

APPENDIX E

Air Quality, Emissions, and Modeling Data

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Acronyms and Abbreviations

$\mu\text{g}/\text{m}^3$	micrograms per cubic meter
AAQS	Ambient Air Quality Standards
AAR	Association of American Railroads
ASOS	Automated Surface Observing System
BLM	Bureau of Land Management
BNSF	BNSF Railway Company
C.F.R.	Code of Federal Regulations
CO	carbon monoxide
CO ₂	carbon dioxide
CO ₂ e	carbon dioxide equivalent
CH ₄	methane
EIS	environmental impact statement
Fed. Reg.	Federal Register
FRA	Federal Railway Administration
g/bhp-hr	grams per brake horsepower-hour
g/cm ³	grams per cubic meter
HC	hydrocarbons
hr	hour
km	kilometer
m ²	square meter
MCA	Montana Code Annotated
mile	mile
mm	millimeters
m/s	meter per second
Montana AAQS	Montana Ambient Air Quality Standards
Montana DEQ	Montana Department of Environmental Quality
MY	model year
N ₂ O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NO ₂	nitrogen dioxide
NO _x	nitrogen oxide
Pb	lead
PM	particulate matter
PM ₁₀	particulate matter ≤ 10 microns
PM _{2.5}	particulate matter ≤ 2.5 microns
ppb	parts per billion
SO ₂	sulfur dioxide
TEOM	tethered elemental oscillating microbalance

ton-mile/gal	ton-mile per gallon
TRR	Tongue River Railroad
TRRC	Tongue River Railroad Company
TSP	total suspended particulates
TSP/km/tonne	total suspended particulates per kilometer per tonne
USEPA	U.S. Environmental Protection Agency
VOC	volatile organic compound
yr	Year

Appendix E

Air Quality, Emissions, and Modeling Data

E.1 Emissions Inventory Data

E.1.1 Locomotive Emissions

This section provides the inputs and emissions calculations used for estimating the BNSF Railway Company (BNSF) locomotive fleet emissions for operating the northern and southern alternatives.¹ The emissions calculations are based on three coal production scenarios—low, medium, and high²—that could be implemented for the proposed Otter Creek Mine and the potentially induced Poker Jim Creek–O’Dell Creek and Canyon Creek Mines. OEA evaluated the locomotive emissions for the initial production year, along with intermediate years 2023 and 2030 and the full build-out scenario of 2037. These analysis years correspond to the years for which OEA modeled coal production and train traffic, as described in Chapter 2, Section 2.3.3.2, *Coal Market Analysis*.³

E.1.1.1 Inputs

General Calculation Method

- Emissions (t/train) = Emission factor (g/bhp-hr) x Activity (bhp-hr/train) x (tons/g conversion). Note that here "activity" is actually in energy units
- Where (Activity [bhp-hr/train]) = Train gross weight (tons) x Route distance (mi) / Fuel efficiency (gross ton-mi/gal diesel) x Fuel energy conversion factor (bhp-hr/gal), and
- Train gross weight = locomotives + cars + coal
- Emissions (t/yr) = Emissions (t/train) x Train volume (trains/yr)
- Where (Train volume [trains/yr]) = Train volume (trains/day) x days/year (365 for continuous mine operation assumed)

¹ The northern alternatives are the Tongue River Alternatives, Colstrip Alternatives, Tongue River Road Alternatives, and Moon Creek Alternatives. The southern alternatives are the Decker Alternatives (Chapter 2, Section 2.1.3, *Alternatives Selected for Detailed Study*).

² Coal production scenarios are discussed in Appendix C, *Coal Production and Markets* and their implications for rail traffic are summarized in Chapter 2, Section 2.3.3, *Rail Traffic*.

³ This appendix provides supporting information for Chapter 4, *Air Quality*, of this *Draft Environmental Impact Statement for the Tongue River Railroad*. This information should not be interpreted as stand-alone information and must be read in combination with the associated chapter.

General Inputs

The general inputs common to each scenario are summarized in Table E.1-1.

Table E.1-1. General Inputs

Description	Value	Unit	Reference/Notes
Weights			
Cars per train	125	cars	TRRC 2013.
Coal per car	118	tons/car	TRRC 2013; Calculated
Maximum gross weight of car	286,000	lb/car	Association of American Railroads (AAR)
or	143	tons	Calculated
Average weight of locomotive	480,000	lb/locomotive	BNSF 2013
or	240	tons/locomotive	Calculated
Number of locomotives per train	4	locomotives/train	TRRC. 2012
Gross weight of loaded train	18,835	tons/train	Calculated
Empty weight of car	25	tons/car	Calculated
Gross weight of unloaded train	4,085	tons/train	Calculated
Number of train trips	2	one-way trips	TRRC 2013
Fuel			
Fuel efficiency	834	gross ton-mi/gal diesel	BNSF 2012a
Fuel energy content conversion factor	20.8	bhp-hr/gal diesel	USEPA 2009
Time			
Weeks in a year	52	weeks	TRRC 2012.
Days in a year	365	days	TRRC 2012
Days in a week	7	days	TRRC 2012
Conversion Factors			
One ton =	907,184.7	grams	USEPA 1985
1 lb =	453.59	grams	USEPA 1985
1 million tons =	1,000,000	tons	USEPA 1985
Terminus Spurs Mileage			Estimated from Figure E-1
Terminus 1 spur	8	miles	
Terminus 1 East spur	9	miles	
Terminus 2 spur	6	miles	
Terminus 2 East spur	4	miles	
TRRC = Tongue River Railroad Company; BNSF = BNSF Railway Company; USEPA = U.S. Environmental Protection Agency; lb/car = pounds per car; lb/locomotive = pounds per locomotive; ton-mile/gal = ton-mile per gallon; bhp-hr/gal = brake horsepower-hour per gallon			

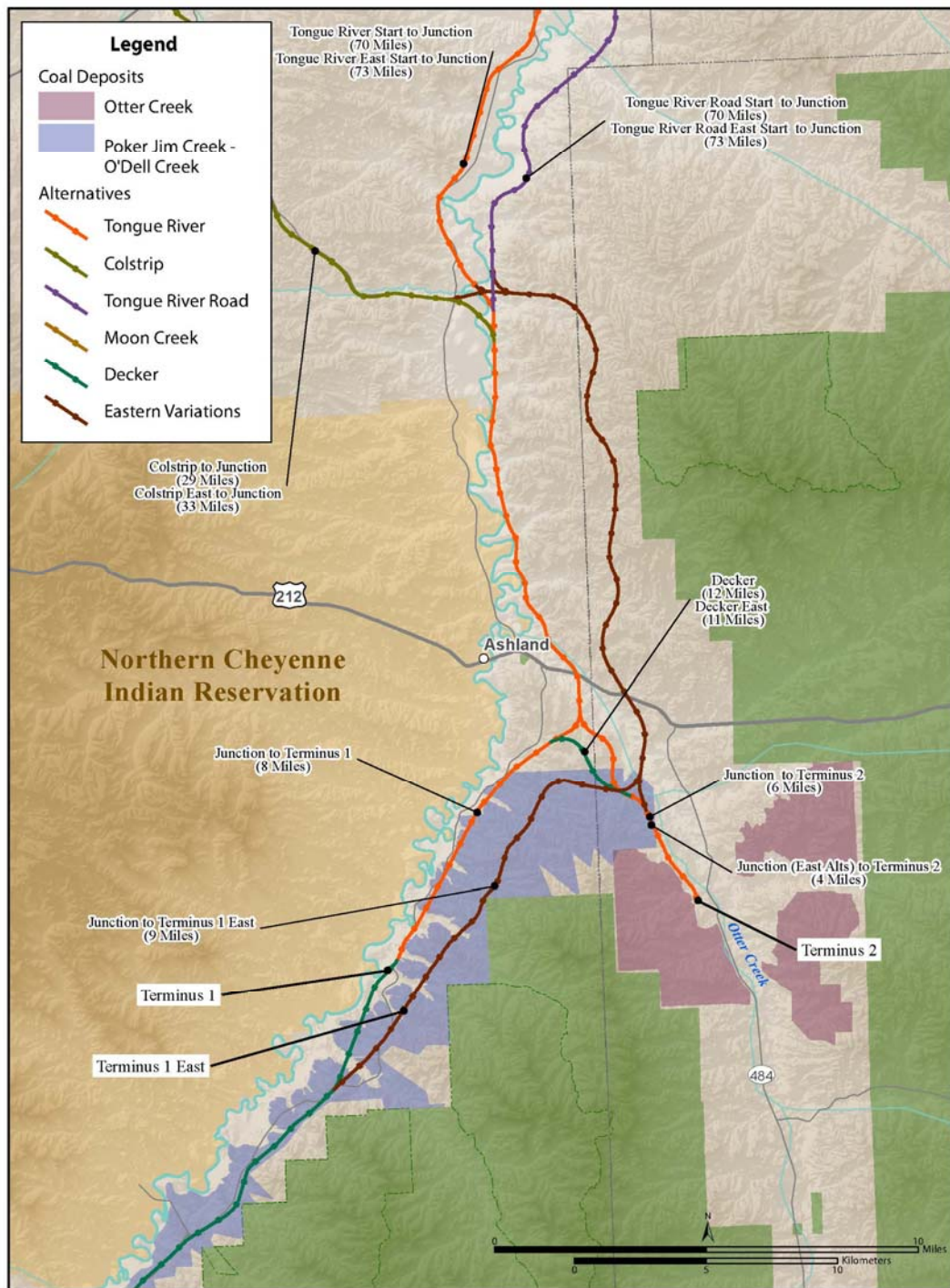


Figure E-1. Air Quality, Northern Alternatives

Trains per Day Calculation Inputs

Tables E.1-2 through E.1-5 show the number of trains per day calculated for the different coal production scenarios (the proposed Otter Creek Mine and the potentially induced Poker Jim Creek–O’Dell Creek and Canyon Creek Mines) as described in Appendix C, *Coal Production and Markets* and Chapter 2, Section 2.3.3, *Rail Traffic*. It assumes that trains operate 365 days per year, with 118 tons per rail car, 125 cars per train for loaded and unloaded trains. Analysis years start in 2017, the estimated first year of operation for the proposed Otter Creek Mine. Tract 2 of the Otter Creek Mine is identified as the first tract to be mined in the Otter Creek mine permit application at 20 million tons/year. Values for the potentially induced Poker Jim Creek–O’Dell Creek Mine are based on maximum production rate as outlined in the 1984 Montco environmental impact statement (EIS). The number of trains is calculated by dividing the annual amount of coal production by the number of days the mine will be in operation in a year (assuming 365). That value is then divided by the amount of tons one coal train car can hold (120 tons as identified in the TRRC application), then dividing that value by the maximum number of train cars per coal train (125 as identified in the TRRC application). An example calculation is as follows:

$$\begin{aligned} &= (20,000,000 \text{ million tons of coal} / 365 \text{ days}) \\ &= (54,794.521 \text{ million tons of coal/day} / 120 \text{ tons per coal train car}) \\ &= (547.95 \text{ cars} / 125 \text{ cars per coal train}) \\ &= 3.65 \text{ trains per day} \end{aligned}$$

Table E.1-2. Northern and Southern Alternatives, Low Production Scenario

Year	Otter Creek (Tract 2)	Number of Trains per day
2017	12,000,000	4.5
2018	16,000,000	5.9
2019	20,000,000	7.4
2020	20,000,000	7.4
2021	20,000,000	7.4
2022	20,000,000	7.4
2023	20,000,000	7.4
2024	20,000,000	7.4
2025	20,000,000	7.4
2026	20,000,000	7.4
2027	20,000,000	7.4
2028	20,000,000	7.4
2029	20,000,000	7.4
2030	20,000,000	7.4
2031	20,000,000	7.4
2032	20,000,000	7.4
2033	20,000,000	7.4
2034	20,000,000	7.4
2035	20,000,000	7.4
2036	20,000,000	7.4
2037	20,000,000	7.4

Table E.1-3. Northern and Southern Alternatives, Medium Production Scenario

Year	Otter Creek (Tract 2)	Number of Trains per day	Poker Jim Creek–O’Dell Creek	Number of Trains per day	Total Number of Trains per day
2017	12,000,000	4.5		0.0	4.5
2018	16,000,000	5.9		0.0	5.9
2019	20,000,000	7.4		0.0	7.4
2020	20,000,000	7.4		0.0	7.4
2021	20,000,000	7.4		0.0	7.4
2022	20,000,000	7.4	7,200,000	2.7	10.1
2023	20,000,000	7.4	9,600,000	3.6	11.0
2024	20,000,000	7.4	12,000,000	4.5	11.9
2025	20,000,000	7.4	12,000,000	4.5	11.9
2026	20,000,000	7.4	12,000,000	4.5	11.9
2027	20,000,000	7.4	12,000,000	4.5	11.9
2028	20,000,000	7.4	12,000,000	4.5	11.9
2029	20,000,000	7.4	12,000,000	4.5	11.9
2030	20,000,000	7.4	12,000,000	4.5	11.9
2031	20,000,000	7.4	12,000,000	4.5	11.9
2032	20,000,000	7.4	12,000,000	4.5	11.9
2033	20,000,000	7.4	12,000,000	4.5	11.9
2034	20,000,000	7.4	12,000,000	4.5	11.9
2035	20,000,000	7.4	12,000,000	4.5	11.9
2036	20,000,000	7.4	12,000,000	4.5	11.9
2037	20,000,000	7.4	12,000,000	4.5	11.9

Table E.1-4. Northern Alternatives, High Production Scenario

Year	Otter Creek (Tract 2)	Number of Trains per day	Poker Jim Creek–O’Dell Creek	Number of Trains per day	Total Number of Trains per day^a
2017	20,400,000	7.6		0.0	7.6
2018	27,200,000	10.1		0.0	10.1
2019	34,000,000	12.6		0.0	12.6
2020	34,000,000	12.6		0.0	12.6
2021	34,000,000	12.6		0.0	12.6
2022	34,000,000	12.6	9,600,000	3.6	16.2
2023	34,000,000	12.6	12,800,000	4.8	17.4
2024	34,000,000	12.6	16,000,000	5.9	18.6
2025	34,000,000	12.6	16,000,000	5.9	18.6
2026	34,000,000	12.6	16,000,000	5.9	18.6
2027	34,000,000	12.6	16,000,000	5.9	18.6
2028	34,000,000	12.6	16,000,000	5.9	18.6
2029	34,000,000	12.6	16,000,000	5.9	18.6
2030	34,000,000	12.6	16,000,000	5.9	18.6
2031	34,000,000	12.6	16,000,000	5.9	18.6
2032	34,000,000	12.6	16,000,000	5.9	18.6
2033	34,000,000	12.6	16,000,000	5.9	18.6
2034	34,000,000	12.6	16,000,000	5.9	18.6
2035	34,000,000	12.6	16,000,000	5.9	17.1
2036	34,000,000	12.6	16,000,000	5.9	17.1
2037	34,000,000	12.6	16,000,000	5.9	17.1

^a Sums have been rounded

Table E.1-5. Southern Alternatives, High Production Scenario

Year	Otter Creek (Tract 2)	Number of Trains per day	Poker-Jim Creek- O'Dell Creek	Number of Trains per day	Canyon Creek	Number of Trains per day	Total Number of Trains per day ^a
2017	20,400,000	7.6		0.0		0.0	7.6
2018	27,200,000	10.1		0.0		0.0	10.1
2019	34,000,000	12.6		0.0		0.0	12.6
2020	34,000,000	12.6		0.0		0.0	12.6
2021	34,000,000	12.6		0.0		0.0	12.6
2022	34,000,000	12.6	9,600,000	3.6		0.0	16.2
2023	34,000,000	12.6	12,800,000	4.8		0.0	17.4
2024	34,000,000	12.6	16,000,000	5.9		0.0	18.6
2025	34,000,000	12.6	16,000,000	5.9		0.0	18.6
2026	34,000,000	12.6	16,000,000	5.9		0.0	18.6
2027	34,000,000	12.6	16,000,000	5.9	13,200,000	4.9	23.5
2028	34,000,000	12.6	16,000,000	5.9	17,600,000	6.5	25.1
2029	34,000,000	12.6	16,000,000	5.9	22,000,000	8.2	26.7
2030	34,000,000	12.6	16,000,000	5.9	22,000,000	8.2	26.7
2031	34,000,000	12.6	16,000,000	5.9	22,000,000	8.2	26.7
2032	34,000,000	12.6	16,000,000	5.9	22,000,000	8.2	26.7
2033	34,000,000	12.6	16,000,000	5.9	22,000,000	8.2	26.7
2034	34,000,000	12.6	16,000,000	5.9	22,000,000	8.2	26.7
2035	34,000,000	12.6	16,000,000	5.9	22,000,000	8.2	26.7
2036	34,000,000	12.6	16,000,000	5.9	22,000,000	8.2	26.7
2037	34,000,000	12.6	16,000,000	5.9	22,000,000	8.2	26.7

^a Sums have been rounded

Locomotive Fleet Inputs

OEA determined locomotive exhaust emissions from U.S. Environmental Protection Agency (USEPA)- recommended exhaust emission rates by tier⁴ for line-haul locomotives for particulate matter, nitrogen oxides (NO_x), carbon monoxide (CO), sulfur dioxide (SO₂) and hydrocarbons (U.S. Environmental Protection Agency 2009a). OEA projected the fraction of the locomotive fleet at each tier level for each analysis year based on BNSF data on its existing fleet and its new locomotive purchases. Using the projected fractions of the BNSF locomotive fleet at each tier, OEA developed weighted emission factors for each analysis year. The USEPA- recommended emission factors in grams per brake horsepower-hour (g/bhp-hr) were converted to a fuel basis (grams per gallon of diesel fuel combusted) using the USEPA-recommended fuel efficiency factor of 20.8 bhp-hr/gallon. OEA calculated fuel

⁴ Tier refers to the EPA emission standards for locomotives (49 C.F.R. Part 1033). The standards range from Tier 0 to Tier 4. The higher the tier number, the more stringent the standard and the later it is phased in.

usage as the train activity in gross ton-miles multiplied by the BNSF-reported fuel efficiency of 834 gross ton-miles per gallon of fuel (BNSF Railway Company 2012). Based on the fleet-weighted emission factors and the fuel usage projected for each year, OEA calculated emissions estimates in tons per year for the initial operation year of 2018, 2023, 2030, and the full build-out year of 2037.

OEA based the projection of the fraction of the BNSF locomotive fleet at each tier level on a breakdown by tier level for BNSF's 2009 fleet as provided to the California Air Resources Board (BNSF Railway Company 2009). The 2009 distribution was "aged" to each analysis year assuming that each year BNSF purchases a certain number of new locomotives and retires the same number of its oldest locomotives (Table E.1-6). As a result, over time the projected number of lower-tier locomotives in BNSF's fleet decreases and the number of higher-tier locomotives increases. In addition, OEA used the following assumptions for the fleet projection.

- The total number of line-haul locomotives in the BNSF fleet is assumed to remain the same for all analysis years.
- All new locomotives that BNSF purchases are used in line-haul (not switching) service.
- The existing Tier 2 locomotives are evenly distributed by model year (MY) (2005–2011).
- Tier 0-1 locomotives are evenly distributed by model years (MY 2004 and earlier).
- Each year the oldest model year of locomotives is retired from the line-haul fleet.
- The number of Tier 2 locomotives in 2013 is assumed to be 170 for each model year (rather than the assumption of 150 in Table E.1-6) so that the total number of Tier 2 locomotives will match the BNSF (2013) value of 1,300.
- New locomotives that BNSF buys in 2013 and 2014 will comply with the Tier 3 emission standard.
- New locomotives that BNSF buys after 2014 will comply with the Tier 4 emission standard.

In 2008, USEPA tightened the emissions standards that older locomotives must meet when they are remanufactured. USEPA indicates these tightened standards with a plus sign after the tier number. Tier 0–2 locomotives that were remanufactured in 2008 or later must meet Tier 0+ – 2+ (73 *Federal Register* [Fed. Reg.] 37096; 40 Code of Federal Regulations [C.F.R.] Part 1033). For example, given BNSF's 6-year interval for remanufacturing (Table E.1-6), in the 2013 fleet the Tier 0 – 2 locomotives of MY 2007 or older would have been remanufactured by 2013 and must meet the Tier 0+ – 2+ standards.

Table E.1-6. BNSF Locomotive Fleet Distribution Assumptions

Description	Value	Unit	Reference/Notes
Locomotives in BNSF existing fleet			
Total all locomotives (approx.)	6,600	locomotives	BNSF 2013.
Total road (line-haul) locomotives (approx.)	4,600	locomotives	BNSF 2013. For calculation purposes, this approximate value was set to 4,650.
GE Evolution Tier 2 locomotives (approx.)	1,300	locomotives	BNSF 2013.
Interval between "major overhauls"	6	years	BNSF 2013. "Major overhaul" is assumed the same as remanufacturing (as defined in USEPA emission standards).
Assumptions for deriving fleet for future years			
Locomotive replacement rate (purchased new)	150	locomotives/year	"150–350" (BNSF 2013). The lower end of the range (150) was used because this results in a conservative (higher emitting) projected fleet.
BNSF = BNSF Railway Company; USEPA = U.S. Environmental Protection Agency			

Based on the assumptions above, Table E.1-7 shows the projected distribution of locomotives by USEPA Tier level for each analysis year.

Table E.1-7. Projected Fraction of Locomotives by USEPA Tier Level for Each Analysis Year

Analysis Year	Tier 0 ^a	Tier 0+	Tier 1	Tier 1+	Tier 2	Tier 2+	Tier 3	Tier 4
2009 (BNSF reported)	0.000	0.516	0.000	0.129	0.065	0.290	0.000	0.000
2013	0.000	0.301	0.000	0.355	0.183	0.129	0.032	0.000
2018	0.000	0.140	0.000	0.355	0.183	0.129	0.065	0.129
2023	0.000	0.000	0.000	0.333	0.183	0.129	0.065	0.290
2030	0.000	0.000	0.000	0.108	0.183	0.129	0.065	0.516
2037	0.000	0.000	0.000	0.000	0.183	0.011	0.065	0.742
Notes:								
^a Tier refers to the USEPA emission standards for locomotives (49 C.F.R. Part 1033). The standards range from Tier 0 to Tier 4. The higher the tier number, the more stringent the standard and the later it is phased in.								
Values in each row may not sum to 1.000 because of rounding								

Table E.1-8 shows the emissions factors by pollutant and year. Tables E.1-9 through E.1-14 show the line haul locomotive distribution by tier, for the various analysis years.

Table E.1-8. Emission Factors by Pollutant and Year, Weighted by Projected Tier Distribution in BNSF Locomotive Fleet

Criteria Pollutants (g/bhp-hr)	2018	2023	2030	2037
CO	1.28	1.28	1.28	1.28
NO _x	5.38	4.39	3.10	2.02
PM ₁₀	0.15	0.12	0.08	0.05
PM _{2.5}	0.14	0.12	0.08	0.05
SO ₂	0.005	0.005	0.005	0.005
VOCs	0.26	0.19	0.13	0.09
Hazardous Pollutants (g/bhp-hr)				
Acetaldehyde	0.000067	0.000054	0.000035	0.000022
Acrolein	0.000013	0.000010	0.000007	0.000004
Benzene	0.000008	0.000006	0.000004	0.000003
1,3-Butadiene	0.000009	0.000007	0.000005	0.000003
Ethylbenzene	0.000469	0.000381	0.000262	0.000183
Formaldehyde	0.000141	0.000113	0.000073	0.000047
n-Hexane	0.001290	0.001048	0.000721	0.000504
Lead	0.000013	0.000010	0.000007	0.000004
Toluene	0.000750	0.000610	0.000420	0.000293
Xylene	0.001184	0.001047	0.000864	0.000777
Greenhouse Gases (g/bhp-hr)				
CO ₂	493.13	493.13	493.13	493.13
CH ₄	0.038	0.038	0.038	0.038
N ₂ O	0.0123	0.0123	0.0123	0.0123

Table E.1-9. Line Haul Locomotive Distribution by Emissions Tier – Analysis Year 2009

Locomotive Model Year	Number of Locomotives	Cumulative Number of Locomotives	Tier
2009	150	150	2
2008	150	300	2
2007	150	450	2+
2006	150	600	2+
2005	150	750	2+
2004	150	900	2+
2003	150	1,050	2+
2002	150	1,200	2+
2001	150	1,350	2+
2000	150	1,500	2+
1999	150	1,650	2+
1998	150	1,800	1+
1997	150	1,950	1+
1996	150	2,100	1+
1995	150	2,250	1+
1994	150	2,400	0+
1993	150	2,550	0+
1992	150	2,700	0+
1991	150	2,850	0+
1990	150	3,000	0+
1989	150	3,150	0+
1988	150	3,300	0+
1987	150	3,450	0+
1986	150	3,600	0+
1985	150	3,750	0+
1984	150	3,900	0+
1983	150	4,050	0+
1982	150	4,200	0+
1981	150	4,350	0+
1980	150	4,500	0+
1979	150	4,650	0+
Sum	4,650		

Fleet Distribution by Tier in Calendar Year 2009		
Tier	Number of Locomotives	Fraction of Locomotives
4	0	0.000
3	0	0.000
2+	1,350	0.290
2	300	0.065
1+	600	0.129
1	0	0.000

0+	2,400	0.516
0	0	0.000
Uncontrolled	0	0.000
All	4,650	1.000

Table E.1-10. Line Haul Locomotive Distribution by Emissions Tier – Analysis Year 2013

Locomotive Model Year		Cumulative Number of Locomotives	Tier
2013	150	150	3
2012	170	320	2
2011	170	490	2
2010	170	660	2
2009	170	830	2
2008	170	1,000	2
2007	150	1,150	2+
2006	150	1,300	2+
2005	150	1,450	2+
2004	150	1,600	2+
2003	150	1,750	1+
2002	150	1,900	1+
2001	150	2,050	1+
2000	150	2,200	1+
1999	150	2,350	1+
1998	150	2,500	1+
1997	150	2,650	1+
1996	150	2,800	1+
1995	150	2,950	1+
1994	150	3,100	1+
1993	150	3,250	1+
1992	150	3,400	0+
1991	150	3,550	0+
1990	150	3,700	0+
1989	150	3,850	0+
1988	150	4,000	0+
1987	150	4,150	0+
1986	150	4,300	0+
1985	150	4,450	0+
1984	150	4,600	0+
1983	50	4,650	0+
1982	0	4,650	0+
1981	0	4,650	0+
1980	0	4,650	0+
1979	0	4,650	0+

Sum	4,650	
Fleet Distribution by Tier in Calendar Year 2013		
Tier	Number of Locomotives	Fraction of Locomotives
4	0	0.000
3	150	0.032
2+	600	0.129
2	850	0.183
1+	1,650	0.355
1	0	0.000
0+	1,400	0.301
0	0	0.000
Uncontrolled	0	0.000
All	4,650	1.000

Table E.1-11. Line Haul Locomotive Distribution by Emissions Tier – Analysis Year 2018

Locomotive Model Year	Number of Locomotives	Cumulative Number of Locomotives	Tier
2018	150	150	4
2017	150	300	4
2016	150	450	4
2015	150	600	4
2014	150	750	3
2013	150	900	3
2012	170	1,070	2
2011	170	1,240	2
2010	170	1,410	2
2009	170	1,580	2
2008	170	1,750	2
2007	150	1,900	2+
2006	150	2,050	2+
2005	150	2,200	2+
2004	150	2,350	2+
2003	150	2,500	1+
2002	150	2,650	1+
2001	150	2,800	1+
2000	150	2,950	1+
1999	150	3,100	1+
1998	150	3,250	1+
1997	150	3,400	1+
1996	150	3,550	1+
1995	150	3,700	1+
1994	150	3,850	1+
1993	150	4,000	1+
1992	150	4,150	0+
1991	150	4,300	0+
1990	150	4,450	0+
1989	150	4,600	0+
1988	50	4,650	0+
1987	0	4,650	0+
1986	0	4,650	0+
1985	0	4,650	0+
1984	0	4,650	0+
1983	0	4,650	0+
1982	0	4,650	0+
1981	0	4,650	0+

Locomotive Model Year	Number of Locomotives	Cumulative Number of Locomotives	Tier
1980	0	4,650	0+
1979	0	4,650	0+
Sum	4,650		
Fleet Distribution by Tier in Calendar Year 2018			
Tier	Number of Locomotives	Fraction of Locomotives	
4	600	0.129	
3	300	0.065	
2+	600	0.129	
2	850	0.183	
1+	1,650	0.355	
1	0	0.000	
0+	650	0.140	
0	0	0.000	
Uncontrolled	0	0.000	
All	4,650	1.000	

Table E.1-12. Line Haul Locomotive Distribution by Emissions Tier – Analysis Year 2023

Locomotive Model Year	Number of Locomotives	Cumulative Number of Locomotives	Tier
2023	150	150	4
2022	150	300	4
2021	150	450	4
2020	150	600	4
2019	150	750	4
2018	150	900	4
2017	150	1,050	4
2016	150	1,200	4
2015	150	1,350	4
2014	150	1,500	3
2013	150	1,650	3
2012	170	1,820	2
2011	170	1,990	2
2010	170	2,160	2
2009	170	2,330	2
2008	170	2,500	2
2007	150	2,650	2+
2006	150	2,800	2+
2005	150	2,950	2+
2004	150	3,100	2+
2003	150	3,250	1+
2002	150	3,400	1+
2001	150	3,550	1+
2000	150	3,700	1+
1999	150	3,850	1+
1998	150	4,000	1+
1997	150	4,150	1+
1996	150	4,300	1+
1995	150	4,450	1+
1994	150	4,600	1+
1993	50	4,650	1+
1992	0	4,650	0+
1991	0	4,650	0+
1990	0	4,650	0+
1989	0	4,650	0+
1988	0	4,650	0+
1987	0	4,650	0+
1986	0	4,650	0+

Locomotive Model Year	Number of Locomotives	Cumulative Number of Locomotives	Tier
1985	0	4,650	0+
1984	0	4,650	0+
1983	0	4,650	0+
1982	0	4,650	0+
1981	0	4,650	0+
1980	0	4,650	0+
1979	0	4,650	0+
Sum	4,650		
Fleet Distribution by Tier in Calendar Year 2023			
Tier	Number of Locomotives	Fraction of Locomotives	
4	1,350	0.290	
3	300	0.065	
2+	600	0.129	
2	850	0.183	
1+	1,550	0.333	
1	0	0.000	
0+	0	0.000	
0	0	0.000	
Uncontrolled	0	0.000	
All	4,650	1.000	

Table E.1-13. Line Haul Locomotive Distribution by Emissions Tier – Analysis Year 2030

Locomotive Model Year	Number of Locomotives	Cumulative Number of Locomotives	Tier
2030	150	150	4
2029	150	300	4
2028	150	450	4
2027	150	600	4
2026	150	750	4
2025	150	900	4
2024	150	1,050	4
2023	150	1,200	4
2022	150	1,350	4
2021	150	1,500	4
2020	150	1,650	4
2019	150	1,800	4
2018	150	1,950	4
2017	150	2,100	4
2016	150	2,250	4

Locomotive Model Year	Number of Locomotives	Cumulative Number of Locomotives	Tier
2015	150	2,400	4
2014	150	2,550	3
2013	150	2,700	3
2012	170	2,870	2
2011	170	3,040	2
2010	170	3,210	2
2009	170	3,380	2
2008	170	3,550	2
2007	150	3,700	2+
2006	150	3,850	2+
2005	150	4,000	2+
2004	150	4,150	2+
2003	150	4,300	1+
2002	150	4,450	1+
2001	150	4,600	1+
2000	50	4,650	1+
1999	0	4,650	1+
1998	0	4,650	1+
1997	0	4,650	1+
1996	0	4,650	1+
1995	0	4,650	1+
1994	0	4,650	1+
1993	0	4,650	1+
1992	0	4,650	0+
1991	0	4,650	0+
1990	0	4,650	0+
1989	0	4,650	0+
1988	0	4,650	0+
1987	0	4,650	0+
1986	0	4,650	0+
1985	0	4,650	0+
1984	0	4,650	0+
1983	0	4,650	0+
1982	0	4,650	0+
1981	0	4,650	0+
1980	0	4,650	0+
1979	0	4,650	0+
Sum	4,650		
Fleet Distribution by Tier in Calendar Year 2030			

Locomotive Model Year	Number of Locomotives	Cumulative Number of Locomotives	Tier
Tier	Number of Locomotives	Fraction of Locomotives	
4	2,400	0.516	
3	300	0.065	
2+	600	0.129	
2	850	0.183	
1+	500	0.108	
1	0	0.000	
0+	0	0.000	
0	0	0.000	
Uncontrolled	0	0.000	
All	4,650	1.000	

Table E.1-14. Line Haul Locomotive Distribution by Emissions Tier – Analysis Year 2037

Locomotive Model Year	Number of Locomotives	Cumulative Number of Locomotives	Tier
2037	150	150	4
2036	150	300	4
2035	150	450	4
2034	150	600	4
2033	150	750	4
2032	150	900	4
2031	150	1,050	4
2030	150	1,200	4
2029	150	1,350	4
2028	150	1,500	4
2027	150	1,650	4
2026	150	1,800	4
2025	150	1,950	4
2024	150	2,100	4
2023	150	2,250	4
2022	150	2,400	4
2021	150	2,550	4
2020	150	2,700	4
2019	150	2,850	4
2018	150	3,000	4
2017	150	3,150	4
2016	150	3,300	4
2015	150	3,450	4
2014	150	3,600	3
2013	150	3,750	3
2012	170	3,920	2
2011	170	4,090	2
2010	170	4,260	2
2009	170	4,430	2
2008	170	4,600	2
2007	50	4,650	2+
2006	0	4,650	2+
2005	0	4,650	2+
2004	0	4,650	2+
2003	0	4,650	1+
2002	0	4,650	1+
2001	0	4,650	1+
2000	0	4,650	1+

Locomotive Model Year	Number of Locomotives	Cumulative Number of Locomotives	Tier
1999	0	4,650	1+
1998	0	4,650	1+
1997	0	4,650	1+
1996	0	4,650	1+
1995	0	4,650	1+
1994	0	4,650	1+
1993	0	4,650	1+
1992	0	4,650	0+
1991	0	4,650	0+
1990	0	4,650	0+
1989	0	4,650	0+
1988	0	4,650	0+
1987	0	4,650	0+
1986	0	4,650	0+
1985	0	4,650	0+
1984	0	4,650	0+
1983	0	4,650	0+
1982	0	4,650	0+
1981	0	4,650	0+
1980	0	4,650	0+
1979	0	4,650	0+
Sum	4,650		
Fleet Distribution by Tier in Calendar Year 2037			
Tier	Number of Locomotives	Fraction of Locomotives	
4	3,450	0.742	
3	300	0.065	
2+	50	0.011	
2	850	0.183	
1+	0	0.000	
1	0	0.000	
0+	0	0.000	
0	0	0.000	
Uncontrolled	0	0.000	
All	4,650	1.000	

E.1.1.2 Emission Calculations

Each group of build alternatives (northern and southern) and each coal production scenario (low, medium, and high) is represented in a table that presents the estimated annual average emissions in tons per year, coupled with tables showing train activity calculations. These calculations are based on the number of trains per day and show the overall mileage and fuel consumption for both loaded and unloaded trains (Tables E.1-15 through E.1-41). The tables show data for 2037, the year in which production reaches the highest levels (production is constant after 2019 with the low production scenario). Tables show additional tables data for 2030 because this is the year in which NO_x emissions would be highest, and based on dispersion modeling (Section E.3.3, *Development of Meteorology*), NO₂ is the only pollutant for which meeting the National Ambient Air Quality Standards (NAAQS) would be a concern.

