass Emissions For the Specific Fuel Type (metric tons) from Equation C-8

[EF] = Fuel-Specific Default Emission Factor for CH_4, from Table C-2 (kg CH_4/mmBtu)	0.003
[CH_4] = Annual CH_4 emissions from combustion of the specified fuel (metric tons)	**0.04**

Enter this value in e-GGRT

VMT conct truck =

Annual N_2O Mass Emissions For the Specific Fuel Type (metric tons) from Equation C-8

[EF] = Fuel-Specific Default Emission Factor for N_2O, from Table C-2 (kg N_2O/mmBtu)	0.0006
[N_2O] = Annual N_2O emissions from combustion of the specified fuel (metric tons)	**0.008**

Enter this value in e-GGRT

INFORMATION ONLY: Annual CH_4 Mass Emissions For the Specific Fuel Type Converted to Carbon Dioxide Equivalent (metric tons CO_2e)

[GWP_{CH4}] = Global Warming Potential for CH_4	25
[CH_4] = Annual CH_4 emissions from combustion of the specified fuel (metric tons CO_2e)	0.96

INFORMATION ONLY: Annual N_2O Mass Emissions For the Specific Fuel Type Converted to Carbon Dioxide Equivalent (metric tons CO_2e)

[GWP_{N2O}] = Global Warming Potential for N_2O	298
[N_2O] = Annual N_2O emissions from combustion of the specified fuel (metric tons CO_2e)	2.28

Total CO2e emissions Space Heaters 805 metric tons CO2e
886 short tons CO2e

Client: Copperwood Resources, Inc. Project ID.: 17C050
Project: Air Permit Application Emissions Calculations - Version 2
Prepared by: CED1 Date: 06/25/18
Checked by: AKM Date: 07/02/18

Facility Stacks

Michigan Rule 336.1331 PM Limits Evaluation

	SV-001	SV-002	SV-003	SV-004	SV-005	SV-006
Limit in lb PM per 1000 lb exhaust gas	0.10	0.10	0.10	0.10	0.10	0.10
Stack exhaust rate - cfm	330000	340000	180000	7540	3625	3625
scfm	330006	340007	179817	2943	1407	1407
Calculate pounds gas:						
	60	60	61	872	880	880
pressure - atm	1	1	1	1	1	1
density - lb/cf	0.075	0.075	0.075	0.075	0.075	0.075
Venitlation exhaust rate - lb/min	24750	25500	13500	566	272	272
lb/hr	1485000	1530000	810000	33930	16313	16313
Hourly rate - 1000 lb exhaust gas	1485.0	1530.0	810.0	33.9	16.3	16.3
PM Emission Sources:						
Stack Emissions[1]- lb PM/hr	4.09	4.22	2.232	0.36	0.16	0.16
PM rate (lb PM per 1000 lb gas)=	0.00276	0.00276	0.00276	0.011	0.010	0.010
Does stack meet Table 31 Limit?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**
New Source Performance Standards:						
40 CFR 60.382 Standard for Particulate Matter						
Limits listed in (a)(1) - gram/dry std cubic meter	0.05	0.05	0.05	0.05	0.05	0.05
Stack Emissions (see summary)- lb PM/hr	4.09	4.22	2.232	0.359	0.161	0.161
convert to g/hr	0.0090	0.0093	0.00492	0.00079	0.00036	0.00036
Stack exhaust rate - scfm	330006	340007	179817	2943	1407	1407
convert to m3/hr	561011	578011	305688	5003	2392	2392
PM concentration - g PM/m3	1.61E-08	1.61E-08	1.61E-08	1.58E-07	1.48E-07	1.48E-07
Does stack meet the NSPS limit?	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**	**Yes**

1 m3/second = 2119 cfm (conversion factor from m3/sec to cfm)
1 cfm = 1.70 m3/hour (conversion factor from cfm to m3/hour)
1 cfm = 0.00047 m3/second (conversion factor from cfm to m3/second)

Emergency Generators

Michigan Rule 336.1402 Emissions of sulfur dioxide from fuel-burning sources other than power plants

Limit	1.7	lb SO2 per mm BTU fuel input	
			molecular weight
Fuel usage at 100% load=	141.6	gal/hr	S = 32
Fuel density=	7.1	lb/gal	SO2 = 64
Fuel heat rating=	19300	Btu/lb for diesel	
Heat Input=	19403448	Btu/hr	
Unit conversion =	1000000	Btu/mm Btu	
Heat Input=	19.40	mm Btu/hr	
Ultra Low Sulfur Diesel Fuel	15	ppm sulfur	
Sulfur emissions			
Fuel usage at 100% load=	141.6	gal/hr	
Fuel density=	7.1	lb/gal	
Fuel usage at 100% load=	1005.4	lb/hr	
Emission rate of S at 15 ppm=	0.01508	lb/hr S	
	0.5	lb S per lb SO2	
Emission rate of SO2 =	0.0302	lb SO2/hr	
Comparative Value =	0.0016	lb SO2/mm Btu fuel input	
Does generator meet SO2 limit?	**Yes**		

Note: Although the hourly SO2 emissions for this generator are presented on page 17 per AP-42, Ch. 3.3 Gasoline and Diesel Industrial Engines, a mass balance approach is taken here to calculate emissions to compare to Michigan limits. Since that chapter of AP-42 was published in 1996, diesel fuel is now mandated as ultra-low sulfur diesel, formulated to contain a maximum of 15 ppm sulfur.

