

Appendix M

Air Quality Impacts

M.1 Existing Emission Sources and Monitoring Data

This section provides estimates of the existing emissions in Siskiyou, California and Klamath, Oregon Counties to identify the major sources of emissions. Existing monitoring data is also provided as context for the region's attainment status.

M.1.1 Emission Sources

Table M-1 presents estimates of existing emissions in Siskiyou County for 2008, the latest year for which an inventory is available. Miscellaneous area-wide processes are the major sources of volatile organic compounds (VOC), carbon monoxide (CO), sulfur oxides (SOx), inhalable particulate matter (PM₁₀), and fine particulate matter (PM_{2.5}) emissions in Siskiyou County, while on-road motor vehicles are the major sources of nitrogen oxides (NOx) emissions. Managed burning and disposal is the major source of VOC, CO, PM₁₀, and PM_{2.5} emissions within the area-wide sources, and residential fuel combustion is the major driver of NOx and SOx emissions within the area-wide sources.

Table M-1. Siskiyou County (California) 2008 Emission Inventories

Source Type	Category	Average Emissions in Tons per Year (TPY)					
		VOC	CO	NOx	SOx	PM ₁₀	PM _{2.5}
Stationary	Fuel Combustion	44	234	245	--	95	92
Stationary	Waste Disposal	--	4	--	--	--	--
Stationary	Cleaning and Surface Coatings	62	--	--	--	--	--
Stationary	Petroleum Production and Marketing	117	--	--	--	--	--
Stationary	Industrial Processes	59	--	--	--	128	59
Area	Solvent Evaporation	1,054	--	--	--	--	--
Area	Miscellaneous Processes	3,616	79,993	139	73	11,650	6,043
Mobile	On-Road Motor Vehicles	1,175	9,695	4,692	4	176	146
Mobile	Other Mobile Sources	893	3,693	1,746	7	95	81
Grand Totals		7,020	93,619	6,822	84	12,144	6,420

Source: California Air Resources Board (CARB) 2009.

Key:

VOC = volatile organic compounds

CO = carbon monoxide

NOx = nitrogen oxides

SOx = sulfur oxides

PM₁₀ = inhalable particulate matter

PM_{2.5} = fine particulate matter

Table M-2 presents estimates of existing emissions in Klamath County for 2002, the latest year in which an inventory is available. Highway and off-highway vehicles represent the majority of CO, NOx, and sulfur dioxide (SO₂) emissions. Fugitive dust, residential wood burning, and agricultural and forestry activities are the major sources of PM₁₀ and PM_{2.5} emissions. The major source of VOC emissions is residential wood burning, followed by highway and off-highway vehicles.

Table M-2. Klamath County (Oregon) 2002 Emission Inventories

Source Type	Category	Average Emissions in Tons per Year (TPY)					
		CO	NOx	PM ₁₀	PM _{2.5}	SO ₂	VOC
Point	Fuel Combustion – Industrial	1,527	626	175	156	11	59
Nonpoint	Fuel Combustion – Industrial	2	14	2	1	49	--
Point	Fuel Combustion – Other	1	2	<1	<1	<1	<1
Nonpoint	Fuel Combustion – Other	9,161	219	1,303	1,303	63	3,248
Point	Other Industrial Processes	14	31	230	89	<1	1,552
Nonpoint	Chemical & Allied Product Mfg	--	--	--	--	--	1
Nonpoint	Other Industrial Processes	11	0	207	58	<1	3
Nonpoint	Solvent Utilization	--	--	--	--	--	2,037
Nonpoint	Storage and Transport	--	--	--	--	--	508
Nonpoint	Waste Disposal & Recycling	1,403	68	233	220	8	100
Nonpoint	Highway Vehicles	35,315	3,198	72	54	82	3,175
Nonpoint	Off-Highway	9,398	3,828	194	180	221	2,829
Nonpoint	Miscellaneous	--	129	7,830	759	--	--
Grand Totals		56,830	8,114	10,248	2,820	425	13,512

Source: *United States Environmental Protection Agency (USEPA) 2010.*

Key:

VOC = volatile organic compounds

CO = carbon monoxide

NOx = nitrogen oxides

SO₂ = sulfur dioxide

PM₁₀ = inhalable particulate matter

PM_{2.5} = fine particulate matter

M.1.2 Monitoring Data

Table M-3 summarizes the air quality data from monitoring stations near the area of analysis in California. Data from the Yreka monitoring station was used to characterize the ambient air quality near the California-based dams. Because the Yreka monitoring station only monitors for ozone (O₃), PM₁₀, and PM_{2.5}, other pollutants are not summarized in the table.

As Table M-3 shows, O₃ concentrations exceeded the California Ambient Air Quality Standards (CAAQS) and PM₁₀ concentrations exceeded the National Ambient Air Quality Standards (NAAQS) during the past three years at the Yreka monitoring station. Area designations in California are applicable to the entire county; because the Yreka monitoring station is exceeding the CAAQS, the rest of the county is designated as a nonattainment area as well. As Figure M-1 shows, there is no clear trend in O₃ concentrations during the past three years; however, substantial year-to-year variations in O₃ concentrations are common.

Table M-3. Summary of Pollutant Monitoring Data in Siskiyou County

Criteria Air Pollutant	Annual Monitoring Data ¹		
	2007	2008	2009
Ozone (O₃) 1-Hour			
1 st High (ppm)	0.072	0.086	0.076
2 nd High (ppm)	0.072	0.078	0.071
Days above CAAQS ²	0	0	0
Ozone (O₃) 8-Hour			
1 st High (ppm) ³	0.065 / 0.064	0.076 / 0.075	0.063 / 0.062
2 nd High (ppm) ³	0.063 / 0.063	0.067 / 0.066	0.060 / 0.060
Days above CAAQS ⁴	0	1	0
Days above NAAQS ⁵	0	0	0
Inhalable Particulate Matter (PM₁₀)			
Highest 24-hour concentration (µg/m ³) ³	189 / 205	162.4 / 176.8	30.8 / 33.4
Annual arithmetic mean (µg/m ³) ³	13 / 15	13 / 18	* / *
Calculated number of days above CAAQS ⁶	*	*	*
Calculated number of days above NAAQS ⁷	7.7	6.1	0.0
Fine Particulate Matter (PM_{2.5})			
Highest 24-hour concentration (µg/m ³)	*	15.1	16.5
Annual arithmetic mean (µg/m ³)	*	*	5.1
Calculated number of days above NAAQS ⁸	*	*	0

Source: CARB 2010b.

Notes:

¹ Monitoring data from Yreka-Foothill Drive monitoring station.² Days above standard = days above 1-hour CAAQS of 0.09 ppm.³ Different methods of analyzing monitored data are used by CARB and USEPA; therefore, both data are provided, respectively, separated by “.”⁴ Days above standard = days above 8-hour CAAQS of 0.070 ppm.⁵ Days above standard = days above 8-hour NAAQS of 0.075 ppm.⁶ Days above standard = days above 24-hour CAAQS of 50 µg/m³.⁷ Days above standard = days above 24-hour NAAQS of 150 µg/m³.⁸ Days above standard = days above 24-hour NAAQS of 35 µg/m³.

Key:

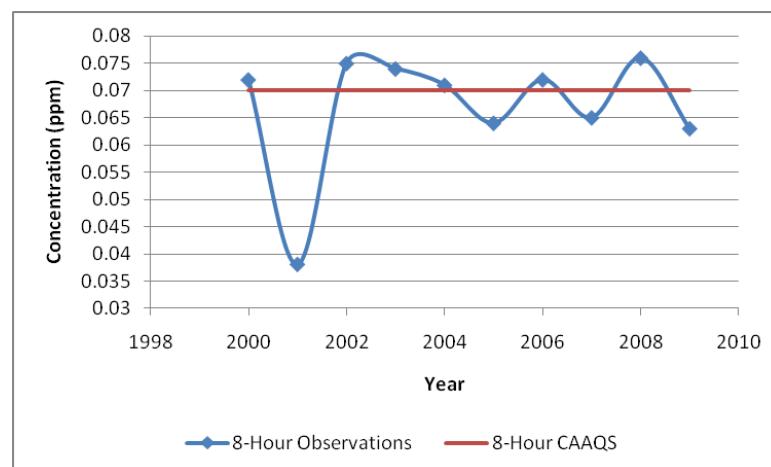
* = data not available

ppm = parts per million

µg/m³ = micrograms per cubic meter

CAAQS = California Ambient Air Quality Standard

NAAQS = National Ambient Air Quality Standard



Source: CARB 2010b.

Figure M-1. 10-Year Trend in Ozone (O₃) Concentrations at Yreka Monitoring Station (Representative of Siskiyou County, California)

Table M-4 summarizes air quality data from monitoring stations in the area of analysis in Oregon. Data from the Klamath Falls monitoring station was used to characterize the ambient air quality near J.C. Boyle Dam. As Table M-4 shows, PM_{2.5} concentrations exceeded the NAAQS during the past three years. The Klamath Falls monitoring station only monitors for PM₁₀ and PM_{2.5}; therefore, this table does not show other pollutants.

Table M-4. Summary of Pollutant Monitoring Data in Klamath County

Criteria Air Pollutant	Annual Monitoring Data ¹		
	2008	2009	2010
Inhalable Particulate Matter (PM₁₀)			
Highest 24-hour concentration ($\mu\text{g}/\text{m}^3$)	77	87	50
Annual arithmetic mean ($\mu\text{g}/\text{m}^3$)	20.7	20.6	15.7
Calculated number of days above NAAQS ²	0	0	0
Fine Particulate Matter (PM_{2.5})			
98 th Percentile 24-hour concentration ($\mu\text{g}/\text{m}^3$) ³	52	44	35
Annual arithmetic mean ($\mu\text{g}/\text{m}^3$) ⁴	12.5	11.3	9.8

Source: Oregon Department of Environmental Quality 2011.

Notes:

¹ Monitoring data from Klamath Falls monitoring station.

² Days above standard = days above 24-hour NAAQS of 150 $\mu\text{g}/\text{m}^3$.

³ Values shown in **bold and italics** are over the NAAQS.

⁴ Data excludes documented wildfire days.

Key:

ppm = parts per million

$\mu\text{g}/\text{m}^3$ = micrograms per cubic meter

NAAQS = National Ambient Air Quality Standard

M.2 Assessment Methods

This section describes the methodology used to develop the emission inventories and the comparison of the analysis results for the California site activities to the California Environmental Quality Act significance thresholds.

M.2.1 Emission Calculation Methodology

In general, the construction emissions were estimated from various emission models and spreadsheet calculations, depending on the source type and data availability. The California Air Resources Board (CARB) Urban Emissions Model (URBEMIS) – Version 9.2.4 was used to estimate fugitive dust emissions from the general movement of the construction equipment on unpaved surfaces and excavation activities (cut/fill). Although URBEMIS is capable of estimating emissions from trucks and construction worker commuting vehicles, it is difficult to modify the model's default settings. Additionally, the model was developed specifically for activities completed in California and the exhaust emission components are not suitable for the construction activities that occur in Oregon. URBEMIS was therefore only used to estimate emissions from fugitive dust, which would be applicable in both states, and other methods were used to estimate emissions from non-dust sources.

Although URBEMIS is suitable for estimating fugitive dust emissions from the operation of the construction equipment and excavation activities, it is not suitable for estimating emissions from unpaved haul roads. Emissions from travel on unpaved roads were estimated using the methodology identified in the *Compilation of Air Pollutant Emission Factors (AP-42)* maintained by the United States Environmental Protection Agency (USEPA). Chapter 13.2.2 (USEPA 2006) was used to estimate the appropriate emission rate for unpaved roads.

Exhaust emissions from the off-road construction equipment operating at each dam site were estimated using the OFFROAD2007 and NONROAD2008a emission factor models for California and Oregon, respectively. Since California is unique amongst other states because it can set its own vehicular emission standards as prescribed in Section 209 of the federal Clean Air Act, it developed its own emissions factor model to estimate emissions from off-road equipment. It was assumed in these calculations that all off-road equipment would be diesel-fueled unless specifically identified as non-diesel fueled (e.g., gasoline) by the project consultants.

In a similar vein, exhaust emissions from on-road vehicles, specifically trucks and construction worker vehicles, were estimated using the EMFAC and MOBILE6.2 emission factor models for California and Oregon, respectively. It was assumed that construction workers would only be operating light-duty passenger cars and trucks; therefore, the emission factor calculations were restricted to only these vehicle classes. A combination of gasoline-fueled (catalyst and non-catalyst) and diesel-fueled engines was also used in the calculations. The default fleet mixes for Siskiyou County, California and Klamath County, Oregon were also used based on information contained in EMFAC for California and provided by the Oregon Department of Environmental Quality for Oregon.

Daily and annual emissions for each year of construction were estimated from appropriate emission factors, number of facilities and features being worked, and the associated schedules that were provided by the project consultants. The following sections provide additional discussion of emission estimation methodologies used for each source group.

M.2.1.1 On-Site Building Demolition and Excavation Activities

The URBEMIS model was developed to estimate construction emissions from land development projects. It treats construction in three phases: Phase 1 – demolition, Phase 2 – site grading, and Phase 3 – building construction. For this Proposed Action, URBEMIS was used for fugitive particulate matter, or dust, emissions from demolition and grading (earth cut/fill) activities. The earth cut/fill activity is included in URBEMIS Phase 2 –Site Grading, which allows the user to select one of four tiers of detail to calculate fugitive dust emissions.