Table E.1-15. Estimated Annual Average Operational Emissions of the Tongue River Railroad: Northern Alternatives, Low Production Scenario

Pollutants	Build Alternatives							
	Tongue River	Tongue River East	Tongue River Road	Tongue River Road East	Moon Creek	Moon Creek East	Colstrip	Colstrip East
Criteria Pollutants (tons/year)								
CO	82.79	84.54	82.79	84.10	81.04	83.11	69.99	72.29
NO _x	130.61	133.37	130.61	132.68	127.85	131.12	110.42	114.04
PM ₁₀	3.24	3.31	3.24	3.29	3.17	3.25	2.74	2.83
PM _{2.5}	3.14	3.21	3.14	3.19	3.07	3.15	2.65	2.74
SO ₂	0.30	0.30	0.30	0.30	0.29	0.30	0.25	0.26
VOCs	5.92	6.05	5.92	6.02	5.80	5.95	5.01	5.17
Hazardous Pollutants (tons/year)								
Acetaldehyde	0.00145	0.00148	0.00145	0.00148	0.00142	0.00146	0.00123	0.00127
Acrolein	0.00028	0.00028	0.00028	0.00028	0.00027	0.00028	0.00023	0.00024
Benzene	0.00017	0.00017	0.00017	0.00017	0.00016	0.00017	0.00014	0.00015
1,3-Butadiene	0.00020	0.00020	0.00020	0.00020	0.00019	0.00020	0.00017	0.00017
Ethylbenzene	0.01185	0.01210	0.01185	0.01204	0.01160	0.01190	0.01002	0.01035
Formaldehyde	0.00306	0.00312	0.00306	0.00311	0.00299	0.00307	0.00259	0.00267
n-Hexane	0.03258	0.03327	0.03258	0.03310	0.03190	0.03271	0.02755	0.02845
Lead	0.00027	0.00028	0.00027	0.00028	0.00027	0.00027	0.00023	0.00024
Toluene	0.01896	0.01936	0.01896	0.01926	0.01856	0.01903	0.01603	0.01655
Xylene	0.05027	0.05133	0.05027	0.05106	0.04920	0.05047	0.04250	0.04389
Greenhouse Gases (tons/year)								
CO ₂	31,894.12	32,568.24	31,894.12	32,399.71	31,220.01	32,020.52	26,964.65	27,849.43
CH ₄	2.48	2.53	2.48	2.52	2.43	2.49	2.10	2.17
N ₂ O	0.79	0.81	0.79	0.81	0.78	0.80	0.67	0.69
CO ₂ e	32,192.78	32,873.21	32,192.78	32,703.10	31,512.35	32,320.36	27,217.15	28,110.21

Assumptions:

Analysis year: 2037

Trains per day—Otter Creek: 7.4

Total trains per day: 7.4

Table E.1-16. Northern Alternatives, Low Production Scenario, Train Activity Calculation

Build Alternatives	Train (Moving)	One- Way Trips/Day	Train Miles/Day	Ton- Miles/Day	Fuel Consumption (gal/day)	Work (bhp-hr/day)
Tongue River	Loaded	3.71	281.2166241	5,296,715	6,351.0	132,100.3
Tongue River	Unloaded	3.71	281.2166241	1,148,770	1,377.4	28,650.4
Tongue River East	Loaded	3.71	287.1604365	5,408,667	6,485.2	134,892.4
Tongue River East	Unloaded	3.71	287.1604365	1,173,050	1,406.5	29,255.9
Tongue River Road	Loaded	3.71	281.2166241	5,296,715	6,351.0	132,100.3
Tongue River Road	Unloaded	3.71	281.2166241	1,148,770	1,377.4	28,650.4
Tongue River Road East	Loaded	3.71	285.6744834	5,380,679	6,451.7	134,194.4
Tongue River Road East	Unloaded	3.71	285.6744834	1,166,980	1,399.3	29,104.5
Moon Creek	Loaded	3.71	275.2728117	5,184,763	6,216.7	129,308.2
Moon Creek	Unloaded	3.71	275.2728117	1,124,489	1,348.3	28,044.8
Moon Creek East	Loaded	3.71	281.2166241	5,296,715	6,351.0	132,100.3
Moon Creek East	Unloaded	3.71	281.2166241	1,148,770	1,377.4	28,650.4
Colstrip	Loaded	3.71	237.7524959	4,478,068	5,369.4	111,683.2
Colstrip	Unloaded	3.71	237.7524959	971,219	1,164.5	24,222.2
Colstrip East	Loaded	3.71	245.5537497	4,625,005	5,545.6	115,347.8
Colstrip East	Unloaded	3.71	245.5537497	1,003,087	1,202.7	25,017.0

Table E.1-17. Estimated Annual Average Operational Emissions of the Tongue River Railroad: Northern Alternatives, Medium Production Scenario

Pollutants	Build Alternatives							
	Tongue River	Tongue River East	Tongue River Road	Tongue River Road East	Moon Creek	Moon Creek East	Colstrip	Colstrip East
Criteria Pollutants (tons/year)								
CO	133.77	138.54	134.16	137.84	130.97	135.74	113.30	118.94
NO _x	211.04	218.56	211.65	217.46	206.62	214.15	178.74	187.64
PM ₁₀	5.23	5.42	5.25	5.39	5.12	5.31	4.43	4.65
PM _{2.5}	5.07	5.25	5.09	5.23	4.97	5.15	4.30	4.51
SO ₂	0.48	0.50	0.48	0.50	0.47	0.49	0.41	0.43
VOCs	9.57	9.91	9.60	9.86	9.37	9.71	8.11	8.51
Hazardous Pollutants (tons/year)								
Acetaldehyde	0.00235	0.00243	0.00236	0.00242	0.00230	0.00238	0.00199	0.00209
Acrolein	0.00045	0.00046	0.00045	0.00046	0.00044	0.00045	0.00038	0.00040
Benzene	0.00027	0.00028	0.00027	0.00028	0.00026	0.00027	0.00023	0.00024
1,3-Butadiene	0.00032	0.00033	0.00032	0.00033	0.00031	0.00033	0.00027	0.00029
Ethylbenzene	0.01915	0.01983	0.01920	0.01973	0.01875	0.01943	0.01622	0.01702
Formaldehyde	0.00494	0.00512	0.00496	0.00509	0.00484	0.00502	0.00419	0.00440
n-Hexane	0.05265	0.05453	0.05280	0.05425	0.05155	0.05343	0.04459	0.04681
Lead	0.00044	0.00046	0.00044	0.00045	0.00043	0.00045	0.00037	0.00039
Toluene	0.03063	0.03173	0.03072	0.03157	0.02999	0.03108	0.02595	0.02724
Xylene	0.08122	0.08412	0.08146	0.08369	0.07952	0.08242	0.06879	0.07222
Greenhouse Gases (tons/year)								
CO ₂	51,536.18	53,373.15	51,685.23	53,103.50	50,457.60	52,294.57	43,649.02	45,823.05
CH ₄	4.01	4.15	4.02	4.13	3.93	4.07	3.40	3.57
N ₂ O	1.28	1.33	1.29	1.32	1.26	1.30	1.09	1.14
CO ₂ e	52,018.77	53,872.94	52,169.21	53,600.77	50,930.08	52,784.25	44,057.75	46,252.14

Assumptions:

Analysis year: 2037

Trains per day—Otter Creek: 7.4

Trains per day—Poker Jim Creek—O'Dell Creek: 4.5

Total trains per day: 11.9

Table E.1-18. Northern Alternatives, Medium Production Scenario, Otter Creek Mine, Train Activity Calculation

Build Alternatives	Train (Moving)	One- Way Trips/Day	Train Miles/Day	Ton-Miles/Day	Fuel Consump (gal/day)	Work (bhp-hr/day)
Tongue River	Loaded	3.71	281.2166241	5,296,715	6,351.0	132,100.3
Tongue River	Unloaded	3.71	281.2166241	1,148,770	1,377.4	28,650.4
Tongue River East	Loaded	3.71	287.1604365	5,408,667	6,485.2	134,892.4
Tongue River East	Unloaded	3.71	287.1604365	1,173,050	1,406.5	29,255.9
Tongue River Road	Loaded	3.71	281.2166241	5,296,715	6,351.0	132,100.3
Tongue River Road	Unloaded	3.71	281.2166241	1,148,770	1,377.4	28,650.4
Tongue River Road East	Loaded	3.71	285.6744834	5,380,679	6,451.7	134,194.4
Tongue River Road East	Unloaded	3.71	285.6744834	1,166,980	1,399.3	29,104.5
Moon Creek	Loaded	3.71	275.2728117	5,184,763	6,216.7	129,308.2
Moon Creek	Unloaded	3.71	275.2728117	1,124,489	1,348.3	28,044.8
Moon Creek East	Loaded	3.71	281.2166241	5,296,715	6,351.0	132,100.3
Moon Creek East	Unloaded	3.71	281.2166241	1,148,770	1,377.4	28,650.4
Colstrip	Loaded	3.71	237.7524959	4,478,068	5,369.4	111,683.2
Colstrip	Unloaded	3.71	237.7524959	971,219	1,164.5	24,222.2
Colstrip East	Loaded	3.71	245.5537497	4,625,005	5,545.6	115,347.8
Colstrip East	Unloaded	3.71	245.5537497	1,003,087	1,202.7	25,017.0

Table E.1-19. Northern Alternatives, Medium Production Scenario, Potentially Induced Poker Jim Creek–O’Dell Creek Mine, Train Activity Calculation

Build Alternatives	Train (Moving)	One- Way Trips/Day	Train Miles/Day	Ton-Miles/Day	Fuel Consump (gal/day)	Work (bhp-hr/day)
Tongue River	Loaded	2.23	173.1878338	3,261,993	3,911.3	81,354.3
Tongue River	Unloaded	2.23	173.1878338	707,472	848.3	17,644.4
Tongue River East	Loaded	2.23	183.4409101	3,455,110	4,142.8	86,170.6
Tongue River East	Unloaded	2.23	183.4409101	749,356	898.5	18,689.0
Tongue River Road	Loaded	2.23	173.1878338	3,261,993	3,911.3	81,354.3
Tongue River Road	Unloaded	2.23	180.5614117	737,593	884.4	18,395.6
Tongue River Road East	Loaded	2.23	182.5493383	3,438,317	4,122.7	85,751.8
Tongue River Road East	Unloaded	2.23	182.5493383	745,714	894.1	18,598.1
Moon Creek	Loaded	2.23	169.6215463	3,194,822	3,830.7	79,679.0
Moon Creek	Unloaded	2.23	169.6215463	692,904	830.8	17,281.1
Moon Creek East	Loaded	2.23	179.8746227	3,387,939	4,062.3	84,495.3
Moon Creek East	Unloaded	2.23	179.8746227	734,788	881.0	18,325.6
Colstrip	Loaded	2.23	147.1093569	2,770,805	3,322.3	69,104.0
Colstrip	Unloaded	2.23	147.1093569	600,942	720.6	14,987.5
Colstrip East	Loaded	2.23	158.4768981	2,984,912	3,579.0	74,443.9
Colstrip East	Unloaded	2.23	158.4768981	647,378	776.2	16,145.6

Table E.1-20. Estimated Annual Average Operational Emissions of the Tongue River Railroad: Northern Alternatives, High Production Scenario

Pollutants	Build Alternatives							
	Tongue River	Tongue River East	Tongue River Road	Tongue River Road East	Moon Creek	Moon Creek East	Colstrip	Colstrip East
Criteria Pollutants (tons/year)								
CO	208.72	215.72	208.72	214.62	204.34	211.34	176.73	185.09
NO _x	329.28	340.32	329.28	338.59	322.37	333.42	278.81	292.01
PM ₁₀	8.16	8.44	8.16	8.39	7.99	8.26	6.91	7.24
PM _{2.5}	7.92	8.18	7.92	8.14	7.75	8.02	6.70	7.02
SO ₂	0.75	0.78	0.75	0.77	0.74	0.76	0.64	0.67
VOCs	14.94	15.44	14.94	15.36	14.62	15.12	12.65	13.25
Hazardous Pollutants (tons/year)								
Acetaldehyde	0.00367	0.00379	0.00367	0.00377	0.00359	0.00371	0.00310	0.00325
Acrolein	0.00070	0.00072	0.00070	0.00072	0.00068	0.00071	0.00059	0.00062
Benzene	0.00042	0.00044	0.00042	0.00043	0.00041	0.00043	0.00036	0.00037
1,3-Butadiene	0.00050	0.00052	0.00050	0.00052	0.00049	0.00051	0.00043	0.00045
Ethylbenzene	0.02987	0.03087	0.02987	0.03072	0.02925	0.03025	0.02529	0.02649
Formaldehyde	0.00771	0.00797	0.00771	0.00793	0.00755	0.00781	0.00653	0.00684
n-Hexane	0.08215	0.08490	0.08215	0.08447	0.08043	0.08318	0.06956	0.07285
Lead	0.00069	0.00071	0.00069	0.00070	0.00067	0.00069	0.00058	0.00061
Toluene	0.04780	0.04940	0.04780	0.04915	0.04679	0.04840	0.04047	0.04239
Xylene	0.12673	0.13098	0.12673	0.13031	0.12407	0.12832	0.10730	0.11238
Greenhouse Gases (tons/year)								
CO ₂	80,409.42	83,105.89	80,409.42	82,684.57	78,724.13	81,420.60	68,085.74	71,308.86
CH ₄	6.26	6.47	6.26	6.43	6.12	6.33	5.30	5.55
N ₂ O	2.00	2.07	2.00	2.06	1.96	2.03	1.70	1.78
CO ₂ e	81,162.38	83,884.09	81,162.38	83,458.82	79,461.31	82,183.02	68,723.29	71,976.59
Assumptions:								
Analysis year: 2037								
Trains per day—Otter Creek: 12.6								
Trains per day—Poker Jim Creek–O’Dell Creek: 5.9								
Total trains per day: 18.6								

Table E.1-21. Northern Alternatives, High Production Scenario, Otter Creek Mine, Train Activity Calculation

Build Alternatives	Train (Moving)	One- Way Trips/Day	Train Miles/Day	Ton-Miles/Day	Fuel Consumption (gal/day)	Work (bhp-hr/day)
Tongue River	Loaded	6.32	478.068261	9,004,416	10,796.7	224,570.6
Tongue River	Unloaded	6.32	478.068261	1,952,909	2,341.6	48,705.6
Tongue River East	Loaded	6.32	488.172742	9,194,734	11,024.9	229,317.1
Tongue River East	Unloaded	6.32	488.172742	1,994,186	2,391.1	49,735.1

Build Alternatives	Train (Moving)	One- Way Trips/Day	Train Miles/Day	Ton- Miles/Day	Fuel Consumption (gal/day)	Work (bhp-hr/day)
Tongue River Road	Loaded	6.32	478.068261	9,004,416	10,796.7	224,570.6
Tongue River Road	Unloaded	6.32	478.068261	1,952,909	2,341.6	48,705.6
Tongue River Road East	Loaded	6.32	485.6466218	9,147,154	10,967.8	228,130.5
Tongue River Road East	Unloaded	6.32	485.6466218	1,983,866	2,378.7	49,477.7
Moon Creek	Loaded	6.32	467.9637799	8,814,098	10,568.5	219,824.0
Moon Creek	Unloaded	6.32	467.9637799	1,911,632	2,292.1	47,676.2
Moon Creek East	Loaded	6.32	478.068261	9,004,416	10,796.7	224,570.6
Moon Creek East	Unloaded	6.32	478.068261	1,952,909	2,341.6	48,705.6
Colstrip	Loaded	6.32	404.1792431	7,612,716	9,128.0	189,861.5
Colstrip	Unloaded	6.32	404.1792431	1,651,072	1,979.7	41,177.8
Colstrip East	Loaded	6.32	417.4413745	7,862,508	9,427.5	196,091.3
Colstrip East	Unloaded	6.32	417.4413745	1,705,248	2,044.7	42,529.0

Table E.1-22. Northern Alternatives, High Production Scenario, Potentially Induced Poker Jim Creek–O'Dell Creek Mine, Train Activity Calculation

Build Alternatives	Train (Moving)	One- Way Trips/Day	Train Miles/Day	Ton- Miles/Day	Fuel Consumption (gal/day)	Work (bhp-hr/day)
Tongue River	Loaded	2.97	230.9171117	4,349,324	5,215.0	108,472.3
Tongue River	Unloaded	2.97	230.9171117	943,296	1,131.1	23,525.9
Tongue River East	Loaded	2.97	244.5878802	4,606,813	5,523.8	114,894.1
Tongue River East	Unloaded	2.97	244.5878802	999,141	1,198.0	24,918.6
Tongue River Road	Loaded	2.97	230.9171117	4,349,324	5,215.0	108,472.3
Tongue River Road	Unloaded	2.97	230.9171117	943,296	1,131.1	23,525.9
Tongue River Road East	Loaded	2.97	243.3991177	4,584,422	5,496.9	114,335.7
Tongue River Road East	Unloaded	2.97	243.3991177	994,285	1,192.2	24,797.5
Moon Creek	Loaded	2.97	226.1620618	4,259,762	5,107.6	106,238.7
Moon Creek	Unloaded	2.97	226.1620618	923,872	1,107.8	23,041.4
Moon Creek East	Loaded	2.97	239.8328303	4,517,251	5,416.4	112,660.5
Moon Creek East	Unloaded	2.97	239.8328303	979,717	1,174.7	24,434.2
Colstrip	Loaded	2.97	196.1458091	3,694,406	4,429.7	92,138.7
Colstrip	Unloaded	2.97	196.1458091	801,256	960.7	19,983.4
Colstrip East	Loaded	2.97	211.3025308	3,979,883	4,772.0	99,258.5
Colstrip East	Unloaded	2.97	211.3025308	863,171	1,035.0	21,527.5

Table E.1-23. Estimated Annual Average Operational Emissions of the Tongue River Railroad: Southern Alternatives, Low Production Scenario

Pollutants	Build Alternatives	
	Decker	Decker East

Criteria Pollutants (tons/year)		
CO	55.88	54.24
NO _x	88.16	85.58
PM ₁₀	2.19	2.12
PM _{2.5}	2.12	2.06
SO ₂	0.20	0.20
VOCs	4.00	3.88
Hazardous Pollutants (tons/year)		
Acetaldehyde	0.00098	0.00095
Acrolein	0.00019	0.00018
Benzene	0.00011	0.00011
1,3-Butadiene	0.00013	0.00013
Ethylbenzene	0.00800	0.00776
Formaldehyde	0.00207	0.00200
n-Hexane	0.02200	0.02135
Lead	0.00018	0.00018
Toluene	0.01280	0.01242
Xylene	0.03393	0.03294
Greenhouse Gases (tons/year)		
CO ₂	21,529.59	20,897.60
CH ₄	1.67	1.63
N ₂ O	0.54	0.52
CO ₂ e	21,731.19	21,093.29
Assumptions:		
Analysis year: 2037		
Trains per day—Otter Creek: 7.4		
Total trains per day: 7.4		

Table E.1-24. Southern Alternatives, Low Production Scenario, Train Activity Calculation

Build Alternatives	Train (Moving)	One- Way Trips/Day	Train Miles/Day	Ton- Miles/Day	Fuel Consumption (gal/day)	Work (bhp-hr/day)
Decker	Loaded	3.71	189.83	3,575,458	4,287.1	89,172.1
Decker	Unloaded	3.71	189.83	775,458	929.8	19,340.0
Decker East	Loaded	3.71	184.26	3,470,503	4,161.3	86,554.5
Decker East	Unloaded	3.71	184.26	752,695	902.5	18,772.2

Table E.1-25. Estimated Annual Average Operational Emissions of the Tongue River Railroad: Southern Alternatives, Medium Production Scenario

Pollutants	Build Alternatives	
	Decker	Decker East
Criteria Pollutants (tons/year)		
CO	80.23	78.26
NO _x	194.27	189.50
PM ₁₀	4.87	4.75
PM _{2.5}	4.72	4.60
SO ₂	0.29	0.28
VOCs	8.22	8.02
Hazardous Pollutants (tons/year)		
Acetaldehyde	0.00219	0.00213
Acrolein	0.00042	0.00041
Benzene	0.00025	0.00025
1,3-Butadiene	0.00030	0.00029
Ethylbenzene	0.01644	0.01603
Formaldehyde	0.00460	0.00449
n-Hexane	0.04520	0.04409
Lead	0.00041	0.00040
Toluene	0.02630	0.02565
Xylene	0.05416	0.05283
Greenhouse Gases (tons/year)		
CO ₂	30,908.23	30,149.85
CH ₄	2.40	2.35
N ₂ O	0.77	0.75
CO ₂ e	31,197.65	30,432.17
Assumptions:		
Analysis year: 2030		
Trains per day—Otter Creek: 7.4		
Trains per day—Poker Jim Creek–O’Dell Creek: 4.5		
Total trains per day: 11.9		

Table E.1-26. Southern Alternatives, Medium Production Scenario, Otter Creek Mine, Train Activity Calculation

Build Alternatives	Train (Moving)	One-Way Trips/Day	Train Miles/Day	Ton-Miles/Day	Fuel Consumption (gal/day)	Work (bhp-hr/day)
Decker	Loaded	3.71	189.83	3,575,458	4,287.1	89,172.1
Decker	Unloaded	3.71	189.83	775,458	929.8	19,340.0
Decker East	Loaded	3.71	184.26	3,470,503	4,161.3	86,554.5
Decker East	Unloaded	3.71	184.26	752,695	902.5	18,772.2

Table E.1-27. Southern Alternatives, Medium Production Scenario, Potentially Induced Poker Jim Creek–O’Dell Creek Mine, Train Activity Calculation

Build Alternatives	Train (Moving)	One-Way Trips/Day	Train Miles/Day	Ton-Miles/Day	Fuel Consumption (gal/day)	Work (bhp-hr/day)
Decker	Loaded	2.23	82.69	1,557,528	1,867.5	38,844.8
Decker	Unloaded	2.23	82.69	337,802	405.0	8,424.8
Decker East	Loaded	2.23	81.58	1,536,537	1,842.4	38,321.3
Decker East	Unloaded	2.23	81.58	333,250	399.6	8,311.3

Table E.1-28. Estimated Annual Average Operational Emissions of the Tongue River Railroad: Southern Alternatives, High Production Scenario

Pollutants	Build Alternatives	
	Decker	Decker East
Criteria Pollutants (tons/year)		
CO	160.45	159.46
NO _x	253.12	251.56
PM ₁₀	6.27	6.24
PM _{2.5}	6.09	6.05
SO ₂	0.58	0.57
VOCs	11.48	11.41
Hazardous Pollutants (tons/year)		
Acetaldehyde	0.00282	0.00280
Acrolein	0.00054	0.00053
Benzene	0.00032	0.00032
1,3-Butadiene	0.00039	0.00038
Ethylbenzene	0.02296	0.02282
Formaldehyde	0.00593	0.00589
n-Hexane	0.06315	0.06276
Lead	0.00053	0.00052
Toluene	0.03674	0.03652
Xylene	0.09742	0.09682
Greenhouse Gases (tons/year)		
CO ₂	61,813.09	61,432.21
CH ₄	4.81	4.78
N ₂ O	1.54	1.53
CO ₂ e	62,391.90	62,007.46
Assumptions: Analysis year: 2037 Trains per day—Otter Creek: 12.6 Trains per day—Poker Jim Creek—O'Dell Creek: 5.9 Trans per day—Canyon Creek: 8.2 Total trains per day: 26.7		

Table E.1-29. Southern Alternatives, High Production Scenario, Proposed Otter Creek Mine, Train Activity Calculation

Build Alternatives	Train (Moving)	One- Way Trips/Day	Train Miles/Day	Ton-Miles/Day	Fuel Consumption (gal/day)	Work (bhp-hr/day)
Decker	Loaded	6.32	322.71	6,078,278	7,288.1	151,592.5
Decker	Unloaded	6.32	322.71	1,318,278	1,580.7	32,877.9
Decker East	Loaded	6.32	313.24	5,899,855	7,074.2	147,142.7
Decker East	Unloaded	6.32	313.24	1,279,581	1,534.3	31,912.8

Table E.1-30. Southern Alternatives, High Production Scenario, Potentially Induced Poker Jim Creek–O’Dell Creek Mine, Train Activity Calculation

Build Alternatives	Train (Moving)	One-Way Trips/Day	Train Miles/Day	Ton-Miles/Day	Fuel Consumption (gal/day)	Work (bhp-hr/day)
Decker	Loaded	2.97	110.26	2,076,704	2,490.1	51,793.1
Decker	Unloaded	2.97	110.26	450,403	540.1	11,233.1
Decker East	Loaded	2.97	108.77	2,048,716	2,456.5	51,095.1
Decker East	Unloaded	2.97	108.77	444,333	532.8	11,081.7

Table E.1-31. Southern Alternatives, High Production Scenario, Potentially Induced Canyon Creek Mine, Train Activity Calculation

Build Alternatives	Train (Moving)	One-Way Trips/Day	Train Miles/Day	Ton-Miles/Day	Fuel Consumption (gal/day)	Work (bhp-hr/day)
Decker	Loaded	4.09	247.02	4,652,643	5,578.7	116,037.1
Decker	Unloaded	4.09	247.02	1,009,081	1,209.9	25,166.5
Decker East	Loaded	4.09	249.06	4,691,126	5,624.9	116,996.9
Decker East	Unloaded	4.09	249.06	1,017,428	1,219.9	25,374.7

Table E.1-32. Estimated Annual Average Operational Emissions of the Tongue River Railroad: Locomotives, Northern and Southern Alternatives, Low Production Scenario

Pollutants	Build Alternatives									
	Tongue River	Tongue River East	Tongue River Road	Tongue River Road East	Moon Creek	Moon Creek East	Colstrip	Colstrip East	Decker	Decker East
Criteria Pollutants (tons/year)										
CO	82.79	84.54	82.79	84.10	81.04	83.11	69.99	72.29	55.88	54.24
NO _x	130.61	133.37	130.61	132.68	127.85	131.12	110.42	114.04	88.16	85.58
PM ₁₀	3.24	3.31	3.24	3.29	3.17	3.25	2.74	2.83	2.19	2.12
PM _{2.5}	3.14	3.21	3.14	3.19	3.07	3.15	2.65	2.74	2.12	2.06
SO ₂	0.30	0.30	0.30	0.30	0.29	0.30	0.25	0.26	0.20	0.20
VOCs	5.92	6.05	5.92	6.02	5.80	5.95	5.01	5.17	4.00	3.88
Hazardous Pollutants (tons/year)										
Acetaldehyde	0.00145	0.00148	0.00145	0.00148	0.00142	0.00146	0.00123	0.00127	0.00098	0.00095
Acrolein	0.00028	0.00028	0.00028	0.00028	0.00027	0.00028	0.00023	0.00024	0.00019	0.00018
Benzene	0.00017	0.00017	0.00017	0.00017	0.00016	0.00017	0.00014	0.00015	0.00011	0.00011
1,3-Butadiene	0.00020	0.00020	0.00020	0.00020	0.00019	0.00020	0.00017	0.00017	0.00013	0.00013
Ethylbenzene	0.01185	0.01210	0.01185	0.01204	0.01160	0.01190	0.01002	0.01035	0.00800	0.00776
Formaldehyde	0.00306	0.00312	0.00306	0.00311	0.00299	0.00307	0.00259	0.00267	0.00207	0.00200
n-Hexane	0.03258	0.03327	0.03258	0.03310	0.03190	0.03271	0.02755	0.02845	0.02200	0.02135
Lead	0.00027	0.00028	0.00027	0.00028	0.00027	0.00027	0.00023	0.00024	0.00018	0.00018
Toluene	0.01896	0.01936	0.01896	0.01926	0.01856	0.01903	0.01603	0.01655	0.01280	0.01242
Xylene	0.05027	0.05133	0.05027	0.05106	0.04920	0.05047	0.04250	0.04389	0.03393	0.03294
Greenhouse Gases (tons/year)										
CO ₂	31,894.12	32,568.24	31,894.12	32,399.71	31,220.01	32,020.52	26,964.65	27,849.43	21,529.59	20,897.60
CH ₄	2.48	2.53	2.48	2.52	2.43	2.49	2.10	2.17	1.67	1.63
N ₂ O	0.79	0.81	0.79	0.81	0.78	0.80	0.67	0.69	0.54	0.52
CO ₂ e	32,192.78	32,873.21	32,192.78	32,703.10	31,512.35	32,320.36	27,217.15	28,110.21	21,731.19	21,093.29
Northern and Southern Alternatives, Low Production Assumptions:										
Analysis year: 2037, Trains per day—Otter Creek: 7.4, Total trains per day: 7.4										

Table E.1-33. Estimated Annual Average Operational Emissions of the Tongue River Railroad: Locomotives, Northern and Southern Alternatives, Medium Production Scenario

Pollutants	Build Alternatives									
	Tongue River	Tongue River East	Tongue River Road	Tongue River Road East	Moon Creek	Moon Creek East	Colstrip	Colstrip East	Decker	Decker East
Criteria Pollutants (tons/year)										
CO	133.77	138.54	134.16	137.84	130.97	135.74	113.30	118.94	80.23	78.26
NO _x	211.04	218.56	211.65	217.46	206.62	214.15	178.74	187.64	194.27	189.50
PM ₁₀	5.23	5.42	5.25	5.39	5.12	5.31	4.43	4.65	4.87	4.75
PM _{2.5}	5.07	5.25	5.09	5.23	4.97	5.15	4.30	4.51	4.72	4.60
SO ₂	0.48	0.50	0.48	0.50	0.47	0.49	0.41	0.43	0.29	0.28
VOCs	9.57	9.91	9.60	9.86	9.37	9.71	8.11	8.51	8.22	8.02
Hazardous Pollutants (tons/year)										
Acetaldehyde	0.00235	0.00243	0.00236	0.00242	0.00230	0.00238	0.00199	0.00209	0.00219	0.00213
Acrolein	0.00045	0.00046	0.00045	0.00046	0.00044	0.00045	0.00038	0.00040	0.00042	0.00041
Benzene	0.00027	0.00028	0.00027	0.00028	0.00026	0.00027	0.00023	0.00024	0.00025	0.00025
1,3-Butadiene	0.00032	0.00033	0.00032	0.00033	0.00031	0.00033	0.00027	0.00029	0.00030	0.00029
Ethylbenzene	0.01915	0.01983	0.01920	0.01973	0.01875	0.01943	0.01622	0.01702	0.01644	0.01603
Formaldehyde	0.00494	0.00512	0.00496	0.00509	0.00484	0.00502	0.00419	0.00440	0.00460	0.00449
n-Hexane	0.05265	0.05453	0.05280	0.05425	0.05155	0.05343	0.04459	0.04681	0.04520	0.04409
Lead	0.00044	0.00046	0.00044	0.00045	0.00043	0.00045	0.00037	0.00039	0.00041	0.00040
Toluene	0.03063	0.03173	0.03072	0.03157	0.02999	0.03108	0.02595	0.02724	0.02630	0.02565
Xylene	0.08122	0.08412	0.08146	0.08369	0.07952	0.08242	0.06879	0.07222	0.05416	0.05283
Greenhouse Gases (tons/year)										
CO ₂	51,536.18	53,373.15	51,685.23	53,103.50	50,457.60	52,294.57	43,649.02	45,823.05	30,908.23	30,149.85
CH ₄	4.01	4.15	4.02	4.13	3.93	4.07	3.40	3.57	2.40	2.35
N ₂ O	1.28	1.33	1.29	1.32	1.26	1.30	1.09	1.14	0.77	0.75
CO ₂ e	52,018.77	53,872.94	52,169.21	53,600.77	50,930.08	52,784.25	44,057.75	46,252.14	31,197.65	30,432.17

Northern and Southern Alternatives, Medium Production Assumptions:

- Analysis year: 2037 (2030 for the southern alternatives, which reach maximum production by 2030). Locomotive emission rates higher in 2030 than 2037, leading to higher total emissions in 2030, and this highest-emission case is shown.
- Trains per day—Otter Creek: 7.4
- Trains per day—Poker Jim Creek–O’Dell Creek: 4.5
- Total trains per day: 11.9

Table E.1-34. Estimated Annual Average Operational Emissions of the Tongue River Railroad: Locomotives, Northern and Southern Alternatives, High Production Scenario

Pollutants	Build Alternatives									
	Tongue River	Tongue River East	Tongue River Road	Tongue River Road East	Moon Creek	Moon Creek East	Colstrip	Colstrip East	Decker	Decker East
Criteria Pollutants (tons/year)										
CO	208.72	215.72	208.72	214.62	204.34	211.34	176.73	185.09	160.45	159.46
NO _x	329.28	340.32	329.28	338.59	322.37	333.42	278.81	292.01	253.12	251.56
PM ₁₀	8.16	8.44	8.16	8.39	7.99	8.26	6.91	7.24	6.27	6.24
PM _{2.5}	7.92	8.18	7.92	8.14	7.75	8.02	6.70	7.02	6.09	6.05
SO ₂	0.75	0.78	0.75	0.77	0.74	0.76	0.64	0.67	0.58	0.57
VOCs	14.94	15.44	14.94	15.36	14.62	15.12	12.65	13.25	11.48	11.41
Hazardous Pollutants (tons/year)										
Acetaldehyde	0.00367	0.00379	0.00367	0.00377	0.00359	0.00371	0.00310	0.00325	0.00282	0.00280
Acrolein	0.00070	0.00072	0.00070	0.00072	0.00068	0.00071	0.00059	0.00062	0.00054	0.00053
Benzene	0.00042	0.00044	0.00042	0.00043	0.00041	0.00043	0.00036	0.00037	0.00032	0.00032
1,3-Butadiene	0.00050	0.00052	0.00050	0.00052	0.00049	0.00051	0.00043	0.00045	0.00039	0.00038
Ethylbenzene	0.02987	0.03087	0.02987	0.03072	0.02925	0.03025	0.02529	0.02649	0.02296	0.02282
Formaldehyde	0.00771	0.00797	0.00771	0.00793	0.00755	0.00781	0.00653	0.00684	0.00593	0.00589
n-Hexane	0.08215	0.08490	0.08215	0.08447	0.08043	0.08318	0.06956	0.07285	0.06315	0.06276
Lead	0.00069	0.00071	0.00069	0.00070	0.00067	0.00069	0.00058	0.00061	0.00053	0.00052
Toluene	0.04780	0.04940	0.04780	0.04915	0.04679	0.04840	0.04047	0.04239	0.03674	0.03652
Xylene	0.12673	0.13098	0.12673	0.13031	0.12407	0.12832	0.10730	0.11238	0.09742	0.09682
Greenhouse Gases (tons/year)										
CO ₂	80,409.42	83,105.89	80,409.42	82,684.57	78,724.13	81,420.60	68,085.74	71,308.86	61,813.09	61,432.21
CH ₄	6.26	6.47	6.26	6.43	6.12	6.33	5.30	5.55	4.81	4.78
N ₂ O	2.00	2.07	2.00	2.06	1.96	2.03	1.70	1.78	1.54	1.53
CO ₂ e	81,162.38	83,884.09	81,162.38	83,458.82	79,461.31	82,183.02	68,723.29	71,976.59	62,391.90	62,007.46

Northern and Southern Alternatives, High Production Assumptions:

- Analysis year: 2037
- Trains per day—Otter Creek: 12.6
- Trains per day—Poker Jim Creek—O'Dell Creek: 5.9
- Trains per day—Canyon Creek (southern alternatives only): 8.2
- Total trains per day, northern alternatives: 18.6
- Total trains per day, southern alternatives: 26.7

Table E.1-35. 2030 Maximum Estimated Operational Emissions for All Build Alternatives, Locomotives, High Production Scenario

Pollutants	Build Alternatives									
	Tongue River	Tongue River East	Tongue River Road	Tongue River Road East	Moon Creek	Moon Creek East	Colstrip	Colstrip East	Decker	Decker East
Criteria Pollutants (tons/year)										
CO	208.72	215.82	152.85	214.73	204.34	211.45	176.73	185.20	188.93	183.90
NO _x	505.40	522.61	370.13	519.96	494.80	512.02	427.94	448.46	457.49	445.31
PM ₁₀	12.66	13.09	9.27	13.02	12.39	12.82	10.72	11.23	11.46	11.15
PM _{2.5}	12.28	12.70	8.99	12.63	12.02	12.44	10.40	10.90	11.12	10.82
SO ₂	0.75	0.78	0.55	0.77	0.74	0.76	0.64	0.67	0.68	0.66
VOCs	21.38	22.11	15.66	22.00	20.93	21.66	18.10	18.97	19.35	18.84
Hazardous Pollutants (tons/year)										
Acetaldehyde	0.00569	0.00588	0.00569	0.00585	0.00557	0.00576	0.00481	0.00505	0.00515	0.00501
Acrolein	0.00108	0.00112	0.00108	0.00111	0.00106	0.00110	0.00092	0.00096	0.00098	0.00095
Benzene	0.00065	0.00068	0.00065	0.00067	0.00064	0.00066	0.00055	0.00058	0.00059	0.00058
1,3-Butadiene	0.00078	0.00081	0.00078	0.00080	0.00076	0.00079	0.00066	0.00069	0.00070	0.00069
Ethylbenzene	0.04276	0.04422	0.04276	0.04399	0.04186	0.04332	0.03621	0.03794	0.03871	0.03768
Formaldehyde	0.01196	0.01237	0.01196	0.01231	0.01171	0.01212	0.01013	0.01062	0.01083	0.01054
n-Hexane	0.11759	0.12159	0.11759	0.12098	0.11512	0.11913	0.09957	0.10434	0.10644	0.10361
Lead	0.00106	0.00110	0.00106	0.00109	0.00104	0.00108	0.00090	0.00094	0.00096	0.00094
Toluene	0.06841	0.07074	0.06841	0.07039	0.06698	0.06931	0.05793	0.06071	0.06193	0.06028
Xylene	0.14091	0.14571	0.14091	0.14497	0.13795	0.14275	0.11931	0.12503	0.12755	0.12415
Greenhouse Gases (tons/year)										
CO ₂	80,409.42	83,148.02	80,409.42	82,726.70	78,724.13	81,462.73	68,085.74	71,350.99	72,787.70	70,849.61
CH ₄	6.26	6.47	6.26	6.44	6.12	6.34	5.30	5.55	5.66	5.51
N ₂ O	2.00	2.07	2.00	2.06	1.96	2.03	1.70	1.78	1.81	1.76
CO _{2e}	81,162.38	83,926.62	81,162.38	83,501.35	79,461.31	82,225.55	68,723.29	72,019.12	73,469.28	71,513.05
Northern and Southern Alternatives, High Production Assumptions:										
• Analysis year: 2030 • Trains per day—Otter Creek: 12.6 • Trains per day—Poker Jim Creek—O'Dell Creek: 5.9 • Trains per day—Canyon Creek (southern alternatives only): 8.2 • Total trains per day, northern alternatives: 18.6 • Total trains per day, southern alternatives: 26.7										

Table E.1-36. Northern Alternatives, High Production Scenario, Proposed Otter Creek Mine, Train Activity Calculation

Build Alternatives	Train (Moving)	One- Way Trips/Day	Train Miles/Day	Ton- Miles/Day	Fuel Consumption (gal/day)	Work (bhp-hr/day)
Tongue River	Loaded	6.32	478.07	9,004,416	10,796.7	224,570.6
Tongue River	Unloaded	6.32	478.07	1,952,909	2,341.6	48,705.6
Tongue River East	Loaded	6.32	494.49	9,313,682	11,167.5	232,283.7
Tongue River East	Unloaded	6.32	494.49	2,019,984	2,422.0	50,378.5
Tongue River Road	Loaded	6.32	478.07	9,004,416	10,796.7	224,570.6
Tongue River Road	Unloaded	6.32	478.07	1,952,909	2,341.6	48,705.6
Tongue River Road East	Loaded	6.32	491.96	9,266,103	11,110.4	231,097.0
Tongue River Road East	Unloaded	6.32	491.96	2,009,664	2,409.7	50,121.1
Moon Creek	Loaded	6.32	467.96	8,814,098	10,568.5	219,824.0
Moon Creek	Unloaded	6.32	467.96	1,911,632	2,292.1	47,676.2
Moon Creek East	Loaded	6.32	484.38	9,123,364	10,939.3	227,537.1
Moon Creek East	Unloaded	6.32	484.38	1,978,707	2,372.6	49,349.0
Colstrip	Loaded	6.32	404.18	7,612,716	9,128.0	189,861.5
Colstrip	Unloaded	6.32	404.18	1,651,072	1,979.7	41,177.8
Colstrip East	Loaded	6.32	423.76	7,981,457	9,570.1	199,057.9
Colstrip East	Unloaded	6.32	423.76	1,731,046	2,075.6	43,172.4

Table E.1-37. Northern Alternatives, High Production Scenario, Potentially Induced Poker Jim Creek–O'Dell Creek Mine, Train Activity Calculation

Build Alternatives	Train (Moving)	One- Way Trips/Day	Train Miles/Day	Ton- Miles/Day	Fuel Consumption (gal/day)	Work (bhp-hr/day)
Tongue River	Loaded	2.97	230.92	4,349,324	5,215.0	108,472.3
Tongue River	Unloaded	2.97	230.92	943,296	1,131.1	23,525.9
Tongue River East	Loaded	2.97	238.64	4,494,861	5,389.5	112,102.0
Tongue River East	Unloaded	2.97	238.64	974,861	1,168.9	24,313.1
Tongue River Road	Loaded	2.97	230.92	4,349,324	5,215.0	108,472.3
Tongue River Road	Unloaded	2.97	230.92	943,296	1,131.1	23,525.9
Tongue River Road East	Loaded	2.97	237.46	4,472,471	5,362.7	111,543.6
Tongue River Road East	Unloaded	2.97	237.46	970,005	1,163.1	24,192.0
Moon Creek	Loaded	2.97	226.16	4,259,762	5,107.6	106,238.7
Moon Creek	Unloaded	2.97	226.16	923,872	1,107.8	23,041.4
Moon Creek East	Loaded	2.97	233.89	4,405,300	5,282.1	109,868.4
Moon Creek East	Unloaded	2.97	233.89	955,437	1,145.6	23,828.6
Colstrip	Loaded	2.97	196.15	3,694,406	4,429.7	92,138.7
Colstrip	Unloaded	2.97	196.15	801,256	960.7	19,983.4
Colstrip East	Loaded	2.97	205.36	3,867,931	4,637.8	96,466.4
Colstrip East	Unloaded	2.97	205.36	838,890	1,005.9	20,922.0

Table E.1-38. Southern Alternatives, High Production Scenario, Proposed Otter Creek Mine, Train Activity Calculation

Build Alternatives	Train (Moving)	One- Way Trips/Day	Train Miles/Day	Ton- Miles/Day	Fuel Consumption (gal/day)	Work (bhp-hr/day)
Decker	Loaded	6.32	322.71	6,078,278	7,288.1	151,592.5
Decker	Unloaded	6.32	322.71	1,318,278	1,580.7	32,877.9
Decker East	Loaded	6.32	313.24	5,899,855	7,074.2	147,142.7
Decker East	Unloaded	6.32	313.24	1,279,581	1,534.3	31,912.8

Table E.1-39. Southern Alternatives, High Production Scenario, Potentially Induced Poker Jim Creek–O'Dell Creek Mine, Train Activity Calculation

Build Alternatives	Train (Moving)	One- Way Trips/Day	Train Miles/Day	Ton- Miles/Day	Fuel Consumption (gal/day)	Work (bhp-hr/day)
Decker	Loaded	2.97	110.26	2,076,704	2,490.1	51,793.1
Decker	Unloaded	2.97	110.26	450,403	540.1	11,233.1
Decker East	Loaded	2.97	108.77	2,048,716	2,456.5	51,095.1
Decker East	Unloaded	2.97	108.77	444,333	532.8	11,081.7

Table E.1-40. Southern Alternatives, High Production Scenario, Potentially Induced Canyon Creek Mine, Train Activity Calculation

Build Alternatives	Train (Moving)	One- Way Trips/Day	Train Miles/Day	Ton- Miles/Day	Fuel Consumption (gal/day)	Work (bhp- hr/day)
Decker	Loaded	4.09	208.81	3,933,003	4,715.8	98,089.3
Decker	Unloaded	4.09	208.81	853,003	1,022.8	21,273.9
Decker East	Loaded	4.09	202.68	3,817,553	4,577.4	95,210.0
Decker East	Unloaded	4.09	202.68	827,964	992.8	20,649.5

Table E.1-41. PM10 and PM2.5 Emissions from All Sources¹ During Project Operation (tons per year)

Sources ² and Pollutants	Build Alternatives ¹									
	Tongue River	Tongue River East	Tongue River Road	Tongue River Road East	Moon Creek	Moon Creek East	Colstrip	Colstrip East	Decker	Decker East
Low production, 2037, 7.4 trains per day for all build alternatives										
PM10	103.20	87.49	108.93	92.61	97.82	81.60	62.14	45.63	31.65	38.68
PM2.5	20.98	18.78	21.72	19.40	19.47	17.17	12.97	10.63	7.66	8.79
Medium production, 2037 for northern alternatives, 2030 for southern alternatives, 11.9 trains per day for all build alternatives										
PM10	149.47	133.88	152.64	137.48	132.95	118.60	85.15	69.78	49.23	58.59
PM2.5	31.38	29.29	31.64	29.61	27.70	25.85	18.68	16.67	13.35	14.92
High production, 2037 and 18.6 trains per day for northern alternatives, 2030 and 26.7 trains per day for southern alternatives										
PM10	216.51	201.46	216.09	202.34	184.36	171.84	118.64	104.67	93.59	111.07
PM2.5	46.47	44.56	46.04	44.34	39.77	38.33	27.33	25.35	24.10	27.23

¹ Locomotives, rail cars, and wind erosion of exposed earth.

² Particulate matter emissions from vehicles delayed at grade crossings are not included because they would total less than 0.1 ton per year of PM10 or PM2.5.

E.1.2 Coal Dust

E.1.2.1 Inputs

This section provides the inputs used in the coal dust analysis calculations and assumptions used for the analysis. The emission rate equations were developed using shaped coal profiles⁵ with a coal material moisture content of 6.2 to 6.6%, but with the top 1 to 2 millimeters of the coal being dry. Shaping alone is estimated to reduce emissions by 50% and this reduction is included in these equations (Table E.1-42). The calculated emission rates are then reduced by a further 70% to account for the application of a topper agent. The total reduction from shaping and topper agent equals the 85% specified in the BNSF tariff. The general analysis method is as follows.

- Emissions (tons/year [yr]) = Emissions (tons/train) × Train volume (trains/yr)
- Emissions (tons/train) = Emission factor (g/tonne-kilometer [km]) × Activity (coal ton-mile [mile]/train) × (units conversions mi/km, tonnes/ton)
- Emission factor (g/tonne-km) = $(V^2 \times 0.0000378) - (V \times 0.000126) + 0.000063$ (Connell Hatch 2008, Witt et al. 1999, Ferreira et al. 2003)
- V = train speed (km/hour [hr])
- Activity (coal ton-mi/train) = Train payload weight (tons coal) × Route distance (mi)
- Train volume (trains/yr) = Train volume (trains/day) × days/yr (365 for continuous mine operation assumed)

⁵ Coal loaded in a rail car is “shaped” to minimize coal dust emissions. The load profile is typically shaped like a bread loaf.