Facility Name:	Copperwood Resources, Inc.	Contact Name:	
Facility Address:		Contact Phone Number:	
Geocoordinates (if known):		Contact Email Address:	

Chemical Name	CAS No.	Screening Level			AQD Screening Level?	AQD Footnote	Allowable Emission Rate (AER)				Proposed Emission Rate (ER)			Is Proposed Emission Rate less than AER?	
							ITSL		IRSL or SRSL						
		ITSL µg/m³	ITSL Avg Time	IRSL or SRSL µg/m³			lbs per month, 24-hr, 8-hr or 1-hr	Max lbs per hour	lbs per month	Max lbs per hour	Rate	Rate Units	Max Hourly ER lbs/hour	Screening Level Specific ER	Max Hourly Rate
Antimony	7440-36-0	0.2	annual		Y		8	0.108			2.47E-04	lbs/24-hr	1.03E-05	yes	yes
Arsenic	7440-38-2			0.002	Y				0.08	0.00108	4.34E-02	lbs/month	6.03E-05	yes	yes
Barium	7440-39-3	5	8-hr		Y	35	0.1	0.1			1.20E-01	lbs/8-hr	1.50E-02	no	yes
Beryllium	7440-41-7	0.02	24-hr		Y		0.0024	0.001			1.32E-03	lbs/24-hr	5.50E-05	yes	yes
Beryllium	7440-41-7			0.004	Y				0.16	0.00216	3.96E-02	lbs/month	5.50E-05	yes	yes
Cadmium	7440-43-9			0.006	Y				0.24	0.00324	2.50E-02	lbs/month	3.47E-05	yes	yes
Chromium, Trivalent	16065-83-1	5	8-hr		Y	17	0.1	0.1			1.92E-02	lbs/8-hr	2.39E-03	yes	yes
Cobalt	7440-48-4	0.2	8-hr		Y		0.004	0.004			0.00068	lbs/8-hr	7.29E-04	yes	yes
Copper	7440-50-8	2	8-hr		Y		0.04	0.04			2.10E+00	lbs/8-hr	2.62E-01	no	no
Magnesium	7439-95-4	100	8-hr		Y	38	2	2			2.73E-01	lbs/8-hr	3.41E-02	yes	yes
Manganese	7439-96-5	0.3	annual		Y	29	12	0.162			1.17E+01	lbs/month	1.63E-02	yes	yes
Mercury	7439-97-6	0.3	annual		Y	7	12	0.162			1.81E-03	lbs/month	2.51E-06	yes	yes
Mercury	7439-97-6	1	24-hr		Y		0.12	0.05			6.02E-05	lbs/24-hr	2.51E-06	yes	yes
Molybdenum	7439-98-7	30	8-hr		Y		0.6	0.6			2.94E-04	lbs/8-hr	3.67E-05	yes	yes
Nickel	7440-02-0			0.058	Y				2.32	0.03132	1.06E+00	lbs/month	1.47E-03	yes	yes
Selenium	7782-49-2	2	8-hr		Y	34	0.04	0.04			2.70E-04	lbs/8-hr	3.38E-05	yes	yes
Silver - soluble	7440-22-4	0.1	8-hr		Y		0.002	0.002			6.41E-04	lbs/8-hr	8.01E-05	yes	yes
Tin	7440-31-5	20	8-hr		Y		0.4	0.4			4.90E-04	lbs/8-hr	6.12E-05	yes	yes
Phosphorus (total)	7723-14-0	1	8-hr		Y	32	0.02	0.02			4.51E-02	lbs/8-hr	5.64E-03	no	yes
Phosphorus (total)	7723-14-0	0.2	annual		Y	32	8	0.108			4.06E+00	lbs/month	5.64E-03	yes	yes
MIBC	108-11-2	1000	8-hr		Y		20	20			5.79E-03	lbs/8-hr	7.23E-04	yes	yes
n-Dodecyl Mecaptan	112-55-0	8	8-hr		Y		0.16	0.16			1.05E-02	lbs/8-hr	1.31E-03	yes	yes

29 - The ITSL for manganese is most appropriately applied to PM10-Mn data rather than TSP-Mn data.

Facility Name:	**Copperwood Resources, Inc.**	**Contact Name:**	
Facility Address:		**Contact Phone Number:**	
		Contact Email Address:	

