

Appendix F

Construction Emission Calculations

Great River Energy
Pilot Knob to Burnsville
Construction Emission Calculations
Summary

Description	Emissions (tons per year)							GHGs CO ₂ e	HAPs Formaldehyde	Total
	NOx	CO	Criteria Pollutants			PM ₁₀	PM _{2.5}			
			VOC	SO ₂						
Off-Road Engine Emissions	17.00	3.65	1.18	0.01	0.60	0.59	777.42	0.00	0.00	
Unpaved Roads	--	--	--	--	1.08	0.11	--	--	--	
Earthmoving	--	--	--	--	79.54	8.37	--	--	--	
TOTAL	17.00	3.65	1.18	0.01	81.22	9.07	777.42	0.00	0.00	

Great River Energy
Pilot Knob to Burnsville
Construction Emission Calculations
Emission Factors for Construction Engines

Equipment	Quantity ^a	Hours per Day	Days per Week	Number of Weeks	Total Hours Used ^b	Max Power (HP)	Load Factor ^c	Loaded Power (HP)	Emission Factors ^{d,e} (g/hp hr)								
									VOC	CO	NOx	PM ₁₀	PM _{2.5}	SO ₂	CO ₂	CH ₄	N ₂ O
Air Compressor	1	10	5	32	1,600	80	1	80	0.367	2.366	4.700	0.240	0.240	0.002	188.262	0.008	0.002
ATV	1	5	5	32	800	20	0.5	10	0.438	2.161	4.440	0.267	0.267	0.002	188.262	0.008	0.002
Backhoe	1	10	5	32	1,600	75	0.8	60	0.367	2.366	4.700	0.240	0.240	0.002	188.262	0.008	0.002
Fork Lift	2	5	5	32	1,600	120	1	120	0.167	0.843	4.335	0.132	0.132	0.002	188.262	0.008	0.002
Concrete Mixer Truck	1	10	5	3	150	325	1	325	0.338	0.867	4.100	0.180	0.180	0.002	188.262	0.008	0.002
Concrete Pump	1	5	5	2	50	300	1	300	0.338	0.867	4.100	0.180	0.180	0.002	188.262	0.008	0.002
Dump Truck	1	10	5	32	1,600	325	0.8	260	0.338	0.867	4.100	0.180	0.180	0.002	188.262	0.008	0.002
Generator	1	10	5	32	1,600	250	0.5	125	0.167	0.843	4.335	0.132	0.132	0.002	188.262	0.008	0.002
Pickup Truck	7	10	5	32	11,200	150	0.25	38	0.167	0.843	4.335	0.132	0.132	0.002	188.262	0.008	0.002
Skid steer loader	2	10	5	32	3,200	50	1	50	0.309	0.748	4.000	0.132	0.132	0.002	188.262	0.008	0.002
Water truck	1	10	5	2	100	100	0.5	50	0.637	2.366	4.700	0.240	0.240	0.002	188.262	0.008	0.002
Large Crane	1	10	5	32	1,600	15	0.21	3	0.438	2.161	4.44	0.267	0.259	0.002	188.262	0.008	0.002
Medium Crane	4	10	5	32	6,400	450	0.7	315	0.3085	0.7475	4.0	0.132	0.128	0.002	188.262	0.008	0.002
Hydrovac Truck	1	10	5	4	200	200	0.59	118	0.3085	0.7475	4.0	0.132	0.128	0.002	188.262	0.008	0.002
Semitruck/Trailer	1	4	5	32	640	500	0.59	500	0.167	0.843	4.335	0.132	0.132	0.002	188.262	0.008	0.002

^a Equipment counts based on experience with construction of a similar projects.

^b Generally assumes work will occur 7 am - 7 pm, Monday through Saturday, for a total of 72 work hours per week over 20 weeks

^c Load Factors from Appendix A of EPA 420_P 04 005, Median Life, Annual Activity, and Load Factor Values for Nonroad Engine Emissions Modeling, USEPA, April 2004.