Table E.1-42. General Inputs

Description	Value	Unit	Reference/Notes
Weights and Areas			
Cars per train	125	cars	TRRC 2013.
Coal payload per car	118	tons/car	TRRC 2013 Calculated
or metric units	107	mton/car	
Unloaded rail car carry-back	0.13	mton/car	CSIRO 2007
Surface Area of Tongue River Coal Rail Car	44.12	m ²	BNSF 2013. Coal Car Specifications
Surface Area for Australian Coal Rail Car	30.37	m ²	Connell Hatch 2008
Conversion Factors			
One ton =	907184.7	grams	USEPA 1985.
One mile =	1.609344	km	USEPA 1985
Particle Size Distribution			
PM10 as fraction of TSP	45		Katestone Scientific 2000
PM-2.5 as fraction of TSP	8.6		Katestone Scientific 2000
Parasitic Fraction of Coal Dust Emissions (accounts for coal spilled on surfaces of car)	5.0	%	Connell Hatch 2008 Witt et al. 1999 Ferreiraa et al.2003
Topping Agent Effectiveness	70% after shaping		Additional effectiveness in reducing emission after shaping of coal pile (shaping alone = 50%, shaping with additional 70% from topping agent = 85% total emission reduction)
Track Mileage (Estimates based on Figure E-1)			
Terminus 1 spur	8	miles	
Terminus 1 East spur	9	miles	
Terminus 2 spur	6	miles	
Terminus 2 East spur	4	miles	
Terminus 1 spur to middle ^a of Canyon Creek Coal Deposit	15.35	miles	
Middle ^a of Canyon Creek Coal Deposit to the end of Decker	27.42	miles	
Middle ^a of Canyon Creek Coal Deposit to the end of Decker East	29.28	miles	
^a Exact location of entrance to potentially induced mine is unknown so a central location along the rail line as it would pass the coal deposit is assumed.			

E.1.2.2 Emission Calculations

This section presents the emission calculations for the coal dust analysis for total suspended particulates (TSP), particulate matter less than or equal to 10 microns in size (PM10), and particulate matter less than or equal to 2.5 microns in size (PM2.5) by build alternative and coal production scenario (Tables E.1-43 to E.1-51).

Table E.1-43. Estimated Annual Average Operational Coal Dust Emissions as TSP, PM10 and PM2.5 for the Tongue River Railroad: Northern Alternatives, Low Production Scenario

Sources and Pollutants	Build Alternatives							
	Tongue River	Tongue River East	Tongue River Road	Tongue River Road East	Moon Creek	Moon Creek East	Colstrip	Colstrip East
Coal Blown from Loaded Rail Cars (tons/year)								
TSP ¹	146.0	151.0	139.8	143.9	112.7	116.7	71.9	75.3
PM10	65.7	68.0	62.9	64.8	50.7	52.5	32.3	33.9
PM2.5	12.6	13.0	12.0	12.4	9.7	10.0	6.2	6.5
Parasitic Load and Vibrations of Rail Cars (tons/year)								
TSP ¹	7.3	7.6	7.0	7.2	5.6	5.8	3.6	3.8
PM10	3.3	3.4	3.1	3.2	2.5	2.6	1.6	1.7
PM2.5	0.6	0.6	0.6	0.6	0.5	0.5	0.3	0.3
Unloaded Rail Cars (tons/year)								
TSP ¹	0.59	0.61	0.57	0.58	0.46	0.47	0.29	0.30
PM10	0.27	0.28	0.25	0.26	0.21	0.21	0.13	0.14
PM2.5	0.05	0.05	0.05	0.05	0.04	0.04	0.03	0.03
Total (tons/year)								
TSP ²	153.9	159.2	147.4	151.7	118.8	123.0	75.7	79.4
PM10	69.3	71.6	66.3	68.3	53.5	55.3	34.1	35.7
PM2.5	13.2	13.7	12.7	13.0	10.2	10.6	6.5	6.8

¹ TSP values were calculated for use in deposition assessment but not are reported in EIS because TSP is no longer a regulated pollutant.

Assumptions:

- Analysis year: 2037
- Trains per day—Otter Creek: 7.4
- Total trains per day: 7.4

Table E.1-44. Estimated Annual Average Operational Coal Dust Emissions as TSP, PM10 and PM2.5 for the Tongue River Railroad: Northern Alternatives, Medium Production Scenario

Sources and Pollutants	Build Alternatives							
	Tongue River	Tongue River East	Tongue River Road	Tongue River Road East	Moon Creek	Moon Creek East	Colstrip	Colstrip East
Coal Blown from Loaded Rail Cars (tons/year)								
TSP ¹	239.3	244.4	227.8	234.1	182.7	190.3	116.8	122.4
PM10	107.7	110.0	102.5	105.3	82.2	85.6	52.6	55.1
PM2.5	20.6	21.0	19.6	20.1	15.7	16.4	10.0	10.5
Parasitic Load and Vibrations of Rail Cars (tons/year)								
TSP ¹	12.0	12.2	11.4	11.7	9.1	9.5	5.8	6.1
PM10	5.4	5.5	5.1	5.3	4.1	4.3	2.6	2.8
PM2.5	1.0	1.1	1.0	1.0	0.8	0.8	0.5	0.5
Unloaded Rail Cars (tons/year)								
TSP ¹	0.96	0.96	0.92	0.95	0.74	0.77	0.47	0.50
PM10	0.43	0.43	0.41	0.43	0.33	0.35	0.21	0.22
PM2.5	0.08	0.08	0.08	0.08	0.06	0.07	0.04	0.04
Total (tons/year)								
TSP ¹	252.3	257.6	240.1	246.7	192.6	200.6	123.1	129.0
PM10	113.5	115.9	108.0	111.0	86.7	90.3	55.4	58.1
PM2.5	21.7	22.2	20.6	21.2	16.6	17.3	10.6	11.1

¹ TSP values were calculated for use in deposition assessment but are not reported in EIS because TSP is no longer a regulated pollutant.

Assumptions:

- Analysis year: 2037
- Trains per day—Otter Creek: 7.4
- Trains per day—Poker Jim Creek –O’Dell Creek: 4.5
- Total trains per day: 11.9

Table E.1-45. Estimated Annual Average Operational Coal Dust Emissions as TSP, PM10 and PM2.5 for the Tongue River Railroad: Northern Alternatives, High Production Scenario

Sources and Pollutants	Build Alternatives							
	Tongue River	Tongue River East	Tongue River Road	Tongue River Road East	Moon Creek	Moon Creek East	Colstrip	Colstrip East
Coal Blown from Loaded Rail Cars (tons/year)								
TSP ¹	374.5	380.5	355.4	364.5	285.0	296.3	182.2	190.5
PM10	168.5	171.2	159.9	164.0	128.3	133.4	82.0	85.7
PM2.5	32.2	32.7	30.6	31.3	24.5	25.5	15.7	16.4
Parasitic Load and Vibrations of Rail Cars (tons/year)								
TSP ¹	18.7	19.0	17.8	18.2	14.3	14.8	9.1	9.5
PM10	8.4	8.6	8.0	8.2	6.4	6.7	4.1	4.3
PM2.5	1.6	1.6	1.5	1.6	1.2	1.3	0.8	0.8
Unloaded Rail Cars (tons/year)								
TSP ¹	1.50	1.50	1.44	1.48	1.15	1.20	0.74	0.77
PM10	0.68	0.68	0.65	0.66	0.52	0.54	0.33	0.35
PM2.5	0.13	0.13	0.12	0.13	0.10	0.10	0.06	0.07
Total (tons/year)								
TSP ¹	394.7	401.0	374.6	384.2	300.4	312.4	192.0	200.8
PM10	177.6	180.5	168.6	172.9	135.2	140.6	86.4	90.4
PM2.5	33.9	34.5	32.2	33.0	25.8	26.9	16.5	17.3

¹ TSP values were calculated for use in deposition assessment but are not reported in EIS because TSP is no longer a regulated pollutant.

Assumptions:

- Analysis year: 2037
- Trains per day—Otter Creek: 12.6
- Trains per day—Poker Jim Creek –O'Dell Creek: 5.9
- Total trains per day: 18.6

Table E.1-46. Estimated Annual Average Operational Coal Dust Emissions as TSP, PM10, PM2.5 for the Tongue River Railroad: Southern Alternatives, Low Production Scenario

Sources and Pollutants	Build Alternatives	
	Decker	Decker East
Coal Blown from Loaded Rail Cars (tons/year)		
TSP ¹	57.4	64.0
PM10	25.8	28.8
PM2.5	4.9	5.5
Parasitic Load and Vibrations of Rail Cars (tons/year)		
TSP ¹	2.9	3.2
PM10	1.3	1.4
PM2.5	0.2	0.3
Unloaded Rail Cars (tons/year)		
TSP ¹	0.23	0.23
PM10	0.10	0.10
PM2.5	0.02	0.02
Total (tons/year)		
TSP ¹	60.5	67.4
PM10	27.2	30.3
PM2.5	5.2	5.8

¹ TSP values were calculated for use in deposition assessment but are not reported in EIS because TSP is no longer a regulated pollutant.

Assumptions:

- Analysis year: 2037
- Trains per day—Otter Creek: 7.4
- Total trains per day: 7.4

Table E.1-47. Estimated Annual Average Operational Coal Dust Emissions as TSP, PM10, PM2.5 for the Tongue River Railroad: Southern Alternatives, Medium Production Scenario

Sources and Pollutants	Build Alternatives	
	Decker	Decker East
Coal Blown from Loaded Rail Cars Due to Train Motion (tons/year)		
TSP ¹	82.7	92.7
PM10	37.2	41.7
PM2.5	7.1	8.0
Parasitic Load and Vibrations of Rail Cars (tons/year)		
TSP ¹	4.1	4.6
PM10	1.9	2.1
PM2.5	0.4	0.4
Unloaded Rail Cars (tons/year)		
TSP ¹	0.33	0.33
PM10	0.15	0.15
PM2.5	0.03	0.03
Total (tons/year)		
TSP ¹	87.2	97.6
PM10	39.2	43.9
PM2.5	7.5	8.4

¹ TSP values were calculated for use in deposition assessment but are not reported in EIS because TSP is no longer a regulated pollutant.

Assumptions:

- Analysis year: 2030
- Trains per day—Otter Creek: 7.4
- Trains per day—Poker Jim Creek –O’Dell Creek: 4.5
- Total trains per day: 11.9

Table E.1-48. Estimated Annual Average Operational Coal Dust Emissions as TSP, PM10, PM2.5 for the Tongue River Railroad: Southern Alternatives, High Production Scenario

Sources and Pollutants	Build Alternatives	
	Decker	Decker East
Coal Blown from Loaded Rail Cars Due to Train Motion (tons/year)		
TSP ¹	168.3	194.9
PM10	75.7	87.7
PM2.5	14.5	16.8
Parasitic Load and Vibrations of Rail Cars (tons/year)		
TSP ¹	8.4	9.7
PM10	3.8	4.4
PM2.5	0.7	0.8
Unloaded Rail Cars (tons/year)		
TSP ¹	0.68	0.69
PM10	0.31	0.31
PM2.5	0.06	0.06
Total (tons/year)		
TSP ¹	177.4	205.3
PM10	79.8	92.4
PM2.5	15.3	17.7

¹ TSP values were calculated for use in deposition assessment but are not reported in EIS because TSP is no longer a regulated pollutant.

Assumptions:

- Analysis year: 2037
- Trains per day—Otter Creek: 12.6
- Trains per day—Poker Jim Creek—O'Dell Creek: 5.9
- Trains per day—Canyon Creek: 8.2
- Total trains per day: 26.7

Table E.1-49. Estimated Annual Average Operational Coal Dust Emissions as TSP, PM10 and PM2.5 for the Tongue River Railroad: Northern and Southern Alternatives, Low Production Scenario

Sources and Pollutants	Build Alternatives									
	Tongue River	Tongue River East	Tongue River Road	Tongue River Road East	Moon Creek	Moon Creek East	Colstrip	Colstrip East	Decker	Decker East
Coal Blown from Loaded Rail Cars (tons/year)										
TSP ¹	146.0	151.0	139.8	143.9	112.7	116.7	71.9	75.3	57.4	64.0
PM10	65.7	68.0	62.9	64.8	50.7	52.5	32.3	33.9	25.8	28.8
PM2.5	12.6	13.0	12.0	12.4	9.7	10.0	6.2	6.5	4.9	5.5
Parasitic Load and Vibrations of Rail Cars (tons/year)										
TSP ¹	7.3	7.6	7.0	7.2	5.6	5.8	3.6	3.8	2.9	3.2
PM10	3.3	3.4	3.1	3.2	2.5	2.6	1.6	1.7	1.3	1.4
PM2.5	0.6	0.6	0.6	0.6	0.5	0.5	0.3	0.3	0.2	0.3
Unloaded Rail Cars (tons/year)										
TSP ¹	0.59	0.61	0.57	0.58	0.46	0.47	0.29	0.30	0.23	0.23
PM10	0.27	0.28	0.25	0.26	0.21	0.21	0.13	0.14	0.10	0.10
PM2.5	0.05	0.05	0.05	0.05	0.04	0.04	0.03	0.03	0.02	0.02
Total (tons/year)										
TSP ¹	153.9	159.2	147.4	151.7	118.8	123.0	75.7	79.4	60.5	67.4
PM10	69.3	71.6	66.3	68.3	53.5	55.3	34.1	35.7	27.2	30.3
PM2.5	13.2	13.7	12.7	13.0	10.2	10.6	6.5	6.8	5.2	5.8

¹ TSP values were calculated for use in deposition assessment but are not reported in EIS because TSP is no longer a regulated pollutant.

Assumptions, northern and southern alternatives

- Analysis year: 2037
- Trains per day—Otter Creek: 7.4
- Total trains per day: 7.4

Table E.1-50. Estimated Annual Average Operational Emissions as TSP, PM10 and PM2.5 for the Tongue River Railroad: Northern and Southern Alternatives, Medium Production Scenario

Sources and Pollutants	Build Alternatives									
	Tongue River	Tongue River East	Tongue River Road	Tongue River Road East	Moon Creek	Moon Creek East	Colstrip	Colstrip East	Decker	Decker East
Coal Blown from Loaded Rail Cars (tons/year)										
TSP ¹	239.3	244.4	227.8	234.1	182.7	190.3	116.8	122.4	82.7	92.7
PM10	107.7	110.0	102.5	105.3	82.2	85.6	52.6	55.1	37.2	41.7
PM2.5	20.6	21.0	19.6	20.1	15.7	16.4	10.0	10.5	7.1	8.0
Parasitic Load and Vibrations of Rail Cars (tons/year)										
TSP ¹	12.0	12.2	11.4	11.7	9.1	9.5	5.8	6.1	4.1	4.6
PM10	5.4	5.5	5.1	5.3	4.1	4.3	2.6	2.8	1.9	2.1
PM2.5	1.0	1.1	1.0	1.0	0.8	0.8	0.5	0.5	0.4	0.4
Unloaded Rail Cars (tons/year)										
TSP ¹	0.96	0.96	0.92	0.95	0.74	0.77	0.47	0.50	0.33	0.33
PM10	0.43	0.43	0.41	0.43	0.33	0.35	0.21	0.22	0.15	0.15
PM2.5	0.08	0.08	0.08	0.08	0.06	0.07	0.04	0.04	0.03	0.03
Total (tons/year)										
TSP ¹	252.3	257.6	240.1	246.7	192.6	200.6	123.1	129.0	87.2	97.6
PM10	113.5	115.9	108.0	111.0	86.7	90.3	55.4	58.1	39.2	43.9
PM2.5	21.7	22.2	20.6	21.2	16.6	17.3	10.6	11.1	7.5	8.4

¹ TSP values were calculated for use in deposition assessment but are not reported in EIS because TSP is no longer a regulated pollutant.

Assumptions, northern and southern alternatives

- Analysis year: 2037
- Trains per day—Otter Creek: 7.4
- Trains per day—Poker Jim Creek-O'Dell Creek: 4.5
- Total trains per day: 11.9

Table E.1-51. Estimated Annual Average Operational Coal Dust Emissions as TSP, PM10 and PM2.5 for the Tongue River Railroad: Northern and Southern Alternatives, High Production Scenario

Sources and Pollutants	Build Alternatives									
	Tongue River	Tongue River East	Tongue River Road	Tongue River Road East	Moon Creek	Moon Creek East	Colstrip	Colstrip East	Decker	Decker East
Coal Blown from Loaded Rail Cars (tons/year)										
TSP ¹	374.5	380.5	355.4	364.5	285.0	296.3	182.2	190.5	168.3	194.9
PM10	168.5	171.2	159.9	164.0	128.3	133.4	82.0	85.7	75.7	87.7
PM2.5	32.2	32.7	30.6	31.3	24.5	25.5	15.7	16.4	14.5	16.8
Parasitic Load and Vibrations of Rail Cars (tons/year)										
TSP ¹	18.7	19.0	17.8	18.2	14.3	14.8	9.1	9.5	8.4	9.7
PM10	8.4	8.6	8.0	8.2	6.4	6.7	4.1	4.3	3.8	4.4
PM2.5	1.6	1.6	1.5	1.6	1.2	1.3	0.8	0.8	0.7	0.8
Unloaded Rail Cars (tons/year)										
TSP ¹	1.50	1.50	1.44	1.48	1.15	1.20	0.74	0.77	0.68	0.69
PM10	0.68	0.68	0.65	0.66	0.52	0.54	0.33	0.35	0.31	0.31
PM2.5	0.13	0.13	0.12	0.13	0.10	0.10	0.06	0.07	0.06	0.06
Total (tons/year)										
TSP ¹	394.7	401.0	374.6	384.2	300.4	312.4	192.0	200.8	177.4	205.3
PM10	177.6	180.5	168.6	172.9	135.2	140.6	86.4	90.4	79.8	92.4
PM2.5	33.9	34.5	32.2	33.0	25.8	26.9	16.5	17.3	15.3	17.7

¹ TSP values were calculated for use in deposition assessment but are not reported in EIS because TSP is no longer a regulated pollutant.

Northern and Southern Alternatives, High Production Assumptions:

- Analysis year: 2037
- Trains per day—Otter Creek: 12.6
- Trains per day—Poker Jim Creek—O'Dell Creek: 5.9
- Trains per day—Canyon Creek (southern alternatives only): 8.2
- Total trains per day, northern alternatives: 18.6
- Total trains per day, southern alternatives: 26.7

E.1.3 Wind Erosion Analysis

Wind can erode exposed earth, causing particulate matter to become airborne. This analysis accounts for potential wind erosion emissions that occur in the right-of-way. Emissions sources are divided into two components for analysis purposes:

- Earth surfaces exposed during construction, but where soil stabilization and revegetation may be ineffective (e.g., planted vegetation does not thrive).
- Montana regulation Montana Code Annotated (MCA) 69-14-722 requires that railroads maintain firebreaks within their right-of-way. Burned earth surfaces are more susceptible

to wind erosion (leading to emissions) than unburned areas. Under this regulation, some of the firebreak may be plowed rather than burned.

Not all soils are susceptible to wind erosion. OEA mapped the soil types present in the right-of-way based on Wind Erodibility Group classifications (U.S. Department of Agriculture 2014). Soils classified as WEG 2, the most erodible group, were identified and assumed to constitute the areas potentially subject to wind erosion emissions. Based on the provisions of MCA 69-14-722 and specifications of the required dimensions and areas of firebreaks, OEA identified the acreages of WEG 2 soils inside and outside of firebreaks that would be required for each build alternative.

For WEG 2 acreage outside of the required firebreak area, OEA calculated emissions based on a factor of 0.38 ton of TSP per acre, per year (U.S. Environmental Protection Agency 1998). For WEG 2 acreage within firebreaks, OEA made the following assumptions:

- The TSP emission factor before burning is the same as for areas outside the firebreak (0.38 ton/acre-year).
- The effect of burning can be expressed as a ratio of the emission factor after burning vs. before burning. This ratio was derived based on tests by Haines et al. (2007) as described below. Haines measured erosion rates of test plots in a wind tunnel for test burns conducted in April and June. The resulting ratios (post-burn/preburn) for April and June were used to establish the initial post-burn emission factor and its rate of decline with time. Values for other months during the growing season were interpolated linearly.
- Over time, as the vegetation grows back, the post-burn emission factor declines linearly until it equals the pre-burn value.
- The emission factor reaches the pre-burn value when the area is 30% revegetated (Albert 2014, Alberta Ministry of Agriculture and Rural Development 2001).
- The time required for vegetation to reach 30% regrowth is equal to the length of the growing season.
- The emission factor for months not during the growing season is equal to the preburn value.
- Burning is repeated annually as required by MCA 69-14-722.
- The overall annual emission factor for areas within firebreaks equals the average of the monthly emission factors for the annual burn cycle calculated according to the assumptions above.

Tables E.1-52 through E.1-56 provide the data used in the calculations.

E.1.3.1 Emission Factors Calculation and Inputs

Table E.1-52. Wind Erosion Adjustment Ratios

Description	Value	Unit	Reference/Note
Adjustment ratios (burned/unburned emission potentials) for April and June	17	Average April ratio	Haines et al. (2007) Table 1: Wind tunnel erosion potentials. April and June are the months in which Haines et al. conducted test burns.
	7	Average June ratio	
Period of time required to reach 30% revegetation (full growing season assumed)	143	days or	Growing season for Miles City, MT (NOAA 2010)
	4.7	Months	
Extrapolate adjustment ratios using Haines et al. (2007) for initial decline and an overall 5 month (rounded) revegetation period	17 – 1	Adjustment range	Calculated. See Table E.1-54, Annual Calculations
Emission factor range from adjustment ratios	6.46 – 0.38	TSP/acre-yr	Calculated. See Table E.1-54, Annual Calculations
Average annual emission factor	1.61	TSP/acre-yr	Calculated. See Table E.1-54, Annual Calculations

Table E.1-53. Wind Erosion Assumptions

Assumptions
• Outside firebreak land (unburned, unplowed) has an emission factor of 0.38 T/acre*yr (USEPA 1998). • A minimum of 30% ground coverage is necessary to bring wind erosion to an acceptable level. • When the firebreak reaches 30% coverage, the emission factor will be back to 0.38 T/acre*yr. • 30% revegetation is reached after an approximately 5-month growing season. (NOAA 2010). • Normals Annual/Seasonal Station Details data: Assume 50% probability of longer than indicated freeze free period at 32°F. (NOAA 2010) • Emission factor adjustment for burned land is applied to plowed land as well.

Table E.1-54. Annual Calculations

Month	# of Months	Adjustment Ratio (at beginning of month)		TSP Emission Factor (tons TSP/ac-yr)
April	1	17	Derived below	6.46
May	2	12	Interpolated	4.55
June	3	7	Derived below	2.66
July	4	5	Interpolated	1.90
August	5	3	Interpolated	1.14
September	6	1	USEPA 1998 (assumed)	0.38
October	7	1	USEPA 1998 (assumed)	0.38
November	8	1	USEPA 1998 (assumed)	0.38
December	9	1	USEPA 1998 (assumed)	0.38
January	10	1	USEPA 1998 (assumed)	0.38
February	11	1	USEPA 1998 (assumed)	0.38
March	12	1	USEPA 1998 (assumed)	0.38
Average Annual Emission Factor within Firebreak				1.61

Table E.1-55. Derivation of April Adjustment Ratio for Emission Factor (Haines et al. 2007)

Dates of Test Series	Surface Condition	PM10 Normalized to 95 mph at 10-meter height	Burned/Unburned Ratios
4/7/2000	Burned	0.59	5.9
4/9/2000	Unburned	0.10	
4/8/2000	Burned	0.17	17
4/10/2000	Unburned	0.01	
4/8/2000	Burned	0.28	28
4/11/2000	Unburned	0.01	
Average Ratio			17

Table E.1-56. Derivation of June Adjustment Ratio for Emission Factor (Haines et al. 2007)

Dates of Test Series	Surface Condition	PM10 Normalized to 95 mph at 10-meter height	Burned/Unburned Ratios
6/21/2000	Burned	0.17	8.5
6/22/2000	Unburned	0.02	
6/21/2000	Burned	0.18	9
6/23/2000	Unburned	<0.02	
6/22/2000	Burned	0.07	3.5
6/23/2000	Unburned	<0.02	
Average Ratio			7

E.1.3.2 Final Emission Factors for Operational Wind Erosion

Tables E.1-57 through E.1-60 provide the final emissions factors.

Table E.1-57. Final Emissions Factors for Inside and Outside the Firebreaks

Emission Factors (TSP/acre-year)	
Inside Firebreak	Outside Firebreak
1.61	0.38

Table E.1-58. Particle Size Fractions Used to Adjust TSP Emission Factors to PM10 and PM2.5

Particle Size Fractions	
PM10/TSP	0.52
PM2.5/PM10	0.15
PM2.5/TSP	0.078
Source: same derivation as in construction emissions spreadsheet, see Table E.1-1, General Inputs	

Table E.1-59. Acreage and Emissions Inside and Outside Firebreak by Build Alternative

Build Alternative & WEG Type	Acreages				Emissions (tons TSP/year)		
	Inside Firebreak: Burned	Inside Firebreak: Plowed	Inside Firebreak: Total	Outside Firebreak	Inside Firebreak	Outside Firebreak	Sum Inside + Outside
Colstrip	31.10	8.13	39.23	138.45	63.34	52.61	115.95
2	14.23	7.00	21.24	37.90	34.29	14.40	48.69
3 ¹	16.87	1.13	17.99	100.55	29.05	38.21	67.26
Colstrip East	6.72	0.65	7.37	82.77	11.90	31.45	43.36
2	2.43	0.17	2.60	24.71	4.19	9.39	13.58
3 ¹	4.29	0.48	4.78	58.06	7.71	22.06	29.77
Decker	6.96	0.26	7.22	97.36	11.66	37.00	48.66
2	0.00	0.00	0.00	11.39	0.00	4.33	4.33
3 ¹	6.96	0.26	7.22	85.97	11.66	32.67	44.33
Decker East	3.90	0.17	4.07	113.13	6.57	42.99	49.56
2	0.34	0.04	0.39	29.88	0.62	11.35	11.98
3 ¹	3.55	0.13	3.68	83.25	5.95	31.64	37.58
Moon Creek	45.42	8.93	54.35	494.89	87.75	188.06	275.80
2	16.17	7.16	23.34	109.23	37.68	41.51	79.18
3 ¹	29.25	1.76	31.01	385.66	50.07	146.55	196.62
Moon Creek East	21.91	1.47	23.38	443.35	37.75	168.47	206.22
2	4.42	0.33	4.75	96.29	7.67	36.59	44.26
3 ¹	17.49	1.14	18.63	347.05	30.08	131.88	161.96
Tongue River	35.17	8.16	43.33	467.31	69.95	177.58	247.53
2	12.44	6.90	19.34	73.26	31.23	27.84	59.07
3 ¹	22.73	1.26	23.98	394.05	38.72	149.74	188.46
Tongue River East	11.66	0.70	12.36	415.77	19.95	157.99	177.94
2	0.69	0.06	0.76	60.32	1.22	22.92	24.14
3 ¹	10.97	0.63	11.60	355.45	18.73	135.07	153.80
Tongue River Road	46.69	14.53	61.22	457.67	98.84	173.92	272.75
2	13.38	6.90	20.28	113.05	32.73	42.96	75.69
3 ¹	33.31	7.63	40.94	344.63	66.10	130.96	197.06
Tongue River Road East	22.73	7.08	29.81	408.80	48.13	155.35	203.47
2	1.57	0.06	1.63	99.66	2.64	37.87	40.51
3 ¹	21.16	7.02	28.18	309.15	45.49	117.48	162.96
Grand Total	232.27	50.07	282.34	3,119.50	455.83	1185.41	1641.24

¹ WEG 3 soil acreage compiled only to check extent of soil groups in right-of-way. WEG 2 appeared to be the more realistic acreage for wind erodible surface so data reported in EIS are based on WEG 2 only.

Table E.1-60. Operational Wind Erosion Emissions by Particle Size Fraction

Alternative	Emissions for WEG 2 Acreage Only (tons/year)			Emissions for WEG 2&3^a Acreage (tons/year)		
	TSP	PM10	PM2.5	TSP	PM10	PM2.5
Colstrip	48.69	25.32	3.80	115.95	60.29	9.04
Colstrip East	13.58	7.06	1.06	43.36	22.55	3.38
Decker	4.33	2.25	0.34	48.66	25.30	3.80
Decker East	11.98	6.23	0.93	49.56	25.77	3.87
Moon Creek	79.18	41.17	6.18	275.80	143.42	21.51
Moon Creek East	44.26	23.01	3.45	206.22	107.23	16.09
Tongue River	59.07	30.71	4.61	247.53	128.71	19.31
Tongue River East	24.14	12.55	1.88	177.94	92.53	13.88
Tongue River Road	75.69	39.36	5.90	272.75	141.83	21.27
Tongue River Road East	40.51	21.06	3.16	203.47	105.81	15.87

^a WEG 3 soil acreage compiled only to check extent of soil groups in right-of-way. WEG 2 appeared to be the more realistic acreage for wind erodible surface so data reported in EIS right-of-way are based on WEG 2 only.

E.1.4 Grade-Crossing Emissions

This section presents the inputs and emissions calculations for vehicles delayed at new and existing grade crossings along the build alternatives.

E.1.4.1 Inputs

Tables E.1-61 through E.1-67 present the inputs used in estimating emissions resulting from vehicle delay at grade crossings.

Table E.1-61. Vehicle Fleet Mix

Vehicle Type	Fraction of Each Vehicle
Combination Long-haul Truck	3%
Combination Short-haul Truck	2%
Intercity Bus	0%
Light Commercial Truck	9%
Motor Home	0%
Motorcycle	1%
Passenger Car	52%
Passenger Truck	28%
Refuse Truck	0%
School Bus	0%
Single Unit Long-haul Truck	1%
Single Unit Short-haul Truck	4%
Transit Bus	0%
Source: MOVES2010B. MT Statewide Default Activity Mix 2015.	

Table E.1-62. MOVES Emission Factors

Road Type	Year ID	FuelType ¹	Source Type ²	Pollutant CO	Rate Unit (g/mi) NO _x	PM10 Brake wear	PM10 Tire wear	PM10 Total Exhaust	
Rural Unrestricted Access	2015	Composite	Combination Long-haul Truck	3.441958763	12.69629771	0.024131423	0.015558901	0.349785845	
			Combination Short-haul Truck	1.533718379	6.865966217	0.022431829	0.014161441	0.269177149	
			Intercity Bus	2.409940033	9.760545953	0.047791453	0.018120762	0.440544112	
			Light Commercial Truck	12.72066449	1.413161408	0.01011546	0.005204891	0.036244314	
			Motor Home	27.23194516	4.172625563	0.026974377	0.008437515	0.088382303	
			Motorcycle	19.77712823	0.860085776	0.000491545	0.002394246	0.051196969	
			Passenger Car	5.765020271	0.400292637	0.006099504	0.004855253	0.011910524	
			Passenger Truck	12.44282913	1.15615936	0.009973111	0.004989752	0.025129935	
			Refuse Truck	3.732079214	6.812822097	0.038318007	0.016933681	0.284480964	
			School Bus	8.919909109	5.548565308	0.039519721	0.014288459	0.240929914	
			Single Unit Long-haul Truck	9.934358638	2.739812051	0.033617507	0.010210319	0.079656902	
			Single Unit Short-haul Truck	11.32787815	2.857511554	0.033460316	0.01021207	0.079056254	
			Transit Bus	3.332375791	7.585242546	0.023181144	0.009722711	0.33923888	
Road Type	Year ID	Fuel Type ¹	Source Type ²	Pollutant PM2.5 Brake wear	Rate Unit (g/mi) Tire wear	PM2.5 Total Exhaust	CO ₂ Equivalent	SO ₂	
Rural Unrestricted Access	2015	Composite	Combination Long-haul Truck	0.006317132	0.003731151	0.339304026	1.027106997	2152.305936	0.01579273
			Combination Short-haul Truck	0.005872206	0.003396029	0.26110898	0.302099536	1881.796708	0.01377797

Road Type	Year ID	Fuel Type ¹	Source Type ²	Pollutant PM2.5 Brake wear	Rate Unit (g/mi) PM2.5 Tire wear	PM2.5 Total Exhaust	VOC	CO ₂ Equivalent	SO ₂
			haul Truck						
			Intercity Bus	0.012510859	0.004345503	0.427341997	0.408478183	1663.050243	0.01247051
			Light Commercial Truck	0.002648023	0.001248175	0.034139077	0.656534425	490.3313605	0.00775436
			Motor Home	0.007061344	0.002023385	0.085013105	0.965518595	952.4650269	0.01258363
			Motorcycle	0.000128677	0.00057416	0.047142678	0.965593322	403.6565451	0.00705631
			Passenger Car	0.001596727	0.001164329	0.010970531	0.246795275	335.8966831	0.00585775
			Passenger Truck	0.002610762	0.001196582	0.02324275	0.648450502	476.1491719	0.00811544
			Refuse Truck	0.010030891	0.004060835	0.275918882	0.398643127	1579.274142	0.01220933
			School Bus	0.010345471	0.003426486	0.233561832	0.59115886	951.1958368	0.00764276
			Single Unit Long- haul Truck	0.008800408	0.002448519	0.077091235	0.435770534	830.4653725	0.00862144
			Single Unit Short- haul Truck	0.008759249	0.002448934	0.0764677	0.445409456	888.4547258	0.00918248
			Transit Bus	0.006068354	0.002331588	0.329064727	0.461422121	1342.016737	0.01007835

Road Type	Year ID	FuelType ¹	Source Type ²	Pollutant Formaldehyde	Rate Unit (g/mi)		N ₂ O	Methane (CH ₄)	CO ₂ derived
					Benzene				
Rural Unrestricted Access	2015	Composite	Combination Long-haul Truck	0.117842514	0.0090828		0.0014909	0.4192621	2,141.38
			Combination Short-haul Truck	0.021996186	0.0020653		0.0015312	0.0281897	1,880.64
			Intercity Bus	0.030978147	0.0029096		0.0018425	0.0306737	1,661.73
			Light Commercial Truck	0.010579337	0.0251276		0.0229035	0.0494335	482.27
			Motor Home	0.020962298	0.0270644		0.0131856	0.0401137	947.53
			Motorcycle	0.009880361	0.0346698		0.0053275	0.0759609	400.17
			Passenger Car	0.002812669	0.0099950		0.0077604	0.0174419	333.15
			Passenger Truck	0.007585219	0.0260224		0.0223905	0.0458420	468.33
			Refuse Truck	0.026230131	0.0042362		0.0026874	0.0330673	1,577.65
			School Bus	0.040162169	0.0092978		0.0070011	0.0786648	947.14
			Single Unit Long-haul Truck	0.019553407	0.0093102		0.0077244	0.0420930	827.11
			Single Unit Short-haul Truck	0.019410809	0.0105047		0.0100276	0.0546513	884.10
			Transit Bus	0.035505637	0.0037873		0.0024049	0.0377890	1,340.36

¹ Fuel is a composite across all types.

² A mix of vehicle types was used for the grade crossing emissions analysis.
Source: ICF 2014. MOVES2010B. MT Statewide Default Activity Mix 2015.

Table E.1-63. Speciation Factors for Hazardous Pollutants

Speciation Fractions		MOVES Post-2007 (Table 11)	
HAP	Basis	Speciation (multiplier)	Source
Acetaldehyde	VOC	0.06934	USEPA 2010a.
Acrolein	VOC	0.00999	USEPA 2010a
Benzene	VOC	0.01291	USEPA 2010a
1,3-butadiene	VOC	0.00080	USEPA 2010a
Ethylbenzene	VOC	0.00627	USEPA 2010a
Formaldehyde	VOC	0.21744	USEPA 2010a
Lead	PM10	0.0000840	USEPA 2010a
n-Hexane	VOC	0.00541	USEPA 2010a
Toluene	VOC	0.02999	USEPA 2010a
Xylene	VOC	0.03800	USEPA 2010a
USEPA. 2010a. MOVES2010B Additional Toxics Added to MOVES. Available: http://www.epa.gov/otaq/models/moves/documents/420b12029a.pdf .			

Table E.1-64. Conversion Rate from Vehicle Miles Traveled (VMT) to Vehicle/hours

Average Vehicle Speed	2.5	mph
Assumption from CN EJE EIS. Appendix K Air Quality and Climate Analysis.		

Table E.1-65. Vehicle Fleet Mix MOVES Emission Factors

Pollutant	g/veh-hr	Pollutant	g/veh-hr
CO	21.26	1,3-Butadiene	0.00
NO _x	3.30	Ethylbenzene	0.01
Pb	0.0011	Formaldehyde	0.02
PM10	0.09	n-Hexane	0.01
PM2.5	0.09	Toluene	0.03
SO ₂	0.02	Xylene	0.04
VOC	1.09	CO ₂	1,234.81
Acetaldehyde	0.08	CH ₄	0.10
Acrolein	0.01	N ₂ O	0.03
Benzene	0.04	CO ₂ e	1,247.18

Table E.1-66. Conversion Factors

1 minute/day	6.0873	hours/year
1 ton =	907184.7	grams

Table E.1-67. Global Warming Potentials for CO₂e Calculations

CO ₂	CH ₄	N ₂ O
1	25	298
Source: IPCC 2007.		

E.1.4.2 Emission Calculations

This section presents the vehicle emission calculation results for new and existing public, at-grade crossings in the transportation study area (Chapter 3, Section 3.3, *Grade-Crossing Delay*, and Section 3.4, *Grade-Crossing Safety*). The following information is provided for each build alternative.

- Grade crossing, train speed, train length, number of trains per day, and anticipated level of delay as calculated in Section 3.3, *Grade-Crossing Delay*.
- Emission calculation results for criteria pollutants,
- Emission calculation results for hazardous pollutants,
- Emission calculation results for greenhouse gas emissions.

Tables E.1-68 through E.1-76 provide grade crossing emission results for the build alternatives and coal production scenarios. Tables E.1-77 through E.1-88 summarize grade crossing emissions by build alternative and coal production scenario. See Appendix D, *Grade-Crossing Safety and Delay Analysis*, for information characterizing existing and proposed conditions for the proposed project.