Fugitive (re-entrained) dust emissions would occur from the movement of construction equipment at each of the construction sites. As a result, the default emission factor in URBEMIS for average construction activities (10 pounds per acre per day of PM₁₀) was

used to estimate fugitive dust emissions from the equipment at the site. It was assumed in the calculations that fugitive dust emissions could occur from the construction equipment during the entire construction schedule. Table M-5 summarizes the size of the construction footprint used in URBEMIS to estimate fugitive dust emissions from the equipment.

Table M-5. Estimated Construction Area (Acres)

Alternative	Iron Gate	Copco 1	Copco 2	J.C. Boyle
Full Facilities Removal	13.1	2.3	2.8	9.7
Partial Facilities Removal	11.7	1.0	0.6	5.1
Fish Passage at Four Dams	5.1	1.5	1.0	2.1
Fish Passage at Two Dams, Remove Copco 1 and Iron Gate	13.1	2.3	1.0	2.1

Source: Wright 2010.

In addition to the re-entrained dust emissions from the movement of equipment at the construction site, emissions could also occur from excavation activities. The next tier in URBEMIS (“Low Level”) was used to refine the emissions estimates for any phase or location that involved soil excavation. The construction window for excavation activities was limited to a shorter window than the entire construction schedule during which excavation activities could occur. Table M-6 summarizes the volumes of the excavated earth, which is based on the estimated volume of excavated material (spoils/cut material) increased by a factor of 20 percent to account for the bulk volume. This adjustment was made to account for the fact that the excavated material would take up more volume when removed from the ground than when compacted.

Table M-6. Estimated Bulk Waste Volume for Earth Materials (cubic yards)

Alternative	Iron Gate ¹	Copco 1	Copco 2 ¹	J.C. Boyle ¹
Full Facilities Removal	1,300,000	n/a	1,800	170,000
Partial Facilities Removal	1,300,000	n/a	1,800	170,000
Fish Passage at Four Dams	n/a	n/a	n/a	n/a
Fish Passage at Two Dams, Remove Copco 1 and Iron Gate	1,300,000	n/a	n/a	n/a

Source: U.S. Department of the Interior (DOI) 2011.

Notes:

¹ Volumes increased 20 percent for loose earth materials.

In addition to fugitive dust emissions from the construction equipment and cut/fill activities, emissions would also occur from the demolition of existing structures at each of the sites. The quantity of building waste expected to be removed during demolition activities is summarized below.

- Copco No. 1 Dam: 300 cubic yards
- Copco No. 2 Dam: 600 cubic yards

- Iron Gate Dam: 400 cubic yards
- J.C. Boyle Dam: 2,000 cubic yards

Building demolition was only assumed to occur in the alternatives that would involve dam removal (i.e., all but the Fish Passage at Four Dams Alternative). The building removal at Copco 1, however, is required to allow the mobilization of large equipment at the site. As a result, its building demolition is assumed to occur under all alternatives.

M.2.1.2 On-Site (Off-Road) Equipment Engine Exhaust Emissions

Emissions would also occur from the combustion of fuel during operation of the off-road construction equipment at each of the dams. As was previously stated, separate emission factor models (i.e., OFFROAD and NONROAD) are used to estimate emissions in California and Oregon.

Preliminary estimates of the type, size (horsepower), and quantity of construction proposed to be used at each of the dam locations was provided by the project consultants. Engine load factors are also incorporated into the emission factor models. Emission factors for each piece of equipment were then selected based on the equipment type (e.g., cranes, excavators, loaders, etc.) and the engine size. It was conservatively assumed that all equipment located at a dam site could operate simultaneously for the entire shift. Iron Gate would have a maximum operating schedule of 14 hours per day, Copco 1 would operate 16 hours per day, and Copco 2 and J.C. Boyle would operate eight hours per day. The total hours of operation for each piece of equipment was also provided with the equipment list provided by the project consultants. Annual emissions were then calculated from the total hours of operation.

In addition to the mobile construction equipment, several stationary generators would be present at each of the dam locations to provide power for electric-operated equipment. Emission factors from Chapter 3.3 (USEPA 1996a) of AP-42 were used to estimate emissions from these generators.

Furthermore, speciation profiles were needed in many cases to convert emissions of PM₁₀ to PM_{2.5}. CARB maintains particulate matter size fractions for various types of equipment (CARB 2010a). Profile number 425 (Diesel Vehicle Exhaust) was used to determine the ratio of PM_{2.5} to PM₁₀ for equipment located in California. The USEPA also maintains generalized particle size distributions in Appendix B.2 to AP-42 (1996b); these size fractions were used to estimate PM_{2.5} emissions from diesel equipment located in Oregon. Finally, the NONROAD model provides emission estimates in terms of total hydrocarbon emissions. The conversion of total hydrocarbons to VOC was estimated from information contained in the USEPA's *Conversion Factors for Hydrocarbon Emission Components* (2003) document.

M.2.1.3 Off-Site (On-Road) Haul Truck Engine Exhaust Emissions and Paved Road Dust

The haul truck engine exhaust emissions were calculated based on EMFAC and MOBILE6.2 emission factors for heavy-duty diesel trucks in Siskiyou County, California and Klamath County, Oregon, respectively. Information on the peak daily and project total round trips was provided by the project consultants. The total project trips were assumed to occur evenly throughout the project schedule. The total vehicle miles traveled was determined from the number of trips and estimated distance to haul each component (e.g., earth, concrete, metal, etc.) to disposal sites near the four facilities and to disposal/recycling facilities in Klamath Falls, Medford and Yreka depending on the component.

Emission factors vary by year based on changes in the vehicle fleet mix by older engines retiring from service and improved emission control technologies and standards in newer engines joining the fleet. As a result, two different emission factors are provided by location (state) and pollutant to reflect these changes in the fleet mix.

Re-entrained road dust from haul truck travel was estimated for paved roads. Paved road dust was estimated using emission factors developed by the Midwest Research Institute (MRI 1996). Table M-7 presents the paved road dust emission factors. The emission factor for average road conditions and average daily trips (ADT) was used throughout the emission calculations.

Table M-7. Paved Road Re-entrained Dust Emission Factors

Road Condition	Average Daily Trips (ADT) ¹		
	High	Low	Average ²
Average conditions ³	0.37	1.3	0.81
Worst-case conditions ⁴	0.64	3.9	2.1

Source: Midwest Research Institute (MRI) 1996.

Notes:

¹ "Arterials" and "major streets" were classified by MRI as high-ADT roads, while "collectors" or "local streets" were classified as low-ADT roads.

² Based on 65 percent of high- and 35 percent of low-ADT silt loading values.

³ Based on median value of MRI sampling data and average vehicle weight of 2.4 tons.

⁴ Based on 90th percentile of MRI sampling data and average vehicle weight of 2.4 tons.

Key:

PM₁₀ = inhalable particulate matter

Additionally, since the MRI emission factors are specific to PM₁₀, CARB size fraction profile number 471 (Paved Road Dust, 97 and after) was used to estimate emissions of PM_{2.5}.

M.2.1.4 Construction Worker Commuting

Emissions associated with construction workers commuting to and from the various dam locations were also estimated for each alternative. It was assumed that construction worker vehicles would consist of a mix of passenger cars and light-duty trucks. The

combination of diesel and gasoline (catalyst and non-catalyst) vehicles from the various emission factor models was retained in the emission factor estimates. As explained in Section P.2.1.2 for trucks, the EMFAC and MOBILE6.2¹ emission factor models were used to estimate emissions. Re-entrained road dust was estimated using the emission factors provided in Table M-7 for average road conditions and average ADT.

M.2.1.5 Unpaved Road Dust

Fugitive dust emissions would also occur from unpaved roads that are used to haul waste materials. The methodology documented in Section 13.2.2 (USEPA 2006) of AP-42 was used to estimate fugitive dust emissions from the trucks operating on these roads.

The unpaved roads section of AP-42 requires an emission factor to be calculated using variables like the surface material silt content and mean vehicle weight on the roads. Two different equations are provided in AP-42 depending on whether the road is located at an industrial site or a publicly accessible road. The latter equation for publicly accessible roads assumes that the road will be dominated by light-duty vehicles; since trucks will be the primary equipment on the various haul roads, the equation for industrial sites (shown below) was used to estimate emissions.

$$E = k(s/12)^a (W/3)^b$$

Where:

E = size-specific emission factor, pounds per vehicle mile traveled (lb/vehicle miles traveled [VMT])

k, a, and b = empirical constants (see Table P-8)

s = surface material silt content, %

W = mean vehicle weight, tons

A silt content of 0.1 percent was used for all haul roads, which is the lowest silt content estimated for gravel roads by the USEPA (1998). The vehicular weight was estimated at 36.5 tons for empty trucks and 80 tons for loaded trucks (Caterpillar 2010). Table M-8 summarizes the empirical constants used in the preceding equation and the calculated emission factors for empty and loaded trucks.

¹ In 2010, the USEPA approved the use of the Motor Vehicle Emissions Simulator (MOVES) model for official State implementation air quality plan submissions to the USEPA and for transportation conformity analyses outside of California (75 FR 9411). The approval also started a two-year grace period that ends on March 2, 2012; the use of MOVES is not required during this timeframe. Since this analysis was completed during the grace period and project-level data was not available for MOVES, MOBILE6.2 was used for the analysis.

Table M-8. Empirical Constants and Emission Factors for Unpaved Roads

Constant	PM _{2.5}	PM ₁₀
k (lb/VMT)	0.15	1.5
a	0.9	0.9
b	0.45	0.45
E, Empty (lb/VMT)	0.0062	0.062
E, Loaded (lb/VMT)	0.0088	0.088

Source: USEPA 2006.

Key:

Ib/VMT = pounds per vehicle mile traveled

PM_{2.5} = fine particulate matter

PM₁₀ = inhalable particulate matter

The emission factors provided in Table M-8 are for uncontrolled fugitive dust emissions. Natural mitigation occurs from annual precipitation, the control efficiency of which can be estimated from the following equation.

$$E_{ext} = E[(365 - P)/365]$$

Where:

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

E = unpaved road dust emission factor (see Table M-8)

P = number of days in a year with at least 0.254 mm (0.01 in) of precipitation

The number of days of precipitation was estimated at approximately 88 days for Klamath County and 84 days for Siskiyou County. The control efficiency of natural mitigation was therefore estimated as 76 percent and 77 percent, respectively, for Klamath and Siskiyou Counties.

M.3 Emission Inventories

Emission inventories were completed for each of the dam locations and alternatives as described in the previous sections. As is shown in Table M-9, peak daily emissions of NOx would be significant under each of the proposed alternatives except Alternative 4; and PM₁₀ peak daily emissions would be significant under each of the alternatives except Alternative 4. As a result, emissions of NOx and PM₁₀ would need to be mitigated. Annual emissions for the total project are provided in Table M-10 for informational purposes.

Table M-9. Summary of Peak Daily Emissions by Alternative

Alternative	Peak Daily Emissions (pounds per day) ¹					
	VOC	CO	NOx	SOx	PM ₁₀	PM _{2.5}
Alt. 2: Full Facilities Removal	131	584	650	9	503	248
Alt. 3: Partial Facilities Removal	128	570	625	9	484	244
Alt 4: Fish Passage at Four Dams	11	63	59	4	11	6
Alt 5: Fish Passage at Two Dams	117	552	620	7	399	225
Threshold of Significance	250	2,500	250	250	250	250

Notes:

¹ Values shown in **bold** exceed the California Environmental Quality Act thresholds of significance.

Key:

VOC = volatile organic compounds

CO = carbon monoxide

NOx = nitrogen oxides

SOx = sulfur oxides

PM₁₀ = inhalable particulate matterPM_{2.5} = fine particulate matter**Table M-10. Summary of Annual Emissions by Alternative**

Alternative	Annual Emissions (tons per year) ¹					
	VOC	CO	NOx	SOx	PM ₁₀	PM _{2.5}
2020						
Alt. 2: Full Facilities Removal	6	24	28	1	20	11
Alt. 3: Partial Facilities Removal	6	23	26	<1	20	11
Alt. 4: Fish Passage at Four Dams ²	2	10	5	<1	2	1
Alt. 5: Fish Passage at Two Dams	4	20	22	<1	18	10

Notes:

¹ Emissions shown are the total emissions for all four dams.² Emissions for Alternative 4 represent the worst-case year for emissions because dam demolition activities occur during different years for each dam site.

Key:

VOC = volatile organic compounds

CO = carbon monoxide

NOx = nitrogen oxides

SOx = sulfur oxides

PM₁₀ = inhalable particulate matterPM_{2.5} = fine particulate matter

M.3.1 Alternative 2: Full Facilities Removal (Proposed Action)

A summary of peak daily emissions associated with the Proposed Action is provided in Table M-11. Emissions are identified for each of the major components of construction, including off-road construction equipment, on-road trucks, construction worker commuting vehicles, and fugitive dust from vehicle re-entrainment on unpaved roads and excavation/grading activities. Peak daily emissions of NOx and PM₁₀would be significant under this alternative.