Chemical Name	CAS No.	Screening Level: ITSL µg/m³	Screening Level: ITSL Avg Time	Screening Level: IRSL or SRSL µg/m³	AQD Screening Level?	AQD Footnote	Allowable Emission Rate (AER): ITSL: lbs per month, 24-hr, 8-hr or 1-hr	Allowable Emission Rate (AER): ITSL: Max lbs per hour	Allowable Emission Rate (AER): IRSL or SRSL: lbs per month	Allowable Emission Rate (AER): IRSL or SRSL: Max lbs per hour	Proposed Emission Rate (ER): Rate	Proposed Emission Rate (ER): Rate Units	Proposed Emission Rate (ER): Max Hourly ER lbs/hour	Is Proposed Emission Rate less than AER?: Screening Level Specific ER	Is Proposed Emission Rate less than AER?: Max Hourly Rate
			annual												
Benzene	71-43-2	30	annual		Y		1200	16.2			1.08E+01	lbs/month	1.51E-02	yes	yes
Benzene	71-43-2	30	24-hr		Y		3.6	1.5			3.61E-01	lbs/24-hr	1.51E-02	yes	yes
Benzene	71-43-2			1	Y				40	0.54	10.84	lbs/month	1.51E-02	yes	yes
Toluene	108-88-3	5000	24-hr		Y		600	250			0.13	lbs/24-hr	5.45E-03	yes	yes
Xylene	1330-20-7	390	annual		Y	2	15600	210.6			2.70	lbs/month	3.74E-03	yes	yes
Propylene	115-07-1	8600	8-hr		Y		172	172			1.30	lbs/24-hr	5.41E-02	yes	yes
Formaldehyde	50-00-0	30	24-hr		Y		3.6	1.5			0.04	lbs/24-hr	1.53E-03	yes	yes
Formaldehyde	50-00-0			0.8	Y				32	0.432	1.10E+00	lbs/month	1.53E-03	yes	yes
1,3-Butadiene	106-99-0	33	annual		Y		1320	17.82			5.46E-01	lbs/month	7.59E-04	yes	yes
1,3-Butadiene	106-99-0			0.3	Y				12	0.162	5.46E-01	lbs/month	7.59E-04	yes	yes
Acetaldehyde	75-07-0	9.00	24-hr		Y		1.08	0.45			0.01	lbs/24-hr	4.89E-04	yes	yes
Acetaldehyde	75-07-0			5	Y				200	2.7	3.52E-01	lbs/month	4.89E-04	yes	yes
Acrolein*	107-02-8	5	1-hr		Y	13	0.005	0.005			1.53E-04	lbs/hr	1.53E-04	yes	yes
Acrolein*	107-02-8	0.16	annual		Y	13	6.4	0.0864			1.10E-01	lbs/month	1.53E-04	yes	yes
Naphthalene	91-20-3	3	annual		Y		120	1.62			0.061	lbs/24-hr	2.52E-03	yes	yes
Naphthalene	91-20-3	520	8-hr		Y		10.4	10.4			0.020	lbs/8-hr	2.52E-03	yes	yes
Naphthalene	91-20-3			0.8	Y				32	0.432	1.816	lbs/month	2.52E-03	yes	yes
Acenaphthylene	208-96-8	35	24-hr		Y		4.2	1.75			0.004	lbs/24-hr	1.79E-04	yes	yes
Acenaphthene	83-32-9	210	24-hr		Y		25.2	10.5			2.18E-03	lbs/24-hr	9.08E-05	yes	yes
Fluorene	86-73-7	140	24-hr		Y		16.8	7			5.96E-03	lbs/24-hr	2.48E-04	yes	yes
Phenanthrene*	85-01-8	0.1	annual		Y		4	0.054			5.70E-01	lbs/month	7.91E-04	yes	yes
Anthracene	120-12-7	1000	24-hr		Y		120	50			5.73E-04	lbs/24-hr	2.39E-05	yes	yes
Fluoranthene	206-44-0	140	24-hr		Y		16.8	7			0.0019	lbs/24-hr	7.82E-05	yes	yes
Pyrene	129-00-0	100	24-hr		Y		12	5			1.7E-03	lbs/24-hr	7.20E-05	yes	yes
PAHs **				0.006	Y	5			0.24	0.00324	1.24E-02	lbs/month	1.73E-05	yes	yes
Benzo(g,h,l)perylene	191-24-2	13	annual		Y		520	7.02			7.77E-03	lbs/month	1.08E-05	yes	yes

* Acrolein and phenanthrene have annual ITSL screening thresholds, however, the allowable emission rate (AER) is expressed in lb/month with no annual rate available in this pre-programmed spreadsheet. To compare values, the Proposed Emission Rate (ER) has been expressed in a lb/month basis (lb/month = lb/hr * 720 hr/month)

** Per Note 5 in the Screening Level Footnotes, the seven carcinogenic polycyclic aromatic hydrocarbons (PAHs) identified from AP-42 for diesel emissions from the emergency generators and fire pump should be evaluated additively, utilizing the relative potency factors (RPF) approved by the AQD in its document *Screening Levels for PAHs* dated November 4, 2015. Table 3 of the Screening Level document provides an example of how this could be done. For screening purposes in this worksheet, the facility-wide maximum hourly emission rate for the seven carcinogenic PAHs were added together, adjusted using the appropriate RPF to develop a Relative Maximum Hourly Emission Rate for each compound. The facility-wide Relative Maximum Hourly Emission Rate was compared against the Secondary Risk Screening Level (SRSL) for benzo(a)pyrene of 0.006 µg/m³.