Table E.1-68. Grade Crossing Emissions, Low Production Scenario, Northern and Southern Alternatives, Year 2037, Criteria Pollutants

Crossing	Criteria Pollutants (tons/year)						
	CO	NOx	Pb	PM10	PM2.5	SO2	VOC
Northern Alternatives							
Colstrip							
Cow Creek Road	2.24E-04	3.47E-05	1.12E-08	9.70E-07	9.22E-07	1.92E-07	1.15E-05
Rosebud Creek Road	2.24E-04	3.47E-05	1.12E-08	9.70E-07	9.22E-07	1.92E-07	1.15E-05
Tongue River Road	5.34E-04	8.28E-05	2.68E-08	2.31E-06	2.20E-06	4.57E-07	2.74E-05
East Tongue River Road	1.40E-04	2.17E-05	7.02E-09	6.06E-07	5.75E-07	1.20E-07	7.17E-06
US212	--	--	--	--	--	--	--
Colstrip East							
Cow Creek Road	2.24E-04	3.47E-05	1.12E-08	9.70E-07	9.22E-07	1.92E-07	1.15E-05
Rosebud Creek Road	2.24E-04	3.47E-05	1.12E-08	9.70E-07	9.22E-07	1.92E-07	1.15E-05
Tongue River Road	5.34E-04	8.28E-05	2.68E-08	2.31E-06	2.20E-06	4.57E-07	2.74E-05
US212	--	--	--	--	--	--	--
Tongue River							
Moon Creek Road	3.08E-04	4.78E-05	1.55E-08	1.34E-06	1.27E-06	2.64E-07	1.58E-05
Snider Creek Road	1.68E-04	2.60E-05	8.43E-09	7.27E-07	6.91E-07	1.44E-07	8.60E-06
Tongue River Road	1.68E-04	2.60E-05	8.43E-09	7.27E-07	6.91E-07	1.44E-07	8.60E-06
East Tongue River Road	1.40E-04	2.17E-05	7.02E-09	6.06E-07	5.75E-07	1.20E-07	7.17E-06
Tongue River East							
Moon Creek Road	3.08E-04	4.78E-05	1.55E-08	1.34E-06	1.27E-06	2.64E-07	1.58E-05
Snider Creek Road	1.68E-04	2.60E-05	8.43E-09	7.27E-07	6.91E-07	1.44E-07	8.60E-06
Tongue River Road	1.68E-04	2.60E-05	8.43E-09	7.27E-07	6.91E-07	1.44E-07	8.60E-06
I-94	--	--	--	--	--	--	--
Tongue River Road							
I-94	--	--	--	--	--	--	--
US212	--	--	--	--	--	--	--
Tongue River Road	7.89E-04	1.22E-04	3.97E-08	3.42E-06	3.25E-06	6.75E-07	4.05E-05
Liscom Creek Road	1.68E-04	2.60E-05	8.43E-09	7.27E-07	6.91E-07	1.44E-07	8.60E-06
Beaver Creek Road	1.68E-04	2.60E-05	8.43E-09	7.27E-07	6.91E-07	1.44E-07	8.60E-06
East Tongue River Road	1.40E-04	2.17E-05	7.02E-09	6.06E-07	5.75E-07	1.20E-07	7.17E-06
Foster Creek Road	3.64E-04	5.65E-05	1.83E-08	1.58E-06	1.50E-06	3.12E-07	1.87E-05
Tongue River Road East							
I-94	--	--	--	--	--	--	--
US212	--	--	--	--	--	--	--
Tongue River Road	7.89E-04	1.22E-04	3.97E-08	3.42E-06	3.25E-06	6.75E-07	4.05E-05
Liscom Creek Road	1.68E-04	2.60E-05	8.43E-09	7.27E-07	6.91E-07	1.44E-07	8.60E-06
Beaver Creek Road	1.68E-04	2.60E-05	8.43E-09	7.27E-07	6.91E-07	1.44E-07	8.60E-06
Foster Creek Road	3.64E-04	5.65E-05	1.83E-08	1.58E-06	1.50E-06	3.12E-07	1.87E-05

Moon Creek							
Moon Creek Road	3.08E-04	4.78E-05	1.55E-08	1.34E-06	1.27E-06	2.64E-07	1.58E-05
Snider Creek Road	1.68E-04	2.60E-05	8.43E-09	7.27E-07	6.91E-07	1.44E-07	8.60E-06
Tongue River Road	1.68E-04	2.60E-05	8.43E-09	7.27E-07	6.91E-07	1.44E-07	8.60E-06
East Tongue River Road	1.40E-04	2.17E-05	7.02E-09	6.06E-07	5.75E-07	1.20E-07	7.17E-06
I-94	--	--	--	--	--	--	--
US212	--	--	--	--	--	--	--
Moon Creek East							
Moon Creek Road	3.08E-04	4.78E-05	1.55E-08	1.34E-06	1.27E-06	2.64E-07	1.58E-05
Snider Creek Road	1.68E-04	2.60E-05	8.43E-09	7.27E-07	6.91E-07	1.44E-07	8.60E-06
Tongue River Road	1.68E-04	2.60E-05	8.43E-09	7.27E-07	6.91E-07	1.44E-07	8.60E-06
I-94	--	--	--	--	--	--	--
US212	--	--	--	--	--	--	--
Southern Alternatives							
Decker Alternative							
Highway 314	1.80E-03	2.79E-04	9.04E-08	7.80E-06	7.41E-06	1.54E-06	9.23E-05
Four-Mile Creek Road	5.58E-05	8.66E-06	2.81E-09	2.42E-07	2.30E-07	4.78E-08	2.86E-06
Tongue River Road –MP 15.71	9.32E-04	1.45E-04	4.68E-08	4.04E-06	3.84E-06	7.97E-07	4.78E-05
Tongue River Road –MP 16.80	9.32E-04	1.45E-04	4.68E-08	4.04E-06	3.84E-06	7.97E-07	4.78E-05
Tongue River Road –MP 34.76	1.96E-04	3.04E-05	9.84E-09	8.49E-07	8.06E-07	1.68E-07	1.00E-05
Decker East Alternative							
Highway 314	1.80E-03	2.79E-04	9.04E-08	7.80E-06	7.41E-06	1.54E-06	9.23E-05
Four-Mile Creek Road	5.58E-05	8.66E-06	2.81E-09	2.42E-07	2.30E-07	4.78E-08	2.86E-06
Tongue River Road –MP 15.71	9.32E-04	1.45E-04	4.68E-08	4.04E-06	3.84E-06	7.97E-07	4.78E-05
Tongue River Road –MP 16.80	1.96E-04	3.04E-05	9.84E-09	8.49E-07	8.06E-07	1.68E-07	1.00E-05
Tongue River Road –MP 34.76	1.96E-04	3.04E-05	9.84E-09	8.49E-07	8.06E-07	1.68E-07	1.00E-05

Table E.1-69. Grade Crossing Emissions, Low Production Scenario, Northern and Southern Alternatives, Year 2037, Hazardous Pollutants

Crossing	Hazardous Pollutants (tons/year)								Xylene
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Ethylbenzene	Formaldehyde	n-Hexane	Toluene	
Northern Alternatives									
Colstrip									
Cow Creek Road	7.96E-07	1.15E-07	4.19E-07	9.18E-09	7.20E-08	2.47E-07	6.21E-08	3.44E-07	4.36E-07
Rosebud Creek Road	7.96E-07	1.15E-07	4.19E-07	9.18E-09	7.20E-08	2.47E-07	6.21E-08	3.44E-07	4.36E-07
Tongue River Road	1.90E-06	2.74E-07	1.00E-06	2.19E-08	1.72E-07	5.88E-07	1.48E-07	8.21E-07	1.04E-06
East Tongue River Road	4.97E-07	7.16E-08	2.62E-07	5.73E-09	4.49E-08	1.54E-07	3.88E-08	2.15E-07	2.72E-07
US212	--	--	--	--	--	--	--	--	--
Colstrip East									
Cow Creek Road	7.96E-07	1.15E-07	4.19E-07	9.18E-09	7.20E-08	2.47E-07	6.21E-08	3.44E-07	4.36E-07
Rosebud Creek Road	7.96E-07	1.15E-07	4.19E-07	9.18E-09	7.20E-08	2.47E-07	6.21E-08	3.44E-07	4.36E-07
Tongue River Road	1.90E-06	2.74E-07	1.00E-06	2.19E-08	1.72E-07	5.88E-07	1.48E-07	8.21E-07	1.04E-06
US212	--	--	--	--	--	--	--	--	--
Tongue River									
Moon Creek Road	1.10E-06	1.58E-07	5.77E-07	1.26E-08	9.91E-08	3.39E-07	8.55E-08	4.74E-07	6.01E-07
Snider Creek Road	5.97E-07	8.60E-08	3.14E-07	6.88E-09	5.39E-08	1.85E-07	4.66E-08	2.58E-07	3.27E-07
Tongue River Road	5.97E-07	8.60E-08	3.14E-07	6.88E-09	5.39E-08	1.85E-07	4.66E-08	2.58E-07	3.27E-07
East Tongue River Road	4.97E-07	7.16E-08	2.62E-07	5.73E-09	4.49E-08	1.54E-07	3.88E-08	2.15E-07	2.72E-07
Tongue River East									
Moon Creek Road	1.10E-06	1.58E-07	5.77E-07	1.26E-08	9.91E-08	3.39E-07	8.55E-08	4.74E-07	6.01E-07
Snider Creek Road	5.97E-07	8.60E-08	3.14E-07	6.88E-09	5.39E-08	1.85E-07	4.66E-08	2.58E-07	3.27E-07
Tongue River Road	5.97E-07	8.60E-08	3.14E-07	6.88E-09	5.39E-08	1.85E-07	4.66E-08	2.58E-07	3.27E-07
I-94	--	--	--	--	--	--	--	--	--
Tongue River Road									
I-94	--	--	--	--	--	--	--	--	--
US212	--	--	--	--	--	--	--	--	--
Tongue River Road	2.81E-06	4.04E-07	1.48E-06	3.24E-08	2.54E-07	8.69E-07	2.19E-07	1.21E-06	1.54E-06
Liscom Creek Road	5.97E-07	8.60E-08	3.14E-07	6.88E-09	5.39E-08	1.85E-07	4.66E-08	2.58E-07	3.27E-07
Beaver Creek Road	5.97E-07	8.60E-08	3.14E-07	6.88E-09	5.39E-08	1.85E-07	4.66E-08	2.58E-07	3.27E-07
East Tongue River Road	4.97E-07	7.16E-08	2.62E-07	5.73E-09	4.49E-08	1.54E-07	3.88E-08	2.15E-07	2.72E-07
Foster Creek Road	1.30E-06	1.87E-07	6.83E-07	1.50E-08	1.17E-07	4.01E-07	1.01E-07	5.61E-07	7.10E-07
Tongue River Road East									
I-94	--	--	--	--	--	--	--	--	--
US212	--	--	--	--	--	--	--	--	--
Tongue River Road	2.81E-06	4.04E-07	1.48E-06	3.24E-08	2.54E-07	8.69E-07	2.19E-07	1.21E-06	1.54E-06
Liscom Creek Road	5.97E-07	8.60E-08	3.14E-07	6.88E-09	5.39E-08	1.85E-07	4.66E-08	2.58E-07	3.27E-07
Beaver Creek Road	5.97E-07	8.60E-08	3.14E-07	6.88E-09	5.39E-08	1.85E-07	4.66E-08	2.58E-07	3.27E-07

Crossing	Hazardous Pollutants (tons/year)								
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Ethylbenzene	Formaldehyde	n-Hexane	Toluene	Xylene
Foster Creek Road	1.30E-06	1.87E-07	6.83E-07	1.50E-08	1.17E-07	4.01E-07	1.01E-07	5.61E-07	7.10E-07
Moon Creek									
Moon Creek Road	1.10E-06	1.58E-07	5.77E-07	1.26E-08	9.91E-08	3.39E-07	8.55E-08	4.74E-07	6.01E-07
Snider Creek Road	5.97E-07	8.60E-08	3.14E-07	6.88E-09	5.39E-08	1.85E-07	4.66E-08	2.58E-07	3.27E-07
Tongue River Road	5.97E-07	8.60E-08	3.14E-07	6.88E-09	5.39E-08	1.85E-07	4.66E-08	2.58E-07	3.27E-07
East Tongue River Road	4.97E-07	7.16E-08	2.62E-07	5.73E-09	4.49E-08	1.54E-07	3.88E-08	2.15E-07	2.72E-07
I-94	--	--	--	--	--	--	--	--	--
US212	--	--	--	--	--	--	--	--	--
Moon Creek East									
Moon Creek Road	1.10E-06	1.58E-07	5.77E-07	1.26E-08	9.91E-08	3.39E-07	8.55E-08	4.74E-07	6.01E-07
Snider Creek Road	5.97E-07	8.60E-08	3.14E-07	6.88E-09	5.39E-08	1.85E-07	4.66E-08	2.58E-07	3.27E-07
Tongue River Road	5.97E-07	8.60E-08	3.14E-07	6.88E-09	5.39E-08	1.85E-07	4.66E-08	2.58E-07	3.27E-07
I-94	--	--	--	--	--	--	--	--	--
US212	--	--	--	--	--	--	--	--	--
Southern Alternatives									
Decker Alternative									
Highway 314	6.40E-06	9.22E-07	3.37E-06	7.38E-08	5.79E-07	1.98E-06	4.99E-07	2.77E-06	3.51E-06
Four-Mile Creek Road	1.99E-07	2.86E-08	1.05E-07	2.29E-09	1.80E-08	6.15E-08	1.55E-08	8.59E-08	1.09E-07
Tongue River Road –MP 15.71	3.31E-06	4.78E-07	1.75E-06	3.82E-08	3.00E-07	1.03E-06	2.59E-07	1.43E-06	1.82E-06
Tongue River Road –MP 16.80	3.31E-06	4.78E-07	1.75E-06	3.82E-08	3.00E-07	1.03E-06	2.59E-07	1.43E-06	1.82E-06
Tongue River Road –MP 34.76	6.96E-07	1.00E-07	3.67E-07	8.03E-09	6.30E-08	2.16E-07	5.43E-08	3.01E-07	3.82E-07
Decker East Alternative									
Highway 314	6.40E-06	9.22E-07	3.37E-06	7.38E-08	5.79E-07	1.98E-06	4.99E-07	2.77E-06	3.51E-06
Four-Mile Creek Road	1.99E-07	2.86E-08	1.05E-07	2.29E-09	1.80E-08	6.15E-08	1.55E-08	8.59E-08	1.09E-07
Tongue River Road –MP 15.71	3.31E-06	4.78E-07	1.75E-06	3.82E-08	3.00E-07	1.03E-06	2.59E-07	1.43E-06	1.82E-06
Tongue River Road –MP 16.80	6.96E-07	1.00E-07	3.67E-07	8.03E-09	6.30E-08	2.16E-07	5.43E-08	3.01E-07	3.82E-07
Tongue River Road –MP 34.76	6.96E-07	1.00E-07	3.67E-07	8.03E-09	6.30E-08	2.16E-07	5.43E-08	3.01E-07	3.82E-07

Table E.1-70. Grade Crossing Emissions, Low Production Scenario, Northern and Southern Alternatives, Year 2037, Greenhouse Gas Emissions

Crossing	Greenhouse Gas Emissions (tons/year)			
	CO ₂	CH ₄	N ₂ O	CO ₂ e
Northern Alternatives				
Colstrip				
Cow Creek Road	1.30E-02	1.10E-06	3.44E-07	1.31E-02
Rosebud Creek Road	1.30E-02	1.10E-06	3.44E-07	1.31E-02
Tongue River Road	3.10E-02	2.63E-06	8.22E-07	3.13E-02
East Tongue River Road	8.12E-03	6.87E-07	2.15E-07	8.20E-03
US212	--	--	--	--
Colstrip East				
Cow Creek Road	1.30E-02	1.10E-06	3.44E-07	1.31E-02
Rosebud Creek Road	1.30E-02	1.10E-06	3.44E-07	1.31E-02
Tongue River Road	3.10E-02	2.63E-06	8.22E-07	3.13E-02
US212	--	--	--	--
Tongue River				
Moon Creek Road	1.79E-02	1.52E-06	4.74E-07	1.81E-02
Snider Creek Road	9.74E-03	8.25E-07	2.58E-07	9.84E-03
Tongue River Road	9.74E-03	8.25E-07	2.58E-07	9.84E-03
East Tongue River Road	8.12E-03	6.87E-07	2.15E-07	8.20E-03
Tongue River East				
Moon Creek Road	1.79E-02	1.52E-06	4.74E-07	1.81E-02
Snider Creek Road	9.74E-03	8.25E-07	2.58E-07	9.84E-03
Tongue River Road	9.74E-03	8.25E-07	2.58E-07	9.84E-03
Tongue River Road				
I-94	--	--	--	--
US212	--	--	--	--
Tongue River Road	4.58E-02	3.88E-06	1.21E-06	4.63E-02
Liscom Creek Road	9.74E-03	8.25E-07	2.58E-07	9.84E-03
Beaver Creek Road	9.74E-03	8.25E-07	2.58E-07	9.84E-03
East Tongue River Road	8.12E-03	6.87E-07	2.15E-07	8.20E-03
Foster Creek Road	2.12E-02	1.79E-06	5.61E-07	2.14E-02
Tongue River Road East				
I-94	--	--	--	--
US212	--	--	--	--
Tongue River Road	4.58E-02	3.88E-06	1.21E-06	4.63E-02
Liscom Creek Road	9.74E-03	8.25E-07	2.58E-07	9.84E-03
Beaver Creek Road	9.74E-03	8.25E-07	2.58E-07	9.84E-03
Foster Creek Road	2.12E-02	1.79E-06	5.61E-07	2.14E-02
Moon Creek				
Moon Creek Road	1.79E-02	1.52E-06	4.74E-07	1.81E-02
Snider Creek Road	9.74E-03	8.25E-07	2.58E-07	9.84E-03
Tongue River Road	9.74E-03	8.25E-07	2.58E-07	9.84E-03
East Tongue River Road	8.12E-03	6.87E-07	2.15E-07	8.20E-03
I-94	--	--	--	--
US212	--	--	--	--
Moon Creek East				
Moon Creek Road	1.79E-02	1.52E-06	4.74E-07	1.81E-02
Snider Creek Road	9.74E-03	8.25E-07	2.58E-07	9.84E-03
Tongue River Road	9.74E-03	8.25E-07	2.58E-07	9.84E-03

Crossing	Greenhouse Gas Emissions (tons/year)			
	CO ₂	CH ₄	N ₂ O	CO ₂ e
I-94	--	--	--	--
US212	--	--	--	--
Southern Alternatives				
Decker Alternative				
Highway 314	1.05E-01	8.85E-06	2.77E-06	1.06E-01
Four-Mile Creek Road	3.24E-03	2.75E-07	8.59E-08	3.28E-03
Tongue River Road (MP 15.71)	5.41E-02	4.58E-06	1.43E-06	5.47E-02
Tongue River Road (MP 16.80)	5.41E-02	4.58E-06	1.43E-06	5.47E-02
Tongue River Road (MP 34.76)	1.14E-02	9.63E-07	3.01E-07	1.15E-02
Decker East Alternative				
Highway 314	1.05E-01	8.85E-06	2.77E-06	1.06E-01
Four-Mile Creek Road	3.24E-03	2.75E-07	8.59E-08	3.28E-03
Tongue River Road (MP 17.26)	5.41E-02	4.58E-06	1.43E-06	5.47E-02
Tongue River Road (MP 36.17)	1.14E-02	9.63E-07	3.01E-07	1.15E-02
Tongue River Road (MP 40.15)	1.14E-02	9.63E-07	3.01E-07	1.15E-02

Table E.1-71. Grade Crossing Emissions, Medium Production Scenario, Northern and Southern Alternatives, Year 2037, Criteria Pollutants

Crossing	Criteria Pollutants (tons/year)						
	CO	NOx	Pb	PM10	PM2.5	SO2	VOC
Northern Alternatives							
Colstrip							
Cow Creek Road	3.60E-04	5.58E-05	1.81E-08	1.56E-06	1.48E-06	3.08E-07	1.85E-05
Rosebud Creek Road	3.60E-04	5.58E-05	1.81E-08	1.56E-06	1.48E-06	3.08E-07	1.85E-05
Tongue River Road	8.58E-04	1.33E-04	4.31E-08	3.72E-06	3.54E-06	7.34E-07	4.40E-05
East Tongue River Road	2.25E-04	3.48E-05	1.13E-08	9.74E-07	9.25E-07	1.92E-07	1.15E-05
US212	--	--	--	--	--	--	--
Colstrip East							
Cow Creek Road	3.60E-04	5.58E-05	1.81E-08	1.56E-06	1.48E-06	3.08E-07	1.85E-05
Rosebud Creek Road	3.60E-04	5.58E-05	1.81E-08	1.56E-06	1.48E-06	3.08E-07	1.85E-05
Tongue River Road	8.58E-04	1.33E-04	4.31E-08	3.72E-06	3.54E-06	7.34E-07	4.40E-05
US212	--	--	--	--	--	--	--
Tongue River							
Moon Creek Road	4.95E-04	7.68E-05	2.49E-08	2.15E-06	2.04E-06	4.24E-07	2.54E-05
Snider Creek Road	2.70E-04	4.18E-05	1.36E-08	1.17E-06	1.11E-06	2.31E-07	1.38E-05
Tongue River Road	2.70E-04	4.18E-05	1.36E-08	1.17E-06	1.11E-06	2.31E-07	1.38E-05
East Tongue River Road	2.25E-04	3.48E-05	1.13E-08	9.74E-07	9.25E-07	1.92E-07	1.15E-05
I-94	--	--	--	--	--	--	--
Tongue River East							
Moon Creek Road	4.95E-04	7.68E-05	2.49E-08	2.15E-06	2.04E-06	4.24E-07	2.54E-05
Snider Creek Road	2.70E-04	4.18E-05	1.36E-08	1.17E-06	1.11E-06	2.31E-07	1.38E-05
Tongue River Road	2.70E-04	4.18E-05	1.36E-08	1.17E-06	1.11E-06	2.31E-07	1.38E-05
I-94	--	--	--	--	--	--	--
Tongue River Road							
I-94	--	--	--	--	--	--	--
US212	--	--	--	--	--	--	--
Tongue River Road	1.27E-03	1.97E-04	6.38E-08	5.50E-06	5.23E-06	1.09E-06	6.51E-05
Liscom Creek Road	2.70E-04	4.18E-05	1.36E-08	1.17E-06	1.11E-06	2.31E-07	1.38E-05
Beaver Creek Road	2.70E-04	4.18E-05	1.36E-08	1.17E-06	1.11E-06	2.31E-07	1.38E-05
East Tongue River Road	2.25E-04	3.48E-05	1.13E-08	9.74E-07	9.25E-07	1.92E-07	1.15E-05
Foster Creek Road	5.86E-04	9.09E-05	2.95E-08	2.54E-06	2.41E-06	5.01E-07	3.01E-05
Tongue River Road East							
I-94	--	--	--	--	--	--	--
US212	--	--	--	--	--	--	--
Tongue River Road	1.27E-03	1.97E-04	6.38E-08	5.50E-06	5.23E-06	1.09E-06	6.51E-05
Liscom Creek Road	2.70E-04	4.18E-05	1.36E-08	1.17E-06	1.11E-06	2.31E-07	1.38E-05
Beaver Creek Road	2.70E-04	4.18E-05	1.36E-08	1.17E-06	1.11E-06	2.31E-07	1.38E-05
Foster Creek Road	5.86E-04	9.09E-05	2.95E-08	2.54E-06	2.41E-06	5.01E-07	3.01E-05
Moon Creek							
Moon Creek Road	4.95E-04	7.68E-05	2.49E-08	2.15E-06	2.04E-06	4.24E-07	2.54E-05
Snider Creek Road	2.70E-04	4.18E-05	1.36E-08	1.17E-06	1.11E-06	2.31E-07	1.38E-05
Tongue River Road	2.70E-04	4.18E-05	1.36E-08	1.17E-06	1.11E-06	2.31E-07	1.38E-05
East Tongue River Road	2.25E-04	3.48E-05	1.13E-08	9.74E-07	9.25E-07	1.92E-07	1.15E-05
I-94	--	--	--	--	--	--	--
US212	--	--	--	--	--	--	--
Moon Creek East							

Crossing	Criteria Pollutants (tons/year)						
	CO	NO _x	Pb	PM10	PM2.5	SO ₂	VOC
Moon Creek Road	4.95E-04	7.68E-05	2.49E-08	2.15E-06	2.04E-06	4.24E-07	2.54E-05
Snider Creek Road	2.70E-04	4.18E-05	1.36E-08	1.17E-06	1.11E-06	2.31E-07	1.38E-05
Tongue River Road	2.70E-04	4.18E-05	1.36E-08	1.17E-06	1.11E-06	2.31E-07	1.38E-05
I-94	--	--	--	--	--	--	--
US212	--	--	--	--	--	--	--
Southern Alternatives							
Decker Alternative							
Highway 314	2.73E-03	4.23E-04	1.37E-07	1.18E-05	1.12E-05	2.33E-06	1.40E-04
Four-Mile Creek Road	8.48E-05	1.31E-05	4.26E-09	3.67E-07	3.49E-07	7.25E-08	4.35E-06
Tongue River Road –MP 15.71	1.41E-03	2.19E-04	7.11E-08	6.13E-06	5.82E-06	1.21E-06	7.25E-05
Tongue River Road –MP 16.80	1.41E-03	2.19E-04	7.11E-08	6.13E-06	5.82E-06	1.21E-06	7.25E-05
Tongue River Road –MP 34.76	2.97E-04	4.61E-05	1.49E-08	1.29E-06	1.22E-06	2.54E-07	1.52E-05
Decker East Alternative							
Highway 314	2.73E-03	4.23E-04	1.37E-07	1.18E-05	1.12E-05	2.33E-06	1.40E-04
Four-Mile Creek Road	8.48E-05	1.31E-05	4.26E-09	3.67E-07	3.49E-07	7.25E-08	4.35E-06
Tongue River Road –MP 15.71	1.41E-03	2.19E-04	7.11E-08	6.13E-06	5.82E-06	1.21E-06	7.25E-05
Tongue River Road –MP 16.80	2.97E-04	4.61E-05	1.49E-08	1.29E-06	1.22E-06	2.54E-07	1.52E-05
Tongue River Road –MP 34.76	2.97E-04	4.61E-05	1.49E-08	1.29E-06	1.22E-06	2.54E-07	1.52E-05

Table E.1-72. Grade Crossing Emissions, Medium Production Scenario, Northern and Southern Alternatives, Year 2037, Hazardous Pollutants

Crossing	Hazardous Pollutants (tons/year)								
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Ethylbenzene	Formaldehyde	n-Hexane	Toluene	Xylene
Northern Alternatives									
Colstrip									
Cow Creek Road	1.28E-06	1.84E-07	6.74E-07	1.48E-08	1.16E-07	3.96E-07	9.99E-08	5.54E-07	7.02E-07
Rosebud Creek Road	1.28E-06	1.84E-07	6.74E-07	1.48E-08	1.16E-07	3.96E-07	9.99E-08	5.54E-07	7.02E-07
Tongue River Road	3.05E-06	4.40E-07	1.61E-06	3.52E-08	2.76E-07	9.46E-07	2.38E-07	1.32E-06	1.67E-06
East Tongue River Road	7.99E-07	1.15E-07	4.21E-07	9.22E-09	7.23E-08	2.48E-07	6.24E-08	3.46E-07	4.38E-07
US212	--	--	--	--	--	--	--	--	--
Colstrip East									
Cow Creek Road	1.28E-06	1.84E-07	6.74E-07	1.48E-08	1.16E-07	3.96E-07	9.99E-08	5.54E-07	7.02E-07
Rosebud Creek Road	1.28E-06	1.84E-07	6.74E-07	1.48E-08	1.16E-07	3.96E-07	9.99E-08	5.54E-07	7.02E-07
Tongue River Road	3.05E-06	4.40E-07	1.61E-06	3.52E-08	2.76E-07	9.46E-07	2.38E-07	1.32E-06	1.67E-06
US212	--	--	--	--	--	--	--	--	--
Tongue River									
Moon Creek Road	1.76E-06	2.54E-07	9.28E-07	2.03E-08	1.59E-07	5.46E-07	1.37E-07	7.62E-07	9.66E-07
Snider Creek Road	9.59E-07	1.38E-07	5.05E-07	1.11E-08	8.68E-08	2.97E-07	7.49E-08	4.15E-07	5.26E-07
Tongue River Road	9.59E-07	1.38E-07	5.05E-07	1.11E-08	8.68E-08	2.97E-07	7.49E-08	4.15E-07	5.26E-07
East Tongue River Road	7.99E-07	1.15E-07	4.21E-07	9.22E-09	7.23E-08	2.48E-07	6.24E-08	3.46E-07	4.38E-07
I-94	--	--	--	--	--	--	--	--	--
Tongue River East									
Moon Creek Road	1.76E-06	2.54E-07	9.28E-07	2.03E-08	1.59E-07	5.46E-07	1.37E-07	7.62E-07	9.66E-07
Snider Creek Road	9.59E-07	1.38E-07	5.05E-07	1.11E-08	8.68E-08	2.97E-07	7.49E-08	4.15E-07	5.26E-07
Tongue River Road	9.59E-07	1.38E-07	5.05E-07	1.11E-08	8.68E-08	2.97E-07	7.49E-08	4.15E-07	5.26E-07
I-94	--	--	--	--	--	--	--	--	--
Tongue River Road									
I-94	--	--	--	--	--	--	--	--	--
US212	--	--	--	--	--	--	--	--	--
Tongue River Road	4.51E-06	6.50E-07	2.38E-06	5.21E-08	4.08E-07	1.40E-06	3.52E-07	1.95E-06	2.47E-06
Liscom Creek Road	9.59E-07	1.38E-07	5.05E-07	1.11E-08	8.68E-08	2.97E-07	7.49E-08	4.15E-07	5.26E-07
Beaver Creek Road	9.59E-07	1.38E-07	5.05E-07	1.11E-08	8.68E-08	2.97E-07	7.49E-08	4.15E-07	5.26E-07
East Tongue River Road	7.99E-07	1.15E-07	4.21E-07	9.22E-09	7.23E-08	2.48E-07	6.24E-08	3.46E-07	4.38E-07
Foster Creek Road	2.08E-06	3.00E-07	1.10E-06	2.40E-08	1.88E-07	6.46E-07	1.63E-07	9.01E-07	1.14E-06
Tongue River Road East									
I-94	--	--	--	--	--	--	--	--	--
US212	--	--	--	--	--	--	--	--	--
Tongue River Road	4.51E-06	6.50E-07	2.38E-06	5.21E-08	4.08E-07	1.40E-06	3.52E-07	1.95E-06	2.47E-06
Liscom Creek Road	9.59E-07	1.38E-07	5.05E-07	1.11E-08	8.68E-08	2.97E-07	7.49E-08	4.15E-07	5.26E-07
Beaver Creek Road	9.59E-07	1.38E-07	5.05E-07	1.11E-08	8.68E-08	2.97E-07	7.49E-08	4.15E-07	5.26E-07

Crossing	Hazardous Pollutants (tons/year)								
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Ethylbenzene	Formaldehyde	n-Hexane	Toluene	Xylene
Foster Creek Road	2.08E-06	3.00E-07	1.10E-06	2.40E-08	1.88E-07	6.46E-07	1.63E-07	9.01E-07	1.14E-06
Moon Creek									
Moon Creek Road	1.76E-06	2.54E-07	9.28E-07	2.03E-08	1.59E-07	5.46E-07	1.37E-07	7.62E-07	9.66E-07
Snider Creek Road	9.59E-07	1.38E-07	5.05E-07	1.11E-08	8.68E-08	2.97E-07	7.49E-08	4.15E-07	5.26E-07
Tongue River Road	9.59E-07	1.38E-07	5.05E-07	1.11E-08	8.68E-08	2.97E-07	7.49E-08	4.15E-07	5.26E-07
East Tongue River Road	7.99E-07	1.15E-07	4.21E-07	9.22E-09	7.23E-08	2.48E-07	6.24E-08	3.46E-07	4.38E-07
I-94	--	--	--	--	--	--	--	--	--
US212	--	--	--	--	--	--	--	--	--
Moon Creek East									
Moon Creek Road	1.76E-06	2.54E-07	9.28E-07	2.03E-08	1.59E-07	5.46E-07	1.37E-07	7.62E-07	9.66E-07
Snider Creek Road	9.59E-07	1.38E-07	5.05E-07	1.11E-08	8.68E-08	2.97E-07	7.49E-08	4.15E-07	5.26E-07
Tongue River Road	9.59E-07	1.38E-07	5.05E-07	1.11E-08	8.68E-08	2.97E-07	7.49E-08	4.15E-07	5.26E-07
I-94	--	--	--	--	--	--	--	--	--
US212	--	--	--	--	--	--	--	--	--
Southern Alternatives									
Decker Alternative									
Highway 314	9.70E-06	1.40E-06	5.11E-06	1.12E-07	8.77E-07	3.01E-06	7.57E-07	4.20E-06	5.32E-06
Four-Mile Creek Road	3.01E-07	4.34E-08	1.59E-07	3.48E-09	2.73E-08	9.34E-08	2.35E-08	1.30E-07	1.65E-07
Tongue River Road – MP 15.71	5.03E-06	7.24E-07	2.65E-06	5.80E-08	4.55E-07	1.56E-06	3.92E-07	2.17E-06	2.76E-06
Tongue River Road – MP 16.80	5.03E-06	7.24E-07	2.65E-06	5.80E-08	4.55E-07	1.56E-06	3.92E-07	2.17E-06	2.76E-06
Tongue River Road – MP 34.76	1.06E-06	1.52E-07	5.57E-07	1.22E-08	9.56E-08	3.27E-07	8.25E-08	4.57E-07	5.79E-07
Decker East Alternative									
Highway 314	9.70E-06	1.40E-06	5.11E-06	1.12E-07	8.77E-07	3.01E-06	7.57E-07	4.20E-06	5.32E-06
Four-Mile Creek Road	3.01E-07	4.34E-08	1.59E-07	3.48E-09	2.73E-08	9.34E-08	2.35E-08	1.30E-07	1.65E-07
Tongue River Road – MP 15.71	5.03E-06	7.24E-07	2.65E-06	5.80E-08	4.55E-07	1.56E-06	3.92E-07	2.17E-06	2.76E-06
Tongue River Road – MP 16.80	1.06E-06	1.52E-07	5.57E-07	1.22E-08	9.56E-08	3.27E-07	8.25E-08	4.57E-07	5.79E-07
Tongue River Road – MP 34.76	1.06E-06	1.52E-07	5.57E-07	1.22E-08	9.56E-08	3.27E-07	8.25E-08	4.57E-07	5.79E-07

Table E.1-73. Grade Crossing Emissions, Medium Production Scenario, Northern and Southern Alternatives, Year 2037, Greenhouse Gas Emissions

Crossing	Greenhouse Gas Emissions (tons/year)			
	CO ₂	CH ₄	N ₂ O	CO ₂ e
Northern Alternatives				
Colstrip				
Cow Creek Road	2.09E-02	1.77E-06	5.54E-07	2.11E-02
Rosebud Creek Road	2.09E-02	1.77E-06	5.54E-07	2.11E-02
Tongue River Road	4.99E-02	4.22E-06	1.32E-06	5.04E-02
East Tongue River Road	1.31E-02	1.11E-06	3.46E-07	1.32E-02
US212	--	--	--	--
Colstrip East				
Cow Creek Road	2.09E-02	1.77E-06	5.54E-07	2.11E-02
Rosebud Creek Road	2.09E-02	1.77E-06	5.54E-07	2.11E-02
Tongue River Road	4.99E-02	4.22E-06	1.32E-06	5.04E-02
US212	--	--	--	--
Tongue River				
Moon Creek Road	2.88E-02	2.44E-06	7.63E-07	2.91E-02
Snider Creek Road	1.57E-02	1.33E-06	4.15E-07	1.58E-02
Tongue River Road	1.57E-02	1.33E-06	4.15E-07	1.58E-02
East Tongue River Road	1.31E-02	1.11E-06	3.46E-07	1.32E-02
Tongue River East				
Moon Creek Road	2.88E-02	2.44E-06	7.63E-07	2.91E-02
Snider Creek Road	1.57E-02	1.33E-06	4.15E-07	1.58E-02
Tongue River Road	1.57E-02	1.33E-06	4.15E-07	1.58E-02
Tongue River Road				
I-94	--	--	--	--
US212	--	--	--	--
Tongue River Road	7.37E-02	6.24E-06	1.95E-06	7.45E-02
Liscom Creek Road	1.57E-02	1.33E-06	4.15E-07	1.58E-02
Beaver Creek Road	1.57E-02	1.33E-06	4.15E-07	1.58E-02
East Tongue River Road	1.31E-02	1.11E-06	3.46E-07	1.32E-02
Foster Creek Road	3.40E-02	2.88E-06	9.02E-07	3.44E-02
Tongue River Road East				
I-94	--	--	--	--
US212	--	--	--	--
Tongue River Road	7.37E-02	6.24E-06	1.95E-06	7.45E-02
Liscom Creek Road	1.57E-02	1.33E-06	4.15E-07	1.58E-02
Beaver Creek Road	1.57E-02	1.33E-06	4.15E-07	1.58E-02
Foster Creek Road	3.40E-02	2.88E-06	9.02E-07	3.44E-02
Moon Creek				
Moon Creek Road	2.88E-02	2.44E-06	7.63E-07	2.91E-02
Snider Creek Road	1.57E-02	1.33E-06	4.15E-07	1.58E-02
Tongue River Road	1.57E-02	1.33E-06	4.15E-07	1.58E-02
East Tongue River Road	1.31E-02	1.11E-06	3.46E-07	1.32E-02
I-94	--	--	--	--
US212	--	--	--	--
Moon Creek East				
Moon Creek Road	2.88E-02	2.44E-06	7.63E-07	2.91E-02
Snider Creek Road	1.57E-02	1.33E-06	4.15E-07	1.58E-02
Tongue River Road	1.57E-02	1.33E-06	4.15E-07	1.58E-02

Crossing	Greenhouse Gas Emissions (tons/year)			
	CO ₂	CH ₄	N ₂ O	CO ₂ e
I-94	--	--	--	--
US212	--	--	--	--
Southern Alternatives				
Decker Alternative				
Highway 314	1.58E-01	1.34E-05	4.20E-06	1.60E-01
Four-Mile Creek Road	4.92E-03	4.17E-07	1.30E-07	4.97E-03
Tongue River Road (MP 15.71)	8.21E-02	6.95E-06	2.18E-06	8.29E-02
Tongue River Road (MP 16.80)	8.21E-02	6.95E-06	2.18E-06	8.29E-02
Tongue River Road (MP 34.76)	1.73E-02	1.46E-06	4.57E-07	1.74E-02
Decker East Alternative				
Highway 314	1.58E-01	1.34E-05	4.20E-06	1.60E-01
Four-Mile Creek Road	4.92E-03	4.17E-07	1.30E-07	4.97E-03
Tongue River Road (MP 17.26)	8.21E-02	6.95E-06	2.18E-06	8.29E-02
Tongue River Road (MP 36.17)	1.73E-02	1.46E-06	4.57E-07	1.74E-02
Tongue River Road (MP 40.15)	1.73E-02	1.46E-06	4.57E-07	1.74E-02

Table E.1-74. Grade Crossing Emissions, High Production Scenario, Northern and Southern Alternatives, Year 2037, Criteria Pollutants

Crossing	Criteria Pollutants (tons/year)						
	CO	NOx	Pb	PM10	PM2.5	SO2	VOC
Northern Alternatives							
Colstrip							
Cow Creek Road	4.50E-04	6.97E-05	2.26E-08	1.95E-06	1.85E-06	3.85E-07	2.31E-05
Rosebud Creek Road	4.50E-04	6.97E-05	2.26E-08	1.95E-06	1.85E-06	3.85E-07	2.31E-05
Tongue River Road	1.07E-03	1.66E-04	5.39E-08	4.65E-06	4.41E-06	9.17E-07	5.50E-05
East Tongue River Road	2.81E-04	4.36E-05	1.41E-08	1.22E-06	1.16E-06	2.40E-07	1.44E-05
US212	--	--	--	--	--	--	--
Colstrip East							
Cow Creek Road	4.50E-04	6.97E-05	2.26E-08	1.95E-06	1.85E-06	3.85E-07	2.31E-05
Rosebud Creek Road	4.50E-04	6.97E-05	2.26E-08	1.95E-06	1.85E-06	3.85E-07	2.31E-05
Tongue River Road	1.07E-03	1.66E-04	5.39E-08	4.65E-06	4.41E-06	9.17E-07	5.50E-05
US212	--	--	--	--	--	--	--
Tongue River							
Moon Creek Road	7.74E-04	1.20E-04	3.89E-08	3.36E-06	3.19E-06	6.63E-07	3.97E-05
Snider Creek Road	4.22E-04	6.54E-05	2.12E-08	1.83E-06	1.74E-06	3.61E-07	2.16E-05
Tongue River Road	4.22E-04	6.54E-05	2.12E-08	1.83E-06	1.74E-06	3.61E-07	2.16E-05
East Tongue River Road	3.51E-04	5.45E-05	1.77E-08	1.52E-06	1.45E-06	3.01E-07	1.80E-05
I-94	--	--	--	--	--	--	--
Tongue River East							
Moon Creek Road	7.74E-04	1.20E-04	3.89E-08	3.36E-06	3.19E-06	6.63E-07	3.97E-05
Snider Creek Road	4.22E-04	6.54E-05	2.12E-08	1.83E-06	1.74E-06	3.61E-07	2.16E-05
Tongue River Road	4.22E-04	6.54E-05	2.12E-08	1.83E-06	1.74E-06	3.61E-07	2.16E-05
I-94	--	--	--	--	--	--	--
Tongue River Road							
I-94	--	--	--	--	--	--	--
US212	--	--	--	--	--	--	--
Tongue River Road	1.98E-03	3.08E-04	9.97E-08	8.60E-06	8.17E-06	1.70E-06	1.02E-04
Liscom Creek Road	4.22E-04	6.54E-05	2.12E-08	1.83E-06	1.74E-06	3.61E-07	2.16E-05
Beaver Creek Road	4.22E-04	6.54E-05	2.12E-08	1.83E-06	1.74E-06	3.61E-07	2.16E-05
East Tongue River Road	3.51E-04	5.45E-05	1.77E-08	1.52E-06	1.45E-06	3.01E-07	1.80E-05
Foster Creek Road	9.16E-04	1.42E-04	4.60E-08	3.97E-06	3.77E-06	7.84E-07	4.70E-05
Tongue River Road East							
I-94	--	--	--	--	--	--	--
US212	--	--	--	--	--	--	--
Tongue River Road	1.98E-03	3.08E-04	9.97E-08	8.60E-06	8.17E-06	1.70E-06	1.02E-04
Liscom Creek Road	4.22E-04	6.54E-05	2.12E-08	1.83E-06	1.74E-06	3.61E-07	2.16E-05
Beaver Creek Road	4.22E-04	6.54E-05	2.12E-08	1.83E-06	1.74E-06	3.61E-07	2.16E-05
Foster Creek Road	9.16E-04	1.42E-04	4.60E-08	3.97E-06	3.77E-06	7.84E-07	4.70E-05
Moon Creek							
Moon Creek Road	7.74E-04	1.20E-04	3.89E-08	3.36E-06	3.19E-06	6.63E-07	3.97E-05
Snider Creek Road	4.22E-04	6.54E-05	2.12E-08	1.83E-06	1.74E-06	3.61E-07	2.16E-05
Tongue River Road	4.22E-04	6.54E-05	2.12E-08	1.83E-06	1.74E-06	3.61E-07	2.16E-05
East Tongue River Road	3.51E-04	5.45E-05	1.77E-08	1.52E-06	1.45E-06	3.01E-07	1.80E-05
I-94	--	--	--	--	--	--	--
US212	--	--	--	--	--	--	--
Moon Creek East							

Crossing	Criteria Pollutants (tons/year)						
	CO	NOx	Pb	PM10	PM2.5	SO2	VOC
Moon Creek Road	7.74E-04	1.20E-04	3.89E-08	3.36E-06	3.19E-06	6.63E-07	3.97E-05
Snider Creek Road	4.22E-04	6.54E-05	2.12E-08	1.83E-06	1.74E-06	3.61E-07	2.16E-05
Tongue River Road	4.22E-04	6.54E-05	2.12E-08	1.83E-06	1.74E-06	3.61E-07	2.16E-05
I-94	--	--	--	--	--	--	--
US212	--	--	--	--	--	--	--
Southern Alternatives							
Decker Alternative							
Highway 314	6.49E-03	1.01E-03	3.26E-07	2.82E-05	2.67E-05	5.56E-06	3.33E-04
Four-Mile Creek Road	2.01E-04	3.12E-05	1.01E-08	8.73E-07	8.30E-07	1.72E-07	1.03E-05
Tongue River Road – MP 15.71	3.36E-03	5.21E-04	1.69E-07	1.46E-05	1.38E-05	2.88E-06	1.72E-04
Tongue River Road – MP 16.80	3.36E-03	5.21E-04	1.69E-07	1.46E-05	1.38E-05	2.88E-06	1.72E-04
Tongue River Road – MP 34.76	7.06E-04	1.10E-04	3.55E-08	3.06E-06	2.91E-06	6.04E-07	3.62E-05
Decker East Alternative							
Highway 314	6.49E-03	1.01E-03	3.26E-07	2.82E-05	2.67E-05	5.56E-06	3.33E-04
Four-Mile Creek Road	2.01E-04	3.12E-05	1.01E-08	8.73E-07	8.30E-07	1.72E-07	1.03E-05
Tongue River Road – MP 15.71	3.36E-03	5.21E-04	1.69E-07	1.46E-05	1.38E-05	2.88E-06	1.72E-04
Tongue River Road – MP 16.80	7.06E-04	1.10E-04	3.55E-08	3.06E-06	2.91E-06	6.04E-07	3.62E-05
Tongue River Road – MP 34.76	7.06E-04	1.10E-04	3.55E-08	3.06E-06	2.91E-06	6.04E-07	3.62E-05