Table M-11. Summary of Peak Daily Emissions for Proposed Action

Source	Peak Daily Emissions (pounds per day)					
	VOC	CO	NOx	SOx	PM ₁₀	PM _{2.5}
Iron Gate						
Construction Equipment	63	248	313	2	12	11
Haul Trucks	3	12	34	<1	5	2
Employee Commuting Vehicles	1	11	1	<1	4	1
Unpaved Roads	--	--	--	--	31	3
Excavation/Grading	--	--	--	--	157	33
Iron Gate Subtotal	67	272	348	2	210	50
Copco 1						
Construction Equipment	26	159	117	1	6	5
Haul Trucks	1	4	11	<1	2	1
Employee Commuting Vehicles	1	13	1	<1	3	1
Unpaved Roads	--	--	--	--	2	<1
Excavation/Grading	--	--	--	--	161	159
Copco 1 Subtotal	27	176	129	1	174	165
Copco 2						
Construction Equipment	19	56	80	1	4	3
Haul Trucks	3	12	32	<1	5	2
Employee Commuting Vehicles	1	16	2	<1	2	<1
Unpaved Roads	--	--	--	--	4	<1
Excavation/Grading	--	--	--	--	3	1
Copco 2 Subtotal	19	56	80	1	4	3
J.C. Boyle						
Construction Equipment	13	22	54	5	9	8
Haul Trucks	1	1	4	<1	2	<1
Employee Commuting Vehicles	2	31	1	<1	2	<1
Unpaved Roads	--	--	--	--	5	1
Excavation/Grading	--	--	--	--	84	17
J.C. Boyle Subtotal	15	54	60	5	103	27
Total Emissions	131	584	650	9	503	248
California Emissions	116	531	590	4	401	221
Oregon Emissions	15	54	60	5	103	27
Significance Criteria	250	2,500	250	250	250	250

Key:

VOC = volatile organic compounds

CO = carbon monoxide

NOx = nitrogen oxides

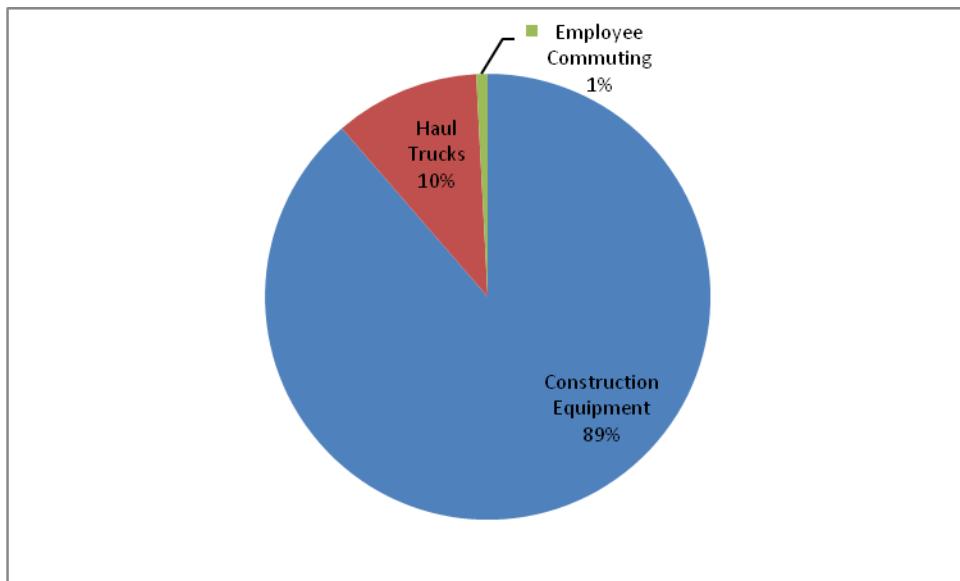
SOx = sulfur oxides

PM₁₀ = inhalable particulate matter

PM_{2.5} = fine particulate matter

As shown in Table M-11, NOx and PM₁₀ are over the significance criteria. The majority of emissions from PM₁₀ are already controlled to a high degree by various fugitive dust control measures; therefore, it will be difficult to reduce emissions to a greater degree. As a result, mitigation measures should focus on reducing NOx emissions. Figure M-2 summarizes the peak NOx daily emissions from all four dams. As is shown in the figure,

the most focus should be placed on reducing emissions from off-road construction equipment.



Source: CDM 2011.

Figure M-2. Distribution of Peak Daily NOx Emissions at All Dams for Full Facilities Removal (Proposed Action)

Table M-12 summarizes annual emissions for each of the sites.

Table M-12. Summary of Annual Emissions for Full Facilities Removal (Proposed Action)

Alternative	Annual Emissions (tons per year)					
	VOC	CO	NOx	SOx	PM ₁₀	PM _{2.5}
2020						
Iron Gate	3	11	14	<1	10	2
Copco 1	1	7	5	<1	8	7
Copco 2	1	3	5	<1	<1	<1
J.C. Boyle	1	3	5	<1	3	1
Project Total (2020)	6	24	28	1	20	11
California Total	5	21	23	<1	18	10
Oregon Total	1	3	5	<1	3	1

Key:

VOC = volatile organic compounds

CO = carbon monoxide

NOx = nitrogen oxides

SOx = sulfur oxides

PM₁₀ = inhalable particulate matter

PM_{2.5} = fine particulate matter

M.3.2 Alternative 3: Partial Facilities Removal Alternative

A summary of peak daily emissions associated with the Partial Facilities Removal Alternative is provided in Table M-13. Peak daily emissions of NOx and PM₁₀ would remain significant under this alternative.

Table M-13. Summary of Peak Daily Emissions for Partial Facilities Removal Alternative

Source	Peak Daily Emissions (pounds per day)					
	VOC	CO	NOx	SOx	PM ₁₀	PM _{2.5}
Iron Gate						
Construction Equipment	63	248	313	2	12	11
Haul Trucks	2	11	30	<1	5	1
Employee Commuting	1	11	1	<1	4	1
Unpaved Roads	--	--	--	--	31	3
Excavation/Grading	--	--	--	--	156	33
Iron Gate Subtotal	66	270	344	2	208	49
Copco 1						
Construction Equipment	26	159	117	1	6	5
Haul Trucks	1	2	6	<1	1	<1
Employee Commuting	1	11	1	<1	3	1
Unpaved Roads	--	--	--	--	2	<1
Excavation/Grading	--	--	--	--	159	158
Copco 1 Subtotal	27	173	124	1	171	165
Copco 2						
Construction Equipment	19	56	80	1	4	3
Haul Trucks	2	8	22	<1	3	1
Employee Commuting	1	16	2	<1	2	<1
Unpaved Roads	--	--	--	--	2	<1
Excavation/Grading	--	--	--	--	1	<1
Copco 2 Subtotal	21	80	103	1	12	5
J.C. Boyle						
Construction Equipment	12	19	49	5	8	7
Haul Trucks	<1	1	3	<1	1	<1
Employee Commuting	1	28	1	<1	2	<1
Unpaved Roads	--	--	--	--	5	1
Excavation/Grading	--	--	--	--	77	16
J.C. Boyle Subtotal	14	48	53	5	94	25
Total Emissions	128	570	625	9	484	244
California Emissions	115	522	571	4	390	219
Oregon Emissions	14	48	53	5	94	25
Significance Criteria	250	2,500	250	250	250	250

Key:

VOC = volatile organic compounds

CO = carbon monoxide

NOx = nitrogen oxides

SOx = sulfur oxides

PM₁₀ = inhalable particulate matter

PM_{2.5} = fine particulate matter

Compared to the Proposed Action, this alternative generally results in fewer PM₁₀ and PM_{2.5} emissions associated with excavation and cut/fill activities because the footprint on which equipment would be operating is smaller than the Proposed Action. Emissions associated with the other components are relatively unaffected because the peak number

of truck trips, construction equipment, or employees does not change between the two alternatives. An exception occurs at J.C. Boyle, which requires fewer workers and less construction equipment under Alternative 3 compared to the Proposed Action.

Table M-14 summarizes annual emissions for each of the sites. As shown in the table, emissions for each year of construction are estimated to be generally lower compared to those under the Proposed Action. This is related to the reduced level of construction activities that would occur under this alternative compared to those under the Proposed Action.

Table M-14. Summary of Annual Emissions for Partial Facilities Removal Alternative

Alternative	Annual Emissions (tons per year)					
	VOC	CO	NOx	SOx	PM ₁₀	PM _{2.5}
2020						
Iron Gate	3	11	14	<1	10	2
Copco 1	1	7	5	<1	7	7
Copco 2	1	3	4	<1	<1	<1
J.C. Boyle	1	2	3	<1	2	1
Project Total (2020)	6	23	26	<1	20	11
California Total	5	21	23	<1	17	10
Oregon Total	1	2	3	<1	2	1

Key:

VOC = volatile organic compounds

CO = carbon monoxide

NOx = nitrogen oxides

SOx = sulfur oxides

PM₁₀ = inhalable particulate matter

PM_{2.5} = fine particulate matter

M.3.3 Alternative 4: Fish Passage at Four Dams

A summary of peak daily emissions associated with the Fish Passage at Four Dams Alternative is provided in Table M-15. Peak daily emissions of each pollutant would be substantially lower than emissions under the Proposed Action. This is largely based on the fact that the dams will remain in place and fugitive dust emissions will be minimal. The reduced level of construction activities compared to that under the Proposed Action also results in fewer emissions from the components (i.e., construction equipment, trucks, and construction worker commuting vehicles). Peak daily emissions would be less than significant for all pollutants.

Table M-15. Summary of Peak Daily Emissions for Fish Passage at Four Dams Alternative

Source	Peak Daily Emissions (pounds per day)					
	VOC	CO	NOx	SOx	PM ₁₀	PM _{2.5}
Iron Gate (2023)						
Construction Equipment	10	54	52	<1	2	2
Haul Trucks	1	3	7	<1	1	<1
Employee Commuting	1	6	1	<1	2	<1
Unpaved Roads	--	--	--	--	--	--
Excavation/Grading	--	--	--	--	2	<1
Iron Gate Subtotal	11	63	59	<1	8	3
Copco 1 (2025)						
Construction Equipment	9	51	37	<1	2	1
Haul Trucks	1	3	7	<1	2	<1
Employee Commuting	1	4	<1	<1	1	<1
Unpaved Roads	--	--	--	--	--	--
Excavation/Grading	--	--	--	--	1	<1
Copco 1 Subtotal	9	51	37	<1	2	1
Copco 2 (2024)						
Construction Equipment	9	51	42	<1	2	2
Haul Trucks	1	3	8	<1	2	<1
Employee Commuting	<1	3	<1	<1	1	<1
Unpaved Roads	--	--	--	--	--	--
Excavation/Grading	--	--	--	--	<1	<1
Copco 2 Subtotal	10	58	50	<1	5	2
J.C. Boyle (2022)						
Construction Equipment	8	14	45	3	6	5
Haul Trucks	1	1	5	<1	3	1
Employee Commuting	<1	<1	<1	<1	1	<1
Unpaved Roads	--	--	--	--	--	--
Excavation/Grading	--	--	--	--	1	<1
J.C. Boyle Subtotal	9	16	50	4	11	6
Maximum Daily Emissions	11	63	59	4	11	6
Significance Criteria ¹	250	2,500	250	250	250	250

Note:

¹ Demolition activities at each dam site occur during different years and do not overlap; therefore, the maximum daily emissions used for significance determinations.

Key:

VOC = volatile organic compounds

CO = carbon monoxide

NOx = nitrogen oxides

SOx = sulfur oxides

PM₁₀ = inhalable particulate matter

PM_{2.5} = fine particulate matter

Table M-16 summarizes annual emissions for each of the sites. As shown in the table, emissions for each year of construction are estimated to be generally lower compared to those under the Proposed Action. This is related to the reduced level of construction activities that would occur under this alternative compared to those under the Proposed Action.

Table M-16. Summary of Fish Passage at Four Dams Alternative

Alternative	Annual Emissions (tons per year)					
	VOC	CO	NOx	SOx	PM ₁₀	PM _{2.5}
Iron Gate (2023)	2	10	5	<1	2	1
Copco 1 (2025)	1	7	3	<1	2	<1
Copco 2 (2024)	1	4	1	<1	1	<1
J.C. Boyle (2022)	<1	<1	2	<1	1	<1
Maximum Annual Emissions	2	10	5	<1	2	1

Key:

VOC = volatile organic compounds

CO = carbon monoxide

NOx = nitrogen oxides

SOx = sulfur oxides

PM₁₀ = inhalable particulate matter

PM_{2.5} = fine particulate matter

M.3.4 Alternative 5: Fish Passage at Two Dams, Remove Copco 1 and Iron Gate

A summary of peak daily emissions associated with the Fish Passage at Two Dams, Remove Copco 1 and Iron Gate Alternative is provided in Table M-17. Peak daily emissions of each pollutant are substantially less than emissions under the Proposed Action. This is largely based on the fact that two dams will remain in place and fugitive dust emissions will be minimal. The reduced level of construction activities compared to that under the Proposed Action also results in fewer emissions from the components (i.e., construction equipment, trucks, and construction worker commuting vehicles). Peak daily emissions of NOx and PM₁₀ would be significant under this alternative.