^d EPA 420 P 04 009, Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling Compression Ignition, USEPA, April 2004 Tier 2 Engines.

^e GHG emission factors from Title 40 Subchapter C Part 98 Subpart C Table C-1 and C-2 to Subpart C.

Assumption:

393.5 hp-hr/MMBtu
453.6 g/lb

Great River Energy
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Emission Estimates from Construction Engines

Equipment	Potential Emissions (ton/)									
	VOC	CO	NOx	PM ₁₀	PM _{2.5}	SO ₂	CO ₂	CH ₄	N ₂ O	CO _{2e}
Air Compressor	5.18E-02	0.334	0.663	0.034	0.034	0.000	26.56	1.1E-03	2.2E-04	26.65
ATV	3.86E-03	0.019	0.039	0.002	0.002	0.000	1.66	6.7E-05	1.3E-05	1.67
Backhoe	3.89E-02	0.250	0.497	0.025	0.025	0.000	19.92	8.1E-04	1.6E-04	19.99
Fork Lift	3.53E-02	0.178	0.917	0.028	0.028	0.000	39.84	1.6E-03	3.2E-04	39.98
Concrete Mixer Truck	1.82E-02	0.047	0.220	0.010	0.010	0.000	10.12	4.1E-04	8.2E-05	10.15
Concrete Pump	5.60E-03	0.014	0.068	0.003	0.003	0.000	3.11	1.3E-04	2.5E-05	3.12
Dump Truck	1.55E-01	0.397	1.880	0.083	0.083	0.001	86.33	3.5E-03	7.0E-04	86.63
Generator	3.68E-02	0.186	0.956	0.029	0.029	0.000	41.50	1.7E-03	3.4E-04	41.65
Pickup Truck	7.73E-02	0.390	2.007	0.061	0.061	0.001	87.16	3.5E-03	7.1E-04	87.46
Skid steer loader	5.44E-02	0.132	0.705	0.023	0.023	0.000	33.20	1.3E-03	2.7E-04	33.32
Water truck	3.51E-03	0.013	0.026	0.001	0.001	0.000	1.04	4.2E-05	8.4E-06	1.04
Large Crane	2.43E-03	0.012	0.025	0.001	0.001	0.000	1.05	4.2E-05	8.5E-06	1.05
Medium Crane	6.86E-01	1.661	8.889	0.293	0.284	0.004	418.37	1.7E-02	3.4E-03	419.80
Hydrovac Truck	8.03E-03	0.019	0.104	0.003	0.003	0.000	4.90	2.0E-04	4.0E-05	4.91
TOTAL	1.18	3.65	17.00	0.60	0.59	0.01	774.77	3.1E-02	6.3E-03	777.42

Global Warming Potentials		
CO ₂	CH ₄	N ₂ O
1	25	298

Source: Title 40 Part 98 Table A-1.

Hazardous Air Pollutants from Construction Engines		
Species	Fraction of VOC	Emissions (tpy)
Benzene	0.02	0.00
Formaldehyde	0.118	0.00
Acetaldehyde	0.053	0.00
1,3 butadiene	0.002	0.00
Acrolein	0.003	0.00
Total HAPs		0.00

Great River Energy
Pilot Knob to Burnsville
Construction Emission Calculations
Fugitive Dust Emissions from Unpaved Roads