Foth

Client: Copperwood Resources, Inc. Project ID.: 17C050
Project: Air Permit Application Emissions Calculations - Version 2
Prepared by: CED1 Date: 06/25/18
Checked by: AKM Date: 07/02/18

Copperwood Air Dispersion Model Input Data - Emission Rates of Criteria Pollutants

Point Sources [1]

Emission Source		Stack Height (Above Ground) (m) [1]	Stack Diameter (m) [1]	Stack Exit Velocity (m/s)	Stack Gas Temp (°K)	PM10 (lb/hr)	PM10 (g/sec)	PM2.5 (lb/hr)	PM2.5 (g/sec)	NO2 (lb/hr)	NO2 (g/sec)	SO2 (lb/hr)	SO2 (g/sec)	CO (lb/hr)	CO (g/sec)
SV-001	West Mine Exhaust Vent	8	2	49.4	289	2.114	**0.266**	0.298	**0.0375**	41.31	**5.205**	4.53	**0.571**	152.79	**19.252**
SV-002	East Mine Exhaust Vent	8	2	50.9	289	2.18	**0.274**	0.307	**0.0386**	42.56	**5.363**	4.67	**0.588**	157.42	**19.836**
SV-003	Portal Mine Exhaust Vent	1	4.8	17.9	289	1.15	**0.145**	0.162	**0.0204**	22.53	**2.839**	2.47	**0.311**	83.34	**10.501**
SV-004	Emergency Generator No. 1	4.5	0.2	112.8	740	0.359	**0.0452**	0.359	**0.0452**	0.74	**0.093**	0.018	**0.0023**	2.15	**0.271**
SV-005	Emergency Generator No. 2	4.5	0.2	54.2	744	0.081	**0.0102**	0.081	**0.0102**	0.45	**0.056**	0.009	**0.0011**	0.50	**0.063**
SV-006	Emergency Generator No. 3	4.5	0.2	54.2	744	0.081	**0.0102**	0.081	**0.0102**	0.45	**0.056**	0.009	**0.0011**	0.50	**0.063**

Volume Sources [3]

Emission Source		Volume Height (m)	Volume Width (m)	Release Height (m)	Adjusted Road Width	Initial Horizontal Dimension (m)	Initial Vertical Dimension (m)	PM10 Emissions (lb/hr)	PM10 Emissions (g/sec)	No. of Volume Source Segments	PM10 Rate per Volume (g/sec)	PM2.5 Emissions (lb/hr)	PM2.5 Emissions (g/sec)	PM2.5 Rate per Volume (g/sec)	NO2 Emissions (lb/hr)	NO2 Emissions (g/sec)	NO2 per Volume (g/sec)	SO2 Emissions (lb/hr)	SO2 Emissions (g/sec)	SO2 per Volume (g/sec)	CO Emissions (lb/hr)	CO Emissions (g/sec)	CO per Volume (g/sec)
F001	Ore Transfer from Portal to First Transfer Point (Transfer Tower) [4]	**N/A**	**N/A**	**0.75**		**0.21**	**0.21**	0.040	**0.0050**	**1**		**0.0060**	**0.0008**										
F002	Surplus Ore Transfer to Ore Stockpile [5]	**N/A**	**N/A**	**5**		**0.21**	**0.21**	0.119	**0.0150**	**1**		**0.0180**	**0.0023**										
F003A/B	Transfer Points at Ore Bins/Reclaim Area [6]	**N/A**	**N/A**	**11.0**		**7.27**	**10.2**	0.080	**0.010**	**2**	**5.03E-03**	**0.0120**	**0.0015**	**7.55E-04**									
F004	Management of Ore within Ore Stockpile Area [7]	**NA**	**N/A**	**16.2**		**0.81**	**3.8**	0.272	**0.034**	**1**		**0.0412**	**0.0052**										
F005	Transfer Points at SAG Mill [8]	**N/A**	**N/A**	**13**		**7.90**	**12.00**	0.004	**0.0005**	**1**		0.001	**7.55E-05**										
F006A/B	Concentrate Handling Operations [9]	**N/A**	**N/A**	**6**		**8.72**	**5.60**	0.004	**0.0005**	**2**	**2.72E-04**	0.0006	**8.15E-05**	**4.07E-05**									
F009A/B	Reagent Mixing and Management [10]	**N/A**	**N/A**	**6.5**		**7.27**	**6.10**	5.00E-05	**6.30E-06**	**2**	**3.15E-06**	5.00E-05	**6.30E-06**	**3.15E-06**									
F010	Space Heaters - Process Plant Building [17]	**N/A**	**N/A**	**13**		**36.1**	**12.10**	1.11E-02	**1.40E-03**	**3**	**4.67E-04**	1.11E-02	**1.40E-03**	**4.67E-04**	0.21	0.026	**0.0087**	0.001	0.00016	**5.41E-05**	0.12	0.015	**0.005**
HR-01	Vehicle Travel on Ore Stockpile [11]	**10.2**	**10.1**	**5.1**	**10.1**	**4.7**	**4.7**	0.990	0.1247	**13**	**9.60E-03**	0.099	0.012	**9.60E-04**									
HR-02	Conct Truck Travel on Access Road [12]	**10**	**8.5**	**5.0**	**8.5**	**7.9**	**4.7**	0.37	0.0469	**239**	**1.96E-04**	0.037	0.005	**1.96E-05**									
HR-03	Water Transport Truck on Access Road [13]	**8.6**	**8.4**	**4.3**	**8.4**	**7.8**	**4.0**	0.48	0.0605	**167**	**3.62E-04**	0.048	0.006	**3.62E-05**									
HR-04	[14]	**10**	**8.5**	**5.0**	**8.5**	**7.9**	**4.7**	0.38	0.0480	**239**	**2.01E-04**	0.038	0.005	**2.01E-05**									
HR-05	Explosives Truck Travel on Access Road [15]	**10**	**8.5**	**5.0**	**8.5**	**7.9**	**4.7**	0.38	0.0476	**150**	**3.17E-04**	0.038	0.005	**3.17E-05**									