**Table M-17. Summary of Peak Daily Emissions for Fish Passage at Two Dams,
Remove Copco 1 and Iron Gate Alternative**

Source	Peak Daily Emissions (pounds per day)					
	VOC	CO	NOx	SOx	PM ₁₀	PM _{2.5}
Iron Gate						
Construction Equipment	63	248	313	2	12	11
Haul Trucks	2	11	30	0	5	1
Employee Commuting	1	22	2	0	5	1
Unpaved Roads	--	--	--	--	31	3
Excavation/Grading	--	--	--	--	157	33
Iron Gate Subtotal	67	282	345	2	209	49
Copco 1						
Construction Equipment	26	159	117	1	6	5
Haul Trucks	1	4	11	0	2	1
Employee Commuting	1	16	2	0	3	1
Unpaved Roads	--	--	--	--	2	0
Excavation/Grading	--	--	--	--	160	159
Copco 1 Subtotal	28	179	129	1	173	165
Copco 2						
Construction Equipment	11	52	70	0	3	3
Haul Trucks	1	4	12	0	2	1
Employee Commuting	0	4	0	0	1	0
Unpaved Roads	--	--	--	--	--	--
Excavation/Grading	--	--	--	--	0	0
Copco 2 Subtotal	12	61	82	0	6	4
J.C. Boyle						
Construction Equipment	8	18	56	4	6	6
Haul Trucks	1	2	6	0	3	1
Employee Commuting	1	12	0	0	1	0
Unpaved Roads	--	--	--	--	--	--
Excavation/Grading	--	--	--	--	1	0
J.C. Boyle Subtotal	10	32	63	4	11	7
Total Emissions	117	552	620	7	399	225
California Emissions	107	521	557	3	388	218
Oregon Emissions	10	32	63	4	11	7
Significance Criteria	250	2,500	250	250	250	250

Key:

VOC = volatile organic compounds

CO = carbon monoxide

NOx = nitrogen oxides

SOx = sulfur oxides

PM₁₀ = inhalable particulate matter

PM_{2.5} = fine particulate matter

Table M-18 summarizes annual emissions for each of the sites. As shown in the table, emissions for construction are estimated to be generally lower in 2020 as compared to those under the Proposed Action. This is related to the reduced level of construction activities that would occur under this alternative compared to those under the Proposed Action.

Table M-18. Summary of Fish Passage at Two Dams, Remove Copco 1 and Iron Gate

Alternative	Annual Emissions (tons per year)					
	VOC	CO	NOx	SOx	PM ₁₀	PM _{2.5}
2020						
Iron Gate	3	12	14	<1	10	2
Copco 1	1	7	5	<1	8	7
Copco 2	<1	1	1	<1	<1	<1
J.C. Boyle	<1	1	2	<1	<1	<1
Project Total (2020)	4	20	22	<1	18	10
California Total	4	19	20	<1	18	10
Oregon Total	<1	1	2	<1	<1	<1

Key:

VOC = volatile organic compounds

CO = carbon monoxide

NOx = nitrogen oxides

SOx = sulfur oxides

PM₁₀ = inhalable particulate matterPM_{2.5} = fine particulate matter

M.4 Mitigation Measures

Several mitigation measures would be required to reduce emissions of PM₁₀, PM_{2.5}, and NOx, depending on the alternative. The following mitigation measures would be used as necessary to reduce emissions:

- AQ-1 – Any off-road construction equipment (e.g., loaders, excavators, etc.) must be equipped with engines that meet the model year (MY) 2015 emission standards for off-road compression-ignition (diesel) engines (13 CCR 2420-2425.1). Older model year engines may also be used if they are retrofit with control devices to reduce emissions to the applicable emission standards.
- AQ-2 – Any on-road construction equipment (e.g., pick-up trucks at the construction sites) must be equipped with engines that meet the MY 2000 or on-road emission standards.
- AQ-3 – Any trucks used to transport materials to or from the construction sites must be equipped with engines that meet the MY 2010 or later emission standards for on-road heavy-duty engines and vehicles (13 CCR 1956.8). Older model engines may also be used if they are retrofit with control devices to reduce emissions to the applicable emission standards.
- AQ-4 – Dust control measures will be incorporated to the maximum extent feasible during blasting operations at Copco 1 Dam. The following control measures will be used during blasting activities:
 - Conduct blasting on calm days to the extent feasible. Wind direction with respect to nearby residences must be considered.

- Design blast stemming to minimize dust and to control fly rock.
- Install wind fence for control of windblown dust

Mitigated measures were calculated as described in the previous sections. Table M-19 summarizes mitigated measures by alternative.

Table M-19. Summary of Mitigated Emissions by Alternative

Alternative ¹	Peak Daily Emissions (lbs/day)					
	VOC	CO	NOx	SOx	PM ₁₀	PM _{2.5}
Full Facilities Removal	66	405	146	3	309	74
Partial Facilities Removal	64	394	137	3	294	60
Fish Passage at Two Dams	54	372	156	3	209	44
Significance Criterion ²	250	2,500	250	250	250	250

Note:

¹ Alternative 4 (Fish Passage at Four Dams) not included in table because mitigation was not required.

As shown in Table M-19, emissions of PM₁₀ would remain significant for the Proposed Action and the Partial Facilities Removal Alternative. As a result, PM₁₀ emissions would remain significant and unavoidable for these two alternatives.

M.5 References

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Table M1A. Summary of Daily Mitigated Emissions

	Peak Daily Emissions (lb/day)					
	ROG	CO	NOx	SOx	PM10	PM2.5
Grand Total						
Alternative 2	66	405	146	3	309	74
Alternative 3	64	394	137	3	294	60
Alternative 5	54	372	156	3	209	44
Threshold	250	2,500	250	250	250	250

Note:

Alternative 4 not included because mitigation not required.

Key:

CO = carbon monoxide

PM2.5 = fine particulate matter

Ib/day = pounds per day

ROG = reactive organic gases

NOx = nitrogen oxides

SOx = sulfur oxides

PM10 = inhalable particulate matter

Table M1B. Alternative 2 Daily Mitigated Emissions Summary (pounds per day)

	Peak Daily Emissions (lb/day)					
	ROG	CO	NOx	SOx	PM10	PM2.5
Iron Gate						
Construction Equipment	36	225	63	2	3	3
Haul Trucks	1	7	14	0	5	1
Employee Commuting	1	11	1	0	4	1
Fugitive Dust - Unpaved Roads	--	--	--	--	31	3
Fugitive Dust - Materials	--	--	--	--	157	33
TOTAL	38	242	78	2	199	40
Copco 1						
Construction Equipment	18	130	51	1	2	9
Haul Trucks	0	2	4	0	2	0
Employee Commuting	1	13	1	0	3	1
Fugitive Dust - Unpaved Roads	--	--	--	--	2	0
Fugitive Dust - Materials	--	--	--	--	161	159
TOTAL	19	144	57	1	170	169
Copco 2						
Construction Equipment	13	51	29	1	1	6
Haul Trucks	1	6	13	0	4	1
Employee Commuting	1	16	2	0	2	0
Fugitive Dust - Unpaved Roads	--	--	--	--	4	0
Fugitive Dust - Materials	--	--	--	--	3	1
TOTAL	15	72	44	1	14	8
JC Boyle						
Construction Equipment	11	58	19	1	1	7
Haul Trucks	1	1	4	0	2	0
Employee Commuting	2	31	1	0	2	0
Fugitive Dust - Unpaved Roads	--	--	--	--	5	1
Fugitive Dust - Materials	--	--	--	--	84	17
TOTAL	13	90	25	1	95	26
Grand Total	85	549	204	5	478	243
California Total	72	459	179	4	384	218
Oregon Total	13	90	25	1	95	26

Peak Daily	66	405	146	3	309	74
California Total	53	315	122	3	214	48
Oregon Total	13	90	25	1	95	26

Note:

Peak daily emissions do not include Copco 1.

Key:

CO = carbon monoxide

lb/day = pounds per day

NOx = nitrogen oxides

PM10 = inhalable particulate matter

PM2.5 = fine particulate matter

ROG = reactive organic gases

SOx = sulfur oxides

Table M1C. Alternative 3 Daily Mitigated Emissions Summary (pounds per day)

	Peak Daily Emissions (lb/day)					
	ROG	CO	NOx	SOx	PM10	PM2.5
Iron Gate						
Construction Equipment	36	225	63	2	3	3
Haul Trucks	1	6	12	0	4	1
Employee Commuting	1	11	1	0	4	1
Fugitive Dust - Unpaved Roads	--	--	--	--	31	3
Fugitive Dust - Materials	--	--	--	--	156	33
TOTAL	38	241	76	2	198	40
Copco 1						
Construction Equipment	18	130	51	1	2	2
Haul Trucks	0	1	3	0	1	0
Employee Commuting	1	11	1	0	3	1
Fugitive Dust - Unpaved Roads	--	--	--	--	2	0
Fugitive Dust - Materials	--	--	--	--	159	158
TOTAL	19	142	55	1	167	161
Copco 2						
Construction Equipment	13	51	29	1	1	1
Haul Trucks	1	4	9	0	3	1
Employee Commuting	1	16	2	0	2	0
Fugitive Dust - Unpaved Roads	--	--	--	--	2	0
Fugitive Dust - Materials	--	--	--	--	1	0
TOTAL	14	70	40	1	9	3
J.C. Boyle						
Construction Equipment	10	53	18	1	1	1
Haul Trucks	0	1	3	0	1	0
Employee Commuting	1	28	1	0	2	0
Fugitive Dust - Unpaved Roads	--	--	--	--	5	1
Fugitive Dust - Materials	--	--	--	--	77	16
TOTAL	12	82	22	1	87	18
Grand Total	83	536	193	4	461	222
California Total	71	454	171	4	374	204
Oregon Total	12	82	22	1	87	18
Peak Daily	64	394	137	3	294	60
California Total	52	311	116	3	207	42
Oregon Total	12	82	22	1	87	18

Note:

Peak daily emissions do not include Copco 1.

Key:

CO = carbon monoxide

lb/day = pounds per day

NOx = nitrogen oxides

PM10 = inhalable particulate matter

PM2.5 = fine particulate matter

ROG = reactive organic gases

SOx = sulfur oxides

Table M1D. Alternative 5 Daily Mitigated Emissions Summary (pounds per day)

	Peak Daily Emissions (lb/day)					
	ROG	CO	NOx	SOx	PM10	PM2.5
Iron Gate						
Construction Equipment	36	225	63	2	3	3
Haul Trucks	2	11	30	0	5	1
Employee Commuting	1	22	2	0	5	1
Fugitive Dust - Unpaved Roads	--	--	--	--	31	3
Fugitive Dust - Materials	--	--	--	--	157	33
TOTAL	40	258	95	2	200	41
Copco 1						
Construction Equipment	18	130	51	1	2	2
Haul Trucks	1	4	11	0	2	1
Employee Commuting	1	16	2	0	3	1
Fugitive Dust - Unpaved Roads	--	--	--	--	2	0
Fugitive Dust - Materials	--	--	--	--	160	159
TOTAL	19	149	64	1	169	162
Copco 2						
Construction Equipment	6	48	26	0	1	1
Haul Trucks	1	4	12	0	2	1
Employee Commuting	0	4	0	0	1	0
Fugitive Dust - Unpaved Roads	--	--	--	--	--	--
Fugitive Dust - Materials	--	--	--	--	0	0
TOTAL	7	57	38	0	4	2
J.C. Boyle						
Construction Equipment	6	45	16	0	1	1
Haul Trucks	1	2	6	0	3	1
Employee Commuting	1	12	0	0	1	0
Fugitive Dust - Unpaved Roads	--	--	--	--	--	--
Fugitive Dust - Materials	--	--	--	--	1	0
TOTAL	7	58	23	0	6	2
Grand Total	73	522	220	4	378	206
California Total	66	464	197	3	373	204
Oregon Total	7	58	23	0	6	2
Peak Daily	54	372	156	3	209	44
California Total	47	314	133	2	204	42
Oregon Total	7	58	23	0	6	2

Note:

Peak daily emissions do not include Copco 1.

Key:

CO = carbon monoxide

lb/day = pounds per day

NOx = nitrogen oxides

PM10 = inhalable particulate matter

PM2.5 = fine particulate matter

ROG = reactive organic gases

SOx = sulfur oxides

Table M1E. Summary of Annual Mitigated Emissions

	2020 Annual Emissions (tpy)					
	ROG	CO	NOx	SOx	PM10	PM2.5
Alternative 2	4	24	9	0	19	11
Alternative 3	4	22	8	0	19	10
Alternative 5	3	19	7	0	17	9

Note:

Alternative 4 not included because mitigation not required

Key:

CO = carbon monoxide

ROG = reactive organic gases

NOx = nitrogen oxides

SOx = sulfur oxides

PM10 = inhalable particulate matter

tpy = tons per year

PM2.5 = fine particulate matter

Table M1F. Alternative 2 Annual Mitigated Emissions Summary (tons per year)

2020 Annual Emissions (tpy)						
	ROG	CO	NOx	SOx	PM10	PM2.5
Iron Gate						
Construction Equipment	2	9	3	0	0	0
Haul Trucks	0	0	0	0	0	0
Employee Commuting	0	0	0	0	0	0
Fugitive Dust - Unpaved Roads	--	--	--	--	1	0
Fugitive Dust - Materials	--	--	--	--	8	2
TOTAL	2	10	3	0	9	2
Copco 1						
Construction Equipment	1	5	2	0	0	0
Haul Trucks	0	0	0	0	0	0
Employee Commuting	0	0	0	0	0	0
Fugitive Dust - Unpaved Roads	--	--	--	--	0	0
Fugitive Dust - Materials	--	--	--	--	7	7
TOTAL	1	6	2	0	7	7
Copco 2						
Construction Equipment	1	3	2	0	0	0
Haul Trucks	0	0	0	0	0	0
Employee Commuting	0	1	0	0	0	0
Fugitive Dust - Unpaved Roads	--	--	--	--	0	0
Fugitive Dust - Materials	--	--	--	--	0	0
TOTAL	1	3	2	0	0	0
JC Boyle						
Construction Equipment	1	4	2	0	0	0
Haul Trucks	0	0	0	0	0	0
Employee Commuting	0	1	0	0	0	0
Fugitive Dust - Unpaved Roads	--	--	--	--	0	0
Fugitive Dust - Materials	--	--	--	--	2	0
TOTAL	1	5	2	0	2	1
Project Total	4	24	9	0	19	11
California Total	3	19	7	0	17	10
Oregon Total	1	5	2	0	2	1