Table E.1-75. Grade Crossing Emissions, High Production Scenario, Northern and Southern Alternatives, Year 2037, Hazardous Pollutants

Crossing	Hazardous Pollutants (tons/year)								
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Ethylbenzene	Formaldehyde	n-Hexane	Toluene	Xylene
Northern Alternatives									
Colstrip									
Cow Creek Road	1.60E-06	2.30E-07	8.43E-07	1.85E-08	1.45E-07	4.95E-07	1.25E-07	6.92E-07	8.77E-07
Rosebud Creek Road	1.60E-06	2.30E-07	8.43E-07	1.85E-08	1.45E-07	4.95E-07	1.25E-07	6.92E-07	8.77E-07
Tongue River Road	3.81E-06	5.49E-07	2.01E-06	4.40E-08	3.45E-07	1.18E-06	2.97E-07	1.65E-06	2.09E-06
East Tongue River Road	9.99E-07	1.44E-07	5.26E-07	1.15E-08	9.03E-08	3.09E-07	7.79E-08	4.32E-07	5.47E-07
US212	--	--	--	--	--	--	--	--	--
Colstrip East									
Cow Creek Road	1.60E-06	2.30E-07	8.43E-07	1.85E-08	1.45E-07	4.95E-07	1.25E-07	6.92E-07	8.77E-07
Rosebud Creek Road	1.60E-06	2.30E-07	8.43E-07	1.85E-08	1.45E-07	4.95E-07	1.25E-07	6.92E-07	8.77E-07
Tongue River Road	3.81E-06	5.49E-07	2.01E-06	4.40E-08	3.45E-07	1.18E-06	2.97E-07	1.65E-06	2.09E-06
US212	--	--	--	--	--	--	--	--	--
Tongue River									
Moon Creek Road	2.75E-06	3.97E-07	1.45E-06	3.18E-08	2.49E-07	8.53E-07	2.15E-07	1.19E-06	1.51E-06
Snider Creek Road	1.50E-06	2.16E-07	7.90E-07	1.73E-08	1.36E-07	4.64E-07	1.17E-07	6.49E-07	8.22E-07
Tongue River Road	1.50E-06	2.16E-07	7.90E-07	1.73E-08	1.36E-07	4.64E-07	1.17E-07	6.49E-07	8.22E-07
East Tongue River Road	1.25E-06	1.80E-07	6.58E-07	1.44E-08	1.13E-07	3.87E-07	9.75E-08	5.40E-07	6.85E-07
I-94	--	--	--	--	--	--	--	--	--
Tongue River East									
Moon Creek Road	2.75E-06	3.97E-07	1.45E-06	3.18E-08	2.49E-07	8.53E-07	2.15E-07	1.19E-06	1.51E-06
Snider Creek Road	1.50E-06	2.16E-07	7.90E-07	1.73E-08	1.36E-07	4.64E-07	1.17E-07	6.49E-07	8.22E-07
Tongue River Road	1.50E-06	2.16E-07	7.90E-07	1.73E-08	1.36E-07	4.64E-07	1.17E-07	6.49E-07	8.22E-07
I-94	--	--	--	--	--	--	--	--	--
Tongue River Road									
I-94	--	--	--	--	--	--	--	--	--
US212	--	--	--	--	--	--	--	--	--
Tongue River Road	7.06E-06	1.02E-06	3.72E-06	8.14E-08	6.38E-07	2.19E-06	5.51E-07	3.05E-06	3.87E-06
Liscom Creek Road	1.50E-06	2.16E-07	7.90E-07	1.73E-08	1.36E-07	4.64E-07	1.17E-07	6.49E-07	8.22E-07
Beaver Creek Road	1.50E-06	2.16E-07	7.90E-07	1.73E-08	1.36E-07	4.64E-07	1.17E-07	6.49E-07	8.22E-07
East Tongue River Road	1.25E-06	1.80E-07	6.58E-07	1.44E-08	1.13E-07	3.87E-07	9.75E-08	5.40E-07	6.85E-07
Foster Creek Road	3.26E-06	4.69E-07	1.72E-06	3.76E-08	2.95E-07	1.01E-06	2.54E-07	1.41E-06	1.79E-06
Tongue River Road East									
I-94	--	--	--	--	--	--	--	--	--
US212	--	--	--	--	--	--	--	--	--
Tongue River Road	7.06E-06	1.02E-06	3.72E-06	8.14E-08	6.38E-07	2.19E-06	5.51E-07	3.05E-06	3.87E-06
Liscom Creek Road	1.50E-06	2.16E-07	7.90E-07	1.73E-08	1.36E-07	4.64E-07	1.17E-07	6.49E-07	8.22E-07
Beaver Creek Road	1.50E-06	2.16E-07	7.90E-07	1.73E-08	1.36E-07	4.64E-07	1.17E-07	6.49E-07	8.22E-07
Foster Creek Road	3.26E-06	4.69E-07	1.72E-06	3.76E-08	2.95E-07	1.01E-06	2.54E-07	1.41E-06	1.79E-06
Moon Creek									
Moon Creek Road	2.75E-06	3.97E-07	1.45E-06	3.18E-08	2.49E-07	8.53E-07	2.15E-07	1.19E-06	1.51E-06
Snider Creek Road	1.50E-06	2.16E-07	7.90E-07	1.73E-08	1.36E-07	4.64E-07	1.17E-07	6.49E-07	8.22E-07
Tongue River Road	1.50E-06	2.16E-07	7.90E-07	1.73E-08	1.36E-07	4.64E-07	1.17E-07	6.49E-07	8.22E-07
East Tongue River Road	1.25E-06	1.80E-07	6.58E-07	1.44E-08	1.13E-07	3.87E-07	9.75E-08	5.40E-07	6.85E-07
I-94	--	--	--	--	--	--	--	--	--
US212	--	--	--	--	--	--	--	--	--

Crossing	Hazardous Pollutants (tons/year)								
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Ethylbenzene	Formaldehyde	n-Hexane	Toluene	Xylene
Moon Creek East									
Moon Creek Road	2.75E-06	3.97E-07	1.45E-06	3.18E-08	2.49E-07	8.53E-07	2.15E-07	1.19E-06	1.51E-06
Snider Creek Road	1.50E-06	2.16E-07	7.90E-07	1.73E-08	1.36E-07	4.64E-07	1.17E-07	6.49E-07	8.22E-07
Tongue River Road	1.50E-06	2.16E-07	7.90E-07	1.73E-08	1.36E-07	4.64E-07	1.17E-07	6.49E-07	8.22E-07
I-94	--	--	--	--	--	--	--	--	--
US212	--	--	--	--	--	--	--	--	--
Southern Alternatives									
Decker Alternative									
Highway 314	2.31E-05	3.33E-06	1.22E-05	2.66E-07	2.09E-06	7.15E-06	1.80E-06	9.99E-06	1.27E-05
Four-Mile Creek Road	7.17E-07	1.03E-07	3.77E-07	8.27E-09	6.48E-08	2.22E-07	5.59E-08	3.10E-07	3.93E-07
Tongue River Road – MP 15.71	1.20E-05	1.72E-06	6.30E-06	1.38E-07	1.08E-06	3.70E-06	9.33E-07	5.17E-06	6.55E-06
Tongue River Road – MP 16.80	1.20E-05	1.72E-06	6.30E-06	1.38E-07	1.08E-06	3.70E-06	9.33E-07	5.17E-06	6.55E-06
Tongue River Road – MP 34.76	2.51E-06	3.62E-07	1.32E-06	2.90E-08	2.27E-07	7.78E-07	1.96E-07	1.09E-06	1.38E-06
Decker East Alternative									
Highway 314	2.31E-05	3.33E-06	1.22E-05	2.66E-07	2.09E-06	7.15E-06	1.80E-06	9.99E-06	1.27E-05
Four-Mile Creek Road	7.17E-07	1.03E-07	3.77E-07	8.27E-09	6.48E-08	2.22E-07	5.59E-08	3.10E-07	3.93E-07
Tongue River Road – MP 15.71	1.20E-05	1.72E-06	6.30E-06	1.38E-07	1.08E-06	3.70E-06	9.33E-07	5.17E-06	6.55E-06
Tongue River Road – MP 16.80	2.51E-06	3.62E-07	1.32E-06	2.90E-08	2.27E-07	7.78E-07	1.96E-07	1.09E-06	1.38E-06
Tongue River Road – MP 34.76	2.51E-06	3.62E-07	1.32E-06	2.90E-08	2.27E-07	7.78E-07	1.96E-07	1.09E-06	1.38E-06

Table E.1-76. Grade Crossing Emissions, High Production Scenario, Northern and Southern Alternatives, Year 2037, Greenhouse Gas Emissions

Crossing	Greenhouse Gas Emissions (tons/year)			
	CO ₂	CH ₄	N ₂ O	CO _{2e}
Northern Alternatives				
Colstrip				
Cow Creek Road	2.61E-02	2.21E-06	6.92E-07	2.64E-02
Rosebud Creek Road	2.61E-02	2.21E-06	6.92E-07	2.64E-02
Tongue River Road	6.22E-02	5.27E-06	1.65E-06	6.29E-02
East Tongue River Road	1.63E-02	1.38E-06	4.32E-07	1.65E-02
US212	--	--	--	--
Colstrip East				
Cow Creek Road	2.61E-02	2.21E-06	6.92E-07	2.64E-02
Rosebud Creek Road	2.61E-02	2.21E-06	6.92E-07	2.64E-02
Tongue River Road	6.22E-02	5.27E-06	1.65E-06	6.29E-02
US212	--	--	--	--
Tongue River				
Moon Creek Road	4.50E-02	3.81E-06	1.19E-06	4.54E-02
Snider Creek Road	2.45E-02	2.07E-06	6.49E-07	2.47E-02
Tongue River Road	2.45E-02	2.07E-06	6.49E-07	2.47E-02
East Tongue River Road	2.04E-02	1.73E-06	5.41E-07	2.06E-02
Tongue River East				
Moon Creek Road	4.50E-02	3.81E-06	1.19E-06	4.54E-02
Snider Creek Road	2.45E-02	2.07E-06	6.49E-07	2.47E-02
Tongue River Road	2.45E-02	2.07E-06	6.49E-07	2.47E-02
Tongue River Road				
I-94	--	--	--	--
US212	--	--	--	--
Tongue River Road	1.15E-01	9.76E-06	3.05E-06	1.16E-01
Liscom Creek Road	2.45E-02	2.07E-06	6.49E-07	2.47E-02
Beaver Creek Road	2.45E-02	2.07E-06	6.49E-07	2.47E-02
East Tongue River Road	2.04E-02	1.73E-06	5.41E-07	2.06E-02
Foster Creek Road	5.32E-02	4.51E-06	1.41E-06	5.37E-02
Tongue River Road East				
I-94	--	--	--	--
US212	--	--	--	--
Tongue River Road	1.15E-01	9.76E-06	3.05E-06	1.16E-01
Liscom Creek Road	2.45E-02	2.07E-06	6.49E-07	2.47E-02
Beaver Creek Road	2.45E-02	2.07E-06	6.49E-07	2.47E-02
Foster Creek Road	5.32E-02	4.51E-06	1.41E-06	5.37E-02
Moon Creek				
Moon Creek Road	4.50E-02	3.81E-06	1.19E-06	4.54E-02
Snider Creek Road	2.45E-02	2.07E-06	6.49E-07	2.47E-02
Tongue River Road	2.45E-02	2.07E-06	6.49E-07	2.47E-02
East Tongue River Road	2.04E-02	1.73E-06	5.41E-07	2.06E-02
I-94	--	--	--	--
US212	--	--	--	--

Crossing	Greenhouse Gas Emissions (tons/year)			
	CO ₂	CH ₄	N ₂ O	CO ₂ e
Moon Creek East				
Moon Creek Road	4.50E-02	3.81E-06	1.19E-06	4.54E-02
Snider Creek Road	2.45E-02	2.07E-06	6.49E-07	2.47E-02
Tongue River Road	2.45E-02	2.07E-06	6.49E-07	2.47E-02
I-94	--	--	--	--
US212	--	--	--	--
Southern Alternatives				
Decker Alternative				
Highway 314	3.77E-01	3.19E-05	9.99E-06	3.81E-01
Four-Mile Creek Road	1.17E-02	9.91E-07	3.10E-07	1.18E-02
Tongue River Road (MP 15.71)	1.95E-01	1.65E-05	5.18E-06	1.97E-01
Tongue River Road (MP 16.80)	1.95E-01	1.65E-05	5.18E-06	1.97E-01
Tongue River Road (MP 34.76)	4.10E-02	3.47E-06	1.09E-06	4.14E-02
Decker East Alternative				
Highway 314	3.77E-01	3.19E-05	9.99E-06	3.81E-01
Four-Mile Creek Road	1.17E-02	9.91E-07	3.10E-07	1.18E-02
Tongue River Road (MP 17.26)	1.95E-01	1.65E-05	5.18E-06	1.97E-01
Tongue River Road (MP 36.17)	4.10E-02	3.47E-06	1.09E-06	4.14E-02
Tongue River Road (MP 40.15)	4.10E-02	3.47E-06	1.09E-06	4.14E-02

Table E.1-77. Summary of Exhaust Emissions by Build Alternative and Coal Production Scenario for Grade Crossing Delay, Criteria Pollutants

Build Alternatives ¹	Criteria Pollutants (tons/year)						
	CO	NO _x	Pb	PM ₁₀	PM _{2.5}	SO ₂	VOC
Low Production Scenario							
Colstrip	1.12E-02	1.73E-03	5.62E-07	4.85E-05	4.61E-05	9.57E-06	5.74E-04
Colstrip East	1.10E-02	1.71E-03	5.55E-07	4.79E-05	4.55E-05	9.45E-06	5.67E-04
Tongue River	7.83E-04	1.21E-04	3.94E-08	3.40E-06	3.23E-06	6.70E-07	4.02E-05
Tongue River East	6.44E-04	9.98E-05	3.23E-08	2.79E-06	2.65E-06	5.51E-07	3.30E-05
Tongue River Road	1.26E-03	1.96E-04	6.36E-08	5.48E-06	5.21E-06	1.08E-06	6.49E-05
Tongue River Road East	1.12E-03	1.74E-04	5.65E-08	4.88E-06	4.63E-06	9.62E-07	5.77E-05
Moon Creek	7.83E-04	1.21E-04	3.94E-08	3.40E-06	3.23E-06	6.70E-07	4.02E-05
Moon Creek East	6.44E-04	9.98E-05	3.23E-08	2.79E-06	2.65E-06	5.51E-07	3.30E-05
Decker	3.92E-03	6.07E-04	1.97E-07	1.70E-05	1.61E-05	3.35E-06	2.01E-04
Decker East	3.18E-03	4.93E-04	1.60E-07	1.38E-05	1.31E-05	2.72E-06	1.63E-04
Medium Production Scenario							
Colstrip	1.63E-02	2.53E-03	8.21E-07	9.97E-05	6.73E-05	1.40E-05	8.38E-04
Colstrip East	1.61E-02	2.50E-03	8.10E-07	6.99E-05	6.64E-05	1.38E-05	8.27E-04
Tongue River	1.26E-03	1.95E-04	6.33E-08	5.46E-06	5.19E-06	1.08E-06	6.46E-05
Tongue River East	1.03E-03	1.60E-04	5.20E-08	4.49E-06	4.26E-06	8.86E-07	5.31E-05
Tongue River Road	2.03E-03	3.15E-04	1.02E-07	8.82E-06	8.37E-06	1.74E-06	1.04E-04
Tongue River Road East	1.81E-03	2.80E-04	9.09E-08	7.84E-06	7.45E-06	1.55E-06	9.28E-05
Moon Creek	1.26E-03	1.95E-04	6.33E-08	5.46E-06	5.19E-06	1.08E-06	6.46E-05
Moon Creek East	1.03E-03	1.60E-04	5.20E-08	4.49E-06	4.26E-06	8.86E-07	5.31E-05
Decker	5.94E-03	9.21E-04	2.98E-07	2.57E-05	2.45E-05	5.08E-06	3.05E-04
Decker East	4.82E-03	7.48E-04	2.42E-07	2.09E-05	1.99E-05	4.12E-06	2.47E-04
High Production Scenario							
Colstrip	2.34E-02	3.64E-03	1.18E-06	1.02E-04	9.66E-05	2.01E-05	1.20E-03
Colstrip East	2.32E-02	3.59E-03	1.16E-06	1.00E-04	9.54E-05	1.98E-05	1.19E-03
Tongue River	1.97E-03	3.05E-04	9.90E-08	8.54E-06	8.11E-06	1.68E-06	1.01E-04
Tongue River East	1.62E-03	2.51E-04	8.13E-08	7.01E-06	6.66E-06	1.38E-06	8.30E-05
Tongue River Road	3.18E-03	4.93E-04	1.60E-07	1.38E-05	1.31E-05	2.72E-06	1.63E-04
Tongue River Road East	2.83E-03	4.38E-04	1.42E-07	1.23E-05	1.16E-05	2.42E-06	1.45E-04
Moon Creek	1.97E-03	3.05E-04	9.90E-08	8.54E-06	8.11E-06	1.68E-06	1.01E-04
Moon Creek East	1.62E-03	2.51E-04	8.13E-08	7.01E-06	6.66E-06	1.38E-06	8.30E-05
Decker	1.41E-02	2.19E-03	7.10E-07	6.13E-05	5.82E-05	1.21E-05	7.25E-04
Decker East	1.15E-02	1.78E-03	5.76E-07	4.97E-05	4.72E-05	9.81E-06	5.88E-04

¹ These values represent the maximum increase across different IPM scenarios and analysis years

Table E.1-78. Summary of Exhaust Emissions by Build Alternative and Coal Production Scenario for Grade Crossing Delay, Hazardous Pollutants

Alternatives ¹	Hazardous Pollutants (tons/year)								
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Ethylbenzene	Formaldehyde	n-Hexane	Toluene	Xylene
Low Production Scenario									
Colstrip	3.98E-05	5.73E-06	2.10E-05	4.59E-07	3.60E-06	1.23E-05	3.10E-06	1.72E-05	2.18E-05
Colstrip East	3.93E-05	5.66E-06	2.07E-05	4.53E-07	3.55E-06	1.22E-05	3.07E-06	1.70E-05	2.15E-05
Tongue River	2.79E-06	4.01E-07	1.47E-06	3.21E-08	2.52E-07	8.63E-07	2.17E-07	1.21E-06	1.53E-06
Tongue River East	2.29E-06	3.30E-07	1.21E-06	2.64E-08	2.07E-07	7.09E-07	1.79E-07	9.90E-07	1.25E-06
Tongue River Road	4.50E-06	6.48E-07	2.37E-06	5.19E-08	4.07E-07	1.39E-06	3.51E-07	1.95E-06	2.46E-06
Tongue River Road East	4.00E-06	5.76E-07	2.11E-06	4.62E-08	3.62E-07	1.24E-06	3.12E-07	1.73E-06	2.19E-06
Moon Creek	2.79E-06	4.01E-07	1.47E-06	3.21E-08	2.52E-07	8.63E-07	2.17E-07	1.21E-06	1.53E-06
Moon Creek East	2.29E-06	3.30E-07	1.21E-06	2.64E-08	2.07E-07	7.09E-07	1.79E-07	9.90E-07	1.25E-06
Decker	1.39E-05	2.01E-06	7.33E-06	1.61E-07	1.26E-06	4.31E-06	1.09E-06	6.02E-06	7.63E-06
Decker East	1.13E-05	1.63E-06	5.96E-06	1.30E-07	1.02E-06	3.50E-06	8.82E-07	4.89E-06	6.20E-06
Medium Production Scenario									
Colstrip	5.81E-05	8.37E-06	3.06E-05	6.71E-07	5.26E-06	1.80E-05	4.53E-06	2.51E-05	3.19E-05
Colstrip East	5.73E-05	8.26E-06	3.02E-05	6.61E-07	5.18E-06	1.78E-05	4.47E-06	2.48E-05	3.14E-05
Tongue River	4.48E-06	6.46E-07	2.36E-06	5.17E-08	4.05E-07	1.39E-06	3.50E-07	1.94E-06	2.46E-06
Tongue River East	3.68E-06	5.30E-07	1.94E-06	4.25E-08	3.33E-07	1.14E-06	2.87E-07	1.59E-06	2.02E-06
Tongue River Road	7.23E-06	1.04E-06	3.81E-06	8.34E-08	6.54E-07	2.24E-06	5.64E-07	3.13E-06	3.96E-06
Tongue River Road East	6.43E-06	9.27E-07	3.39E-06	7.42E-08	5.82E-07	1.99E-06	5.02E-07	2.78E-06	3.53E-06
Moon Creek	4.48E-06	6.46E-07	2.36E-06	5.17E-08	4.05E-07	1.39E-06	3.50E-07	1.94E-06	2.46E-06
Moon Creek East	3.68E-06	5.30E-07	1.94E-06	4.25E-08	3.33E-07	1.14E-06	2.87E-07	1.59E-06	2.02E-06
Decker	2.11E-05	3.04E-06	1.11E-05	2.44E-07	1.91E-06	6.54E-06	1.65E-06	9.13E-06	1.16E-05
Decker East	1.71E-05	2.47E-06	9.03E-06	1.98E-07	1.55E-06	5.31E-06	1.34E-06	7.42E-06	9.40E-06

Alternatives ¹	Hazardous Pollutants (tons/year)								
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Ethylbenzene	Formaldehyde	n-Hexane	Toluene	Xylene
High Production Scenario									
Colstrip	8.34E-05	1.20E-05	4.39E-05	9.62E-07	7.54E-06	2.58E-05	6.51E-06	3.61E-05	4.57E-05
Colstrip East	8.24E-05	1.19E-05	4.34E-05	9.51E-07	7.45E-06	2.55E-05	6.43E-06	3.56E-05	4.52E-05
Tongue River	7.00E-06	1.01E-06	3.69E-06	8.08E-08	6.33E-07	2.17E-06	5.46E-07	3.03E-06	3.84E-06
Tongue River East	5.75E-06	8.29E-07	3.03E-06	6.64E-08	5.20E-07	1.78E-06	4.49E-07	2.49E-06	3.15E-06
Tongue River Road	1.13E-05	1.63E-06	5.95E-06	1.30E-07	1.02E-06	3.50E-06	8.82E-07	4.89E-06	6.20E-06
Tongue River Road East	1.01E-05	1.45E-06	5.30E-06	1.16E-07	9.09E-07	3.11E-06	7.85E-07	4.35E-06	5.51E-06
Moon Creek	7.00E-06	1.01E-06	3.69E-06	8.08E-08	6.33E-07	2.17E-06	5.46E-07	3.03E-06	3.84E-06
Moon Creek East	5.75E-06	8.29E-07	3.03E-06	6.64E-08	5.20E-07	1.78E-06	4.49E-07	2.49E-06	3.15E-06
Decker	5.02E-05	7.24E-06	2.65E-05	5.80E-07	4.54E-06	1.56E-05	3.92E-06	2.17E-05	2.75E-05
Decker East	4.08E-05	5.88E-06	2.15E-05	4.71E-07	3.69E-06	1.26E-05	3.18E-06	1.76E-05	2.24E-05

¹ These values represent the maximum increase across different IPM scenarios and analysis years

Table E.1-79. Summary of Exhaust Emissions by Build Alternative and Coal Production Scenario for Grade Crossing Delay, Greenhouse Gas Emissions

Alternatives ¹	Greenhouse Gas Emissions (tons/year)			
	CO ₂	CH ₄	N ₂ O	CO ₂ e
Low Production Scenario				
Colstrip	6.50E-01	5.50E-05	1.72E-05	6.56E-01
Colstrip East	6.42E-01	5.43E-05	1.70E-05	6.48E-01
Tongue River	4.55E-02	3.85E-06	1.21E-06	4.59E-02
Tongue River East	3.74E-02	3.17E-06	9.91E-07	3.78E-02
Tongue River Road	7.34E-02	6.22E-06	1.95E-06	7.42E-02
Tongue River Road East	6.53E-02	5.53E-06	1.73E-06	6.60E-02
Moon Creek	4.55E-02	3.85E-06	1.21E-06	4.59E-02
Moon Creek East	3.74E-02	3.17E-06	9.91E-07	3.78E-02
Decker	2.27E-01	1.93E-05	6.03E-06	2.30E-01
Decker East	1.85E-01	1.56E-05	4.89E-06	1.86E-01
Medium Production Scenario				
Colstrip	9.49E-01	8.04E-05	2.51E-05	9.59E-01
Colstrip East	9.36E-01	7.93E-05	2.48E-05	9.45E-01
Tongue River	7.32E-02	6.20E-06	1.94E-06	7.39E-02
Tongue River East	6.01E-02	5.09E-06	1.59E-06	6.07E-02
Tongue River Road	1.18E-01	1.00E-05	3.13E-06	1.19E-01
Tongue River Road East	1.05E-01	8.90E-06	2.78E-06	1.06E-01
Moon Creek	7.32E-02	6.20E-06	1.94E-06	7.39E-02
Moon Creek East	6.01E-02	5.09E-06	1.59E-06	6.07E-02
Decker	3.45E-01	2.92E-05	9.14E-06	3.48E-01
Decker East	2.80E-01	2.37E-05	7.42E-06	2.83E-01
High Production Scenario				
Colstrip	1.36E+00	1.15E-04	3.61E-05	1.38E+00
Colstrip East	1.35E+00	1.14E-04	3.57E-05	1.36E+00
Tongue River	1.14E-01	9.69E-06	3.03E-06	1.15E-01
Tongue River East	9.40E-02	7.96E-06	2.49E-06	9.49E-02
Tongue River Road	1.85E-01	1.56E-05	4.89E-06	1.86E-01
Tongue River Road East	1.64E-01	1.39E-05	4.35E-06	1.66E-01
Moon Creek	1.14E-01	9.69E-06	3.03E-06	1.15E-01
Moon Creek East	9.40E-02	7.96E-06	2.49E-06	9.49E-02
Decker	8.20E-01	6.95E-05	2.17E-05	8.29E-01
Decker East	6.66E-01	5.64E-05	1.77E-05	6.73E-01

¹ These values represent the maximum increase across different IPM scenarios and analysis years.

Table E.1-80. Grade Crossing Emissions, Segment 3 from Colstrip, MT – Nichols, MT, Downline Analysis, Low Production Scenario, Year 2037, Criteria Pollutants

FRA Crossing ID	Criteria Pollutants (tons/year)						
	CO	NO _x	Pb	PM ₁₀	PM _{2.5}	SO ₂	VOC
060514U	1.24E-04	1.92E-05	6.21E-09	5.36E-07	5.09E-07	1.06E-07	6.34E-06
060499U	1.67E-03	2.59E-04	8.39E-08	7.23E-06	6.87E-06	1.43E-06	8.56E-05
060524A	1.78E-04	2.76E-05	8.96E-09	7.73E-07	7.34E-07	1.52E-07	9.14E-06
086276D	3.21E-03	4.98E-04	1.61E-07	1.39E-05	1.32E-05	2.75E-06	1.65E-04
099063F	4.08E-03	6.32E-04	2.05E-07	1.77E-05	1.68E-05	3.49E-06	2.09E-04
Total Emissions	9.26E-03	1.44E-03	4.65E-07	4.01E-05	3.81E-05	7.92E-06	4.75E-04

Table E.1-81. Grade Crossing Emissions, Segment 3 from Colstrip, MT – Nichols, MT, Downline Analysis, Low Production Scenario, Year 2037, Hazardous Pollutants

FRA Crossing ID	Hazardous Pollutants (tons/year)								
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Ethylbenzene	Formaldehyde	n-Hexane	Toluene	Xylene
060514U	4.39E-07	6.33E-08	2.31E-07	5.07E-09	3.97E-08	1.36E-07	3.43E-08	1.90E-07	2.41E-07
060499U	5.93E-06	8.55E-07	3.13E-06	6.85E-08	5.37E-07	1.84E-06	4.63E-07	2.57E-06	3.25E-06
060524A	6.34E-07	9.13E-08	3.34E-07	7.31E-09	5.73E-08	1.96E-07	4.95E-08	2.74E-07	3.47E-07
086276D	1.14E-05	1.65E-06	6.01E-06	1.32E-07	1.03E-06	3.54E-06	8.91E-07	4.94E-06	6.26E-06
099063F	1.45E-05	2.09E-06	7.64E-06	1.67E-07	1.31E-06	4.49E-06	1.13E-06	6.27E-06	7.95E-06
Total Emissions	3.29E-05	4.74E-06	1.73E-05	3.80E-07	2.98E-06	1.02E-05	2.57E-06	1.42E-05	1.80E-05

Table E.1-82. Grade Crossing Emissions, Segment 3 from Colstrip, MT – Nichols, MT, Downline Analysis, Low Production Scenario, Year 2037, Greenhouse Gas Emissions

FRA Crossing ID	Greenhouse Gas Emissions (tons/year)			
	CO ₂	CH ₄	N ₂ O	CO ₂ e
060514U	7.18E-03	6.08E-07	1.90E-07	7.25E-03
060499U	9.69E-02	8.21E-06	2.57E-06	9.79E-02
060524A	1.04E-02	8.77E-07	2.74E-07	1.05E-02
086276D	1.86E-01	1.58E-05	4.94E-06	1.88E-01
099063F	2.37E-01	2.01E-05	6.28E-06	2.39E-01
Total Emissions	5.38E-01	4.55E-05	1.43E-05	5.43E-01

Table E.1-83. Grade Crossing Emissions, Segment 3 from Colstrip, MT – Nichols, MT, Downline Analysis, Medium Production Scenario, Year 2037, Criteria Pollutants

FRA Crossing ID	Criteria Pollutants (tons/year)						
	CO	NO _x	Pb	PM ₁₀	PM _{2.5}	SO ₂	VOC
060514U	1.78E-04	2.77E-05	8.97E-09	7.74E-07	7.35E-07	1.53E-07	9.15E-06
060499U	2.41E-03	3.74E-04	1.21E-07	1.04E-05	9.92E-06	2.06E-06	1.24E-04
060524A	2.58E-04	3.99E-05	1.29E-08	1.12E-06	1.06E-06	2.20E-07	1.32E-05
086276D	4.64E-03	7.19E-04	2.33E-07	2.01E-05	1.91E-05	3.97E-06	2.38E-04
099063F	5.89E-03	9.13E-04	2.96E-07	2.55E-05	2.43E-05	5.04E-06	3.02E-04
Total Emissions	1.34E-02	2.07E-03	6.72E-07	5.80E-05	5.51E-05	1.14E-05	6.86E-04

Table E.1-84. Grade Crossing Emissions, Segment 3 from Colstrip, MT – Nichols, MT, Downline Analysis, Medium Production Scenario, Year 2037, Hazardous Pollutants

FRA Crossing ID	Hazardous Pollutants (tons/year)								
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Ethylbenzene	Formaldehyde	n-Hexane	Toluene	Xylene
060514U	6.35E-07	9.14E-08	3.34E-07	7.32E-09	5.74E-08	1.97E-07	4.95E-08	2.75E-07	3.48E-07
060499U	8.57E-06	1.23E-06	4.51E-06	9.89E-08	7.75E-07	2.65E-06	6.69E-07	3.71E-06	4.70E-06
060524A	9.16E-07	1.32E-07	4.83E-07	1.06E-08	8.29E-08	2.84E-07	7.15E-08	3.96E-07	5.02E-07
086276D	1.65E-05	2.38E-06	8.69E-06	1.90E-07	1.49E-06	5.11E-06	1.29E-06	7.13E-06	9.04E-06
099063F	2.10E-05	3.02E-06	1.10E-05	2.42E-07	1.89E-06	6.49E-06	1.63E-06	9.06E-06	1.15E-05
Total Emissions	4.76E-05	6.85E-06	2.51E-05	5.49E-07	4.30E-06	1.47E-05	3.71E-06	2.06E-05	2.61E-05

Table E.1-85. Grade Crossing Emissions, Segment 3 from Colstrip, MT – Nichols, MT, Downline Analysis, Medium Production Scenario, Year 2037, Greenhouse Gas Emissions

FRA Crossing ID	Greenhouse Gas Emissions (tons/year)			
	CO ₂	CH ₄	N ₂ O	CO ₂ e
060514U	1.04E-02	8.78E-07	2.75E-07	1.05E-02
060499U	1.40E-01	1.19E-05	3.71E-06	1.41E-01
060524A	1.50E-02	1.27E-06	3.96E-07	1.51E-02
086276D	2.69E-01	2.28E-05	7.14E-06	2.72E-01
099063F	3.42E-01	2.90E-05	9.07E-06	3.46E-01
Total Emissions	7.77E-01	6.58E-05	2.06E-05	7.84E-01

Table E.1-86. Grade Crossing Emissions, Segment 3 from Colstrip, MT – Nichols, MT, Downline Analysis, High Production Scenario, Year 2037, Criteria Pollutants

FRA Crossing ID	Criteria Pollutants (tons/year)						
	CO	NO _x	Pb	PM ₁₀	PM _{2.5}	SO ₂	VOC
060514U	2.60E-04	4.03E-05	1.31E-08	1.13E-06	1.07E-06	2.23E-07	1.33E-05
060499U	3.51E-03	5.45E-04	1.77E-07	1.52E-05	1.45E-05	3.01E-06	1.80E-04
060524A	3.76E-04	5.83E-05	1.89E-08	1.63E-06	1.55E-06	3.22E-07	1.93E-05
086276D	6.76E-03	1.05E-03	3.40E-07	2.93E-05	2.78E-05	5.78E-06	3.47E-04
099063F	8.59E-03	1.33E-03	4.32E-07	3.72E-05	3.54E-05	7.35E-06	4.41E-04
Total Emissions	1.95E-02	3.02E-03	9.80E-07	8.45E-05	8.03E-05	1.67E-05	1.00E-03

Table E.1-87. Grade Crossing Emissions, Segment 3 from Colstrip, MT – Nichols, MT, Downline Analysis, High Production Scenario, Year 2037, Hazardous Pollutants

FRA Crossing ID	Hazardous Pollutants (tons/year)								
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Ethylbenzene	Formaldehyde	n-Hexane	Toluene	Xylene
060514U	9.25E-07	1.33E-07	4.87E-07	1.07E-08	8.37E-08	2.87E-07	7.22E-08	4.00E-07	5.07E-07
060499U	1.25E-05	1.80E-06	6.58E-06	1.44E-07	1.13E-06	3.87E-06	9.75E-07	5.41E-06	6.85E-06
060524A	1.34E-06	1.93E-07	7.04E-07	1.54E-08	1.21E-07	4.14E-07	1.04E-07	5.78E-07	7.32E-07
086276D	2.40E-05	3.46E-06	1.27E-05	2.77E-07	2.17E-06	7.45E-06	1.88E-06	1.04E-05	1.32E-05
099063F	3.06E-05	4.40E-06	1.61E-05	3.52E-07	2.76E-06	9.46E-06	2.38E-06	1.32E-05	1.67E-05
Total Emissions	6.94E-05	9.99E-06	3.65E-05	8.00E-07	6.27E-06	2.15E-05	5.41E-06	3.00E-05	3.80E-05

Table E.1-88. Grade Crossing Emissions, Segment 3 from Colstrip, MT – Nichols, MT, Downline Analysis, High Production Scenario, Year 2037, Greenhouse Gas Emissions

FRA Crossing ID	Greenhouse Gas Emissions (tons/year)			
	CO ₂	CH ₄	N ₂ O	CO ₂ e
060514U	1.51E-02	1.28E-06	4.00E-07	1.53E-02
060499U	2.04E-01	1.73E-05	5.41E-06	2.06E-01
060524A	2.18E-02	1.85E-06	5.78E-07	2.20E-02
086276D	3.93E-01	3.33E-05	1.04E-05	3.97E-01
099063F	4.99E-01	4.23E-05	1.32E-05	5.04E-01
Total Emissions	1.13E+00	9.59E-05	3.00E-05	1.14E+00

E.1.5 Construction Emissions

E.1.5.1 Inputs

Tables E.1-89 through E.1-108 present the inputs used in estimating construction emissions.

Table E.1-89. NONROAD Emission Factors by Piece of Equipment, Criteria Pollutants

Criteria Pollutants Emission Factors (g/hp-hr) (EPA 2009b)											
Construction Equipment	Number Required ¹	Yearly Average Operation ¹ (hours)	Fuel Consumption Rate (gal/hr/piece of equip.)	Fuel Consumption (gal)	CO	NO _x	Pb	PM10	PM2.5	SO ₂	VOC
CAT 777 (100-ton haul trucks)	7	38,000	26.76	7118178.4	0.19	0.55	1.93E-06	0.02	0.02	0.0007	0.04
CAT 992 Front-end loader	1	5,500	26.71	146892.1	0.09	0.25	1.01E-06	0.01	0.01	0.0003	0.02
CAT D10 dozer	1	5,500	13.11	72115.0	0.46	1.16	5.79E-06	0.07	0.07	0.0020	0.08
CAT D9 dozer	1	5,500	13.11	72115.0	0.46	1.16	5.79E-06	0.07	0.07	0.0020	0.08
CAT D8 dozers	2	7,000	7.26	101645.1	0.32	0.93	5.23E-06	0.06	0.06	0.0021	0.09
CAT 14G motor graders	3	12,500	7.13	267292.4	0.19	0.56	3.15E-06	0.04	0.04	0.0013	0.06
CAT 825 compactor	1	5,500	6.69	36795.1	0.06	0.19	1.03E-06	0.01	0.01	0.0004	0.02
CAT 10,000 gal. water wagons	3	14,500	7.53	327627.4	0.02	0.10	3.24E-07	0.00	0.00	0.0003	0.01
Smooth drum roller	1	5,500	6.69	36795.1	0.06	0.19	1.03E-06	0.01	0.01	0.0004	0.02
CAT 637 scrapers	3	7,500	13.03	293073.6	0.24	0.61	3.02E-06	0.04	0.03	0.0010	0.04
CAT 345 excavators	1	10,600	12.66	134181.4	0.31	0.78	4.03E-06	0.05	0.05	0.0015	0.06
CAT 966 front-end loaders	2	10,600	12.93	274114.4	0.92	2.28	1.11E-05	0.13	0.13	0.0034	0.15
Generator sets	3	8,000	2.14	51250.2	0.20	0.37	3.06E-06	0.04	0.04	0.0004	0.04
Rock drills	3	8,000	5.32	127599.4	0.06	0.21	9.38E-07	0.01	0.01	0.0002	0.02

¹ Equipment numbers and hours were provided by the Applicant and were based on the Colstrip Alternative. These hours were scaled based on the ratios provided by the Applicant (Table E.1-177) to estimate the equipment usage for each of the other build alternatives.

Table E.1-90. NONROAD Emission Factors by Piece of Equipment, Hazardous Pollutants¹

Construction Equipment	Hazardous Pollutants Emission Factors (g/hp-hr) (EPA 2009b)								
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Ethylbenzene	Formaldehyde	n-Hexane	Toluene	Xylene
CAT 777 (100-ton haul trucks)	1.54E-03	2.86E-04	3.39E-04	1.26E-04	1.15E-04	3.38E-03	8.51E-05	1.87E-04	1.64E-04
CAT 992 Front-end loader	6.44E-04	1.20E-04	1.42E-04	5.29E-05	4.81E-05	1.42E-03	3.57E-05	7.85E-05	6.86E-05
CAT D10 dozer	2.93E-03	5.46E-04	6.46E-04	2.41E-04	2.19E-04	6.45E-03	0.000162	3.57E-04	3.12E-04
CAT D9 dozer	2.93E-03	5.46E-04	6.46E-04	2.41E-04	2.19E-04	6.45E-03	0.000162	3.57E-04	3.12E-04
CAT D8 dozers	3.27E-03	6.09E-04	7.20E-04	2.68E-04	2.44E-04	7.19E-03	0.000181	3.98E-04	3.48E-04
CAT 14G motor graders	1.99E-03	3.70E-04	4.38E-04	1.63E-04	1.48E-04	4.37E-03	0.00011	2.42E-04	2.11E-04
CAT 825 compactor	6.09E-04	1.13E-04	1.34E-04	5.00E-05	4.55E-05	1.34E-03	3.37E-05	7.42E-05	6.48E-05
CAT 10,000 gal. water wagons	4.46E-04	8.30E-05	9.82E-05	3.66E-05	3.33E-05	9.81E-04	2.47E-05	5.43E-05	4.74E-05
Smooth drum roller	6.09E-04	1.13E-04	1.34E-04	5.00E-05	4.55E-05	1.34E-03	3.37E-05	7.42E-05	6.48E-05
CAT 637 scrapers	1.52E-03	2.84E-04	3.36E-04	1.25E-04	1.14E-04	3.35E-03	8.45E-05	1.86E-04	1.62E-04
CAT 345 excavators	2.10E-03	3.91E-04	4.63E-04	1.72E-04	1.57E-04	4.62E-03	0.000116	2.56E-04	2.24E-04
CAT 966 front-end loaders	5.43E-03	1.01E-03	1.20E-03	4.46E-04	4.05E-04	1.19E-02	0.000301	6.61E-04	5.78E-04
Generator sets	1.57E-03	2.92E-04	3.45E-04	1.29E-04	1.17E-04	3.45E-03	8.68E-05	1.91E-04	1.67E-04
Rock drills	6.10E-04	1.14E-04	1.34E-04	5.00E-05	4.55E-05	1.34E-03	3.38E-05	7.43E-05	6.49E-05

¹ Equipment hours were provided by the Applicant and were based on the Colstrip Alternative. These hours were scaled based on the ratios provided by the Applicant (Table E.1-177) for each build alternative.