Area Sources

Emission Source	**X-Axis** Length (m)	**Y-Axis Length (m)**	**Release Height (m)**	**Initial Vertical (m)**	Area (m2)	PM10 Emissions (lb/hr)	PM10 Emissions (g/sec)	PM10 Emissions (g/m^2-sec)	PM2.5 Emissions (lb/hr)	PM2.5 Emissions (g/sec)	PM2.5 Emissions (g/m^2-sec)
F007 - Wind Erosion at Ore Stockpile			**15**	**7.0**	**51,790**	0.23	0.03	**5.56E-07**	0.057	0.007	**1.39E-07**
F008 - Wind Erosion at TDF			**30**	**14.0**	**38,079**	0.4	0.05	**1.33E-06**	0.205	0.026	**6.79E-07**

Building Dimensions [16]

Building Name	X-Axis Bldg/Structure Length (m)	Y-Axis Bldg/Structure Width (m)	Bldg/ Structure Height (m)	Area (m2)	UTM Coordinates Easting (m)	UTM Coordinates Northing (m)
Process Plant and Support Facility	**108.4**	**37.8**	**26**	**4,098**	270405	5172284
Concentrate Processing Area	**43**	**34**	**12**	**1,462**	270366	5172261
Reagent Building	**31.6**	**14**	**4.8**	**442**	270397	5172325
Ore Bins/Reclaim Area	**32**	**18.8**	**22**	**602**	270564	5172416
Warehouse	**37.7**	**37.5**	**6**	**1,414**	270446	5172436
Truck Shop/Mine Services Area	**18.6**	**46.3**	**6**	**861**	270472	5172467
Dry	**37.5**	**25**	**3**	**938**	270423	5172467

Foth

Client: Copperwood Resources, Inc. Project ID.: 17C050
Project: Air Permit Application Emissions Calculations - Version 2
Prepared by: CED1 Date: 06/25/18
Checked by: AKM Date: 07/02/18

Notes:

(1) Stack heights and diameters were calculated based on outlet information provided by Copperwood. All listed heights are measured from the base of the area where they are located. The dimensions for the portal exhaust is based on information provided by Copperwood.

(2) The emergency generators will operate as needed a maximum of 500 hours per year. The three emergency generators will be located as shown on Figure 2.

(3) All volume sources were calculated based on the MDEQ guidance document entitled *Air Dispersion Modeling Guidance Document* dated September 2009.

(4) This represents particulate emissions vented from conveyor No. 1 transfer tower at F001. The transfer conveyor is assumed to be 1.5 meters above ground, with the release height being 1.5 / 2 = 0.75. The initial horizontal dimension is the width of the conveyor = 3 feet = 0.91 meters / 4.3 = 0.21 meters. The initial vertical dimension is the drop distance = 3 feet = 0.91 meters / 4.3 = 0.21 meters.

(5) To estimate this volume source at F002, the release height was the height of the drop point at the ore stockpile = 10 / 2 = 5 meters. The initial horizontal dimension is the width of the conveyor = 3 feet = 0.91 meters / 4.3 = 0.21 meters. The initial vertical dimension is the drop distance = 3 feet = 0.91 meters / 4.3 = 0.21 meters.

(6) To estimate emissions from the ore bins/reclaim area (F003), it will be assumed the emissions will be released within the footprint of the structure. Therefore, the release height for the structure is the height of the bins = 22 meters / 2 = 11 meters. There will be two volume sources. The initial horizontal dimension for each volume source = 31.25 / 4.3 = 7.27 meters (which is half the length of one side of the structure), while the initial vertical dimension = 22 / 2.15 = 10.2 meters.

(7) For F004, to estimate emissions from a FE loader at a pile, it was assumed the release height for the FE loader bucket will be at about 4 feet in height or 1.2 meters. Given the height of the Ore Stockpile will be 15 meters above ground level, the adjusted loader height will be 1.2 + 15 = 16.2 meters. The initial horizontal dimension is the width of the bucket = 3.5 meters / 4.3 = 0.81 meters. The initial vertical dimension is the height of the drop = 16.2 / 4.3 = 3.8 meters.

(8) F005 will be a drop point just inside the process plant building. To estimate emissions from inside the process plant, the release height will be the height of the building = 26 meters / 2 = 13 meters. The initial horizontal dimension will be the width of the building = 34 / 4.3 = 7.9 meters. The initial vertical dimension will be 26 / 2.15 = 12 meters.

(9) Emissions from the concentrate load-out area at F006 include management of concentrate inside the building. This emission source is minimal due to enclosure of the drop point and the fact the material is 9% moisture. It is nonetheless included in air dispersion modeling to be conservative. For purposes of modeling, it is assumed it would be a volume source that includes just the southwest end of the building. The volume is one source that includes release of the emissions from the roof of the building. The release height is the midpoint of the building height = 12 / 2 = 6 meters. There will be two volume sources. The initital horizontal dimension is one-half of the building width = 37.5 / 4.3 = 8.72 meters. The initial vertical dimension is the building height = 12 / 2.15 = 5.6 meters.