Key:

CO = carbon monoxide

ROG = reactive organic gases

NOx = nitrogen oxides

SOx = sulfur oxides

PM10 = inhalable particulate matter

tpy = tons per year

PM2.5 = fine particulate matter

Table M1G. Alternative 3 Annual Mitigated Emissions Summary (tons per year)

2020 Annual Emissions (tpy)						
	ROG	CO	NOx	SOx	PM10	PM2.5
Iron Gate						
Construction Equipment	2	9	3	0	0	0
Haul Trucks	0	0	0	0	0	0
Employee Commuting	0	0	0	0	0	0
Fugitive Dust - Unpaved Roads	--	--	--	--	1	0
Fugitive Dust - Materials	--	--	--	--	8	2
TOTAL	2	10	3	0	9	2
Copco 1						
Construction Equipment	1	5	2	0	0	0
Haul Trucks	0	0	0	0	0	0
Employee Commuting	0	0	0	0	0	0
Fugitive Dust - Unpaved Roads	--	--	--	--	0	0
Fugitive Dust - Materials	--	--	--	--	7	7
TOTAL	1	6	2	0	7	7
Copco 2						
Construction Equipment	1	2	2	0	0	0
Haul Trucks	0	0	0	0	0	0
Employee Commuting	0	1	0	0	0	0
Fugitive Dust - Unpaved Roads	--	--	--	--	0	0
Fugitive Dust - Materials	--	--	--	--	0	0
TOTAL	1	3	2	0	0	0
J.C. Boyle						
Construction Equipment	1	3	1	0	0	0
Haul Trucks	0	0	0	0	0	0
Employee Commuting	0	1	0	0	0	0
Fugitive Dust - Unpaved Roads	--	--	--	--	0	0
Fugitive Dust - Materials	--	--	--	--	2	0
TOTAL	1	4	1	0	2	0
Project Total	4	22	8	0	19	10

Key:

CO = carbon monoxide

ROG = reactive organic gases

NOx = nitrogen oxides

SOx = sulfur oxides

PM10 = inhalable particulate matter

tpy = tons per year

PM2.5 = fine particulate matter

Table M1H. Alternative 5 Annual Mitigated Emissions Summary (tons per year)

	2020 Annual Emissions (tpy)					
	ROG	CO	NOx	SOx	PM10	PM2.5
Iron Gate						
Construction Equipment	2	9	3	0	0	0
Haul Trucks	0	0	1	0	0	0
Employee Commuting	0	1	0	0	0	0
Fugitive Dust - Unpaved Roads	--	--	--	--	1	0
Fugitive Dust - Materials	--	--	--	--	8	2
TOTAL	2	11	4	0	9	2
Copco 1						
Construction Equipment	1	5	2	0	0	0
Haul Trucks	0	0	0	0	0	0
Employee Commuting	0	1	0	0	0	0
Fugitive Dust - Unpaved Roads	--	--	--	--	0	0
Fugitive Dust - Materials	--	--	--	--	7	7
TOTAL	1	6	2	0	7	7
Copco 2						
Construction Equipment	0	1	0	0	0	0
Haul Trucks	0	0	0	0	0	0
Employee Commuting	0	0	0	0	0	0
Fugitive Dust - Unpaved Roads	--	--	--	--	--	--
Fugitive Dust - Materials	--	--	--	--	0	0
TOTAL	0	1	1	0	0	0
J.C. Boyle						
Construction Equipment	0	1	1	0	0	0
Haul Trucks	0	0	0	0	0	0
Employee Commuting	0	0	0	0	0	0
Fugitive Dust - Unpaved Roads	--	--	--	--	--	--
Fugitive Dust - Materials	--	--	--	--	0	0
TOTAL	0	2	1	0	0	0
Project Total	3	19	7	0	17	9

Key:

CO = carbon monoxide

ROG = reactive organic gases

NOx = nitrogen oxides

SOx = sulfur oxides

PM10 = inhalable particulate matter

tpy = tons per year

PM2.5 = fine particulate matter

Table M2A. Summary of Daily Mitigated Off-Road Construction Emissions (Alternative 2)

Location	VOC	CO	NOx	SO2	PM10	PM2.5
Iron Gate	36	225	63	2	3	3
Copco 1	18	130	51	1	2	9
Copco 2	13	51	29	1	1	6
J.C. Boyle	11	58	19	1	1	7
Total	77	463	163	4	7	25
California %	86%	87%	88%	87%	88%	72%
Oregon %	14%	13%	12%	13%	12%	28%

Key:

CO = carbon monoxide

PM2.5 = fine particulate matter

NOx = nitrogen oxides

SO2 = sulfur dioxide

PM10 = inhalable particulate matter

VOC = volatile organic compounds

Table M2B. Summary of Annual Mitigated Off-Road Construction Emissions (Alternative 2)

Location	VOC	CO	NOx	SO2	PM10	PM2.5
Iron Gate	1.5	9.3	2.6	0.1	0.1	0.1
Copco 1	0.7	5.1	2.0	0.0	0.1	0.4
Copco 2	0.8	2.5	1.8	0.1	0.1	0.3
J.C. Boyle	0.9	4.3	1.7	0.1	0.1	0.5
Total	3.9	21.3	8.2	0.2	0.4	1.2
California %	77%	80%	79%	75%	79%	63%
Oregon %	23%	20%	21%	25%	21%	37%

Key:

CO = carbon monoxide

PM2.5 = fine particulate matter

NOx = nitrogen oxides

SO2 = sulfur dioxide

PM10 = inhalable particulate matter

VOC = volatile organic compounds

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Table M2C. Mitigated Off-Road Construction Equipment Emissions for Iron Gate Dam (Alternative 2)

Maximum Daily Work Hours 14 hours																							
Dam Removal Duration																							
		Start Date 6/1/2020																					
		End Date 9/23/2020																					
		83 days (5 days/week)																					
		99 days (6 days/week)																					
Quantity	Equipment Description	OFFROAD Category	Rating (hp)	Fuel Type	2020 Emission Factors (g/hp-hr or g/gal for on-highway)						Peak Daily Emissions (lbs/day)						2020 Emissions (tons per year)						
					ROG	CO	NOx	SOx	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5	
1	Crane - crawler, 150-200 ton	Cranes	335	Diesel	0.04	0.29	0.08	0.00	0.00	0.04	0.39	3.03	0.82	0.02	0.03	0.39	0.02	0.13	0.03	0.00	0.00	0.02	
1	Crane - rough terrain hydraulic, 50 ton	Cranes	130	Diesel	0.05	1.11	0.10	0.00	0.00	0.00	0.19	4.46	0.40	0.01	0.02	0.01	0.01	0.19	0.02	0.00	0.00	0.00	0.00
4	Excavator - 180,000-240,000 lb, Hitachi ZX870 to EX1200	Excavators	646	Diesel	0.06	0.43	0.12	0.00	0.00	0.00	5.02	34.60	9.30	0.19	0.35	0.32	0.21	1.44	0.39	0.01	0.01	0.01	0.01
20	Dump truck - articulated, 35 ton, Cat 735	Off-Highway Trucks	435	Diesel	0.08	0.46	0.12	0.00	0.00	0.00	20.31	124.77	33.29	0.65	1.30	1.19	0.84	5.18	1.38	0.03	0.05	0.05	0.05
2	Dozer - D8	Rubber Tired Dozers	347	Diesel	0.07	0.45	0.12	0.00	0.00	0.00	1.48	9.59	2.57	0.05	0.10	0.09	0.06	0.40	0.11	0.00	0.00	0.00	0.00
1	Pick-up truck, 1/2 ton, on-highway 4x4	N/A - Onroad	191	Gasoline	2.59	28.49	3.08	0.09	0.83	0.57	0.19	2.11	0.23	0.01	0.06	0.04	0.01	0.09	0.01	0.00	0.00	0.00	0.00
1	Pick-up truck, 1/2 ton, on-highway 4x4	N/A - Onroad	160	Diesel	1.64	15.84	44.50	0.10	1.61	1.14	0.06	0.62	1.74	0.00	0.06	0.04	0.00	0.03	0.07	0.00	0.00	0.00	0.00
1	Pick-up truck, 1 ton, on-highway 4x4	N/A - Onroad	195	Diesel	1.64	15.84	44.50	0.10	1.61	1.14	0.08	0.76	2.12	0.00	0.08	0.05	0.00	0.03	0.09	0.00	0.00	0.00	0.00
1	Water tanker, off-highway, 5000 gal	Off-Highway Trucks	175	Diesel	0.10	1.94	0.17	0.00	0.01	0.01	0.56	10.47	0.91	0.02	0.04	0.04	0.02	0.43	0.04	0.00	0.00	0.00	0.00
1	Engine generator, 6.5 KW	N/A - Offroad diesel engine	13	Diesel	1.14	3.03	14.06	0.93	1.00	0.97	0.46	1.22	5.64	0.37	0.40	0.39	0.02	0.05	0.23	0.02	0.02	0.02	0.02
1	Engine generator, 10 KW	N/A - Offroad diesel engine	21	Gasoline	9.79	3.16	4.99	0.27	0.33	0.32	6.35	2.05	3.23	0.17	0.21	0.21	0.26	0.08	0.13	0.01	0.01	0.01	0.01
4	Submersible pump, 4" dia, 230 volt	Other Construction Equipment	175	Diesel	0.05	1.44	0.13	0.00	0.00	0.00	1.10	31.08	2.84	0.07	0.10	0.10	0.05	1.29	0.12	0.00	0.00	0.00	0.00

Key:

CO = carbon monoxide

g/gal = grams per gallon

g/hp-hr = grams per horsepower-hour

hp = horsepower

lbs/day = pounds per day

NOx = nitrogen oxides

PM10 = inhalable particulate matter

PM2.5 = fine particulate matter

ROG = reactive organic gases

SO2 = sulfur dioxide

tpy = tons per day

ROG	CO	NOx	SO2	PM10	PM2.5
Total Daily (lb/day)	36.18	224.75	63.11	1.57	2.75
Total Annual 2020 (tpy)	1.5	9.3	2.6	0.1	0.1

Legend:

Onroad vehicle - emissions estimated by EMFAC2007

Stationary source - emissions estimated by AP-42 for diesel engines

Table M2D. Mitigated Off-Road Construction Equipment Emissions for Copco 1 (Alternative 2)

Maximum Daily Work Hours 8

Dam Removal Duration

Start Date 12/30/2019

End Date 4/15/2020

78 (5 days/week)

Quantity		Equipment Description	Rating (hp)	Fuel Type	2020 Emission Factors (g/hp-hr or g/gal for on-highway)						Peak Daily Emissions (lbs/day)						2020 Emissions (tons per year)					
Primary	Secondary				ROG	CO	NOx	SOx	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5
1	1	Crane - crawler, 150-200 ton	335	Diesel	0.04	0.29	0.08	0.00	0.00	0.04	0.44	3.46	0.94	0.02	0.03	0.44	0.02	0.13	0.04	0.00	0.00	0.02
1	1	Crane - rough terrain hydraulic, 50 ton	130	Diesel	0.05	1.11	0.10	0.00	0.00	0.05	0.22	5.10	0.46	0.01	0.02	0.22	0.01	0.20	0.02	0.00	0.00	0.01
1	0	Excavator - hydraulic ram	321	Diesel	0.06	0.39	0.10	0.00	0.00	0.06	0.32	2.19	0.59	0.01	0.02	0.32	0.01	0.09	0.02	0.00	0.00	0.01
1	1	Excavator - 45,000-60,000 lb, Komatsu 220-350	219.5	Diesel	0.08	0.54	0.14	0.00	0.01	0.08	0.59	4.21	1.09	0.03	0.04	0.59	0.02	0.16	0.04	0.00	0.00	0.02
3	0	Excavator - <20,000 lb	168	Diesel	0.08	1.62	0.14	0.00	0.01	0.08	0.68	14.36	1.27	0.03	0.05	0.68	0.03	0.56	0.05	0.00	0.00	0.03
1	0	Loader - WA250 IT	138	Diesel	0.06	1.47	0.13	0.00	0.01	0.06	0.15	3.58	0.32	0.01	0.01	0.15	0.01	0.14	0.01	0.00	0.00	0.01
1	0	Loader - WA450	273	Diesel	0.05	0.38	0.10	0.00	0.00	0.05	0.23	1.82	0.49	0.01	0.02	0.23	0.01	0.07	0.02	0.00	0.00	0.01
2	0	Dump truck - articulated, 30 ton, Cat 730	325	Diesel	0.08	0.46	0.12	0.00	0.00	0.08	0.87	5.33	1.42	0.03	0.06	0.87	0.03	0.21	0.06	0.00	0.00	0.03
1	1	Pick-up truck, 1/2 ton, on-highway 4x4		Gasoline	2.59	28.49	3.08	0.09	0.83	0.57	0.66	7.32	0.79	0.02	0.21	0.15	0.03	0.29	0.03	0.00	0.01	0.01
1	1	Pick-up truck, 1/2 ton, on-highway 4x4		Diesel	1.64	15.84	44.50	0.10	1.61	1.14	0.22	2.15	6.05	0.01	0.22	0.16	0.01	0.08	0.24	0.00	0.01	0.01
1	1	Pick-up truck, 1 ton, on-highway 4x4		Diesel	1.64	15.84	44.50	0.10	1.61	1.14	0.27	2.62	7.37	0.02	0.27	0.19	0.01	0.10	0.29	0.00	0.01	0.01
1	1	Pick-up truck, 3/4 ton, on-highway 4x4		Gasoline	2.59	28.49	3.08	0.09	0.83	0.57	0.99	10.93	1.18	0.03	0.32	0.22	0.04	0.43	0.05	0.00	0.01	0.01
1	1	Water tanker, off-highway, 5000 gal	175	Diesel	0.10	1.94	0.17	0.00	0.01	0.10	0.63	11.97	1.04	0.02	0.04	0.63	0.02	0.47	0.04	0.00	0.00	0.02
1	1	Engine generator, 6.5 KW	13	Diesel	1.14	3.03	14.06	0.93	1.00	0.97	0.52	1.39	6.45	0.43	0.46	0.45	0.02	0.05	0.25	0.02	0.02	0.02
1	1	Engine generator, 10 KW	21	Gasoline	9.79	3.16	4.99	0.27	0.33	0.32	7.25	2.34	3.70	0.20	0.24	0.24	0.28	0.09	0.14	0.01	0.01	0.01
4	4	Air compressor, 850-1200 cfm	106	Diesel	0.07	1.63	0.68	0.00	0.01	0.07	1.09	24.37	10.22	0.05	0.08	1.09	0.04	0.95	0.40	0.00	0.00	0.04
4	4	Drills - air/hydraulic track, jackleg, or sinker	291	Diesel	0.06	0.50	0.14	0.00	0.00	0.06	2.35	20.38	5.55	0.11	0.20	2.35	0.09	0.79	0.22	0.00	0.01	0.09
2	2	Submersible pump, 4" dia, 230 volt	53	Diesel	0.07	1.63	0.68	0.00	0.01	0.07	0.27	6.09	2.55	0.01	0.02	0.27	0.01	0.24	0.10	0.00	0.00	0.01