Table E.1-91. NONROAD Emission Factors by Piece of Equipment, Greenhouse Gases¹

Construction Equipment	Greenhouse Gas Emission Factors (g/hp-hr) (EPA 2009b)			
	CO ₂	CH ₄	N ₂ O	CO _{2e}
CAT 777 (100-ton haul trucks)	94.25	10.31	4.58	1,717.9345
CAT 992 Front-end loader	30.68	10.31	4.58	1,654.3730
CAT D10 dozer	246.90	10.31	4.58	1,870.5912
CAT D9 dozer	246.90	10.31	4.58	1,870.5912
CAT D8 dozers	270.18	10.31	4.58	1,893.8739
CAT 14G motor graders	165.75	10.31	4.58	1,789.4435
CAT 825 compactor	45.68	10.31	4.58	1,669.3699
CAT 10,000 gal. water wagons	45.22	10.31	4.58	1,668.9054
Smooth drum roller	45.68	10.31	4.58	1,669.3699
CAT 637 scrapers	126.85	10.31	4.58	1,750.5437
CAT 345 excavators	187.97	10.31	4.58	1,811.6623
CAT 966 front-end loaders	408.38	10.31	4.58	2,032.0703
Generator sets	48.19	10.31	4.58	1,671.8766
Rock drills	25.98	10.31	4.58	1,649.6696

¹ Equipment hours were provided by the Applicant and were based on the Colstrip Alternative. These hours were scaled based on the ratios provided by the Applicant (Table E.1-177) for each build alternative.

Table E.1-92. MOVES Emission Factors by Piece of Equipment, Criteria Pollutants

Construction Equipment ^{1,2}	MOVES Vehicle Type	# of Pieces of Equip	Total Op (hours)	Total VMT	Fuel Rate (gal/VMT)	Fuel Consump (gal)	Criteria Pollutant – Emission Factors (g/mi)						
							CO	NO _x	Pb	PM10	PM2.5	SO ₂	VOC
4,000 gal. water trucks	Single Unit Short Haul Truck	2	7,000	210,000	0.106	22,226	2.11E+00	7.54E-02	6.85E-06	8.15E-02	1.49E-01	3.93E-03	8.85E-03
Fuel trucks	Single Unit Short Haul Truck	2	20,000	600,000	0.106	63,504	2.11E+00	7.54E-02	6.85E-06	8.15E-02	1.49E-01	3.93E-03	8.85E-03
Mechanics service trucks	Light Commercial Truck	6	13,000	1,170,000	0.281	328,945	1.46E+00	2.50E-01	2.17E-05	2.58E-01	1.79E-01	8.02E-03	2.93E-02
Pickups	Passenger Truck	15	2,500	562,500	0.301	169,041	3.16E+00	2.77E-01	2.42E-05	2.88E-01	1.31E-01	6.63E-03	2.36E-02

¹ MOVES 2015 Data for Diesel, Rural Unrestricted Vehicles

² Equipment hours were provided by the Applicant and were based on the Colstrip Alternative. These hours were scaled based on the ratios provided by the Applicant (Table E.1-177) for each build alternative.

Table E.1-93. MOVES Emission Factors by Piece of Equipment, Hazardous Pollutants

Construction Equipment ^{1,2}	Hazardous Pollutants – Emission Factors (g/mi)								
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Ethylbenzene	Formaldehyde	n-Hexane	Toluene	Xylene
4,000 gal. water trucks	3.15E-04	5.86E-05	6.94E-05	2.58E-05	2.35E-05	6.93E-04	1.74E-05	3.83E-05	3.35E-05
Fuel trucks	3.15E-04	5.86E-05	6.94E-05	2.58E-05	2.35E-05	6.93E-04	1.74E-05	3.83E-05	3.35E-05
Mechanics service trucks	1.04E-03	1.94E-04	2.29E-04	2.29E-04	7.77E-05	2.29E-03	5.77E-05	1.27E-04	1.11E-04
Pickups	1.03E-02	1.56E-04	1.85E-04	6.89E-05	6.27E-05	1.85E-03	4.65E-05	1.02E-04	8.93E-05

¹ MOVES 2015 Data for Diesel, Rural Unrestricted Vehicles

² Equipment hours were provided by the Applicant and were based on the Colstrip Alternative. These hours were scaled based on the ratios provided by the Applicant (Table E.1-177) for each build alternative.

Table E.1-94. MOVES Emission Factors by Piece of Equipment, Greenhouse Gases

Construction Equipment ¹	Greenhouse Gas Emission Factors (g/mi)			
	CO ₂	CH ₄	N ₂ O	CO _{2e}
4,000 gal. water trucks	1.52E+03	1.55E+03	2.64E-02	7.28E-02
Fuel trucks	1.52E+03	1.55E+03	2.64E-02	7.28E-02
Mechanics service trucks	2.88E+03	2.90E+03	2.99E-02	3.28E-02
Pickups	3.08E+03	3.10E+03	4.09E-02	4.33E-02

¹ MOVES 2015 Data for Diesel, Rural Unrestricted Vehicles
² Equipment hours were provided by the Applicant and were based on the Colstrip Alternative. These hours were scaled based on the ratios provided by the Applicant (Table E.1-177) for each build alternative.

Table E.1-95. Emission Factors for Construction Equipment (g/hp-hr)

NONROAD Equipment Description	THC- Exhaust+ Crankcase	CO-Exhaust	NO _x -Exhaust	CO ₂ -Exhaust	SO ₂ -Exhaust	PM-Exhaust [PM10]	Fuel Consumption (gal/hr/ piece of equip)
CAT 777 (100-ton haul trucks)	0.04	0.19	0.55	94.25	0.00	0.02	26.76
CAT 992 Front-end loader	0.02	0.09	0.25	30.68	0.00	0.01	26.71
CAT D10 dozer	0.08	0.46	1.16	246.90	0.00	0.07	13.11
CAT D9 dozer	0.08	0.46	1.16	246.90	0.00	0.07	13.11
CAT D8 dozers	0.09	0.32	0.93	270.18	0.00	0.06	7.26
CAT 14G motor graders	0.05	0.19	0.56	165.75	0.00	0.04	7.13
CAT 825 compactor	0.02	0.06	0.19	45.68	0.00	0.01	6.69
CAT 10,000 gal. water wagons	0.01	0.02	0.10	45.22	0.00	0.00	7.53
Smooth drum roller	0.02	0.06	0.19	45.68	0.00	0.01	6.69
CAT 637 scrapers	0.04	0.24	0.61	126.85	0.00	0.04	13.03
CAT 345 excavators	0.06	0.31	0.78	187.97	0.00	0.05	12.66
CAT 966 front-end loaders	0.14	0.92	2.28	408.38	0.00	0.13	12.93
Generator sets	0.04	0.20	0.37	48.19	0.00	0.04	2.14
Rock drills	0.02	0.06	0.21	25.98	0.00	0.01	5.32

Source: USEPA NONROAD2008a run for 2015 for Rosebud+Custer+Big Horn+Powder River Co., Montana.

Table E.1-96. Derived Emission Factors for Other Pollutants

Pollutant	Basis	Speciation (multiplier)	Reference for Speciation
Criteria			
Pb -- see HAPs below			
PM2.5	PM10	0.97	USEPA 2009b
VOC	THC	1.053	USEPA 2009b
HAP			
Acetaldehyde	VOC	0.035559	USEPA 2010
Acrolein	VOC	0.006622	USEPA 2010
Benzene	VOC	0.007835	USEPA 2010
1,3-butadiene	VOC	0.002918	USEPA 2010
Ethylbenzene	VOC	0.002655	USEPA 2010
Formaldehyde	VOC	0.078225	USEPA 2010
Lead	PM10	0.0000840	USEPA 2011a
n-Hexane	VOC	0.00197	USEPA 2010
Toluene	VOC	0.00433	USEPA 2010
Xylene	VOC	0.003784	USEPA 2010
GHG	Value	Unit	Reference
CH ₄	0.18	g/Kg diesel fuel	USEPA 2013
	10.31	g/hp-hr	Calculated
N ₂ O	0.08	g/Kg diesel fuel	USEPA 2013
	4.58	g/hp-hr	Calculated

Table E.1-97. Factors Used for Conversion of CH₄ and N₂O from Fuel Basis to hp-hr Basis

			USEPA 2014a
Density of diesel fuel	3.196	kg/gal	
Avg. energy conversion efficiency	17.93	hp-hr/gal	Calculated

Table E.1-98. Global Warming Potential for CO₂e Calculation

CO ₂	CH ₄	N ₂ O
1	25	298
Source: IPCC 2007		
CO ₂ e = CO ₂ equivalent.		

Table E.1-99. Factors for Conversion

Mass Conversion Factor	Value	Unit	Reference
Scraper productivity rate	219	cu yd/hr	CBC 2004
Grams to US tons	1.102E-06	tons/g	USEPA 1985

Table E.1-100. MOVES Model Output

RoadType	yearID	FuelType	SourceType	CO	NOx	PM10 Brakewear	PM10 Tirewear	PM10 Total Exh	PM2.5 Brakewear	PM2.5 Tirewear	PM2.5 Total Exh	VOC	CO ₂ Equivalent	SO ₂	Formaldehyde	Benzene	N ₂ O	Methane (CH ₄)	CO ₂ Derive	Fuel Efficiency (gal/mi)
Rural Unrestricted Access	2 0 1 5	Composite	Combination Long-haul Truck	10.91	40.31	0.08	0.05	1.14	0.02	0.01	1.10	3.21	6961.93	0.05	0.37	0.03	0.00	1.29	6928.22	0.68
			Combination Short-haul Truck	5.04	22.34	0.08	0.05	0.88	0.02	0.01	0.86	0.99	6118.82	0.04	0.07	0.01	0.01	0.09	6114.97	0.60
			Intercity Bus	7.87	31.74	0.16	0.06	1.44	0.04	0.01	1.39	1.34	5409.07	0.04	0.10	0.01	0.01	0.10	5404.75	0.53
			Light Commercial Truck	41.26	4.59	0.03	0.02	0.12	0.01	0.00	0.11	2.14	1596.30	0.03	0.03	0.08	0.07	0.16	1570.08	0.15
			Motor Home	88.56	13.56	0.09	0.03	0.29	0.02	0.01	0.28	3.16	3097.51	0.04	0.07	0.09	0.04	0.13	3081.32	0.30
			Motorcycle	64.31	2.79	0.00	0.01	0.17	0.00	0.00	0.15	3.15	1310.22	0.02	0.03	0.11	0.02	0.25	1298.81	0.13
			Passenger Car	18.68	1.30	0.02	0.02	0.04	0.01	0.00	0.04	0.80	1094.15	0.02	0.01	0.03	0.03	0.06	1085.22	0.11
			Passenger Truck	40.32	3.75	0.03	0.02	0.08	0.01	0.00	0.08	2.11	1549.61	0.03	0.02	0.08	0.07	0.15	1524.19	0.15
			Refuse Truck	12.19	22.16	0.13	0.06	0.93	0.03	0.01	0.90	1.31	5138.13	0.04	0.09	0.01	0.01	0.11	5132.78	0.50
			School Bus	29.08	17.99	0.13	0.05	0.78	0.03	0.01	0.76	1.93	3082.52	0.02	0.13	0.03	0.02	0.26	3069.24	0.30
			Single Unit Long-haul Truck	32.42	8.93	0.11	0.03	0.26	0.03	0.01	0.25	1.43	2708.38	0.03	0.06	0.03	0.03	0.14	2697.38	0.26
			Single Unit Short-haul Truck	36.97	9.32	0.11	0.03	0.26	0.03	0.01	0.25	1.46	2897.00	0.03	0.06	0.03	0.03	0.18	2882.73	0.28
			Transit Bus	10.85	24.60	0.08	0.03	1.10	0.02	0.01	1.07	1.50	4345.97	0.03	0.12	0.01	0.01	0.12	4340.52	0.42

Table E.1-101. Speciation Fractions

HAP	MOVES Pre-2007 (Table 11)		Source
	Basis	Speciation (multiplier)	
Acetaldehyde	VOC	0.035559	USEPA 2010
Acrolein	VOC	0.006622	USEPA 2010
Benzene	VOC	0.007835	USEPA 2010
1,3-butadiene	VOC	0.002918	USEPA 2010
Ethylbenzene	VOC	0.002655	USEPA 2010
Formaldehyde	VOC	0.078225	USEPA 2010
Lead	PM10	0.0000840	USEPA 2010
n-Hexane	VOC	0.00197	USEPA 2010
Toluene	VOC	0.00433	USEPA 2010
Xylene	VOC	0.003784	USEPA 2010

Table E.1-102. Conversion Factors

For Conversion from Veh-hr to VMT		
Average vehicle speed	15	mph
For Deriving Fuel Rate from CO₂		
Average Ratio CO ₂ /Fuel in NONROAD	0.01130	tons CO ₂ /gal
General Conversion Factors		
1 kilogram	2.205	pounds
Diesel fuel density	7.045	lb/gallon
1 kilogram	1,000	grams

Table E.1-103. Equipment Usage

No. of Units	Equipment Type ¹	Horsepower (hp)	SCC Code	Total Operated Hours ²	Total Hours per Piece of Equip.	NONROAD HP
7	CAT 777 (100-ton haul trucks)	916	2270002051	38,000	5,429	1,000
1	CAT 992 Front-end loader	814	2270002060	5,500	5,500	1,000
1	CAT D10 dozer	600	2270002069	5,500	5,500	600
1	CAT D9 dozer	436	2270002069	5,500	5,500	600
2	CAT D8 dozers	317	2270002069	7,000	3,500	300
3	CAT 14G motor graders	259	2270002048	12,500	4,167	300
1	CAT 825 compactor	354	2270002015	5,500	5,500	300
3	CAT 10,000 gal. water wagons	Off road	2270002051	14,500	4,833	300
2	4,000 gal. water trucks	MOVES	MOVES	7,000	3,500	MOVES
1	Smooth drum roller		2270002015	5,500	5,500	300
3	CAT 637 scrapers	500	2270002018	7,500	2,500	600
1	CAT 345 excavators		2270002036	10,600	10,600	600
2	CAT 966 front-end loaders		2270002060	10,600	5,300	600
2	Fuel trucks	MOVES	MOVES	20,000	10,000	MOVES
6	Mechanics service trucks	MOVES	MOVES	13,000	2,167	MOVES
3	Generator sets		2270006005	8,000	2,667	100
3	Rock drills		2270002033	8,000	2,667	300
15	Pickups	MOVES	MOVES	2,500	167	MOVES

¹ Assume all equipment uses diesel fuel

² Estimate of hours based on the Colstrip Alternative
Source: CAT 2014.

Table E.1-104. Construction Schedule

Alternative	12-Month Schedule		8-Month Schedule	
	Months	Years	Months	Years
Colstrip	16.0	1.3	20.0	2.5
Colstrip East	22.1	1.8	30.0	4.0
Tongue River	20.1	1.7	24.0	3.0
Tongue River East	30.4	2.5	38.0	4.7
Tongue River Road	30.0	2.5	36.0	5.0
Tongue River Road East	36.2	3.0	45.2	5.6
Moon Creek	29.5	2.5	36.0	5.0
Moon Creek East	39.8	3.3	49.7	6.2
Decker	36.0	3.0	45.0	6.0
Decker East	36.0	3.0	45.0	6.0

Table E.1-105. Ratio of Cubic Yards of Earth Moved By Alternative Compared to Colstrip

Ratio	Alternative
1.00	Colstrip
1.38	Colstrip East
1.26	Tongue River
1.90	Tongue River East
1.87	Tongue River Road
2.26	Tongue River Road East
1.85	Moon Creek
2.48	Moon Creek East
2.21	Decker
2.21	Decker East

Source: TRRC

Table E.1-106. Alternative Characteristics

Alternative	Earthwork Required				
	ROW Length (mi) (A)	ROW Area (ac) (A)	Cut (10⁶ cu yd)	Fill (10⁶ cu yd)	Total (10⁶ cu yd)
Tongue River	83.7	3,783	21.32	20.30	41.62
Tongue River East	86.3	3,803	32.41	30.40	62.81
Colstrip	72.0	2,040	17.81	15.27	33.08
Colstrip East	75.1	2,094	25.57	20.07	45.64
Tongue River Road	83.7	4,234	31.51	30.43	61.94
Tongue River Road East	85.9	4,218	39.94	34.81	74.75
Moon Creek	82.1	4,026	30.85	30.20	61.05
Moon Creek East	84.7	4,047	41.94	40.27	82.21
Decker	51.1	2,826	35.71	37.32	73.03
Decker East	49.6	2,695	35.29	37.87	73.16

Table E.1-107. Fugitive Particulate Matter Inputs

Source/Description	Value	Unit	Reference/Notes
Note: Throughout the analysis, "tons" refers to US short tons (2,000 lb) unless metric tons (tonnes) are specified.			
Emission Factors -- General Construction	Uncontrolled Emission Factor	Controlled Emission Factor	
Fugitive PM10 emission factor	0.11	0.055	tons PM10/a c-mo WRAP 2006, Table 3.2. WRAP value assumed to be uncontrolled emission factor.
Fugitive particle size ratio (PM2.5/PM10)	0.15	--	-- USEPA 2006. Note that particle size ratios may differ for different emission sources.
Fugitive PM2.5 emission factor	0.0165	0.008	tons PM2.5/ac-mo calculated
Width of disturbed land area within right-of-way	--	--	ft Not accounted for -- conservatively assumed entire right-of-way is disturbed
Note: no data available on number of acres disturbed at one time. In applying the above factors, assumed conservatively that entire right-of-way is disturbed for entire period of construction activity.			
WRAP general construction factor was developed for activities without a significant earthmoving component, but TRR does have a large amount of earthmoving, so account for earthmoving as a separate component below.			
Emission Factors -- Earthmoving	Uncontrolled Emission Factor	Controlled Emission Factor	
			ton/1,000 cu yd WRAP 2006, Table 3.2, factor for on-site cut/fill. WRAP value assumed to be uncontrolled emission factor.
PM10	0.059	0.030	lb/cu yd calculated
PM10	0.118	0.059	lb/cu yd calculated
Fugitive particulate matter emission factors -- earthwork basis	PM2.5	0.018	0.009 lb/cu yd calculated
Control Measures			
Watering	PM10 and PM2.5	50%	% emission reduction WRAP 2006. Construction Methodology.

Table E.1-108. Bridge Construction Inputs

No. of Units	Equipment Type	NONROAD/ MOVES HP	SCC Code	Total Operated Hours				
				Colstrip/East	Tongue River/East	Tongue River Road/East	Moon Creek/East	Decker/East
1	Crane	600	2270002045	2,250	1,000	2,750	2,000	1,000
1	Tractor Trailer		N/A	1,350	600	1,650	1,200	600

E.1.5.2 Emissions Calculations

Tables E.1-109 through E.1-128 summarize construction emissions by build alternative.

Table E.1-109. Summary of Construction Exhaust Emissions (total tons)

	Tongue River	Tongue River East	Colstrip	Colstrip East	Tongue River Road	Tongue River Road East	Moon Creek	Moon Creek East	Decker	Decker East
Criteria Pollutants (tons)										
CO	2,118.97	3,194.81	1,684.30	2,322.09	3,152.69	3,804.00	3,106.94	4,181.62	3,771.82	3,773.27
NO _x	1,380.87	2,081.86	1,101.64	1,513.84	2,063.73	2,484.90	2,034.49	2,726.47	2,427.22	2,431.96
Pb	0.005	0.008	0.004	0.006	0.007	0.009	0.007	0.010	0.009	0.009
PM ₁₀	59.20	89.23	47.21	64.94	88.33	106.44	87.03	116.85	103.90	104.08
PM _{2.5}	57.11	86.08	45.55	62.66	85.22	102.69	83.96	112.73	100.22	100.41
SO ₂	3.01	4.54	2.40	3.30	4.49	5.41	4.42	5.95	5.33	5.33
VOC	177.69	267.90	141.44	194.74	264.86	319.30	261.07	350.73	314.35	314.70
Hazardous Air Pollutants (tons)										
Acetaldehyde	6.33	9.54	5.04	6.93	9.43	11.37	9.29	12.49	11.19	11.20
Acrolein	1.18	1.77	0.94	1.29	1.75	2.11	1.73	2.32	2.08	2.08
Benzene	4.00	6.03	3.18	4.38	5.96	7.18	5.87	7.90	7.13	7.13
1,3-Butadiene	0.52	0.78	0.41	0.57	0.77	0.93	0.76	1.02	0.92	0.92
Ethylbenzene	0.47	0.71	0.38	0.52	0.70	0.85	0.69	0.93	0.83	0.84
Formaldehyde	8.54	12.87	6.81	9.36	12.75	15.36	12.57	16.86	15.01	15.04
n-Hexane	0.35	0.53	0.28	0.38	0.52	0.63	0.51	0.69	0.62	0.62
Toluene	0.77	1.16	0.61	0.84	1.15	1.38	1.13	1.52	1.36	1.36
Xylene	0.67	1.01	0.54	0.74	1.00	1.21	0.99	1.33	1.19	1.19
Greenhouse Gas Emissions (tons)										
CO ₂	306,047.37	461,948.73	244,685.22	334,508.76	460,995.02	552,902.13	455,676.64	605,048.57	541,396.10	542,810.56
CH ₄	1,216.33	1,830.60	976.13	1,340.35	1,817.66	2,189.60	1,786.70	2,400.46	2,127.74	2,131.40
N ₂ O	540.56	813.56	433.80	595.69	807.75	973.07	793.98	1,066.81	945.60	947.22
CO ₂ e	497,543.66	750,154.21	398,359.72	545,533.42	747,146.82	897,618.38	736,949.73	982,969.70	876,378.36	878,367.54

Table E.1-110. Summary of Construction Exhaust Emissions (average tons/year) – 12 month Construction Schedule

	Tongue River	Tongue River East	Colstrip	Colstrip East	Tongue River Road	Tongue River Road East	Moon Creek	Moon Creek East	Decker	Decker East
Criteria Pollutants (tons/year)										
CO	1,262.30	1,262.20	1,263.23	1,262.63	1,263.05	1,262.72	1,262.96	1,262.36	1,257.27	1,257.76
NO _x	822.60	822.50	826.23	823.15	826.79	824.85	827.01	823.08	809.07	810.65
Pb	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PM ₁₀	35.26	35.25	35.41	35.31	35.39	35.33	35.38	35.28	34.63	34.69
PM _{2.5}	34.02	34.01	34.16	34.07	34.14	34.09	34.13	34.03	33.41	33.47
SO ₂	1.79	1.79	1.80	1.80	1.80	1.80	1.80	1.79	1.78	1.78
VOC	105.85	105.84	106.08	105.89	106.11	105.99	106.12	105.88	104.78	104.90
Hazardous Air Pollutants (tons/year)										
Acetaldehyde	3.77	3.77	3.78	3.77	3.78	3.77	3.78	3.77	3.73	3.73
Acrolein	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.70	0.69	0.69
Benzene	2.38	2.38	2.39	2.38	2.39	2.39	2.39	2.38	2.38	2.38
1,3-Butadiene	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31
Ethylbenzene	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28	0.28
Formaldehyde	5.09	5.09	5.10	5.09	5.11	5.10	5.11	5.09	5.00	5.01
n-Hexane	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21
Toluene	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.45	0.45
Xylene	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.40
Greenhouse Gas Emissions (tons/year)										
CO ₂	182,316.17	182,506.08	183,513.91	181,888.42	184,687.17	183,533.94	185,230.79	182,654.69	180,465.37	180,936.85
CH ₄	724.58	723.23	732.09	728.81	728.20	726.83	726.28	724.66	709.25	710.47
N ₂ O	322.02	321.42	325.35	323.91	323.61	323.01	322.75	322.05	315.20	315.74
CO ₂ e	296,392.86	296,369.91	298,769.79	296,632.63	299,327.38	297,961.30	299,567.21	296,743.16	292,126.12	292,789.18

Table E.1-111. Summary of Construction Exhaust Emissions (average tons/year) – 8 month Construction Schedule

	Tongue River	Tongue River East	Colstrip	Colstrip East	Tongue River Road	Tongue River Road East	Moon Creek	Moon Creek East	Decker	Decker East
Criteria Pollutants (tons/year)										
CO	706.32	673.17	673.72	580.52	630.54	673.45	621.39	673.26	628.64	628.88
NO _x	460.29	438.66	440.66	378.46	412.75	439.92	406.90	438.98	404.54	405.33
Pb	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PM ₁₀	19.73	18.80	18.88	16.24	17.67	18.84	17.41	18.81	17.32	17.35
PM _{2.5}	19.04	18.14	18.22	15.66	17.04	18.18	16.79	18.15	16.70	16.73
SO ₂	1.00	0.96	0.96	0.83	0.90	0.96	0.88	0.96	0.89	0.89
VOC	59.23	56.45	56.58	48.68	52.97	56.53	52.21	56.47	52.39	52.45
Hazardous Air Pollutants (tons/year)										
Acetaldehyde	2.11	2.01	2.01	1.73	1.89	2.012	1.86	2.01	1.87	1.87
Acrolein	0.39	0.37	0.37	0.32	0.35	0.374	0.35	0.37	0.35	0.35
Benzene	1.33	1.27	1.27	1.10	1.19	1.272	1.17	1.27	1.19	1.19
1,3-Butadiene	0.17	0.16	0.17	0.14	0.15	0.165	0.15	0.16	0.15	0.15
Ethylbenzene	0.16	0.15	0.15	0.13	0.14	0.150	0.14	0.15	0.14	0.14
Formaldehyde	2.85	2.71	2.72	2.34	2.55	2.719	2.51	2.71	2.50	2.51
n-Hexane	0.12	0.11	0.11	0.10	0.10	0.111	0.10	0.11	0.10	0.10
Toluene	0.26	0.24	0.24	0.21	0.23	0.245	0.23	0.24	0.23	0.23
Xylene	0.22	0.21	0.21	0.18	0.20	0.214	0.20	0.21	0.20	0.20
Greenhouse Gas Emissions (tons/year)										
CO ₂	102,015.79	97,336.58	97,874.09	83,627.19	92,199.00	97,884.77	91,135.33	97,415.83	90,232.68	90,468.43
CH ₄	405.44	385.72	390.45	335.09	363.53	387.64	357.34	386.49	354.62	355.23
N ₂ O	180.19	171.42	173.52	148.92	161.55	172.27	158.80	171.76	157.60	157.87
CO ₂ e	165,847.89	158,063.95	159,343.89	136,383.36	149,429.36	158,912.69	147,389.95	158,263.02	146,063.06	146,394.59

Table E.1-112. Total Particulate Matter Emissions from Construction (tons total for 12-month construction period)

Alternative	PM10			PM2.5		
	Fugitive	Exhaust	Total	Fugitive	Exhaust	Total
Tongue River	5,420	59.2	5,479	813	57.1	870
Tongue River East	8,207	89.2	8,296	1,231	86.1	1,317
Colstrip	2,771	47.2	2,818	416	45.6	461
Colstrip East	3,888	64.9	3,953	583	62.7	646
Tongue River Road	8,803	88.3	8,891	1,320	85.2	1,406
Tongue River Road East	10,593	106.4	10,699	1,589	102.7	1,692
Moon Creek	8,338	87.0	8,425	1,251	84.0	1,335
Moon Creek East	11,272	116.9	11,389	1,691	112.7	1,804
Decker	7,750	103.9	7,854	1,163	100.2	1,263
Decker East	7,495	104.1	7,599	1,124	100.4	1,225

Table E.1-113. Summary of Construction Particulate Matter Emissions (total tons) – 8 month Construction Schedule

Alternative	PM10			PM2.5		
	Fugitive	Exhaust	Total	Fugitive	Exhaust	Total
Tongue River	6,222	59.2	6,282	933	57.1	990
Tongue River East	9,795	89.2	9,884	1,469	86.1	1,555
Colstrip	3,220	47.2	3,267	483	45.6	529
Colstrip East	4,801	64.9	4,866	720	62.7	783
Tongue River Road	10,211	88.3	10,300	1,532	85.2	1,617
Tongue River Road East	12,690	106.4	12,796	1,903	102.7	2,006
Moon Creek	9,773	87.0	9,860	1,466	84.0	1,550
Moon Creek East	13,484	116.9	13,601	2,023	112.7	2,135
Decker	9,149	103.9	9,253	1,372	100.2	1,473
Decker East	8,829	104.1	8,933	1,324	100.4	1,425

Table E.1-114. Summary of Construction Particulate Matter Emissions (average tons/year) – 12 month Construction Schedule

Alternative	PM10			PM2.5		
	Fugitive	Exhaust	Total	Fugitive	Exhaust	Total
Tongue River	3,229	35.26	3,264	484	34.02	518
Tongue River East	3,242	35.25	3,278	486	34.01	520
Colstrip	2,078	35.41	2,114	312	34.16	346
Colstrip East	2,114	35.31	2,149	317	34.07	351
Tongue River Road	3,527	35.39	3,562	529	34.14	563
Tongue River Road East	3,516	35.33	3,552	527	34.09	562
Moon Creek	3,389	35.38	3,425	508	34.13	543
Moon Creek East	3,403	35.28	3,438	510	34.03	544
Decker	2,583	34.63	2,618	388	33.41	421
Decker East	2,498	34.69	2,533	375	33.47	408

Table E.1-115. Summary of Construction Particulate Matter Emissions (average tons/year) – 8 month Construction Schedule

Alternative	PM10			PM2.5		
	Fugitive	Exhaust	Total	Fugitive	Exhaust	Total
Tongue River	2,074	19.73	2,094	311	19.04	330
Tongue River East	2,064	18.80	2,083	310	18.14	328
Colstrip	1,288	18.88	1,307	193	18.22	211
Colstrip East	1,200	16.24	1,216	180	15.66	196
Tongue River Road	2,042	17.67	2,060	306	17.04	323
Tongue River Road East	2,247	18.84	2,265	337	18.18	355
Moon Creek	1,955	17.41	1,972	293	16.79	310
Moon Creek East	2,171	18.81	2,190	326	18.15	344
Decker	1,525	17.32	1,542	229	16.70	245
Decker East	1,472	17.35	1,489	221	16.73	237

Table E.1-116. Construction Fugitive Particulate Matter Emissions

Alternative	ROW Area (ac) (A)	General Construction		Earthmoving		Total Fugitive Particulate Matter Emissions			
		Construction Activity Duration (mo) (C, D)	Fugitive PM10 Emissions (tons for constr. period)	Fugitive PM2.5 Emissions (tons for constr. period)	Earthwork Required (cut+fill) (10 ⁶ cy) (B)	Fugitive PM10 Emissions (tons for constr. period)	Fugitive PM2.5 Emissions (tons for constr. period)	Fugitive PM10 Emissions (tons for constr. period)	Fugitive PM2.5 Emissions (tons for constr. period)
Tongue River	3,783	20.14	4,191	629	41.66	1,228.89	184.33	5,420.03	813.00
Tongue River East	3,803	30.37	6,354	953	62.81	1,852.95	277.94	8,206.74	1,231.01
Colstrip	2,040	16.00	1,795	269	33.09	976.08	146.41	2,771.11	415.67
Colstrip East	2,094	22.07	2,541	381	45.64	1,346.33	201.95	3,887.65	583.15
Tongue River Road	4,234	29.95	6,976	1,046	61.94	1,827.29	274.09	8,803.11	1,320.47
Tongue River Road East	4,218	36.15	8,387	1,258	74.76	2,205.36	330.80	10,592.69	1,588.90
Moon Creek	4,026	29.52	6,537	981	61.05	1,800.91	270.14	8,337.97	1,250.70
Moon Creek East	4,047	39.75	8,847	1,327	82.20	2,424.97	363.75	11,272.14	1,690.82
Decker	2,826	36.00	5,596	839	73.03	2,154.51	323.18	7,750.19	1,162.53
Decker East	2,695	36.00	5,337	801	73.16	2,158.20	323.73	7,495.09	1,124.26

Table E.1-117. Construction Exhaust Emissions Inventory, Criteria Pollutants

EQUIPMENT DATA					TRR MOVES/NONROAD DATA		EMISSIONS USING TRR EMISSION FACTORS						
Construction Equipment	Horsepower (hp)	Total Operation (hours)	Pieces of Equip	VMT (onroad veh only)	Fuel Rate (gal/VMT or gal/hr/piece of equip)	Fuel Consump (total gal)	Criteria Pollutant Emissions (total tons)						
							CO	NO _x	Pb	PM10	PM2.5	SO ₂	VOC
CAT 777 (100-ton haul trucks)	1,000	38,000	7	n.a.	26.76	7,118,178	244.66	685.65	2.43E-03	28.92	28.05	0.893	54.25
CAT 992 Front-end loader	1,000	5,500	1	n.a.	26.71	146,892	68.31	201.34	7.99E-04	9.51	9.22	0.202	14.37
CAT D10 dozer	600	5,500	1	n.a.	13.11	72,115	2.05	5.17	2.57E-05	0.31	0.30	0.009	0.37
CAT D9 dozer	600	5,500	1	n.a.	13.11	72,115	2.05	5.17	2.57E-05	0.31	0.30	0.009	0.37
CAT D8 dozers	300	7,000	2	n.a.	7.26	101,645	0.42	1.22	6.83E-06	0.08	0.08	0.003	0.12
CAT 14G motor graders	300	12,500	3	n.a.	7.13	267,292	1.20	3.53	1.97E-05	0.23	0.23	0.008	0.35
CAT 825 compactor	300	5,500	1	n.a.	6.69	36,795	1.66	4.98	2.76E-05	0.33	0.32	0.010	0.46
CAT 10,000 gal. water wagons	300	14,500	3	n.a.	7.53	327,627	4.07	16.83	5.70E-05	0.68	0.66	0.055	2.21
Smooth drum roller	300	5,500	1	n.a.	6.69	36,795	1.66	4.98	2.76E-05	0.33	0.32	0.010	0.46
CAT 637 scrapers	600	7,500	3	n.a.	13.03	293,074	5.40	13.57	6.72E-05	0.80	0.78	0.023	0.95
CAT 345 excavators	600	10,600	1	n.a.	12.66	134,181	5.17	12.95	6.71E-05	0.80	0.78	0.025	0.98
CAT 966 front-end loaders	600	10,600	2	n.a.	12.93	274,114	2.30	5.71	2.78E-05	0.33	0.32	0.008	0.38
Generator sets	100	8,000	3	n.a.	2.14	51,250	0.66	1.20	9.92E-06	0.12	0.11	0.001	0.14
Rock drills	300	8,000	3	n.a.	5.32	127,599	3.23	12.21	5.46E-05	0.65	0.63	0.013	1.00
4,000 gal. water trucks	n.a.	7,000	2	210,000	0.11	22,226	0.49	0.02	1.58E-06	0.02	0.03	0.001	0.00
Fuel trucks	n.a.	20,000	2	600,000	0.11	63,504	1.39	0.05	4.53E-06	0.05	0.10	0.003	0.01
Mechanics service trucks	n.a.	13,000	6	1,170,000	0.28	328,945	1.88	0.32	2.80E-05	0.33	0.23	0.010	0.04
Pickups	n.a.	2,500	15	562,500	0.30	169,041	1.96	0.17	1.50E-05	0.18	0.08	0.004	0.01
Total Emissions (total tons)						9,643,390.758	29.77	348.54	975.07	3.69E-03	43.97	42.53	1.29

Table E.1-118. Construction Exhaust Emissions Inventory, Hazardous Pollutants

Construction Equipment	Hazardous Pollutants Emissions (total tons)								
	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Ethylbenzene	Formaldehyde	n-Hexane	Toluene	Xylene
CAT 777 (100-ton haul trucks)	1.93E+00	3.59E-01	4.25E-01	1.58E-01	1.44E-01	4.24E+00	1.07E-01	2.35E-01	2.05E-01
CAT 992 Front-end loader	5.11E-01	9.52E-02	1.13E-01	4.19E-02	3.82E-02	1.12E+00	2.83E-02	6.22E-02	5.44E-02
CAT D10 dozer	1.30E-02	2.43E-03	2.87E-03	1.07E-03	9.73E-04	2.87E-02	7.22E-04	1.59E-03	1.39E-03
CAT D9 dozer	1.30E-02	2.43E-03	2.87E-03	1.07E-03	9.73E-04	2.87E-02	7.22E-04	1.59E-03	1.39E-03
CAT D8 dozers	4.27E-03	7.96E-04	9.42E-04	3.51E-04	3.19E-04	9.40E-03	2.37E-04	5.20E-04	4.55E-04
CAT 14G motor graders	1.24E-02	2.32E-03	2.74E-03	1.02E-03	9.28E-04	2.74E-02	6.89E-04	1.51E-03	1.32E-03
CAT 825 compactor	1.64E-02	3.05E-03	3.61E-03	1.34E-03	1.22E-03	3.60E-02	9.07E-04	1.99E-03	1.74E-03
CAT 10,000 gal. water wagons	7.84E-02	1.46E-02	1.73E-02	6.44E-03	5.86E-03	1.73E-01	4.35E-03	9.55E-03	8.35E-03
Smooth drum roller	1.64E-02	3.05E-03	3.61E-03	1.34E-03	1.22E-03	3.60E-02	9.07E-04	1.99E-03	1.74E-03
CAT 637 scrapers	3.39E-02	6.32E-03	7.48E-03	2.79E-03	2.53E-03	7.47E-02	1.88E-03	4.13E-03	3.61E-03
CAT 345 excavators	3.50E-02	6.51E-03	7.71E-03	2.87E-03	2.61E-03	7.69E-02	1.94E-03	4.26E-03	3.72E-03
CAT 966 front-end loaders	1.36E-02	2.54E-03	3.00E-03	1.12E-03	1.02E-03	3.00E-02	7.55E-04	1.66E-03	1.45E-03
Generator sets	5.07E-03	9.45E-04	1.12E-03	4.16E-04	3.79E-04	1.12E-02	2.81E-04	6.18E-04	5.40E-04
Rock drills	3.55E-02	6.61E-03	7.82E-03	2.91E-03	2.65E-03	7.80E-02	1.97E-03	4.32E-03	3.78E-03
4,000 gal. water trucks	7.29E-05	1.36E-05	1.61E-05	5.98E-06	5.44E-06	1.60E-04	4.04E-06	8.87E-06	7.76E-06
Fuel trucks	2.08E-04	3.88E-05	4.59E-05	1.71E-05	1.55E-05	4.58E-04	1.15E-05	2.54E-05	2.22E-05
Mechanics service trucks	1.34E-03	2.50E-04	2.96E-04	2.96E-04	1.00E-04	2.95E-03	7.44E-05	1.64E-04	1.43E-04
Pickups	6.36E-03	9.69E-05	1.15E-04	4.27E-05	3.89E-05	1.14E-03	2.88E-05	6.34E-05	5.54E-05
Total Emissions (total tons)	2.73	0.51	0.60	0.22	0.20	5.98	0.15	0.33	0.29

Table E.1-119. Construction Exhaust Emissions Inventory, Greenhouse Gases

Construction Equipment	Greenhouse Gas Emissions (total tons)			
	CO ₂	CH ₄	N ₂ O	CO ₂ e
CAT 777 (100-ton haul trucks)	118,328.74	431.98	191.99	186,341.92
CAT 992 Front-end loader	24,328.38	62.52	27.79	34,172.39
CAT D10 dozer	1,097.06	37.51	16.67	7,003.47
CAT D9 dozer	1,097.06	37.51	16.67	7,003.47
CAT D8 dozers	353.25	23.87	10.61	4,111.87
CAT 14G motor graders	1,037.50	42.63	18.95	7,749.33
CAT 825 compactor	1,227.97	18.76	8.34	4,181.17
CAT 10,000 gal. water wagons	7,954.95	49.45	21.98	15,740.67
Smooth drum roller	1,227.97	18.76	8.34	4,181.17
CAT 637 scrapers	2,824.48	51.16	22.74	10,878.67
CAT 345 excavators	3,128.40	72.30	32.13	14,511.66
CAT 966 front-end loaders	1,024.64	72.30	32.13	12,407.90
Generator sets	156.15	9.09	4.04	1,588.00
Rock drills	1,511.29	27.28	12.13	5,806.85
4,000 gal. water trucks	352.83	0.03	0.0169	358.71
Fuel trucks	1008.08	0.10	0.0482	1,024.90
Mechanics service trucks	3717.89	0.23	0.0423	3,736.29
Pickups	1910.58	0.08	0.0268	1,920.62
Total Emissions (total tons)	172,287.21	955.58	424.64	322,719.05

Table E.1-120. Construction Supply Train Emissions, Inside the Proposed Project Area, Criteria Pollutants

Alternatives	Build Material	Length of Trip (one-way – miles)	Criteria Pollutants Emission Factors (tons/day)						
			CO	NOx	Pb	PM10	PM2.5	SO2	VOC
Colstrip	Rail	36	0.09	0.66	0.00	0.01	0.01	0.00	0.04
Colstrip	Tie	36	0.06	0.48	0.00	0.01	0.01	0.00	0.03
Colstrip	Ballast	36	1.36	10.53	0.00	0.24	0.23	0.00	0.65
Total Emissions for All Materials			1.51	11.67	0.00	0.26	0.25	0.01	0.72
Colstrip East	Rail	37.55	0.27	2.05	0.00	0.05	0.04	0.00	0.13
Colstrip East	Tie	37.55	0.15	1.17	0.00	0.03	0.03	0.00	0.07
Colstrip East	Ballast	37.55	2.97	22.97	0.00	0.51	0.50	0.01	1.42
Total Emissions for All Materials			3.39	26.18	0.00	0.58	0.57	0.01	1.62
Tongue River	Rail	41.85	0.29	2.26	0.00	0.05	0.05	0.00	0.14
Tongue River	Tie	41.85	0.19	1.50	0.00	0.03	0.03	0.00	0.09
Tongue River	Ballast	41.85	4.36	33.67	0.00	0.75	0.73	0.02	2.08
Total Emissions for All Materials			4.84	37.42	0.00	0.84	0.81	0.02	2.31
Tongue River East	Rail	43.15	0.21	1.62	0.00	0.04	0.04	0.00	0.10
Tongue River East	Tie	43.15	0.15	1.17	0.00	0.03	0.03	0.00	0.07
Tongue River East	Ballast	43.15	3.70	28.63	0.00	0.64	0.62	0.01	1.77
Total Emissions for All Materials			4.07	31.43	0.00	0.70	0.68	0.01	1.94
Tongue River Road	Rail	41.85	0.20	1.53	0.00	0.03	0.03	0.00	0.09
Tongue River Road	Tie	41.85	0.13	1.02	0.00	0.02	0.02	0.00	0.06
Tongue River Road	Ballast	41.85	3.14	24.29	0.00	0.54	0.53	0.01	1.50
Total Emissions for All Materials			3.47	26.84	0.00	0.60	0.58	0.01	1.66
Tongue River Road East	Rail	42.95	0.41	3.14	0.00	0.07	0.07	0.00	0.19
Tongue River Road East	Tie	42.95	0.23	1.81	0.00	0.04	0.04	0.00	0.11
Tongue River Road East	Ballast	42.95	5.01	38.70	0.00	0.86	0.84	0.02	2.39
Total Emissions for All Materials			5.65	43.66	0.00	0.97	0.95	0.02	2.69
Moon Creek	Rail	41.05	0.44	3.38	0.00	0.08	0.07	0.00	0.21
Moon Creek	Tie	41.05	0.28	2.20	0.00	0.05	0.05	0.00	0.14