(10) Emissions from the reagent building include particulate emissions from mixing of reagents. While these sources are exempt sources, they are being included in air dispersion modeling to be conservative. Modeling for TACs associated with reagent mixing was not required. For purposes of modeling, it is assumed emissions would come from the entire building. Therefore, the building was divided into two volume sources using MDEQ guidance for setting up volume sources associated with release of emissions from building roofs/vents. The release height is the midpoint of the building height = 13 / 2 = 6.5 meters. The initial horizontal dimension of each volume source is 31.25 / 4.3 = 7.27 meters. The initial vertical dimension of each volume source is 13 / 2.15 = 6.1 meters.

(11) For HR-01, this included estimation of vehicle height, volume width, release height, initial lateral dimension and initial vertical dimension. Based on use of a CAT 990H FE loader, the height is 5.1 meters, the width is 4.1 meters and length 12.8 meters. Given this information, the volume height is 5.1 * 2 = 10.2 meters, with the volume width being the loader width + 6 meters = 4.1 + 6 = 10.1 meters. The release height = volume height / 2 = 10.2 / 2 = 5.1 meters. The initial horizontal dimension = the volume width / 2.15 = / 2.15 = 4.7 meters, with the initial vertical dimension = height of the volume / 2.15 or 10.2 / 2.15 = 4.7 meters.

(12) For HR-02, this included estimation of vehicle height, volume width, release height, initial lateral dimension and initial vertical dimension. Based on use of bulk product haul truck, the height is 16 feet (including trailer + distance from ground) or 5 meters. The width is 8.3 feet or 2.5 meters. The overall length (including trailer and cab) is 53 feet or 16 meters. Given this information, the volume height is 5 * 2 = 10 meters, with the volume width being the truck width + 6 meters = 8.5 meters. The release height = volume height / 2 = 10 / 2 = 5 meters. For alternating volume sources, the initial horizontal dimension = 2 X the adjusted road width / 2.15 = 17 / 2.15 = 7.9 meters, with the initial vertical dimension = height of the volume / 2.15 or 10 / 2.15 = 4.7 meters.

(13) For HR-03, this included estimation of vehicle height, volume width, release height, initial lateral dimension and initial vertical dimension. Based on use of water transport truck, the height is 14 feet (including trailer + distance from ground) or 4.3 meters. The width is 8 feet or 2.4 meters. The overall length (including trailer and cab) is 65 feet or 19.8 meters. Given this information, the volume height is 4.3 * 2 = 8.6 meters, with the volume width being the truck width + 6 meters = 8.4 meters. The release height = volume height / 2 = 8.6 / 2 = 4.3 meters. For alternating volume sources, the initial horizontal dimension = 2 X the adjusted road width / 2.15 = 16.8 / 2.15 = 7.8 meters, with the initial vertical dimension = height of the volume / 2.15 or 8.6 / 2.15 = 4 meters.

(14) For HR-04, this included estimation of vehicle height, volume width, release height, initial lateral dimension and initial vertical dimension. Based on use of bulk product delivery truck, the height is 16 feet (including trailer + distance from ground) or 5 meters. The width is 8.3 feet or 2.5 meters. The overall length (including trailer and cab) is 53 feet or 16 meters. Given this information, the volume height is 5 * 2 = 10 meters, with the volume width being the truck width + 6 meters = 8.5 meters. The release height = volume height / 2 = 10 / 2 = 5 meters. For alternating volume sources, the initial horizontal dimension = 2 X the adjusted road width / 2.15 = 17 / 2.15 = 7.9 meters, with the initial vertical dimension = height of the volume / 2.15 or 10 / 2.15 = 4.7 meters.

(15) For HR-05, this included estimation of vehicle height, volume width, release height, initial lateral dimension and initial vertical dimension. Based on use of bulk product delivery truck, the height is 16 feet (including trailer + distance from ground) or 5 meters. The width is 8.3 feet or 2.5 meters. The overall length (including trailer and cab) is 53 feet or 16 meters. Given this information, the volume height is 5 * 2 = 10 meters, with the volume width being the truck width + 6 meters = 8.5 meters. The release height = volume height / 2 = 10 / 2 = 5 meters. For alternating volume sources, the initial horizontal dimension = 2 X the adjusted road width / 2.15 = 17 / 2.15 = 7.9 meters, with the initial vertical dimension = height of the volume / 2.15 or 10 / 2.15 = 4.7 meters.

(16) Dimensions are provided for buildings on-site that are adjacent identified emission sources. These additional buildings are included in the dispersion model even though these structures do not release emissions. This is because these structures could have some impact on downwash and/or cavity effects at the site. Dimensions for buildings were provided by Lycopodium.

(17) Space heaters will be located throughout the process plant building to provide additional heating, particularly during winter months. For purposes of air dispersion modeling, it is assumed emission would come from the entire building. Therefore, the building was dividd into three volume sources using MDEQ guidance for setting up volume sources associated with release of emissions from buildings. The release height is the midpoint of the building height = 26/2 = 13 meters. The initial horizontal dimension of each volume source is 108.4/3 = 36.1 meters. The initial vertical dimension of each volume source is 26/2.15 = 12.1 meters.