Key:

CO = carbon monoxide

PM10 = inhalable particulate matter

g/gal = grams per gallon

PM2.5 = fine particulate matter

g/hp-hr = grams per horsepower-hour

ROG = reactive organic gases

hp = horsepower

SO2 = sulfur dioxide

lbs/day = pounds per day

tpy = tons per day

NOx = nitrogen oxides

	ROG	CO	NOx	SO2	PM10	PM2.5
Total Daily (lb/day)	17.76	129.61	51.47	1.05	2.32	9.23
Total Annual 2020 (tpy)	0.69	5.05	2.01	0.04	0.09	0.36

Legend:

Onroad vehicle - emissions estimated by EMFAC2007

Stationary source - emissions estimated by AP-42 for diesel engines

Table M2E. Mitigated Off-Road Construction Equipment Emissions for Copco 2 (Alternative 2)

Quantity	Equipment Description	OFFROAD Category	Rating (hp)	Fuel Type	Fuel Amount (gal)	Total Hours	Hours	Peak Daily	2020 Emission Factors (g/hp-hr or g/gal for on-highway sources)					Peak Daily Emissions (lbs/day)					2020 Emissions (tons per year)						
									ROG	CO	NOx	SOx	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5	ROG	CO	NOx	SO2	PM10
1	Lattice boom crane, Manitowoc Crawler, 150T(US), 160'boom	Cranes	335	Diesel	12,111	1,096	8	0.04	0.29	0.08	0.00	0.00	0.04	0.22	1.73	0.47	0.01	0.02	0.22	0.02	0.12	0.03	0.00	0.00	0.02
2	Hydraulic yard crane, Grove 4x4x4, 13.6MT, 52' boom	Cranes	130	Diesel	7,749	1,904	8	0.05	1.11	0.10	0.00	0.00	0.05	0.22	5.10	0.46	0.01	0.02	0.22	0.01	0.30	0.03	0.00	0.00	0.01
2	Hydraulic excavator, 2.5 cy, long reach, Cat H120 Hoe Ram (3000 fib)	Excavators	321	Diesel	24,408	1,808	8	0.06	0.39	0.10	0.00	0.00	0.06	0.64	4.39	1.18	0.02	0.04	0.64	0.04	0.25	0.07	0.00	0.00	0.04
2	Hydraulic excavator, 2.5 cy	Excavators	321	Diesel	29,548	2,192	8	0.06	0.39	0.10	0.00	0.00	0.06	0.64	4.39	1.18	0.02	0.04	0.64	0.04	0.30	0.08	0.00	0.00	0.04
2	Articulated wheel loader, Cat966, 5.0 cy	Rubber Tired Loaders	246	Diesel	17,361	2,192	8	0.06	0.49	0.13	0.00	0.00	0.06	0.52	4.25	1.12	0.03	0.04	0.52	0.04	0.29	0.08	0.00	0.00	0.04
1	Articulated wheel loader, Cat988, 8.2 cy	Rubber Tired Loaders	475	Diesel	1,946	128	8	0.05	0.38	0.10	0.00	0.00	0.05	0.39	3.17	0.86	0.02	0.03	0.39	0.00	0.03	0.01	0.00	0.00	0.00
2	Dump truck, Cat740, 22.8-30 cy, 38.1 MT	Off-Highway Trucks	415	Diesel	11,686	1,408	8	0.08	0.46	0.12	0.00	0.00	0.08	1.11	6.80	1.81	0.04	0.07	1.11	0.05	0.30	0.08	0.00	0.00	0.05
1	Crawler dozer, Cat238	Crawler Tractors	238	Diesel	4,677	504	8	0.07	0.56	0.15	0.00	0.01	0.07	0.30	2.33	0.61	0.01	0.02	0.30	0.01	0.07	0.02	0.00	0.00	0.01
2	Pick-up truck, 1/2 ton, on-highway 4x4	N/A - Emfac	160	Diesel	4,209	2,192	8	1.64	15.84	44.50	0.10	1.61	1.14	0.11	1.07	3.01	0.01	0.11	0.08	0.01	0.07	0.21	0.00	0.01	0.01
1	Pick-up truck, 1 ton, on-highway 4x4	N/A - Emfac	195	Diesel	2,565	1,096	8	1.64	15.84	44.50	0.10	1.61	1.14	0.07	0.65	1.84	0.00	0.07	0.05	0.00	0.04	0.13	0.00	0.00	0.00
1	Water tanker, off-highway, 5000 gal	Off-Highway Trucks	175	Diesel	191	32	8	0.10	1.94	0.17	0.00	0.01	0.10	0.32	5.98	0.52	0.01	0.02	0.32	0.00	0.01	0.00	0.00	0.00	0.00
3	Engine generator, 6.5 KW	N/A - AP42 3.3-1	13	Diesel	2,302	3,288	8	1.14	3.03	14.06	0.93	1.00	0.97	0.78	2.08	9.67	0.64	0.69	0.67	0.05	0.14	0.66	0.04	0.05	0.05
2	Engine generator, 10 KW	N/A - AP42 3.3-1	21	Gasoline	3,968	2,192	8	9.79	3.16	4.99	0.27	0.33	0.32	7.25	2.34	3.70	0.20	0.24	0.24	0.50	0.16	0.25	0.01	0.02	0.02
1	Air compressor, 160 cfm, 100 psi	Other Construction Equipment	60	Diesel	2,367	1,096	8	0.07	1.63	0.68	0.00	0.01	0.07	0.08	1.72	0.72	0.00	0.01	0.08	0.01	0.12	0.05	0.00	0.00	0.01
2	Air compressor, 250 cfm, 100 psi	Other Construction Equipment	80	Diesel	6,313	2,192	8	0.07	1.63	0.68	0.00	0.01	0.07	0.21	4.60	1.93	0.01	0.02	0.21	0.01	0.32	0.13	0.00	0.00	0.01

Key:

CO = carbon monoxide

PM10 = inhalable particulate matter

g/gal = grams per gallon

PM2.5 = fine particulate matter

g/hp-hr = grams per horsepower-hour

ROG = reactive organic gases

hp = horsepower

SO2 = sulfur dioxide

Ibs/day = pounds per day

tpy = tons per day

ROG	CO	NOx	SO2	PM10	PM2.5
Total Daily (lb/day)	12.85	50.61	29.08	1.03	1.44
Total Annual 2020 (tpy)	0.79	2.53	1.82	0.07	0.09

Legend:

- Onroad vehicle - emissions estimated by EMFAC2007
- Stationary source - emissions estimated by AP-42 for diesel engines

Table M2F. Mitigated Off-Road Construction Equipment Emissions for JC Boyle (Alternative 2)

Maximum Daily Work Hours 8 hours

Note: Emission calculations assume that construction equipment meet California emission standards for MY2015 and newer equipment

Quantity	Equipment Description	Fuel Type	OFFROAD Category	Rating (hp)	Fuel Amount (gal)	Total Hours	Peak Daily Hours	2020 Emission Factors (g/hp-hr or g/gal for on highway sources)					Peak Daily Emissions (lbs/day)					2020 Emissions (tons per year)							
								VOC	CO	NOx	SOx	PM10	PM2.5	VOC	CO	NOx	SO2	PM10	PM2.5	VOC	CO	NOx	SO2	PM10	PM2.5
1	Lattice boom crane, Manitowoc Crawler, 150T(US), 160'boom	Diesel	Cranes	335	23,603	2,136	8	0.04	0.29	0.08	0.00	0.00	0.04	0.22	1.73	0.47	0.01	0.02	0.22	0.03	0.23	0.06	0.00	0.00	0.03
2	Hydraulic yard crane, Grove 4x4x4, 52' boom, 13.6MT	Diesel	Cranes	130	3,256	800	8	0.05	1.11	0.10	0.00	0.00	0.05	0.22	5.10	0.46	0.01	0.02	0.22	0.01	0.13	0.01	0.00	0.00	0.01
2	Hydraulic excavator, 2.5 cy, long reach, Cat H120 Hoe Ram (3000 flb)	Diesel	Excavators	321	57,672	4,272	8	0.06	0.39	0.10	0.00	0.00	0.06	0.64	4.39	1.18	0.02	0.04	0.64	0.08	0.59	0.16	0.00	0.01	0.08
2	Hydraulic excavator, 2.5 cy	Diesel	Excavators	321	57,587	4,272	8	0.06	0.39	0.10	0.00	0.00	0.06	0.64	4.39	1.18	0.02	0.04	0.64	0.08	0.59	0.16	0.00	0.01	0.08
1	Hydraulic excavator, 6 cy	Diesel	Excavators	513	11,014	488	8	0.06	0.43	0.12	0.00	0.00	0.06	0.57	3.92	1.06	0.02	0.04	0.57	0.02	0.12	0.03	0.00	0.00	0.02
2	Articulated wheel loader, Cat966, 5.0 cy	Diesel	Rubber Tired Loaders	246	11,912	1,504	8	0.06	0.49	0.13	0.00	0.00	0.06	0.52	4.25	1.12	0.03	0.04	0.52	0.02	0.20	0.05	0.00	0.00	0.02
5	Dump truck, Cat740, 22.8-30 cy, 38.1 MT	Diesel	Off-Highway Trucks	415	16,600	2,000	8	0.08	0.46	0.12	0.00	0.00	0.08	2.77	17.01	4.54	0.09	0.18	2.77	0.07	0.43	0.11	0.00	0.00	0.07
1	Crawler dozer, Cat238	Diesel	Crawler Tractors	238	9,280	1,000	8	0.07	0.56	0.15	0.00	0.01	0.07	0.30	2.33	0.61	0.01	0.02	0.30	0.02	0.15	0.04	0.00	0.00	0.02
1	Pick-up truck, 1/2 ton, on-highway 4x4	Diesel	N/A - MOBILE	160	3,072	1,600	8	3.60	7.91	4.61	0.10	0.64	0.39	0.12	0.27	0.16	0.00	0.02	0.01	0.01	0.03	0.02	0.00	0.00	0.00
1	Pick-up trucks, 1 ton, on-highway 4x4	Diesel	N/A - MOBILE	195	3,744	1,600	8	3.60	7.91	4.61	0.10	0.64	0.39	0.15	0.33	0.19	0.00	0.03	0.02	0.01	0.03	0.02	0.00	0.00	0.00
1	Water tanker, off-highway, 5000 gal	Diesel	Off-Highway Trucks	175	12,582	2,104	8	0.10	1.94	0.17	0.00	0.01	0.10	0.32	5.98	0.52	0.01	0.02	0.32	0.04	0.79	0.07	0.00	0.00	0.04
1	Engine generator, 6.5 KW	Diesel	N/A - AP42 3.3-1	13	1,495	2,136	8	1.14	3.03	14.06	0.93	1.00	0.94	0.26	0.69	3.22	0.21	0.23	0.21	0.03	0.09	0.43	0.03	0.03	0.03
1	Engine generator, 10 KW	Gasoline	N/A - AP42 3.3-1	21	3,446	1,904	8	9.79	3.16	4.99	0.27	0.33	0.31	3.63	1.17	1.85	0.10	0.12	0.11	0.43	0.14	0.22	0.01	0.01	0.01
1	Air compressor, 160 cfm, 100 psi	Diesel	Other Construction Equipment	60	5,754	2,136	8	0.07	1.63	0.68	0.00	0.01	0.07	0.08	1.72	0.72	0.00	0.01	0.08	0.01	0.23	0.10	0.00	0.00	0.01
2	Air compressor, 250 cfm, 100 psi	Diesel	Other Construction Equipment	80	12,303	4,272	8	0.07	1.63	0.68	0.00	0.01	0.07	0.21	4.60	1.93	0.01	0.02	0.21	0.03	0.61	0.26	0.00	0.00	0.03