Alternatives	Build Material	Length of Trip (one-way – miles)	Criteria Pollutants Emission Factors (tons/day)						
			CO	NO _x	Pb	PM ₁₀	PM _{2.5}	SO ₂	VOC
Moon Creek	Ballast	41.05	6.61	51.11	0.00	1.14	1.11	0.02	3.15
Total Emissions for All Materials			7.33	56.69	0.00	1.27	1.23	0.03	3.50
Moon Creek East	Rail	42.35	0.23	1.77	0.00	0.04	0.04	0.00	0.11
Moon Creek East	Tie	42.35	0.18	1.40	0.00	0.03	0.03	0.00	0.09
Moon Creek East	Ballast	42.35	4.72	36.49	0.00	0.81	0.79	0.02	2.25
Total Emissions for All Materials			5.13	39.65	0.00	0.89	0.86	0.02	2.45
Decker	Rail	25.55	0.20	1.53	0.00	0.03	0.03	0.00	0.09
Decker	Tie	25.55	0.13	1.02	0.00	0.02	0.02	0.00	0.06
Decker	Ballast	25.55	3.09	23.90	0.00	0.53	0.52	0.01	1.47
Total Emissions for All Materials			3.42	26.45	0.00	0.59	0.57	0.01	1.63
Decker East	Rail	24.8	0.41	3.13	0.00	0.07	0.07	0.00	0.19
Decker East	Tie	24.8	0.23	1.81	0.00	0.04	0.04	0.00	0.11
Decker East	Ballast	24.8	4.94	38.18	0.00	0.85	0.83	0.02	2.36
Total Emissions for All Materials			5.58	43.11	0.00	0.96	0.93	0.02	2.66

Table E.1-121. Construction Supply Train Emissions, Inside the Proposed Project Area, Hazardous Pollutants

Alternatives	Build Material	Length of Trip (one-way – miles)	Hazardous Pollutants Emission Factors (tons/day)								
			Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Ethylbenzene	Formaldehyde	n-Hexane	Toluene	Xylene
Colstrip	Rail	36.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Colstrip	Tie	36.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Colstrip	Ballast	36.00	0.02	0.00	0.01	0.00	0.00	0.05	0.00	0.00	0.00
Total Emissions for All Materials			0.03	0.00	0.01	0.00	0.00	0.06	0.00	0.00	0.00
Colstrip East	Rail	37.55	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Colstrip East	Tie	37.55	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Colstrip East	Ballast	37.55	0.05	0.01	0.01	0.00	0.00	0.11	0.00	0.01	0.01
Total Emissions for All Materials			0.06	0.01	0.01	0.00	0.00	0.13	0.00	0.01	0.01
Tongue River	Rail	41.85	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Tongue River	Tie	41.85	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Tongue River	Ballast	41.85	0.07	0.01	0.02	0.01	0.01	0.16	0.00	0.01	0.01
Total Emissions for All Materials			0.08	0.02	0.02	0.01	0.01	0.18	0.00	0.01	0.01
Tongue River East	Rail	43.15	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Tongue River East	Tie	43.15	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Tongue River East	Ballast	43.15	0.06	0.01	0.01	0.01	0.00	0.14	0.00	0.01	0.01
Total Emissions for All Materials			0.07	0.01	0.02	0.01	0.01	0.15	0.00	0.01	0.01
Tongue River Road	Rail	41.85	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Tongue River Road	Tie	41.85	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Tongue River Road	Ballast	41.85	0.05	0.01	0.01	0.00	0.00	0.12	0.00	0.01	0.01
Total Emissions for All Materials			0.06	0.01	0.01	0.00	0.00	0.13	0.00	0.01	0.01
Tongue River Road East	Rail	42.95	0.01	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
Tongue River Road East	Tie	42.95	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00

Alternatives	Build Material	Length of Trip (one-way – miles)	Hazardous Pollutants Emission Factors (tons/day)								
			Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Ethylbenzene	Formaldehyde	n-Hexane	Toluene	Xylene
Tongue River Road East	Ballast	42.95	0.08	0.02	0.02	0.01	0.01	0.19	0.00	0.01	0.01
Total Emissions for All Materials			0.10	0.02	0.02	0.01	0.01	0.21	0.01	0.01	0.01
Moon Creek	Rail	41.05	0.01	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
Moon Creek	Tie	41.05	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Moon Creek	Ballast	41.05	0.11	0.02	0.02	0.01	0.01	0.25	0.01	0.01	0.01
Total Emissions for All Materials			0.12	0.02	0.03	0.01	0.01	0.27	0.01	0.02	0.01
Moon Creek East	Rail	42.35	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Moon Creek East	Tie	42.35	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Moon Creek East	Ballast	42.35	0.08	0.01	0.02	0.01	0.01	0.18	0.00	0.01	0.01
Total Emissions for All Materials			0.09	0.02	0.02	0.01	0.01	0.19	0.00	0.01	0.01
Decker	Rail	25.55	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Decker	Tie	25.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Decker	Ballast	25.55	0.05	0.01	0.01	0.00	0.00	0.12	0.00	0.01	0.01
Total Emissions for All Materials			0.06	0.01	0.01	0.00	0.00	0.13	0.00	0.01	0.01
Decker East	Rail	24.8	0.01	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00
Decker East	Tie	24.8	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
Decker East	Ballast	24.8	0.08	0.02	0.02	0.01	0.01	0.18	0.00	0.01	0.01
Total Emissions for All Materials			0.09	0.02	0.02	0.01	0.01	0.21	0.01	0.01	0.01

Table E.1-122. Bridge Construction Emissions¹ (total tons)

Alternative	Number of Bridges	Criteria Pollutants Emissions (total tons)							Hazardous Pollutants Emissions (total tons)								
		CO	NO _x	Pb	PM ₁₀	PM _{2.5}	SO ₂	VOC	Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Ethylbenzene	Formaldehyde	n-Hexane	Toluene	Xylene
Colstrip	4	1.66	5.55	0.00	0.25	0.25	0.01	0.35	1.28E-02	2.35E-03	2.78E-03	1.04E-03	9.79E-04	2.77E-02	7.00E-04	1.54E-03	1.34E-03
Colstrip East	4	1.66	5.55	0.00	0.25	0.25	0.01	0.35	1.28E-02	2.35E-03	2.78E-03	1.04E-03	9.79E-04	2.77E-02	7.00E-04	1.54E-03	1.34E-03
Tongue River	2	0.74	2.47	0.00	0.11	0.11	0.00	0.16	5.68E-03	1.04E-03	1.23E-03	4.60E-04	4.35E-04	1.23E-02	3.11E-04	6.83E-04	5.96E-04
Tongue River East	3	0.74	2.47	0.00	0.11	0.11	0.00	0.16	5.68E-03	1.04E-03	1.23E-03	4.60E-04	4.35E-04	1.23E-02	3.11E-04	6.83E-04	5.96E-04
Tongue River Road	7	2.03	6.79	0.00	0.31	0.31	0.01	0.43	1.56E-02	2.87E-03	3.40E-03	1.27E-03	1.20E-03	3.39E-02	8.56E-04	1.88E-03	1.64E-03
Tongue River Road East	7	2.03	6.79	0.00	0.31	0.31	0.01	0.43	1.56E-02	2.87E-03	3.40E-03	1.27E-03	1.20E-03	3.39E-02	8.56E-04	1.88E-03	1.64E-03
Moon Creek	4	1.48	4.94	0.00	0.23	0.22	0.01	0.32	1.14E-02	2.09E-03	2.47E-03	9.21E-04	8.70E-04	2.46E-02	6.23E-04	1.37E-03	1.19E-03
Moon Creek East	5	1.48	4.94	0.00	0.23	0.22	0.01	0.32	1.14E-02	2.09E-03	2.47E-03	9.21E-04	8.70E-04	2.46E-02	6.23E-04	1.37E-03	1.19E-03
Decker	1	0.74	2.47	0.00	0.11	0.11	0.00	0.16	5.68E-03	1.04E-03	1.23E-03	4.60E-04	4.35E-04	1.23E-02	3.11E-04	6.83E-04	5.96E-04
Decker East	1	0.74	2.47	0.00	0.11	0.11	0.00	0.16	5.68E-03	1.04E-03	1.23E-03	4.60E-04	4.35E-04	1.23E-02	3.11E-04	6.83E-04	5.96E-04

¹ Bridges are included in construction requirements outlined by the Applicant for surface water crossings required for the rail line and for road relocations by build alternative.

Alternative	Greenhouse Gas Emissions (total tons)			
	CO ₂	CH ₄	N ₂ O	CO ₂ e
Colstrip	1067.69	15.38	6.82	3484.70
Colstrip East	1067.69	15.38	6.82	3484.70
Tongue River	474.53	6.83	3.03	1548.75
Tongue River East	474.53	6.83	3.03	1548.75
Tongue River Road	1304.95	18.79	8.34	4259.07
Tongue River Road East	1304.95	18.79	8.34	4259.07
Moon Creek	949.05	13.67	6.06	3097.51
Moon Creek East	949.05	13.67	6.06	3097.51
Decker	474.53	6.83	3.03	1548.75
Decker East	474.53	6.83	3.03	1548.75

Table E.1-123. Construction Supply Train Emissions, Inside the Proposed Project Area, Greenhouse Gases

Alternatives	Build Material	Length of Trip (one-way – miles)	Greenhouse Gas Emission Factors (tons/day)			
			CO ₂	CH ₄	N ₂ O	CO ₂ e
Colstrip	Rail	36.00	477.36	0.04	0.01	481.83
Colstrip	Tie	36.00	346.59	0.03	0.01	349.84
Colstrip	Ballast	36.00	7,638.07	0.59	0.19	7,709.59
Total Emissions for All Materials			8,462.02	0.66	0.21	8,541.26
Colstrip East	Rail	37.55	1,487.88	0.12	0.04	1501.81
Colstrip East	Tie	37.55	845.26	0.07	0.02	853.17
Colstrip East	Ballast	37.55	16,653.12	1.30	0.41	16,809.06
Total Emissions for All Materials			18,986.26	1.48	0.47	19,164.05
Tongue River	Rail	41.85	1,636.02	0.13	0.04	1,651.34
Tongue River	Tie	41.85	1,084.55	0.08	0.03	1,094.70
Tongue River	Ballast	41.85	24,414.78	1.90	0.61	24,643.40
Total Emissions for All Materials			27,135.34	2.11	0.68	27,389.44
Tongue River East	Rail	43.15	1,177.14	0.09	0.03	1,188.16
Tongue River East	Tie	43.15	850.83	0.07	0.02	858.80
Tongue River East	Ballast	43.15	20,761.03	1.62	0.52	20,955.44
Total Emissions for All Materials			22,789.01	1.77	0.57	23,002.40
Tongue River Road	Rail	41.85	1,109.87	0.09	0.03	1,120.27
Tongue River Road	Tie	41.85	738.68	0.06	0.02	745.59
Tongue River Road	Ballast	41.85	17,615.29	1.37	0.44	17,780.24
Total Emissions for All Materials			19,463.84	1.51	0.48	19,646.10
Tongue River Road East	Rail	42.95	2,280.56	0.18	0.06	2,301.92
Tongue River Road East	Tie	42.95	1,315.62	0.10	0.03	1,327.94
Tongue River Road East	Ballast	42.95	28,065.77	2.18	0.70	28,328.57
Total Emissions for All Materials			31,661.95	2.46	0.79	31,958.43
Moon Creek	Rail	41.05	2,452.18	0.19	0.06	2,475.14
Moon Creek	Tie	41.05	1,592.48	0.12	0.04	1,607.40

Alternatives	Build Material	Length of Trip (one-way – miles)	Greenhouse Gas Emission Factors (tons/day)			
			CO ₂	CH ₄	N ₂ O	CO _{2e}
Moon Creek	Ballast	41.05	37,063.27	2.88	0.92	37,410.33
Total Emissions for All Materials			41,107.93	3.20	1.02	41,492.86
Moon Creek East	Rail	42.35	1,281.49	0.10	0.03	1,293.49
Moon Creek East	Tie	42.35	1,015.54	0.08	0.03	1,025.05
Moon Creek East	Ballast	42.35	26,458.88	2.06	0.66	26,706.64
Total Emissions for All Materials			28,755.90	2.24	0.72	29,025.17
Decker	Rail	25.55	1,109.87	0.09	0.03	1,120.27
Decker	Tie	25.55	738.68	0.06	0.02	745.59
Decker	Ballast	25.55	17,328.86	1.35	0.43	17,491.13
Total Emissions for All Materials			19,177.41	1.49	0.48	19,356.99
Decker East	Rail	24.8	2,270.65	0.18	0.06	2,291.91
Decker East	Tie	24.8	1,310.64	0.10	0.03	1,322.91
Decker East	Ballast	24.8	27,682.98	2.15	0.69	27,942.21
Total Emissions for All Materials			31,264.27	2.43	0.78	31,557.03

Table E.1-124. Construction Supply Train Emissions, Inside the Proposed Project Area, Trains Activity Calculation

Build Alternatives	Train (Moving)	One- Way Trips/Day	Ton-Miles/Day	Fuel Consumption (gal/day)	Work (bhp-hr/day)
Colstrip	Loaded – Rail	7	1476437	1770.3	36822.4
Colstrip	Loaded – Tie	12	830561	995.9	20714.2
Colstrip	Loaded – Ballast	62	14555245	17452.3	363008.5
Colstrip	Unloaded – Rail	7	216437	259.5	5398.0
Colstrip	Unloaded – Tie	12	398561	477.9	9940.1
Colstrip	Unloaded – Ballast	62	12531565	15025.9	312537.8
Colstrip East	Loaded – Rail	9	1980008	2374.1	49381.5
Colstrip East	Loaded – Tie	13	938514	1125.3	23406.6
Colstrip East	Loaded – Ballast	66	16161408	19378.2	403066.3
Colstrip East	Unloaded – Rail	9	290258	348.0	7239.1
Colstrip East	Unloaded – Tie	13	450364	540.0	11232.1
Colstrip East	Unloaded – Ballast	66	13914416	16684.0	347026.2
Tongue River	Loaded – Rail	14	3432717	4116.0	85612.1
Tongue River	Loaded – Tie	22	1770132	2122.5	44147.2
Tongue River	Loaded – Ballast	123	33568033	40249.4	837188.3
Tongue River	Unloaded – Rail	14	503217	603.4	12550.3
Tongue River	Unloaded – Tie	22	849432	1018.5	21184.9
Tongue River	Unloaded – Ballast	123	28900921	34653.4	720790.3
Tongue River East	Loaded – Rail	16	4044970	4850.1	100881.7
Tongue River East	Loaded – Tie	23	1908078	2287.9	47587.6
Tongue River East	Loaded – Ballast	127	35736321	42849.3	891265.6
Tongue River East	Unloaded – Rail	16	592970	711.0	14788.7
Tongue River East	Unloaded – Tie	23	915628	1097.9	22835.8
Tongue River East	Unloaded – Ballast	127	30767742	36891.8	767349.0
Tongue River Road	Loaded – Rail	14	3432717	4116.0	85612.1
Tongue River Road	Loaded – Tie	22	1770132	2122.5	44147.2
Tongue River Road	Loaded – Ballast	121	33022211	39595.0	823575.5

Build Alternatives	Train (Moving)	One- Way Trips/Day	Ton-Miles/Day	Fuel Consumption (gal/day)	Work (bhp-hr/day)
Tongue River Road	Unloaded – Rail	14	503217	603.4	12550.3
Tongue River Road	Unloaded – Tie	22	849432	1018.5	21184.9
Tongue River Road	Unloaded – Ballast	121	28430987	34089.9	709070.2
Tongue River Road East	Loaded – Rail	16	4026222	4827.6	100414.2
Tongue River Road East	Loaded – Tie	23	1899234	2277.3	47367.0
Tongue River Road East	Loaded – Ballast	125	35010515	41979.0	873163.9
Tongue River Road East	Unloaded – Rail	16	590222	707.7	14720.2
Tongue River Road East	Unloaded – Tie	23	911384	1092.8	22730.0
Tongue River Road East	Unloaded – Ballast	125	30142848	36142.5	751764.1
Moon Creek	Loaded – Rail	14	3367098	4037.3	83975.6
Moon Creek	Loaded – Tie	22	1736295	2081.9	43303.3
Moon Creek	Loaded – Ballast	121	32390962	38838.1	807832.1
Moon Creek	Unloaded – Rail	14	493598	591.8	12310.4
Moon Creek	Unloaded – Tie	22	833195	999.0	20779.9
Moon Creek	Unloaded – Ballast	121	27887503	33438.3	695515.7
Moon Creek East	Loaded – Rail	16	3969976	4760.2	99011.4
Moon Creek East	Loaded – Tie	23	1872703	2245.4	46705.3
Moon Creek East	Loaded – Ballast	125	34521427	41392.6	860966.1
Moon Creek East	Unloaded – Rail	16	581976	697.8	14514.5
Moon Creek East	Unloaded – Tie	23	898653	1077.5	22412.4
Moon Creek East	Unloaded – Ballast	125	29721761	35637.6	741262.1
Decker	Loaded – Rail	9	1347249	1615.4	33600.5
Decker	Loaded – Tie	14	687712	824.6	17151.6
Decker	Loaded – Ballast	75	12496186	14983.4	311655.5
Decker	Unloaded – Rail	9	197499	236.8	4925.6
Decker	Unloaded – Tie	14	330012	395.7	8230.5
Decker	Unloaded – Ballast	75	10758786	12900.2	268324.6
Decker East	Loaded – Rail	11	1598302	1916.4	39861.7

Build Alternatives	Train (Moving)	One- Way Trips/Day	Ton-Miles/Day	Fuel Consumption (gal/day)	Work (bhp-hr/day)
Decker East	Loaded – Tie	15	715205	857.6	17837.2
Decker East	Loaded – Ballast	79	12776270	15319.3	318640.8
Decker East	Unloaded – Rail	11	234302	280.9	5843.5
Decker East	Unloaded – Tie	15	343205	411.5	8559.5
Decker East	Unloaded – Ballast	79	10999929	13189.4	274338.8

Table E.1-125. Construction Supply Train Emissions, Downline¹, Train Activity Calculation

Build Alternatives	Train (Moving)	One-Way Trips/Day	Ton-Miles/Day	Fuel Consump (gal/day)	Work (bhp- hr/day)
Colstrip	Loaded – Rail	7	14723363	17653.9	367201.4
Colstrip	Loaded – Tie	12	8282534	9931.1	206566.8
Colstrip	Loaded – Ballast	62	145148133	174038.5	3620001.4
Colstrip	Unloaded – Rail	7	2158363	2588.0	53829.7
Colstrip	Unloaded – Tie	12	3974534	4765.6	99125.1
Colstrip	Unloaded – Ballast	62	124967546	149841.2	3116696.6
Colstrip East	Loaded – Rail	9	19011769	22795.9	474154.4
Colstrip East	Loaded – Tie	13	9011486	10805.1	224746.9
Colstrip East	Loaded – Ballast	66	155179644	186066.7	3870187.8
Colstrip East	Unloaded – Rail	9	2787019	3341.7	69508.4
Colstrip East	Unloaded – Tie	13	4324336	5185.1	107849.1
Colstrip East	Unloaded – Ballast	66	133604332	160197.0	3332098.5
Tongue River	Loaded – Rail	14	31731102	38046.9	791375.2
Tongue River	Loaded – Tie	22	16362620	19619.4	408084.5
Tongue River	Loaded – Ballast	123	310293750	372054.9	7738741.0
Tongue River	Unloaded – Rail	14	4651602	5577.5	116011.2
Tongue River	Unloaded – Tie	22	7851920	9414.8	195827.2
Tongue River	Unloaded – Ballast	123	267152239	320326.4	6662789.6
Tongue River East	Loaded – Rail	16	36385982	43628.3	907468.1
Tongue River East	Loaded – Tie	23	17163861	20580.2	428067.5
Tongue River East	Loaded – Ballast	127	321461248	385445.1	8017258.9
Tongue River East	Unloaded – Rail	16	5333982	6395.7	133029.8
Tongue River East	Unloaded – Tie	23	8236411	9875.8	205416.5
Tongue River East	Unloaded – Ballast	127	276767070	331855.0	6902584.0
Tongue River Road	Loaded – Rail	14	31731102	38046.9	791375.2
Tongue River Road	Loaded – Tie	22	16362620	19619.4	408084.5
Tongue River Road	Loaded – Ballast	121	305248323	366005.2	7612907.8

Build Alternatives	Train (Moving)	One-Way Trips/Day	Ton-Miles/Day	Fuel Consump (gal/day)	Work (bhp- hr/day)
Tongue River Road	Unloaded – Rail	14	4651602	5577.5	116011.2
Tongue River Road	Unloaded – Tie	22	7851920	9414.8	195827.2
Tongue River Road	Unloaded – Ballast	121	262808300	315117.9	6554451.6
Tongue River Road East	Loaded – Rail	16	36367233	43605.8	907000.5
Tongue River Road East	Loaded – Tie	23	17155017	20569.6	427846.9
Tongue River Road East	Loaded – Ballast	125	316235837	379179.7	7886936.9
Tongue River Road East	Unloaded – Rail	16	5331233	6392.4	132961.2
Tongue River Road East	Unloaded – Tie	23	8232167	9870.7	205310.6
Tongue River Road East	Unloaded – Ballast	125	272268171	326460.6	6790381.2
Moon Creek	Loaded – Rail	14	31665483	37968.2	789738.7
Moon Creek	Loaded – Tie	22	16328782	19578.9	407240.6
Moon Creek	Loaded – Ballast	121	304617074	365248.3	7597164.4
Moon Creek	Unloaded – Rail	14	4641983	5565.9	115771.3
Moon Creek	Unloaded – Tie	22	7835682	9395.3	195422.3
Moon Creek	Unloaded – Ballast	121	262264816	314466.2	6540897.1
Moon Creek East	Loaded – Rail	16	36310988	43538.4	905597.8
Moon Creek East	Loaded – Tie	23	17128485	20537.8	427185.2
Moon Creek East	Loaded – Ballast	125	315746750	378593.2	7874739.1
Moon Creek East	Unloaded – Rail	16	5322988	6382.5	132755.6
Moon Creek East	Unloaded – Tie	23	8219435	9855.4	204993.1
Moon Creek East	Unloaded – Ballast	125	271847084	325955.7	6779879.3
Decker	Loaded – Rail	9	19117229	22922.3	476784.6
Decker	Loaded – Tie	14	9758510	11700.9	243377.7
Decker	Loaded – Ballast	75	177318679	212612.3	4422336.4
Decker	Unloaded – Rail	9	2802479	3360.3	69894.0
Decker	Unloaded – Tie	14	4682810	5614.9	116789.5
Decker	Unloaded – Ballast	75	152665280	183051.9	3807479.4
Decker East	Loaded – Rail	11	23317166	27958.2	581531.2

Build Alternatives	Train (Moving)	One-Way Trips/Day	Ton-Miles/Day	Fuel Consump (gal/day)	Work (bhp- hr/day)
Decker East	Loaded – Tie	15	10433917	12510.7	260222.4
Decker East	Loaded – Ballast	79	186389296	223488.4	4648558.0
Decker East	Unloaded – Rail	11	3418166	4098.5	85249.2
Decker East	Unloaded – Tie	15	5006917	6003.5	124872.7
Decker East	Unloaded – Ballast	79	160474769	192415.8	4002248.4

¹ Assumed that the further location downline for equipment would be the Pipestone Quarry in Whitehall, MT.

Table E.1-126. Construction Workforce Emissions (Commuting to and from Project Area), Criteria Pollutants

Alternative	Total VMT ¹	Criteria Pollutants Emission Factors (total tons)						
		CO	NO _x	Pb	PM ₁₀	PM _{2.5}	SO ₂	VOC
Colstrip	100	1332.59	109.35	0.0002	2.72	2.51	1.10	63.89
Colstrip East	100	1838.06	150.82	0.0003	3.76	3.47	1.52	88.12
Tongue River	100	1677.73	137.67	0.0003	3.43	3.17	1.38	80.44
Tongue River East	100	2529.73	207.58	0.0004	5.17	4.77	2.09	121.29
Tongue River Road	100	2494.69	204.70	0.0004	5.10	4.71	2.06	119.61
Tongue River Road East	100	3010.85	247.06	0.0005	6.15	5.68	2.48	144.35
Moon Creek	100	2458.67	201.75	0.0004	5.03	4.64	2.03	117.88
Moon Creek East	100	3310.68	271.66	0.0006	6.77	6.25	2.73	158.73
Decker	100	2998.33	246.03	0.0005	6.13	5.66	2.47	143.75
Decker East	100	2998.33	246.03	0.0005	6.13	5.66	2.47	143.75

¹ Assuming one vehicle per worker and 100 miles round trip per day.

Table E.1-127. Construction Workforce Emissions (Commuting to and from Project Area), Hazardous Pollutants

Alternative	Total VMT ¹	Hazardous Pollutants Emission Factors (total tons)								
		Acetaldehyde	Acrolein	Benzene	1,3-Butadiene	Ethylbenzene	Formaldehyde	n-Hexane	Toluene	Xylene
Colstrip	100	2.27	0.42	2.57	0.19	0.17	0.74	0.13	0.28	0.24
Colstrip East	100	3.13	0.58	3.55	0.26	0.23	1.02	0.17	0.38	0.33
Tongue River	100	2.86	0.53	3.24	0.23	0.21	0.93	0.16	0.35	0.30
Tongue River East	100	4.31	0.80	4.89	0.35	0.32	1.40	0.24	0.53	0.46
Tongue River Road	100	4.25	0.79	4.82	0.35	0.32	1.38	0.24	0.52	0.45
Tongue River Road East	100	5.13	0.96	5.81	0.42	0.38	1.67	0.28	0.63	0.55
Moon Creek	100	4.19	0.78	4.75	0.34	0.31	1.36	0.23	0.51	0.45
Moon Creek East	100	5.64	1.05	6.39	0.46	0.42	1.84	0.31	0.69	0.60
Decker	100	5.11	0.95	5.79	0.42	0.38	1.66	0.28	0.62	0.54
Decker East	100	5.11	0.95	5.79	0.42	0.38	1.66	0.28	0.62	0.54

¹ Assuming one vehicle per worker and 100 miles per day.

Table E.1-128. Construction Workforce Emissions (Commuting to and from Project Area), Greenhouse Gases

Alternative	Total VMT ¹	Greenhouse Gas Emission Factors (total tons)			
		CO ₂	CH ₄	N ₂ O	CO ₂ e
Colstrip	100	62,868.29	4.51	2.13	63,614.71
Colstrip East	100	86,715.23	6.22	2.93	87,744.77
Tongue River	100	79,151.00	5.68	2.68	80,090.73
Tongue River East	100	119,346.41	8.57	4.04	120,763.37
Tongue River Road	100	117,693.49	8.45	3.98	119,090.82
Tongue River Road East	100	142,044.63	10.19	4.80	143,731.07
Moon Creek	100	115,994.27	8.32	3.92	117,371.43
Moon Creek East	100	156,189.68	11.21	5.28	158,044.07
Decker	100	141,453.66	10.15	4.78	143,133.09
Decker East	100	141,453.66	10.15	4.78	143,133.09

¹ Assuming one vehicle per worker and 100 miles per day

E.2 Dispersion Modeling Analysis of Near-Field Air Quality and Coal Deposition

This section describes the air quality modeling methods, assumptions, and general approach that OEA used to assess the potential near-field air quality and particulate matter deposition impacts caused by operation of the proposed rail line. The proposed rail line would transport coal by open rail cars from the proposed Otter Creek Mine and other mines (if the availability of rail service induces their development) to customers outside the region. The air quality modeling for the criteria air pollutant impact examined emissions from trains during operation of the rail line beginning with the start-up year, along with intermediate years and the full build-out year. The emissions from coal dust were considered and included in the particulate matter impacts. Coal dust deposition estimates focused on the highest production year when maximum amounts of coal dust deposition to the ground would be expected to occur.

The emissions sources and how they were characterized and included in the air quality modeling are discussed first. Locomotive exhaust from train activity is the sole emissions source for all criteria pollutants except particulate matter. In addition to locomotive exhaust, coal dust from the rail cars contributes fugitive particulate matter. Much of the basis for the coal dust emissions is based on research conducted in Australia by government agencies, academics, and the Australian Rail Track Corporation over the past 10 years. A discussion is presented on the particle size distribution important in characterizing the location and amount of mass deposited. Meteorology and the air quality modeling of the air concentration and

deposition amounts are also discussed. Finally, the receptor locations that were used in the modeling are identified and methods for evaluating air quality and deposition are described.

E.2.1 Emissions Sources

Several emission sources are associated with coal trains. The types of sources and their characteristics are briefly listed below, followed by a discussion on how the emission source strength is determined for each source type.

E.2.1.1 Combustion Sources

- Emissions associated with locomotive engine exhaust.
- Results for particulate matter will be reported as combined concentrations due to locomotive exhaust and all other sources.

E.2.1.2 Coal Dust-Only Sources⁶

- Fugitive coal dust emissions from loaded, uncovered coal rail cars in transit. These are the principal sources of coal dust.
- Spillage or leakage of coal dust from any of the rail car surfaces or components.
- Residual coal from unloaded coal rail cars.

E.2.1.3 Other Emission Sources

- Wheel-rail dust generated by the frictional processes of the wheels against the steel rails.
- Brake dust.

E.2.2 Emissions Source Strength Determination

E.2.2.1 Locomotive Exhaust Emissions

Exhaust emissions are determined using USEPA-recommended exhaust emission rates by Tier for line-haul locomotives for particulate matter, NO_x, CO, SO₂ and hydrocarbons. (USEPA-420-F-09-025, April 2009). The fraction of the locomotive fleet at each Tier level was projected for each analysis year based on BNSF data on its existing fleet and its new locomotive purchases. Using the projected fractions of the BNSF locomotive fleet at each Tier, weighted emission factors were developed for each analysis year. The USEPA-recommended emission factors in grams per brake horsepower-hour (g/bhp-hr) were converted to a fuel basis (grams per gallon of diesel fuel combusted) using the USEPA-

⁶ Previously spilled coal that has deposited on the ground also could be resuspended by wind action. This fugitive coal dust may move in the prevailing wind direction if threshold wind speeds occur frequently under low soil moisture conditions. Eventually it would redeposit back onto the ground, so the total mass of deposition in the area over which the dust has been moved would not change. The previously deposited dust that has been moved does not represent a new source of coal deposition and is therefore not included as an additional emissions source in the modeling.

recommended fuel efficiency factor of 20.8 bhp-hr/gallon. Fuel usage was calculated as the train activity in gross ton-miles, times the BNSF-reported fuel efficiency of 834 gross ton-miles per gallon of fuel. Based on the fleet-weighted emission factors and the fuel usage projected for each year, emissions estimates in tons per year were calculated for the initial operation year of 2018, two intermediate years, and the full build-out year of 2037.

E.2.3 Coal Dust Emissions

E.2.3.1 Coal Dust Emission Source Strength

The emission factor for total coal dust from a moving fully loaded coal rail car were calculated using the equation reported in the Queensland Rail (2008) *Environmental Evaluation of Fugitive Coal Dust Emissions from Coal Trains Goonyella, Blackwater and Moura Coal Rail Systems Queensland Rail Limited*. This study developed an estimate for a loaded coal train emissions factor in metric units of g of TSP/km/tonne as follows:

$$\text{Emission Factor (loaded coal train) (g TSP/km/tonne)} = 0.0000378(V)^2 - 0.000126(V) + 0.000063$$

where V is the speed of the train (km/hr)

The basis for this equation was work by Witt et al. (1999), which developed a suite of equations for different particle size bins. This is discussed further in the next section.

The coal pile in the rail cars used to develop this equation was shaped so that the top had a smooth “bread loaf” profile. This “profiling” is a common procedure for coal shippers to reduce fugitive coal dust emissions. BNSF, which would operate the proposed rail line, has indicated that it would require such shaping (or equally effective means of coal dust suppression) as well. This equation was developed in the absence of any significant rainfall in Australia and represents a conservative (high) estimate for use in the study area which does receive rainfall (rain tends to reduce coal dust emissions from rail cars). This emission factor is applied to the distance traveled (in km) and the load transported (in tonnes) to calculate TSP emissions in grams for a given time period. After applying this emission factor, the emissions were increased by a factor of 1.34 to account for the larger sized rail cars used to transport coal in the United States (44.12 m²) (BNSF Railway Company 2013) versus Australia (30.37 m²) (Bradken 2013). This adjustment assumes that the emission rate is proportional to the surface area of the opening at the top of the car.

In addition to windblown emissions, coal dust is emitted as a result of car vibrations during travel and spills onto the surfaces and components of the rail cars during loading. Variations in the coal load profile, coal moisture content, and precipitation also affect emissions. The Queensland Rail (2008) study found that these emissions sources, other than windblown, amounted to no more than 5% of the base emission factor. Thus, an additional amount of 5% was added to characterize the amount of coal dust emitted due to processes other than wind.

Australia's national science agency, the Commonwealth Scientific and Industrial Research Organization (CSIRO 2007) and Queensland Rail Ltd. conducted a study of the volume of coal that is left in the cars after the train leaves an unloading station. The worst-case coal carry-back was found to be 0.13 metric tons per car (CSIRO 2007). Even though the coal carry-back is somewhat shielded from escaping by the walls of the rail car, OEA used this emission factor as a conservative estimate using the same equation for the loaded train car to estimate the unloaded rail car emissions.

The above equation did not assume the application of a topper agent (e.g., surfactant coating or encrusting agent). The coal dust emissions were adjusted assuming that a topper agent has been applied to the surface of the coal pile in the car. OEA assumed an 85% reduction in coal dust emissions from the combination of shaping the coal and application of a topper agent, consistent with TRRC's commitment to implement the current BNSF tariff that requires coal shippers to reduce fugitive coal dust emissions by 85% if the Board approves a build alternative.

E.2.3.2 Coal Dust Particle Size Distribution

The rate at which coal dust is removed from the atmosphere and deposited to the ground is primarily a function of the coal particle sizes found within the coal. Katestone Scientific (2000) identified the distribution of particle sizes from coal samples in Australia that are likely to be emitted when the material is subject to wind erosion and handling. These reported particle size distributions from 11 different coal types are reported in 10-micron increments starting at 50 microns as shown in Table E.2-1. Because deposition rates fall rapidly between 2.5 and 10 microns, additional data were needed within the 0-10 micron interval to estimate the 0 to 2.5 micron portion of the distribution (i.e., PM_{2.5}). As part of the Katestone (2000) study ambient air quality monitoring was performed using a tethered elemental oscillating microbalance (TEOM) instrument sampler that measured TSP, PM₁₀, and PM_{2.5} near the Hay Point coal export terminal. The reported average ratio of PM₁₀ to TSP was 26.7%, and the ratio of PM_{2.5} to TSP was 5.1%. Most of the material collected on the TEOM filters was from coal dust, and the reported fractions are likely to be indicative of the ratio associated with coal transport by rail car. Thus, Table E.2-1 was expanded assuming that the Hay Point PM₁₀ to PM_{2.5} ratio of 5.2 (=26.7%/5.1%) was appropriate to apply for these sub-10 micron particles.

Ideally, the characterization of the particle size distribution for the proposed rail line could be improved by matching the coal characteristics of the coal that TRRC would haul with one of the 11 coals assessed in the Katestone Scientific (2000) study (Table E.2-1). However, the coal characterization information on these 11 coal types is not available. OEA therefore conservatively assumed the worst-case size distributions from the 11 coal types. For deposition, the worst-case coal type (resulting in the highest near field deposition) is coal that has the smallest fraction (least mass) of coal dust less than 10 microns size. Coal of this size comes from the Moranbah North mine. To assess PM₁₀ and PM_{2.5} ambient air concentrations, the worst-case coal type (resulting in the highest near field concentrations) is

coal from the Coppabella mine, which has the largest fraction (greatest mass) of coal dust less than 10 microns size.

Table E.2-1. Coal Size Distribution from Australian Mines

Percent Coal Dust less than 50 Microns from 11 Coal Mines												
Particle Size (µm)	FL	BC	BT	BA	GC	OC	CB	GY	MN	RS	SW	Avg
40–50	6.1	8.3	7.4	6.4	6.8	12.1	4	7.5	14.3	8.6	12.5	8.5
30–40	13.6	14.5	14.3	13.1	11.1	13.8	13	15.4	14.7	14.3	15.6	13.9
20–30	19.1	15.3	14	13.1	18.6	13.8	13	15.4	19.6	17.1	15.6	15.9
20–10	27	27.1	26.8	22.5	25.8	2.8	25	22	24.5	22.9	21.0	24.4
0–10	34.1	34.8	37.4	44.9	37.7	37.4	45	39.6	26.9	37.1	34.4	37.2
Estimated PM 2.5												
10–2.5	27.6	28.2	30.3	36.3	30.5	30.3	36.4	32.0	21.8	30.0	27.8	30.1
0–2.5	6.5	6.6	7.1	8.6	7.2	7.1	8.6	7.6	5.1	7.1	6.6	7.1

Mines: Fox Leigh (FL), Burton Coking (BC), Burton Thermal (BT), Blair Atho (BA), German Creek (GC), Oakey Creek (OC), Coppabella (CB), Goonyella (GY), Mornabah North (MN), Riverside (RS), South Walker (SW)
Source: Katestone Scientific 2000.

For particles larger than 50 microns, OEA used the particle coal mass loss data relationship with air velocity as developed by Witt et al. (1999). Here a quadratic equation was fitted to experimental data points to develop estimates of mass loss from a coal car as a function of train speed for a range of particle sizes. Witt et al. (1999) developed quadratic relationships for four particle size increments up to 2,000 microns and later validated the equations against wind tunnel testing.

E.2.4 Emissions from Wheel to Rail Contact

The ambient particulate matter concentrations due to wheel to rail contact were based on three studies. The study by Lorenzo et al. (2006) found an average concentration of 4.3 µg/m³ at 10 meters from the rail line (with background removed), based on an ambient PM10 air monitoring study conducted over a 4-day period in which an average 700 trains passed-by per day (all electric powered). The composition of the PM10 was 67% iron, 22% aluminum, and the remaining 11% calcium. Abbasi et al. (2012) found that wheel-rail contact had the peak concentration of particles in the 3 to 6 microns in diameter range, an indicator that most of the mass is found in the sub 10-micron size. A 1-year study by Gehrig et al. (2007) used continuous PM10 monitoring at a location 5 kilometers northwest of Zurich where about 750 all-electric trains (550 passenger and 200 freight) passed by per day at constant speed and with an average train length of 20 cars. This study found (after subtracting background) an average PM10 concentration due to wheel-contact of 1.0 µg/m³ at 10 meters and 0.25 µg/m³ at 120 meters, consisting of iron. Applying the Gehrig et al. (2007) results to the same ratios as found in the Lorenzo study for aluminum and calcium, the total estimated PM10 concentrations at 10 and 120 meters would be 1.5 and 0.38 µg/m³, respectively.

The concentrations from these monitoring studies were then adjusted for application to this study by linearly adjusting by the ratio of:

- the average wind speed for Birney-Tongue River (2.3 m/s) to that for Zurich (2.0 m/s); and
- the average daily number of rail cars for Birney-Tongue River to the average daily number of cars reported in Gehrig et al. (2007).

These results were then added to the air quality modeling results.

Emissions of brake dust were assumed negligible based on Gehrig et al.'s (2007) observation that slowing down using the service (friction) brakes usually occurs only at low speeds before the trains stop. All other braking is done by the locomotive engines in dynamic braking mode.

E.3 Method for Near-Field Air Quality Modeling

E.3.1 Characterization of Coal Dust and Locomotive Emissions for Air Dispersion Modeling

Emission sources on the trains were modeled as a line of area sources, corresponding to the train's path over the track. Meteorological data representative of the build alternative routes was used, as described below. The modeled area sources were distributed in a line oriented northeast-southwest corresponding to the orientation of the proposed rail line near the meteorological station as well as the general orientation of the Tongue River Valley. Pollutant concentrations were calculated at locations (receptors) at various distances from the track on both sides of the proposed rail line. A railroad is a linear, near-ground emissions source, and for such a source, the variation of pollutant concentration with distance from the track is the same for all locations along the line. This approach allows the results to be applied to any location along the alternative routes.