Client: Copperwood Resources, Inc. Project ID.: 17C050
Project: Air Permit Application Emissions Calculations - Version 2
Prepared by: CED1 Date: 06/25/18
Checked by: AKM Date: 07/02/18

Copperwood Air Dispersion Model Input Data - Emission Rates of Toxic Air Contaminants

	% Copper [2]	% Lead [2]	% Barium [2]	% Phosphorus [2]
Ore	1.460	1.10E-03	0.07559	0.00
Concentrate	29.170	1.00E-03	0.01860	2.48
Native Soils	0.00197	1.54E-03	0.0188	0.07
Tailings	0.4675	1.27E-03	0.0535	0.00

Point Sources

Emission Source		Copper	Lead	Barium	Phosphorus	Units
SV-001 West Mine Exhaust Vent		7.53E-03	5.66E-06	3.90E-04	0.00	g/sec
SV-002 East Mine Exhaust Vent		7.76E-03	5.84E-06	4.02E-04	0.00	g/sec
SV-003 Portal Mine Exhaust Vent		4.11E-03	3.09E-06	2.13E-04	0.00	g/sec
SV-004 - Emergency Generator No. 1						g/sec
SV-005 - Emergency Generator No. 2						g/sec
SV-006 - Emergency Generator No. 3						g/sec

Volume Sources

Emission Source	Number of Volume Source Segments	Copper	Lead	Barium	Phosphorus	Units
F001 - Ore Transfer at Transfer Tower	1	2.00E-04	1.51E-07	1.04E-05	0.00	g/sec
F002 - Surplus Ore Transfer to Ore Stockpile	1	4.74E-04	3.56E-07	2.45E-05	0.00	g/sec
F003A&B - Transfer Points at Ore Bins/Reclaim Area [1]	2	2.00E-04	1.51E-07	1.04E-05	0.00	g/sec
F004 - Management of Ore at Ore Stockpile	1	1.06E-03	7.97E-07	5.48E-05	0.00	g/sec
F005 - Transfer Points at SAG Mill	1	2.00E-05	1.51E-08	1.04E-06	0.00	g/sec
F006A&B - Concentrate Handling Operations [1]	2	2.16E-04	7.41E-09	1.38E-07	1.84E-05	g/sec
HR-01 - Vehicle Travel on Ore Stockpile [1]	13	6.55E-04	4.93E-07	3.39E-05	0.00	g/sec
HR-02 - Concentrate Truck Travel on Access Road [1, 3]	239	1.81E-08	1.41E-08	1.73E-07	6.5E-07	g/sec
HR-03 - Water Truck Travel on Access Road [1, 3]	167	3.34E-08	2.60E-08	3.18E-07	1.20E-06	g/sec
HR-04 - Reagent/Grinding Media Truck on Access Road [1,3]	239	1.85E-08	1.44E-08	1.77E-07	6.67E-07	g/sec
HR-05 - Explosives Truck Travel on Access Road [1,3]	150	3.48E-05	2.71E-05	2.79E-07	1.05E-06	g/sec

Area Sources

Emission Source	Area	Copper	Lead	Barium	Phosphorus	Units
F007 - Wind Erosion at Ore Stockpile	51,790	4.06E-08	3.05E-11	2.10E-09	0.00	g/m2-sec
F008 - Wind Erosion at TDF	38,079	1.20E-08	3.26E-11	1.37E-09	0.00	g/m2-sec

Notes:

1. Each barium, copper, lead, and phosphorus concentration is for each volume source segment. Lead is included here although it is regulated as a federal criteria pollutant
2. Lead and TAC emission rates for ore materials are based on PM emission composition.
3. For vehicle travel on the access road (HR-02, HR-03, HR-04, and HR-05), all emission calculations were calculated based on the percentage of TACs in native soils. Note that the access road will be dressed with clean aggregate material, such that trucks are not in direct contact with native soils over the route.

Table C-1 to Subpart C - Default CO_2 Emission Factors and High Heat Values for Various Types of Fuel

Fuel Type	Default High Heat Value	Default CO_2 Emission Factor
Coal and Coke	**mmBtu/short ton**	**kg CO_2 /mmBtu**
Anthracite	25.09	103.69
Bituminous	24.93	93.28
Subbituminous	17.25	97.17
Lignite	14.21	97.72
Coal Coke	24.80	113.67
Mixed (Commercial sector)	21.39	94.27
Mixed (Industrial coking)	26.28	93.90
Mixed (Industrial sector)	22.35	94.67
Mixed (Electric Power sector)	19.73	95.52
Natural Gas	**mmBtu/scf**	**kg CO_2 /mmBtu**
(Weighted U.S. Average)	1.026E-03	53.06
Petroleum Products	**mmBtu/gallon**	**kg CO_2 /mmBtu**
Distillate Fuel Oil No. 1	0.139	73.25
Distillate Fuel Oil No. 2	0.138	73.96
Distillate Fuel Oil No. 4	0.146	75.04
Residual Fuel Oil No. 5	0.140	72.93
Residual Fuel Oil No. 6	0.150	75.10
Used Oil	0.138	74.00
Kerosene	0.135	75.20
Liquefied petroleum gases (LPG)[1]	0.092	61.71
Propane[1]	0.091	62.87
Propylene[1]	0.091	67.77
Ethane[1]	0.068	59.60
Ethanol	0.084	68.44
Ethylene[2]	0.058	65.96
Isobutane[1]	0.099	64.94
Isobutylene[1]	0.103	68.86
Butane[1]	0.103	64.77
Butylene[1]	0.105	68.72
Naphtha (<401 deg F)	0.125	68.02
Natural Gasoline	0.110	66.88
Other Oil (>401 deg F)	0.139	76.22
Pentanes Plus	0.110	70.02
Petrochemical Feedstocks	0.125	71.02
Petroleum Coke	0.143	102.41
Special Naphtha	0.125	72.34
Unfinished Oils	0.139	74.54
Heavy Gas Oils	0.148	74.92
Lubricants	0.144	74.27