Key:

CO = carbon monoxide

PM10 = inhalable particulate matter

g/gal = grams per gallon

PM2.5 = fine particulate matter

g/hp-hr = grams per horsepower-hour

ROG = reactive organic gases

hp = horsepower

SO2 = sulfur dioxide

lbs/day = pounds per day

tpy = tons per day

NOx = nitrogen oxides

	VOC	CO	NOx	SO2	PM10	PM2.5
Total Daily (lb/day)	10.62	57.88	19.20	0.56	0.85	6.82
Total Annual 2020 (tpy)	0.91	4.34	1.73	0.06	0.08	0.46

Legend:

Onroad vehicle - emissions estimated by MOBILE6.2

Stationary source - emissions estimated by AP-42 for diesel engines

Table M2G. Mitigated Daily Haul Truck Emissions
Alternative 2 - Full Facilities Removal (Proposed Action)

Dam	Waste Material	Peak Daily Trips	Round Trip Distance (mi)	Road Conditions		Average		Daily Mitigated Emissions (lbs/day) - 2020												
				ADT	Average	PM10 Total	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM10 Paved Road Dust	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	PM2.5 Paved Road Dust					
J.C. Boyle (Oregon)	Earth	160	1	0.09	0.17	0.59	0.00	0.31	0.01	0.00	0.29	0.06	0.01	0.00	0.00	0.04				
	Concrete	50	3	0.09	0.16	0.56	0.00	0.29	0.01	0.00	0.27	0.05	0.01	0.00	0.00	0.04				
	Metal	10	44	0.26	0.46	1.64	0.01	0.85	0.03	0.03	0.79	0.16	0.03	0.01	0.01	0.12				
	Building Waste	10	44	0.26	0.46	1.64	0.01	0.85	0.03	0.01	0.79	0.16	0.03	0.01	0.01	0.12				
	J.C. Boyle Subtotal	230	92	0.70	1.23	4.42	0.03	2.30	0.08	0.07	2.13	0.42	0.07	0.02	0.01	0.32				
Copco 1 (California)	Concrete	50	2	0.06	0.29	0.61	0.00	0.21	0.02	0.01	0.18	0.05	0.01	0.00	0.00	0.03				
	Metal	5	62	0.19	0.91	1.90	0.01	0.65	0.05	0.02	0.55	0.14	0.05	0.01	0.01	0.08				
	Building Waste	5	62	0.19	0.91	1.90	0.01	0.65	0.05	0.02	0.55	0.14	0.05	0.01	0.01	0.08				
	Copco 1 Subtotal	60	126	0.44	2.10	4.41	0.03	1.50	0.12	0.06	1.29	0.33	0.11	0.01	0.02	0.19				
Copco 2 (California)	Earth	50	2	0.06	0.29	0.61	0.00	0.21	0.02	0.01	0.18	0.05	0.01	0.00	0.00	0.03				
	Concrete (dam)	50	2	0.06	0.29	0.61	0.00	0.21	0.02	0.01	0.18	0.05	0.01	0.00	0.00	0.03				
	Concrete (plant)	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
	Metal (dam)	5	62	0.19	0.91	1.90	0.01	0.65	0.05	0.02	0.55	0.14	0.05	0.01	0.01	0.08				
	Metal (plant)	10	56	0.34	1.64	3.43	0.02	1.17	0.09	0.04	0.30	1.00	0.26	0.08	0.01	0.15				
	Building Waste	10	56	0.34	1.64	3.43	0.02	1.17	0.09	0.04	1.00	0.26	0.08	0.01	0.01	0.15				
	Wood-stave planks	2	240	0.29	1.40	2.94	0.02	1.00	0.08	0.04	0.30	0.86	0.22	0.07	0.01	0.13				
	Copco 2 Subtotal	127	418	1.29	6.17	12.91	0.08	4.40	0.34	0.17	0.13	3.77	0.97	0.31	0.04	0.06	0.57			
Iron Gate (California)	Earth	800	2	0.98	4.68	9.79	0.06	3.34	0.26	0.13	0.10	2.86	0.74	0.24	0.03	0.04	0.43			
	Concrete	50	2	0.06	0.29	0.61	0.00	0.21	0.02	0.01	0.18	0.05	0.01	0.00	0.00	0.03				
	Metal	5	54	0.16	0.79	1.65	0.01	0.56	0.04	0.02	0.48	0.12	0.04	0.01	0.01	0.07				
	Building Waste	5	54	0.16	0.79	1.65	0.01	0.56	0.04	0.02	0.48	0.12	0.04	0.01	0.01	0.07				
	Iron Gate Subtotal	860	112	1.37	6.55	13.71	0.09	4.68	0.36	0.18	0.14	4.00	1.03	0.33	0.04	0.06	0.60			
				Grand Total	1,277	748	3.79	16.05	35.45	0.23	12.89	0.89	0.47	0.35	11.18	2.76	0.82	0.12	0.15	1.68
				California Total	1047	656	3.09	14.82	31.03	0.20	10.58	0.81	0.40	0.32	9.05	2.34	0.75	0.10	0.14	1.36
				Oregon Total	230	92	0.70	1.23	4.42	0.03	2.30	0.08	0.07	0.03	2.13	0.42	0.07	0.02	0.01	0.32
				California %	82%	88%	82%	92%	88%	85%	82%	91%	85%	91%	81%	85%	91%	85%	81%	
				Oregon %	18%	12%	18%	8%	12%	15%	18%	9%	15%	9%	19%	15%	9%	15%	19%	

Source: U.S. Department of the Interior, Bureau of Reclamation. 2011. Detailed Plan for Dam Removal - Klamath River Dams. Klamath Hydroelectric Project, FERC License No. 2082, Oregon - California. June 15.

Key:

CO = carbon monoxide

Ibs/day = pounds per day

mi = miles

NOx = nitrogen oxides

PM10 = inhalable particulate matter

PM2.5 = fine particulate matter

ROG = reactive organic gases

SOx = sulfur oxides

Table M2H. Mitigated Annual Haul Truck Emissions
Alternative 2 - Full Facilities Removal (Proposed Action)

Dam	Waste Material	Annual Trips	Round Trip Distance (mi)	Road Conditions		Annual Mitigated Emissions (tons per year) - 2020									
				ADT	Average	PM10 Total	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM10 Paved Road Dust	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	PM2.5 Paved Road Dust
J.C. Boyle	Earth	8,500	1	0.00	0.00	0.02	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00
	Concrete	2,600	3	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00
	Metal	430	44	0.01	0.01	0.04	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.00	0.00
	Building Waste	200	44	0.00	0.00	0.02	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00
	J.C. Boyle Subtotal	11,730	92	0.01	0.02	0.08	0.00	0.04	0.00	0.00	0.04	0.01	0.00	0.00	0.01
Copco 1 (California)	Concrete	4,000	2	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
	Metal	170	62	0.00	0.02	0.03	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
	Building Waste	30	62	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Copco 1 Subtotal	4,200	126	0.01	0.03	0.06	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00
Copco 2 (California)	Earth	90	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Concrete (dam)	400	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Concrete (plant)	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Metal (dam)	45	62	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Metal (plant)	145	56	0.00	0.01	0.02	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00
	Building Waste	60	56	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Wood-stave planks	45	240	0.00	0.02	0.03	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00
	Copco 2 Subtotal	785	418	0.01	0.04	0.08	0.00	0.03	0.00	0.00	0.02	0.01	0.00	0.00	0.00
Iron Gate (California)	Earth	60,000	2	0.04	0.18	0.37	0.00	0.13	0.01	0.00	0.11	0.03	0.01	0.00	0.02
	Concrete	750	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Metal	130	54	0.00	0.01	0.02	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00
	Building Waste	40	54	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Iron Gate Subtotal	60,920	112	0.04	0.19	0.40	0.00	0.14	0.01	0.01	0.12	0.03	0.01	0.00	0.02
	Grand Total	77,635	748	0.07	0.28	0.62	0.00	0.21	0.02	0.01	0.01	0.20	0.05	0.01	0.00
	California Total	65,905	656	0.05	0.26	0.54	0.00	0.17	0.01	0.01	0.16	0.04	0.01	0.00	0.02
	Oregon Total	11,730	92	0.01	0.02	0.08	0.00	0.04	0.00	0.00	0.04	0.01	0.00	0.00	0.01
	California %	85%	88%	81%	92%	87%	85%	80%	91%	85%	90%	80%	84%	91%	80%
	Oregon %	15%	12%	19%	8%	13%	15%	20%	9%	15%	10%	20%	16%	9%	20%

Source: U.S. Department of the Interior, Bureau of Reclamation. 2011. Detailed Plan for Dam Removal - Klamath River Dams. Klamath Hydroelectric Project, FERC License No. 2082, Oregon - California. June 15.

Key:

CO = carbon monoxide

PM2.5 = fine particulate matter

mi = miles

ROG = reactive organic gases

NOx = nitrogen oxides

SOx = sulfur oxides

PM10 = inhalable particulate matter

Table M3A. Summary of Daily Mitigated Off-Road Construction Emissions (Alternative 3)

Location	VOC	CO	NOx	SO2	PM10	PM2.5
Iron Gate	36	225	63	2	3	3
Copco 1	18	130	51	1	2	2
Copco 2	13	51	29	1	1	1
J.C. Boyle	10	53	18	1	1	1
Total	77	458	161	4	7	7
California %	87%	88%	89%	87%	89%	89%
Oregon %	13%	12%	11%	13%	11%	11%

Key:

CO = carbon monoxide

PM2.5 = fine particulate matter

NOx = nitrogen oxides

SO2 = sulfur dioxide

PM10 = inhalable particulate matter

VOC = volatile organic compounds

Table M3B. Summary of Annual Mitigated Off-Road Construction Emissions (Alternative 3)

Location	VOC	CO	NOx	SO2	PM10	PM2.5
Iron Gate	1.5	9.3	2.6	0.1	0.1	0.1
Copco 1	0.7	5.1	2.0	0.0	0.1	0.1
Copco 2	0.7	2.1	1.7	0.1	0.1	0.1
J.C. Boyle	0.8	2.9	1.3	0.1	0.1	0.1
Total	3.7	19.4	7.6	0.2	0.4	0.3
California %	79%	85%	83%	77%	81%	81%
Oregon %	21%	15%	17%	23%	19%	19%

Key:

CO = carbon monoxide

PM2.5 = fine particulate matter

NOx = nitrogen oxides

SO2 = sulfur dioxide

PM10 = inhalable particulate matter

VOC = volatile organic compounds

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Table M3C. Mitigated Off-Road Construction Equipment Emissions for Iron Gate Dam (Alternative 3)

2020 Emission Factors (g/hp-hr or g/gal for on-highway sources)												Peak Daily Emissions (lbs/day)						2020 Emissions (tons per year)							
Quantity	Equipment Description	OFFROAD Category	Rating (hp)	Fuel Type	ROG	CO	NOx	SOx	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5			
1	Crane - crawler, 150-200 ton	Cranes	335	Diesel	0.04	0.29	0.08	0.00	0.00	0.00	0.39	3.03	0.82	0.02	0.03	0.03	0.02	0.13	0.03	0.00	0.00	0.00	0.00		
1	Crane - rough terrain hydraulic, 50 ton	Cranes	130	Diesel	0.05	1.11	0.10	0.00	0.00	0.00	0.19	4.46	0.40	0.01	0.02	0.01	0.01	0.19	0.02	0.00	0.00	0.00	0.00		
4	Excavator - 180,000-240,000 lb, Hitachi ZX870 to EX120	Excavators	646	Diesel	0.06	0.43	0.12	0.00	0.00	0.00	5.02	34.60	9.30	0.19	0.35	0.32	0.21	1.44	0.39	0.01	0.01	0.01	0.01		
20	Dump truck - articulated, 35 ton, Cat 735	Off-Highway Trucks	435	Diesel	0.08	0.46	0.12	0.00	0.00	0.00	20.31	124.77	33.29	0.65	1.30	1.19	0.84	5.18	1.38	0.03	0.05	0.05	0.05		
2	Dozer - D8	Rubber Tired Dozers	347	Diesel	0.07	0.45	0.12	0.00	0.00	0.00	1.48	9.59	2.57	0.05	0.10	0.09	0.06	0.40	0.11	0.00	0.00	0.00	0.00		
1	Pick-up truck, 1/2 ton, on-highway 4x4	N/A - Onroad	191	Gasoline	2.59	28.49	3.08	0.09	0.83	0.57	0.19	2.11	0.23	0.01	0.06	0.04	0.01	0.09	0.01	0.00	0.00	0.00	0.00		
1	Pick-up truck, 1/2 ton, on-highway 4x4	N/A - Onroad	160	Diesel	1.64	15.84	44.50	0.10	1.61	1.14	0.06	0.62	1.74	0.00	0.06	0.04	0.00	0.03	0.07	0.00	0.00	0.00	0.00		
1	Pick-up truck, 1 ton, on-highway 4x4	N/A - Onroad	195	Diesel	1.64	15.84	44.50	0.10	1.61	1.14	0.08	0.76	2.12	0.00	0.08	0.05	0.00	0.03	0.09	0.00	0.00	0.00	0.00		
1	Water tanker, off-highway, 5000 gal	Off-Highway Trucks	175	Diesel	0.10	1.94	0.17	0.00	0.01	0.01	0.56	10.47	0.91	0.02	0.04	0.04	0.02	0.43	0.04	0.00	0.00	0.00	0.00		
1	Engine generator, 6.5 KW	N/A - Offroad diesel engine	13	Diesel	1.14	3.03	14.06	0.93	1.00	0.97	0.46	1.22	5.64	0.37	0.40	0.39	0.02	0.05	0.23	0.02	0.02	0.02	0.02	0.02	
1	Engine generator, 10 KW	N/A - Offroad diesel engine	21	Gasoline	9.79	3.16	4.99	0.27	0.33	0.32	6.35	2.05	3.23	0.17	0.21	0.21	0.26	0.08	0.13	0.01	0.01	0.01	0.01	0.01	0.01
4	Submersible pump, 4" dia, 230 volt	Other Construction Equipment	175	Diesel	0.05	1.44	0.13	0.00	0.00	0.00	1.10	31.08	2.84	0.07	0.10	0.10	0.05	1.29	0.12	0.00	0.00	0.00	0.00	0.00	0.00