Because the mines would operate continuously, producing coal and loading trains at an essentially constant rate, for a given coal production level the number of trains per day is essentially constant throughout the year. However, the specific time of day when each train would pass the receptors cannot be known, so the source emissions activity was assumed to be evenly distributed over the day. The AERMOD (13350) model was applied using the following modeling options for coal dust and locomotive emissions:

- Averaging concentration periods of 1-hour, 8-hour, 24-hour, and annual average
- Include both dry and wet deposition
- Monthly deposition totals for both wet and dry
- Coal dust: Release height of 4 meters
- Coal dust: Initial sigma-z of 1.86 meters

- Locomotive exhaust day time: Release height of 4.61 meters⁷
- Locomotive exhaust day time: Initial sigma-z of 2.12 meters
- Locomotive exhaust night time: Release height of 14.31 meters
- Locomotive exhaust night time: Initial sigma-z of 6.56 meters
- Flat terrain
- Coal dust particle density: 0.83 g/cm³
- Track oriented in a southwest to northeast direction corresponding to the general orientation of the Tongue River Valley.
- Emission sources modeled as a set of area sources with a width of 6 meters to allow for turbulent mixing from a moving train
- Emission sources were modeled as having a total length of twice that of the actual train to minimize end effects. (Modeled source configuration of ten area sources of equal length, keeping the aspect ratio to less than 1:100 per 09292 version of AERMOD.)
- Unit train consisting of 125 coal cars
- Four locomotives per train
- Length of each train: 2,113 meters (includes locomotives, coal cars, and their separation distance between cars)

E.3.2 Characterization of Train Activity

Projected train traffic on the rail line would initially consist of 7.4 round trip trains per day (3.7 loaded and 3.7 unloaded), shipping approximately 20 million tons of coal annually. Each train would consist of 125 cars using four locomotives. At higher coal mine production scenarios the number of trains could be as high as 26.7 trains (13.35 each way) per day depending on the analysis year and project alternative. As for the emissions inventory described above, OEA modeled and evaluated the combination of coal dust emissions and locomotive emissions for the initial production year, along with intermediate years 2023 and 2030 and the full build-out scenario of 2037. OEA identified the combination of analysis year and train traffic level that resulted in the highest emissions. (For particulate matter, the combined coal dust and locomotive exhaust was reported.) The year for highest emissions may vary by air pollutant as the locomotive emission rates change from year to year due to BNSF locomotive fleet turnover.

⁷ Release heights were based on screening modeling for Notch 3 throttle setting for day (D stability) and night (F stability) plume rise height for a suite of locomotive engines, reported in CARB (2004) *Roseville Rail yard Study* Appendix G, Table G-1.

E.3.3 Development of Meteorology

USEPA provides guidance for the use of meteorological data for air quality dispersion modeling in Appendix W to 40 C.F.R. Part 51. The guidance specifies that the meteorological data selected for use in an air quality assessment should be spatially and temporally representative of the air pollution transport and dispersion conditions in the area of concern. To be representative, the data should have the following characteristics:

- Collected at a location proximate to the area of study,
- Collected at a location with similar terrain to the area of study,
- Collected at a location with exposure to conditions over a wide area,
- Collected at an elevation proximate to the elevation of the emissions of the study,
- Collected for a sufficient similar period of time, and
- Adequate quality control.

For this study, the meteorological data should be representative of the conditions along the rail line yet general enough to represent adequately the variations in those conditions over the length of the new rail line. Thus, the meteorological data used for modeling any location along the rail line should be taken from a measurement site that is influenced by similar terrain, land use, exposure conditions, and elevation. It should also meet the characteristics listed above.

The only weather monitoring stations near the project area are at Birney and Miles City. The monitoring station at Birney, operated by Montana DEQ, is the more representative meteorological station for almost the entire extent of the study area. The average wind speed at Birney (2.4 meters per second, about 5.4 mph) is lower than the average wind speed at Miles City (4.1 meters per second, about 9.2 mph). Use of the lower wind speed at Birney results in a more conservative analysis (higher pollutant concentrations) than the higher wind speed at Miles City. Accordingly, OEA used the data from the Birney station for the air quality analysis.

The most representative meteorological data available is for a continuous three-year record (February 5, 2010, through February 4, 2013) of wind and temperature data from the Birney-Tongue River air monitoring station (45.3661° N, 106.4897° W, elevation 3,127 feet). This rural site is located within the Tongue River Basin about 3 miles north of Birney. OEA's review of the Birney-Tongue River temperature data indicated some problems with the temperature sensor, varying erratically over the course of a few hours. Consequently, OEA used hourly temperature data collected at the National Weather Service Automated Surface Observing System (ASOS) site in Sheridan, Wyoming, which is the nearest continuous ASOS meteorological station about 75 kilometer southwest). The Sheridan site lies within the Tongue River Basin, and its elevation is within 1,000 feet of that of the Birney-Tongue River site. The Sheridan monitor provided the needed hourly cloud cover data and was used

to provide historical record on seasonal snow cover—important to the characterization of the seasonal changes in surface roughness and albedo (the fraction of incoming solar radiation that a surface reflects).

The wind data measured at the Birney-Tongue River site shows a prevailing wind direction (southwest–northeast) oriented along the same axis as the Tongue River and the influencing terrain, as shown in Figure E-2. Most of the build alternatives would extend in the same southwest–northeast direction, although in some locations for some build alternatives, the alignment would run in a more north–south direction. This overall similarity of orientation supports the conclusion that the Birney data are representative of the proposed rail alignment.

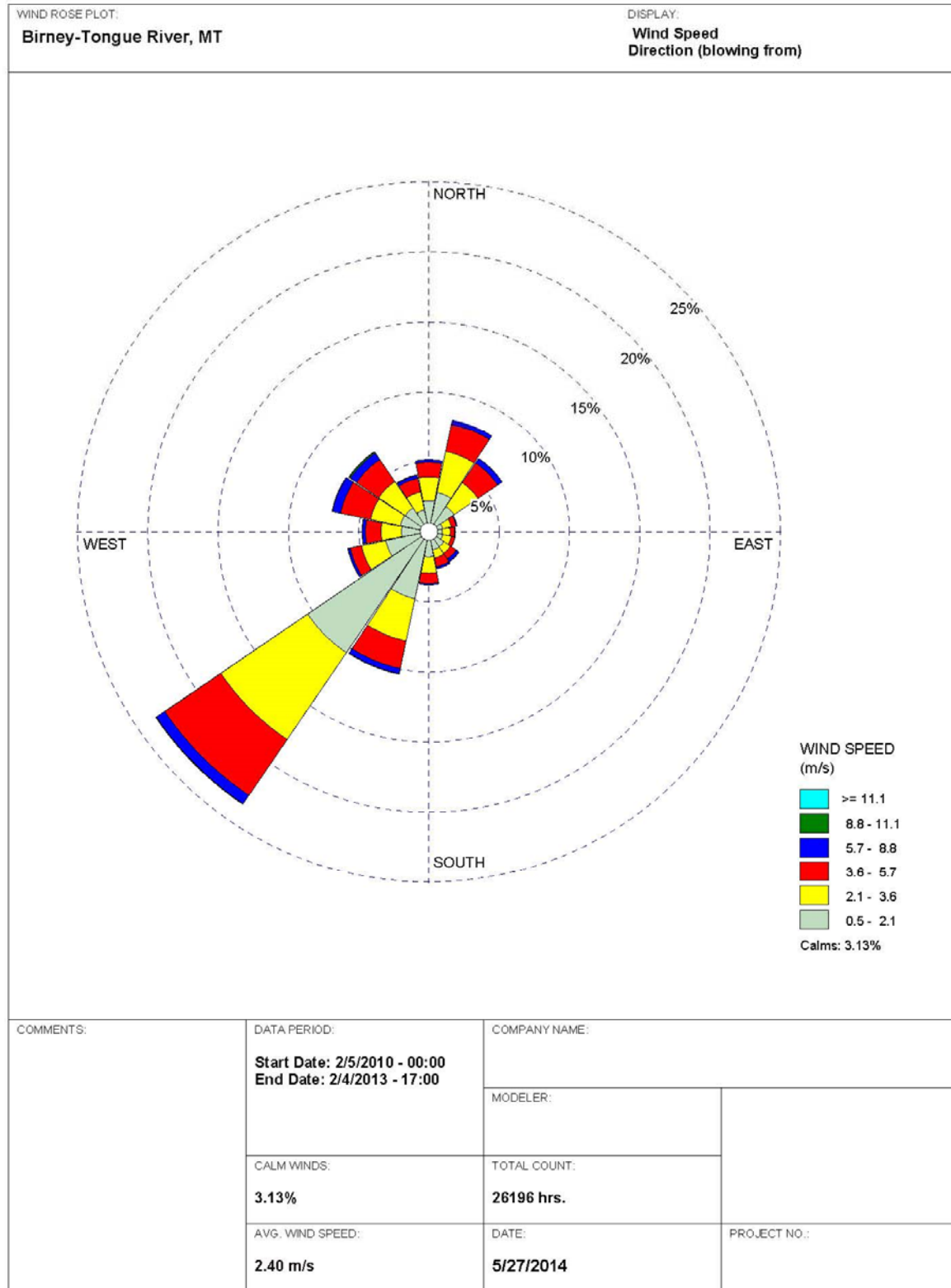
The Birney-Tongue River site location is generally characteristic of the land use found along the entire rail alignment, which is dominated by a relatively well-mixed group of five land use types: lowland/prairie grassland, sagebrush, conifer-dominated forest woodland, agriculture, and a floodplain bordering the river. Finally, the elevation of the Birney-Tongue River monitor is similar to the elevations of the right-of-way for all of the project alternatives ranging from a little over 3,000 feet to 2,350 feet at Miles City. Thus, the Birney-Tongue River wind data are generally representative of most locations for all of the alternatives.

OEA used the 1992 National Land Cover Data Base (Vogelmann et al., 1998) at the location of the Birney-Tongue River air monitoring station to develop the seasonal surface roughness, albedo, and Bowen ratio for use in processing the meteorological data through AERMET.

E.3.4 Receptors

Discrete receptors were modeled at distances starting at 10 meters from the center of the track of the proposed rail line, then every 10 meters out to 300 meters in a direction perpendicular to the rail track. This resolved the location of the maximum concentration and deposition impacts. This group of receptors was placed at the mid-point of the length of the modeled sources to minimize any end effects. The railroad is a single, linear, near-ground emission source and for such a source the variation of concentration with distance from the track would be the same for all locations along the line. No additional emission sources were modeled. Consequently, this “transect” array of receptors in a line perpendicular to the track is sufficient to resolve the concentration at any point along the rail line, and a more extensive array of receptors is not necessary.

Figure E-2. Birney-Tongue River Wind Rose



E.3.5 Air Quality Model Output

E.3.5.1 Background Concentration and Comparison to National and Montana Air Quality Standards

Air quality modeling results for the project were summed with the background concentrations and the results compared to the applicable National and Montana ambient air quality standards as shown in Chapter 4, *Air Quality*. Table E.3-1 shows the relevant Montana and national ambient air quality standards along with the background concentrations. Background concentrations were based on those reported in BLM (2013).

Table E.3-1. Federal and State Ambient Air Quality Standards and Background Concentrations

Pollutant	Averaging Period	Federal NAAQS ³		State AAQS ²	Background Concentration
		Concentration μg/m ³	Form of NAAQS	Concentration μg/m ³	Concentration μg/m ³
CO	1-hour	40,000	H2H (each year)	26,450 ⁵	7,213
	8-hour	10,000	H2H (each year)	10,000	2,175
	Annual	100	Max. annual average (each year)	90 ⁶	6.0
Pb	Rolling 3-month	0.15	Not to be exceeded	--	0.0005
NO ₂	1-hour	188	3-year average of the 98 th percentile concentrations	--	40.0
PM ₁₀	24-hour	150	NTBE more than once per year on average over 3 years	--	30
	Annual	Revoked ⁴	--	50 ⁶	8
PM _{2.5}	24-hour	35	3-year average of the 98 th percentile concentrations	--	22.5
SO ₂	1-hour	196	5-year average of the 99 th percentile concentrations	--	35
	24-hour	365	H2H (each year)	262	11.0
	Annual	80	Max. annual average (each year)	52 ⁶	3.0

AAQS = Ambient Air Quality Standards; CO = carbon monoxide; H1H = highest-first-high; H2H = highest-second-high; μg/m³ = micrograms per cubic meter; NAAQS = National Ambient Air Quality Standards; NO₂ = nitrogen dioxide; PM_{2.5} = particulate matter ≤ 2.5 microns; PM₁₀ = particulate matter ≤ 10 microns; ppb = parts per billion

¹ NAAQS are codified in 40 C.F.R. Part 50.

² Montana AAQS are codified in Title 17, Chapter 8, Subchapter 2 of the Ambient Air Quality in the Administrative Rules of Montana and are shown in this column.

³ In a January 15, 2013 final rule (GPO 2013a), the USEPA lowered the annual primary PM_{2.5} standard from 15.0 μg/m³ to 12 μg/m³. The revised standard becomes effective on March 18, 2013, and includes a new secondary 24-hour PM_{2.5} visibility standard of 30 deciviews (equivalent to 19 kilometers standard visual range) based on the 90th percentile averaged over 3 years.

⁴ The annual PM₁₀NAAQS was revoked on October 17, 2006 but the annual PM₁₀ PSD increments remain in effect.

⁵ Based on H1H.

⁶ Not to be exceeded in the averaging period specified.

E.3.5.2 Air Quality Modeling Results Across Production Scenarios and Build Alternatives – Concentrations

Air quality modeling results of the air concentration from train operation and background concentration are reported in tabular format for the various build alternatives (northern or

southern), coal production scenario (low, medium, and high) and for four analysis years: 2018, 2023, 2030, and 2037. The total combined concentrations are expressed as a percentage of the national or Montana ambient air quality standards. Results vary over the different analysis years due to changes in the locomotive fleet and the number of trains operating on the rail line. Tables E.3-2 through E.3-14 show the results with the earliest analysis year of 2018 starting with the lowest production rate and finishing with the highest coal production rate for each analysis year.

Table E.3-2. Tongue River Railroad Air Quality Modeled Concentrations for the Northern or Southern Alternatives, 2018, Low or Medium Production Scenario

Pollutant	Averaging Period	Form ¹	Modeled Concentration (µg/m ³)	Background Concentration ^{2,3,4} (µg/m ³)	Total Concentration (µg/m ³)	NAAQS or Montana Standard ⁵ (µg/m ³)	Total Concentration Percentage of NAAQS or Montana Standard
CO	1-hour	H2H	43	7,213	7,256	26,450	27%
	8-hour	H2H	15	2,175	2,190	10,000	22%
Pb	Quarterly	H1H	0.00002	0.0005	0.00052	0.15	<1%
NO ₂ ⁷	1-hour	H8H	136	15	151	188	80%
	Annual	H1H	5	3	9	90	10%
PM ₁₀ ⁶	24-hour	H2H	7.7	30	38	150	25%
	Annual	H1H	2.1	8	10	50	20%
PM _{2.5} ⁶	24-hour	H8H	1.4	22.5	23.9	35	68%
	Annual	H2H	0.5	5.5	6.0	12	50%
SO ₂	1-hour	H4H	0.15	35	35.1	196	18%
	24-hour	H2H	0.02	11	11	262	4%
	Annual	H1H	0.00	3	3	52	6%

¹ H1H = highest-first-high, H2H = highest-second-high, H4H = highest-fourth-high, H8H = highest-eighth-high.

² Background concentrations were provided by MDEQ (MDEQ 2012a, 2012b).

³ Birney-Tongue River Montana DEQ Air Monitoring Data for NO₂ (2011-2013) (USEPA 2014b)

⁴ USEPA 2008

⁵ The lower of the two air quality standards.

⁶ Includes 85% reduction in coal dust emissions from profiling of coal in rail car and application of topper agent.

⁷ 5% of the NO_x emitted as NO₂ and ozone limiting method applied (Fritz 2014). Modeled 1-hour NO₂ concentrations shown are not adjusted for model bias.

Table E.3-3. Tongue River Railroad Air Quality Modeled Concentrations for Southern or Northern Alternatives, 2018 High Production Scenario

Pollutant	Averaging Period	Form ¹	Modeled Concentration (µg/m ³)	Background Concentration ^{2,3,3} (µg/m ³)	Total Concentration (µg/m ³)	NAAQS or Montana Standard ⁵ (µg/m ³)	Total Concentration Percentage of NAAQS or Montana Standard
CO	1-hour	H2H	73	7,213	7,286	26,450	28%
	8-hour	H2H	25	2,175	2,200	10,000	22%
Lead	Quarterly	H1H	0.00004	0.0005	0.0005	0.15	<1%
NO ₂ ⁷	1-hour	H8H	215	15	230	188	122%
	Annual	H1H	9	3	12	90	14%
PM ₁₀ ⁶	24-hour	H2H	12.8	30	43	150	29%
	Annual	H1H	3.4	8	11	50	23%
PM _{2.5} ⁶	24-hour	H8H	2.4	22.5	24.9	35	71%
	Annual	H2H	0.8	5.5	6.3	12	53%
SO ₂	1-hour	H4H	0.25	35	35.3	196	18%
	24-hour	H2H	0.03	11	11	262	4%
	Annual	H1H	0.01	3	3	52	6%

¹ H1H = highest-first-high, H2H = highest-second-high, H4H = highest-fourth-high, H8H = highest-eighth-high.

² Background concentrations were provided by MDEQ (MDEQ 2012a, 2012b).

³ Birney-Tongue River Montana DEQ Air Monitoring Data for NO₂ (2011-2013) (USEPA 2014b)

⁴ USEPA 2008

⁵ The lower of the two air quality standards.

⁶ Includes 85% reduction in coal dust emissions from profiling of coal in rail car and application of topper agent.

⁷ 5% of the NO_x emitted as NO₂ and ozone limiting method applied (Fritz 2014). Modeled 1-hour NO₂ concentrations shown are not adjusted for model bias.

Table E.3-4. Tongue River Railroad Air Quality Modeled Concentrations for the Northern or Southern Alternatives, 2023 Low Production Scenario

Pollutant	Averaging Period	Form ¹	Modeled Concentration (µg/m ³)	Background Concentration ^{2,3,4} (µg/m ³)	Total Concentration (µg/m ³)	NAAQS or Montana Standard ⁵ (µg/m ³)	Total Concentration Percentage of NAAQS or Montana Standard
CO	1-hour	H2H	54	7,213	7,267	26,450	27%
	8-hour	H2H	18	2,175	2,193	10,000	22%
Lead	Quarterly	H1H	0.00002	0.0005	0.00052	0.15	<1%
NO ₂ ⁷	1-hour	H8H	139	15	154	188	82%
	Annual	H1H	6	3	9	90	10%
PM ₁₀ ⁶	24-hour	H2H	7.7	30	38	150	25%
	Annual	H1H	2.1	8	10	50	20%
PM _{2.5} ⁶	24-hour	H8H	1.4	22.5	23.9	35	68%
	Annual	H2H	0.5	5.5	6.0	12	50%

Pollutan	Averagin	Form	Modeled	Background	Total	NAAQS	Total
SO ₂	1-hour	H4H	0.18	35	35.2	196	18%
	24-hour	H2H	0.03	11	11	262	4%
	Annual	H1H	0.01	3	3	52	6%

¹ H1H = highest-first-high, H2H = highest-second-high, H4H = highest-fourth-high, H8H = highest-eighth-high.

² Background concentrations were provided by MDEQ (MDEQ 2012a, 2012b).

³ Birney-Tongue River Montana DEQ Air Monitoring Data for NO₂ (2011-2013) (USEPA 2014b)

⁴ USEPA 2008

⁵ The lower of the two air quality standards.

⁶ Includes 85% reduction in coal dust emissions from profiling of coal in rail car and application of topper agent.

⁷ 5% of the NO_x emitted as NO₂ and ozone limiting method applied (Fritz 2014). Modeled 1-hour NO₂ concentrations shown are not adjusted for model bias.

Table E.3-5. Tongue River Railroad Air Quality Modeled Concentrations for the Northern or Southern Alternatives, 2023, Medium Production Scenario

Pollutant	Averaging Period	Form ¹	Modeled Concentration (µg/m ³)	Background Concentration ^{2,3,4} (µg/m ³)	Total Concentration (µg/m ³)	NAAQS or Montana Standard ⁵ (µg/m ³)	Total Concentration Percentage of NAAQS or Montana Standard
CO	1-hour	H2H	80	7,213	7,293	26,450	28%
	8-hour	H2H	27	2,175	2,202	10,000	22%
Lead	Quarterly	H1H	0.0000	0.0005	0.0005	0.15	<1%
NO ₂ ⁷	1-hour	H8H	199	15	214	188	114%
	Annual	H1H	8	3	11	90	13%
PM ₁₀ ⁶	24-hour	H2H	12.4	30	42	150	28%
	Annual	H1H	3.3	8	11	50	23%
PM _{2.5} ⁶	24-hour	H8H	2.2	22.5	24.7	35	71%
	Annual	H2H	0.8	5.5	6.3	12	52%
SO ₂	1-hour	H4H	0.27	35	35.3	196	18%
	24-hour	H2H	0.04	11	11	262	4%
	Annual	H1H	0.01	3	3	52	6%

¹ H1H = highest-first-high, H2H = highest-second-high, H4H = highest-fourth-high, H8H = highest-eighth-high.

² Background concentrations were provided by MDEQ (MDEQ 2012a, 2012b).

³ Birney-Tongue River Montana DEQ Air Monitoring Data for NO₂ (2011-2013) (USEPA 2014b)

⁴ USEPA 2008

⁵ The lower of the two air quality standards.

⁶ Includes 85% reduction in coal dust emissions from profiling of coal in rail car and application of topper agent.

⁷ 5% of the NO_x emitted as NO₂ and ozone limiting method applied (Fritz 2014). Modeled 1-hour NO₂ concentrations shown are not adjusted for model bias.

Table E.3-6. Tongue River Railroad Air Quality Modeled Concentrations for the Northern or Southern Alternatives, 2023, High Production Scenario

Pollutant	Averaging Period	Form ¹	Modeled Concentration (µg/m ³)	Background Concentration ^{2,3,4} (µg/m ³)	Total Concentration (µg/m ³)	NAAQS or Montana Standard ⁵ (µg/m ³)	Total Concentration Percentage of NAAQS or Montana Standard
CO	1-hour	H2H	126	7,213	7,339	26,450	28%
	8-hour	H2H	43	2,175	2,218	10,000	22%
Lead	Quarterly	H1H	0.0001	0.0005	0.0006	0.15	<1%
NO ₂ ⁷	1-hour	H8H	266	15	281	188	149%
	Annual	H1H	12	3	16	90	17%
PM ₁₀ ⁶	24-hour	H2H	19.3	30	49	150	33%
	Annual	H1H	5.2	8	13	50	26%
PM _{2.5} ⁶	24-hour	H8H	3.5	22.5	26.0	35	74%
	Annual	H2H	1.2	5.5	6.7	12	56%
SO ₂	1-hour	H4H	0.43	35	35.4	196	18%
	24-hour	H2H	0.06	11	11	262	4%
	Annual	H1H	0.01	3	3	52	6%

¹ H1H = highest-first-high, H2H = highest-second-high, H4H = highest-fourth-high, H8H = highest-eighth-high.

² Background concentrations were provided by MDEQ (MDEQ 2012a, 2012b).

³ Birney-Tongue River Montana DEQ Air Monitoring Data for NO₂ (2011-2013) (USEPA 2014b)

⁴ USEPA 2008

⁵ The lower of the two air quality standards.

⁶ Includes 85% reduction in coal dust emissions from profiling of coal in rail car and application of topper agent.

⁷ 5% of the NO_x emitted as NO₂ and ozone limiting method applied (Fritz 2014). Modeled 1-hour NO₂ concentrations shown are not adjusted for model bias.

Table E.3-7. Tongue River Railroad Air Quality Modeled Concentrations for the Northern or Southern Alternatives, 2030, Low Production Scenario

Pollutant	Averaging Period	Form¹	Modeled Concentration (µg/m³)	Background Concentration^{2,3,4} (µg/m³)	Total Concentration (µg/m³)	NAAQS or Montana Standard⁵ (µg/m³)	Total Concentration Percentage of NAAQS or Montana Standard
CO	1-hour	H2H	54	7,213	7,267	26,450	27%
	8-hour	H2H	18	2,175	2,193	10,000	22%
Lead	Quarterly	H1H	0.00002	0.0005	0.00052	0.15	<1%
NO ₂ ⁷	1-hour	H8H	100	15.0	115	188	61%
	Annual	H1H	4.0	3.2	7.2	90	8%
PM ₁₀ ⁶	24-hour	H2H	7.6	30	38	150	25%
	Annual	H1H	2.0	8.0	10	50	20%
PM _{2.5} ⁶	24-hour	H8H	1.3	22.5	23.8	35	68%
	Annual	H2H	0.4	5.5	5.9	12	50%
SO ₂	1-hour	H4H	0.18	35.0	35.2	196	18%
	24-hour	H2H	0.03	11.0	11	262	4%
	Annual	H1H	0.01	3.0	3	52	6%

¹ H1H = highest-first-high, H2H = highest-second-high, H4H = highest-fourth-high, H8H = highest-eighth-high.

² Background concentrations were provided by MDEQ (MDEQ 2012a, 2012b).

³ Birney-Tongue River Montana DEQ Air Monitoring Data for NO₂ (2011-2013) (USEPA 2014b)

⁴ USEPA 2008

⁵ The lower of the two air quality standards.

⁶ Includes 85% reduction in coal dust emissions from profiling of coal in rail car and application of topper agent.

⁷ 5% of the NO_x emitted as NO₂ and ozone limiting method applied (Fritz 2014). Modeled 1-hour NO₂ concentrations shown are not adjusted for model bias.

Table E.3-8. Tongue River Railroad Air Quality Modeled Concentrations for the Northern or Southern Alternatives, 2030, Medium Production Scenario

Pollutant	Averaging Period	Form¹	Modeled Concentration (µg/m³)	Background Concentration^{2,3,4} (µg/m³)	Total Concentration (µg/m³)	NAAQS or Montana Standard⁵ (µg/m³)	Total Concentration Percentage of NAAQS or Montana Standard
CO	1-hour	H2H	86	7,213	7,299	26,450	28%
	8-hour	H2H	29	2,175	2,204	10,000	22%
Lead	Quarterly	H1H	0.0000	0.0005	0.0005	0.15	<1%
NO ₂ ⁷	1-hour	H8H	156	15	171	188	91%
	Annual	H1H	6	3	9	90	11%
PM ₁₀ ⁶	24-hour	H2H	12.2	30	42	150	28%
	Annual	H1H	3.2	8.0	11.2	50	22%
PM _{2.5} ⁶	24-hour	H8H	2.0	22.5	24.5	35	70%
	Annual	H2H	0.7	5.5	6.2	12	52%
SO ₂	1-hour	H4H	0.29	35	35.3	196	18%
	24-hour	H2H	0.04	11	11	262	4%
	Annual	H1H	0.01	3	3	52	6%

¹ H1H = highest-first-high, H2H = highest-second-high, H4H = highest-fourth-high, H8H = highest-eighth-high.

² Background concentrations were provided by MDEQ (MDEQ 2012a, 2012b).

³ Birney-Tongue River Montana DEQ Air Monitoring Data for NO₂ (2011-2013) (USEPA 2014b)

⁴ USEPA 2008

⁵ The lower of the two air quality standards.

⁶ Includes 85% reduction in coal dust emissions from profiling of coal in rail car and application of topper agent.

⁷ 5% of the NO_x emitted as NO₂ and ozone limiting method applied (Fritz 2014). Modeled 1-hour NO₂ concentrations shown are not adjusted for model bias.

Table E.3-9. Tongue River Railroad Air Quality Modeled Concentrations for the Northern Alternatives, 2030, High Production Scenario

Pollutant	Averaging Period	Form ¹	Modeled Concentration (µg/m ³)	Background Concentration ^{2,3,4} (µg/m ³)	Total Concentration (µg/m ³)	NAAQS or Montana Standard ⁵ (µg/m ³)	Total Concentration Percentage of NAAQS or Montana Standard
CO	1-hour	H2H	135	7,213	7,348	26,450	28%
	8-hour	H2H	46	2,175	2,221	10,000	22%
Lead	Quarterly	H1H	0.0001	0.0005	0.0006	0.15	<1%
NO ₂ ⁷	1-hour	H8H	221	15	236	188	126%
	Annual	H1H	10	3	13	90	14%
PM ₁₀ ⁶	24-hour	H2H	19.0	30	49	150	33%
	Annual	H1H	5.1	8	13	50	26%
PM _{2.5} ⁶	24-hour	H8H	3.2	22.5	25.7	35	73%
	Annual	H2H	1.1	5.5	6.6	12	55%
SO ₂	1-hour	H4H	0.46	35	35	196	18%
	24-hour	H2H	0.06	11	11	262	4%
	Annual	H1H	0.01	3	3	52	6%

¹ H1H = highest-first-high, H2H = highest-second-high, H4H = highest-fourth-high, H8H = highest-eighth-high.

² Background concentrations were provided by MDEQ (MDEQ 2012a, 2012b).

³ Birney-Tongue River Montana DEQ Air Monitoring Data for NO₂ (2011-2013) (USEPA 2014b)

⁴ USEPA 2008

⁵ The lower of the two air quality standards.

⁶ Includes 85% reduction in coal dust emissions from profiling of coal in rail car and application of topper agent.

⁷ 5% of the NO_x emitted as NO₂ and ozone limiting method applied (Fritz 2014). Modeled 1-hour NO₂ concentrations shown are not adjusted for model bias.

Table E.3-10. Tongue River Railroad Air Quality Modeled Concentrations for the Southern Alternatives, 2030, High Production Scenario

Pollutant	Averaging Period	Form ¹	Modeled Concentration (µg/m ³)	Background Concentration ^{2,3,4} (µg/m ³)	Total Concentration (µg/m ³)	NAAQS or Montana Standard ⁵ (µg/m ³)	Total Concentration Percentage of NAAQS or Montana Standard
CO	1-hour	H2H	194	7,213	7,407	26,450	28%
	8-hour	H2H	66	2,175	2,241	10,000	22%
Lead	Quarterly	H1H	0.0001	0.0005	0.0006	0.15	<1%
NO ₂ ⁷	1-hour	H8H	282	15	297	188	158%
	Annual	H1H	13	3	17	90	18%
PM ₁₀ ⁶	24-hour	H2H	27.3	30	57	150	38%
	Annual	H1H	7.3	8	15	50	31%
PM _{2.5} ⁶	24-hour	H8H	4.6	22.5	27.1	35	77%
	Annual	H2H	1.6	5.5	7.1	12	59%
SO ₂	1-hour	H4H	0.66	35	35.7	196	18%
	24-hour	H2H	0.09	11	11	262	4%
	Annual	H1H	0.02	3	3	52	6%

¹ H1H = highest-first-high, H2H = highest-second-high, H4H = highest-fourth-high, H8H = highest-eighth-high.

² Background concentrations were provided by MDEQ (MDEQ 2012a, 2012b).

³ Birney-Tongue River Montana DEQ Air Monitoring Data for NO₂ (2011-2013) (USEPA 2014b)

⁴ USEPA 2008

⁵ The lower of the two air quality standards.

⁶ Includes 85% reduction in coal dust emissions from profiling of coal in rail car and application of topper agent.

⁷ 5% of the NO_x emitted as NO₂ and ozone limiting method applied (Fritz 2014). Modeled 1-hour NO₂ concentrations shown are not adjusted for model bias.

Table E.3-11. Tongue River Railroad Air Quality Modeled Concentrations for the Northern or Southern Alternatives, 2037, Low Production Scenario

Pollutant	Averaging Period	Form¹	Modeled Concentration (µg/m³)	Background Concentration^{2,3,4} (µg/m³)	Total Concentration (µg/m³)	NAAQS or Montana Standard⁵ (µg/m³)	Total Concentration Percentage of NAAQS or Montana Standard
CO	1-hour	H2H	54	7,213	7,267	26,450	27%
	8-hour	H2H	18	2,175	2,193	10,000	22%
Lead	Quarterly	H1H	0.00002	0.0005	0.00052	0.15	<1%
NO ₂ ⁷	1-hour	H8H	65	15	80	188	43%
	Annual	H1H	3	3	6	90	6%
PM10 ⁶	24-hour	H2H	7.5	30	37	150	25%
	Annual	H1H	2.0	8	10	50	20%
PM2.5 ⁶	24-hour	H8H	1.2	22.5	24	35	68%
	Annual	H2H	0.4	5.5	5.9	12	49%
SO ₂	1-hour	H4H	0.18	35	35	196	18%
	24-hour	H2H	0.03	11	11	262	4%
	Annual	H1H	0.01	3	3	52	6%

¹ H1H = highest-first-high, H2H = highest-second-high, H4H = highest-fourth-high, H8H = highest-eighth-high.

² Background concentrations were provided by MDEQ (MDEQ 2012a, 2012b).

³ Birney-Tongue River Montana DEQ Air Monitoring Data for NO₂ (2011-2013) (USEPA 2014b)

⁴ USEPA 2008

⁵ The lower of the two air quality standards.

⁶ Includes 85% reduction in coal dust emissions from profiling of coal in rail car and application of topper agent.

⁷ 5% of the NO_x emitted as NO₂ and ozone limiting method applied (Fritz 2014). Modeled 1-hour NO₂ concentrations shown are not adjusted for model bias.

Table E.3-12. Tongue River Railroad Air Quality Modeled Concentrations for the Northern or Southern Alternatives, 2037, Medium Production Scenario

Pollutant	Averaging Period	Form ¹	Modeled Concentration (µg/m ³)	Background Concentration ^{2,3,4} (µg/m ³)	Total Concentration (µg/m ³)	NAAQS or Montana Standard ⁵ (µg/m ³)	Total Concentration Percentage of NAAQS or Montana Standard
CO	1-hour	H2H	86	7,213	7,299	26,450	28%
	8-hour	H2H	29	2,175	2,204	10,000	22%
Lead	Quarterly	H1H	0.0000	0.0005	0.0005	0.15	<1%
NO ₂ ⁷	1-hour	H8H	104	15	119	188	63%
	Annual	H1H	4	3	7	90	8%
PM ₁₀ ⁶	24-hour	H2H	12.0	30	42	150	28%
	Annual	H1H	3.2	8	11	50	22%
PM _{2.5} ⁶	24-hour	H8H	1.9	22.5	24.4	35	70%
	Annual	H2H	0.7	5.5	6.2	12	51%
SO ₂	1-hour	H4H	0.29	35	35	196	18%
	24-hour	H2H	0.04	11	11	262	4%
	Annual	H1H	0.01	3	3	52	6%

¹ H1H = highest-first-high, H2H = highest-second-high, H4H = highest-fourth-high, H8H = highest-eighth-high.

² Background concentrations were provided by MDEQ (MDEQ 2012a, 2012b).

³ Birney-Tongue River Montana DEQ Air Monitoring Data for NO₂ (2011-2013) (USEPA 2014b)

⁴ USEPA 2008

⁵ The lower of the two air quality standards.

⁶ Includes 85% reduction in coal dust emissions from profiling of coal in rail car and application of topper agent.

⁷ 5% of the NO_x emitted as NO₂ and ozone limiting method applied (Fritz 2014). Modeled 1-hour NO₂ concentrations shown are not adjusted for model bias.

Table E.3-13. Tongue River Railroad Air Quality Modeled Concentrations for the Northern Alternatives, 2037, High Production Scenario

Pollutant	Averaging Period	Form ¹	Modeled Concentration (µg/m ³)	Background Concentration ^{2,3,4} (µg/m ³)	Total Concentration (µg/m ³)	NAAQS or Montana Standard ⁵ (µg/m ³)	Total Concentration Percentage of NAAQS or Montana Standard
CO	1-hour	H2H	135	7,213	7,348	26,450	28%
	8-hour	H2H	46	2,175	2,221	10,000	22%
Lead	Quarterly	H1H	0.0001	0.0005	0.0006	0.15	<1%
NO ₂ ⁷	1-hour	H8H	158	15	173	188	92%
	Annual	H1H	6	3	10	90	11%
PM ₁₀ ⁶	24-hour	H2H	18.8	30	49	150	33%
	Annual	H1H	5.0	8	13	50	26%
PM _{2.5} ⁶	24-hour	H8H	3.0	22.5	25.5	35	73%
	Annual	H2H	1.1	5.5	6.6	12	55%
SO ₂	1-hour	H4H	0.46	35	35	196	18%
	24-hour	H2H	0.06	11	11	262	4%
	Annual	H1H	0.01	3	3	52	6%

¹ H1H = highest-first-high, H2H = highest-second-high, H4H = highest-fourth-high, H8H = highest-eighth-high.

² Background concentrations were provided by MDEQ (MDEQ 2012a, 2012b).

³ Birney-Tongue River Montana DEQ Air Monitoring Data for NO₂ (2011-2013) (USEPA 2014b)

⁴ USEPA 2008

⁵ The lower of the two air quality standards.

⁶ Includes 85% reduction in coal dust emissions from profiling of coal in rail car and application of topper agent.

⁷ 5% of the NO_x emitted as NO₂ and ozone limiting method applied (Fritz 2014). Modeled 1-hour NO₂ concentrations shown are not adjusted for model bias.

Table E.3-14. Tongue River Railroad Air Quality Modeled Concentrations for the Southern Alternatives, 2037, High Production Scenario

Pollutant	Averaging Period	Form ¹	Modeled Concentration (µg/m ³)	Background Concentration ^{2,3,4} (µg/m ³)	Total Concentration (µg/m ³)	NAAQS or Montana Standard ⁵ (µg/m ³)	Total Concentration Percentage of NAAQS or Montana Standard
CO	1-hour	H2H	194	7,213	7,407	26,450	28%
	8-hour	H2H	66	2,175	2,241	10,000	22%
Lead	Quarterly	H1H	0.0001	0.0005	0.0006	0.15	<1%
NO ₂ ⁷	1-hour	H8H	214	15.0	229	188	122%
	Annual	H1H	9	3.2	12	90	14%
PM ₁₀ ⁶	24-hour	H2H	26.9	30	57	150	38%
	Annual	H1H	7.2	8	15	50	30%
PM _{2.5} ⁶	24-hour	H8H	4.3	22.5	26.8	35	76%
	Annual	H2H	1.6	5.5	7.1	12	59%
SO ₂	1-hour	H4H	0.66	35	36	196	18%
	24-hour	H2H	0.09	11	11	262	4%
	Annual	H1H	0.02	3	3	52	6%

¹ H1H = highest-first-high, H2H = highest-second-high, H4H = highest-fourth-high, H8H = highest-eighth-high.

² Background concentrations were provided by MDEQ (MDEQ 2012a, 2012b).

³ Birney-Tongue River Montana DEQ Air Monitoring Data for NO₂ (2011-2013) (USEPA 2014b)

⁴ USEPA 2008

⁵ The lower of the two air quality standards.

⁶ Includes 85% reduction in coal dust emissions from profiling of coal in rail car and application of topper agent.

⁷ 5% of the NO_x emitted as NO₂ and ozone limiting method applied (Fritz 2014). Modeled 1-hour NO₂ concentrations shown are not adjusted for model bias.

E.3.5.3 Air Quality Modeling Results across Production Scenarios and Build Alternatives – Deposition

OEA modeled deposition using the same methods as for concentrations as discussed above. OEA used the results to evaluate the potential human health impacts of coal dust via ingestion, and the ecological impacts of coal dust and topper agent constituents.

The modeling outputs estimated coal dust deposition rates by month for the 3 years modeled using AERMOD. Wet, dry, and total coal dust deposition rates were modeled based on estimated rail car coal dust emissions, adjusted for the use of load profiling and topper agents for coal dust emission reduction. As with the modeling for concentrations, deposition rates were estimated at 10-meter intervals from the center of the rail line to a distance of 300 meters on each side of the rail line. For deposition, particle size categories or “bins” of less than 50 microns diameter (TSP size), 50 to 250 microns diameter, and the sum of the two (i.e., all particles up to 250 microns diameter) were evaluated. OEA did not explicitly model particles of aerodynamic diameter larger than 250 microns because coal particles of this size

would deposit very quickly after being blown from a rail car and would deposit within the right-of-way, and the AERMOD deposition algorithm is not applicable for these larger size particles. Calculations based on Stokes law were used for these larger size particles to determine settling velocity. Based on those calculations particles larger than 250 microns would all be deposited to the ground within 5 meters from the centerline of the rail track.

From the calculation and modeling results, OEA selected the average maximum monthly deposition over the 3 years of meteorological data for use in the ingestion and ecological analyses. OEA estimated that the particles larger than 250 microns would deposit at a maximum rate of 149 g/m² per month, which would occur within 5 meters of the centerline of the rail track on the southeast side, and at a rate of 105 g/m² per month on the northwest side of the track, based on the coal dust emission rate with use of load profiling and topper agents for coal dust emission control. For the 50- to 250-micron-sized coal particles, the maximum deposition rate would be 52.7 g/m² per month and would occur at 40 meters (131 feet) from the centerline of the rail line. The maximum combined (TSP plus particulates 50 to 250 microns in size) deposition rate would be 53.7 g/m² per month, of which the TSP contribution would be 1.1 g/m² per month (36 mg/m² per day). OEA conservatively selected the maximum value at 40 meters for the coal dust exposure analysis even though this distance would typically be within the right-of-way where humans would not typically be exposed.

A Queensland, Australia study of the deposition of coal dust along rail lines reported a TSP deposition rate at 10 meters from the edge of the rail track of 30 mg/m² per day (0.9 g/m² per month), but did not report the level of coal train activity (Queensland Rail 2008). This value is comparable to the OEA value noted above for TSP sized coal particles. The OEA value assumes coal profiling (shaping) and application of a topper agent, and train traffic of 26.7 trips per day corresponding to the high production scenario for the southern alternatives.

Chapter 6, *Coal Dust*, and Appendix G, *Coal Dust Analysis*, provide additional detail on the use of the deposition modeling results in estimating the ingestion and ecological impacts.

E.5 Coal Dust Bibliography

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