Equipment	Quantity ^a	Total Days Used	VMT ^b	W	Emission Factor (lb/VMT) ^c		Emissions (ton/yr)	
					PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}
ATV	1	160	80	20	1.73	0.17	0.07	0.01
Backhoe	1	160	80	50	2.62	0.26	0.10	0.01
Bulldozer	0	0	0	20	1.73	0.17	0.00	0.00
Fork Lift	2	320	160	20	1.73	0.17	0.14	0.01
Concrete Mixer Truck	1	15	8	20	1.73	0.17	0.01	0.00
Dump Truck	1	160	80	21	1.77	0.18	0.07	0.01
Excavator	0	0	0	22	1.81	0.18	0.00	0.00
Front End Loader	0	0	0	23	1.85	0.18	0.00	0.00
Pickup Truck	7	1,120	560	24	1.88	0.19	0.53	0.05
Piping Truck	0	0	0	25	1.92	0.19	0.00	0.00
Skid steer loader	2	320	160	26	1.95	0.20	0.16	0.02
Water truck	1	10	5	20	1.73	0.17	0.00	0.00
Welding Machine	0	0	0	20	1.73	0.17	0.00	0.00
TOTAL	--	--	--	--	--	--	1.08	0.11

^a Equipment counts are estimated based current construction plan.

^b Each vehicle is assumed to travel 0.5 mile per day on site.

^c AP-42 Section 13.2.2 Unpaved Roads, dated November 2006, Equations 1a and 2 TOTALS 11.19 1.12 Surface Silt content based on Table 13.2.2 1 construction sites.

Eq 1a: $E = k * (s/12)^a * (W/3)^b$

Eq 2: $E_{ext} = E * [(365-P)/365]$

where:

VMT = Vehicle Miles Traveled

W = Mean Vehicle Weight, tons

S = Mean Vehicle Speed, mph

P = 120 days with at least 0.01 inches rain, EPA's AP-42 Figure 13.2.2-1

s = 8.5 surface material silt content (%) for construction sites, EPA's AP-42 Table 13.2.2-1

E = size-specific emission factor, lb/ VMT

E_{ext} = annual size-specific emission factor extrapolated for natural migration, lb/VMT

Constants	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

Great River Energy
Pilot Knob to Burnsville
Construction Emission Calculations
Fugitive Dust Emissions from Earthmoving Activities

Summary of Fugitive Dust Emissions From Earthmoving Activities							
Construction Activity	Daily Material Handling		Average Exposed Area (acres)	Emission Factors^{b-d} (lb/ton)		Emissions (ton)	
	Construction Rate^a (ton/day)	Handling Time (days)		PM₁₀	PM_{2.5}	PM₁₀	PM_{2.5}
	Topsoil removed by scraper ^e	909.1		822	---	0.058	0.0061
Wind erosion of exposed areas	--	822	370.54	0.38	0.03999	57.87	6.09
TOTAL						79.54	8.37

Notes and Assumptions:

^a Soil density: 1.25 tons per yard

^b As worst case, PM₁₀ is set equal to Total Particulate Matter. PM_{2.5} is set to 0.105 times PM₁₀ per EPA's AP-42 Table 11.9 1

^c Emission factor: AP 42 Section 11.9 Western Surface Coal Mining, Table 11.9 4, July 1998, topsoil removal by scraper

^d Wind Erosion Exposed Areas emission factor: AP 42 Section 11.9 Western Surface Coal Mining, Table 11.9 4, July 1998, wind erosion of exposed areas (ton/yr/acre)

^e Assumes the entire workspace is cleared to 1 foot deep, 1.25 tons per cubic yard.

Construction Schedule		
Work Hours:	12	7 am - 7 pm
Work Days	6	Monday through Saturday
Hours per week	72	
Crews:	1	
Weeks:	35	
Total Days:	822	

Note: Construction will not occur at any one location for the entire 822 days; however, to be conservative, these calculations assume the ground is disturbed for that entire period.

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Construction Emission Calculations
Fugitive Dust Emissions from Earthmoving Activities

Topsoil Removed by Scraper^a					
County/Facility	Total (Acres)	Soil Volume (yd³)	Soil Weight (ton)	Duration (Days)	Daily Material Handling Rate (ton/day)
Dakota County	370.5	597,809	747,261	822	909
TOTAL	370.5	597,809	747,261		909

^a Acreages calculated from the route widths in section 3.1.4.