Table C-1 to Subpart C - Default CO_2 Emission Factors and High Heat Values for Various Types of Fuel

Fuel Type	Default High Heat Value	Default CO_2 Emission Factor
Motor Gasoline	0.125	70.22
Aviation Gasoline	0.120	69.25
Kerosene-Type Jet Fuel	0.135	72.22
Asphalt and Road Oil	0.158	75.36
Crude Oil	0.138	74.54
Other Fuels (Solid)	**mmBtu/short ton**	**kg CO_2 /mmBtu**
Municipal Solid Waste	9.95 [3]	90.70
Tires	28.00	85.97
Plastics	38.00	75.00
Petroleum Coke	30.00	102.41
Other Fuels (Gaseous)	**mmBtu/scf**	**kg CO_2 /mmBtu**
Blast Furnace Gas	9.20E-05	274.32
Coke Oven Gas	5.99E-04	46.85
Propane Gas	2.52E-03	61.46
Fuel Gas [4]	1.39E-03	59.00
Biomass Fuels - Solid	**mmBtu/short ton**	**kg CO_2 /mmBtu**
Wood and Wood Residuals (dry basis)[5]	17.48	93.80
Agricultural Byproducts	8.25	118.17
Peat	8.00	111.84
Solid Byproducts	10.39	105.51
Biomass Fuels - Gaseous	**mmBtu/scf**	**kg CO_2 /mmBtu**
Landfill Gas	4.85E-04	52.07
Other Biomass Gases	6.55E-04	52.07
Biomass Fuels - Liquid	**mmBtu/gallon**	**kg CO_2 /mmBtu**
Ethanol	0.084	68.44
Biodiesel	0.128	73.84
Rendered Animal Fat	0.125	71.06
Vegetable Oil	0.120	81.55

[1] The HHV for components of LPG determined at 60°F and saturation pressure with the exception of ethylene.

[2] Ethylene HHV determined at 41°F (5°C) and saturation pressure.

[3] Use of this default HHV is allowed only for: (a) units that combust MSW, do not generate steam, and are allowed to use Tier 1; (b) units that derive no more than 10 percent of their annual heat input from

Table C-1 to Subpart C - Default CO_2 Emission Factors and High Heat Values for Various Types of Fuel

Fuel Type	Default High Heat Value	Default CO_2 Emission Factor

MSW and/or tires; and (c) small batch incinerators that combust no more than 1,000 tons of MSW per year.

[4] Reporters subject to subpart X of this part that are complying with §98.243(d) or subpart Y of this part may only use the default HHV and the default CO_2 emission factor for fuel gas combustion under the conditions prescribed in §98.243(d)(2)(i) and (d)(2)(ii) and §98.252(a)(1) and (a)(2), respectively. Otherwise, reporters subject to subpart X or subpart Y shall use either Tier 3 (Equation C–5) or Tier 4.

[5] Use the following formula to calculate a wet basis HHV for use in Equation C-1: HHVw=((100-M)/100)*HHVd where HHVw = wet basis HHV, M = moisture content(percent) and HHVd=dry basis HHV from Table C-1.

Table C-2 to Subpart C - Default CH_4 and N_2O Emission Factors for Various Types of Fuel

Fuel Type	Default CH_4 Emission Factor (kg CH_4/mmBtu)	Default N_2O Emission Factor (kg N_2O/mmBtu)
Coal and Coke (All fuel types in Table C-1	1.1E-02	1.6E-03
Natural Gas	1.0E-03	1.0E-04
Petroleum (All fuel types in Table C-1)	3.0E-03	6.0E-04
Fuel Gas	3.0E-03	6.0E-04
Municipal Solid Waste	3.2E-02	4.2E-03
Tires	3.2E-02	4.2E-03
Blast Furnace Gas	2.2E-05	1.0E-04
Coke Oven Gas	4.8E-04	1.0E-04
Biomass Fuels - Solid (All fuel types in Table C-1, except wood and wood residuals)	3.2E-02	4.2E-03
Wood and wood residuals	7.2E-03	3.6E-03
Biomass Fuels - Gaseous (All fuel types in Table C-1)	3.2E-03	6.3E-04
Biomass Fuels – Liquid (All fuel types in Table C-1)	1.1E-03	1.1E-04

Note: Those employing this table are assumed to fall under the IPCC definitions of the "Energy Industry" or "Manufacturing Industries and Construction". In all fuels except for coal the values for these two categories are identical. For coal combustion, those who fall within the IPCC "Energy Industry" category may employ a value of 1 g of CH4/mmBtu.

Client: Copperwood Resources, Inc. Project ID.:
Project: Air Permit Application Emissions Calculations - Version 2
Prepared by: CED1 Date:
Checked by: AKM Date:

Client: Copperwood Resources, Inc. Project ID.:
Project: Air Permit Application Emissions Calculations
Prepared by: Date:
Checked by: Date:

17C050

06/25/18
07/02/18

17C050