Key:

CO = carbon monoxide

g/gal = grams per gallon

g/hp-hr = grams per horsepower-hour

hp = horsepower

lbs/day = pounds per day

NOx = nitrogen oxides

PM10 = inhalable particulate matter

PM2.5 = fine particulate matter

ROG = reactive organic gases

SO2 = sulfur dioxide

tpy = tons per day

	ROG	CO	NOx	SO2	PM10	PM2.5
Total Daily (lb/day)	36.18	224.75	63.11	1.57	2.75	2.52
Total Annual 2020 (tpy)	1.50	9.33	2.62	0.07	0.11	0.10

Legend:

Onroad vehicle - emissions estimated by EMFAC2007

Stationary source - emissions estimated by AP-42 for diesel engines

Table M3D. Mitigated Off-Road Construction Equipment Emissions for Copco 1 (Alternative 3)

Maximum Daily Work Hours

8

Dam Removal Duration

Start Date 12/30/2019

End Date 4/15/2020

78 (5 days/week)

Quantity	Primary	Secondary	Equipment Description	Rating (hp)	Fuel Type	2020 Emission Factors (g/hp-hr or g/gal for on-highway sources)						Peak Daily Emissions (lbs/day)						2020 Emissions (tons per year)						
						ROG	CO	NOx	SOx	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5	
1	1	1	Crane - crawler, 150-200 ton	335	Diesel	0.04	0.29	0.08	0.00	0.00	0.00	0.44	3.46	0.94	0.02	0.03	0.03	0.02	0.13	0.04	0.00	0.00	0.00	0.00
1	1	1	Crane - rough terrain hydraulic, 50 ton	130	Diesel	0.05	1.11	0.10	0.00	0.00	0.00	0.22	5.10	0.46	0.01	0.02	0.02	0.01	0.20	0.02	0.00	0.00	0.00	0.00
1	0		Excavator - hydraulic ram	321	Diesel	0.06	0.39	0.10	0.00	0.00	0.00	0.32	2.19	0.59	0.01	0.02	0.02	0.01	0.09	0.02	0.00	0.00	0.00	0.00
1	1		Excavator - 45,000-60,000 lb, Komatsu 220-350	219.5	Diesel	0.08	0.54	0.14	0.00	0.01	0.00	0.59	4.21	1.09	0.03	0.04	0.04	0.02	0.16	0.04	0.00	0.00	0.00	0.00
3	0		Excavator - <20,000 lb	168	Diesel	0.08	1.62	0.14	0.00	0.01	0.01	0.68	14.36	1.27	0.03	0.05	0.05	0.03	0.56	0.05	0.00	0.00	0.00	0.00
1	0		Loader - WA250 IT	138	Diesel	0.06	1.47	0.13	0.00	0.01	0.00	0.15	3.58	0.32	0.01	0.01	0.01	0.01	0.14	0.01	0.00	0.00	0.00	0.00
1	0		Loader - WA450	273	Diesel	0.05	0.38	0.10	0.00	0.00	0.00	0.23	1.82	0.49	0.01	0.02	0.02	0.01	0.07	0.02	0.00	0.00	0.00	0.00
2	0		Dump truck - articulated, 30 ton, Cat 730	325	Diesel	0.08	0.46	0.12	0.00	0.00	0.00	0.87	5.33	1.42	0.03	0.06	0.05	0.03	0.21	0.06	0.00	0.00	0.00	0.00
1	1		Pick-up truck, 1/2 ton, on-highway 4x4		Gasoline	2.59	28.49	3.08	0.09	0.83	0.57	0.66	7.32	0.79	0.02	0.21	0.15	0.03	0.29	0.03	0.00	0.01	0.01	
1	1		Pick-up truck, 1/2 ton, on-highway 4x4		Diesel	1.64	15.84	44.50	0.10	1.61	1.14	0.22	2.15	6.05	0.01	0.22	0.16	0.01	0.08	0.24	0.00	0.01	0.01	
1	1		Pick-up truck, 1 ton, on-highway 4x4		Diesel	1.64	15.84	44.50	0.10	1.61	1.14	0.27	2.62	7.37	0.02	0.27	0.19	0.01	0.10	0.29	0.00	0.01	0.01	
1	1		Pick-up truck, 3/4 ton, on-highway 4x4		Gasoline	2.59	28.49	3.08	0.09	0.83	0.57	0.99	10.93	1.18	0.03	0.32	0.22	0.04	0.43	0.05	0.00	0.01	0.01	
1	1		Water tanker, off-highway, 5000 gal	175	Diesel	0.10	1.94	0.17	0.00	0.01	0.01	0.63	11.97	1.04	0.02	0.04	0.04	0.02	0.47	0.04	0.00	0.00	0.00	
1	1		Engine generator, 6.5 KW	13	Diesel	1.14	3.03	14.06	0.93	1.00	0.97	0.52	1.39	6.45	0.43	0.46	0.45	0.02	0.05	0.25	0.02	0.02	0.02	
1	1		Engine generator, 10 KW	21	Gasoline	9.79	3.16	4.99	0.27	0.33	0.32	7.25	2.34	3.70	0.20	0.24	0.24	0.28	0.09	0.14	0.01	0.01	0.01	
4	4		Air compressor, 850-1200 cfm	106	Diesel	0.07	1.63	0.68	0.00	0.01	0.01	1.09	24.37	10.22	0.05	0.08	0.08	0.04	0.95	0.40	0.00	0.00	0.00	
4	4		Drills - air/hydraulic track, jackleg, or sinker	291	Diesel	0.06	0.50	0.14	0.00	0.00	0.00	2.35	20.38	5.55	0.11	0.20	0.18	0.09	0.79	0.22	0.00	0.01	0.01	
2	2		Submersible pump, 4" dia, 230 volt	53	Diesel	0.07	1.63	0.68	0.00	0.01	0.01	0.27	6.09	2.55	0.01	0.02	0.02	0.01	0.24	0.10	0.00	0.00	0.00	

Key:

CO = carbon monoxide

g/gal = grams per gallon

g/hp-hr = grams per horsepower-hour

hp = horsepower

lbs/day = pounds per day

NOx = nitrogen oxides

PM10 = inhalable particulate matter

PM2.5 = fine particulate matter

ROG = reactive organic gases

SO2 = sulfur dioxide

tpy = tons per day

	ROG	CO	NOx	SO2	PM10	PM2.5
Total Daily (lb/day)	17.76	129.61	51.47	1.05	2.32	1.94
Total Annual 2020 (tpy)	0.69	5.05	2.01	0.04	0.09	0.08

Legend:

Onroad vehicle - emissions estimated by EMFAC2007

Stationary source - emissions estimated by AP-42 for diesel engines

Table M3E. Mitigated Off-Road Construction Equipment Emissions for Copco 2 (Alternative 3)

Quantity	Equipment Description	OFFROAD Category	Rating (hp)	Fuel Type	Fuel Amount (gal)	Total Hours	Peak Daily Hours	2020 Emission Factors (g/hp-hr or g/gal for on-highway sources)						Peak Daily Emissions (lbs/day)						2020 Emissions (tons per year)								
								ROG	CO	NOx	SOx	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5			
1	Lattice boom crane, Manitowoc Crawler, 150T(US), 160'boom	Cranes	335	Diesel	9,989	904	8	0.04	0.29	0.08	0.00	0.00	0.00	0.22	1.73	0.47	0.01	0.02	0.02	0.01	0.10	0.03	0.00	0.00	0.00	0.00		
2	Hydraulic yard crane, Grove 4x4x4, 13.6MT, 52' boom	Cranes	130	Diesel	7,749	1,904	8	0.05	1.11	0.10	0.00	0.00	0.00	0.22	5.10	0.46	0.01	0.02	0.02	0.01	0.30	0.03	0.00	0.00	0.00	0.00		
2	Hydraulic excavator, 2.5 cy, long reach, Cat H120 Hoe Ram (3000 flb)	Excavators	321	Diesel	16,200	1,200	8	0.06	0.39	0.10	0.00	0.00	0.00	0.64	4.39	1.18	0.02	0.04	0.04	0.02	0.16	0.04	0.00	0.00	0.00	0.00		
2	Hydraulic excavator, 2.5 cy	Excavators	321	Diesel	24,372	1,808	8	0.06	0.39	0.10	0.00	0.00	0.00	0.64	4.39	1.18	0.02	0.04	0.04	0.04	0.25	0.07	0.00	0.00	0.00	0.00		
2	Articulated wheel loader, Cat966, 5.0 cy	Rubber Tired Loaders	246	Diesel	17,361	2,192	8	0.06	0.49	0.13	0.00	0.00	0.00	0.52	4.25	1.12	0.03	0.04	0.04	0.04	0.29	0.08	0.00	0.00	0.00	0.00		
1	Articulated wheel loader, Cat988, 8.2 cy	Rubber Tired Loaders	475	Diesel	1,946	128	8	0.05	0.38	0.10	0.00	0.00	0.00	0.39	3.17	0.86	0.02	0.03	0.03	0.00	0.03	0.01	0.00	0.00	0.00	0.00	0.00	
2	Dump truck, Cat740, 22.8-30 cy, 38.1 MT	Off-Highway Trucks	415	Diesel	7,702	928	8	0.08	0.46	0.12	0.00	0.00	0.00	1.11	6.80	1.81	0.04	0.07	0.07	0.03	0.20	0.05	0.00	0.00	0.00	0.00	0.00	
1	Crawler dozer, Cat238	Crawler Tractors	238	Diesel	4,677	504	8	0.07	0.56	0.15	0.00	0.01	0.00	0.30	2.33	0.61	0.01	0.02	0.02	0.01	0.07	0.02	0.00	0.00	0.00	0.00	0.00	
2	Pick-up truck, 1/2 ton, on-highway 4x4	N/A - Emfac	160	Diesel	4,209	2,192	8	1.64	15.84	44.50	0.10	1.61	1.14	0.11	1.07	3.01	0.01	0.11	0.08	0.01	0.07	0.21	0.00	0.01	0.01	0.00	0.01	0.00
1	Pick-up truck, 1 ton, on-highway 4x4	N/A - Emfac	195	Diesel	2,565	1,096	8	1.64	15.84	44.50	0.10	1.61	1.14	0.07	0.65	1.84	0.00	0.07	0.05	0.00	0.04	0.13	0.00	0.00	0.00	0.00	0.00	0.00
1	Water tanker, off-highway, 5000 gal	Off-Highway Trucks	175	Diesel	191	32	8	0.10	1.94	0.17	0.00	0.01	0.01	0.32	5.98	0.52	0.01	0.02	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
3	Engine generator, 6.5 KW	N/A - AP42 3.3-1	13	Diesel	2,302	3,288	8	1.14	3.03	14.06	0.93	1.00	0.97	0.78	2.08	9.67	0.64	0.69	0.67	0.05	0.14	0.66	0.04	0.05	0.05	0.00	0.00	0.00
2	Engine generator, 10 KW	N/A - AP42 3.3-1	21	Gasoline	3,968	2,192	8	9.79	3.16	4.99	0.27	0.33	0.32	7.25	2.34	3.70	0.20	0.24	0.24	0.50	0.16	0.25	0.01	0.02	0.02	0.02	0.00	0.00
1	Air compressor, 160 cfm, 100 psi	Other Construction Equipment	60	Diesel	1,572	728	8	0.07	1.63	0.68	0.00	0.01	0.01	0.08	1.72	0.72	0.00	0.01	0.01	0.00	0.08	0.03	0.00	0.00	0.00	0.00	0.00	0.00
2	Air compressor, 250 cfm, 100 psi	Other Construction Equipment	80	Diesel	4,193	1,456	8	0.07	1.63	0.68	0.00	0.01	0.01	0.21	4.60	1.93	0.01	0.02	0.01	0.01	0.21	0.09	0.00	0.00	0.00	0.00	0.00	0.00

Key:

CO = carbon monoxide

PM10 = inhalable particulate matter

g/gal = grams per gallon

PM2.5 = fine particulate matter

g/hp-hr = grams per horsepower-hour

ROG = reactive organic gases

hp = horsepower

SO2 = sulfur dioxide

Ibs/day = pounds per day

tpy = tons per day

Legend:

Onroad vehicle - emissions estimated by EMFAC2007
Stationary source - emissions estimated by AP-42 for diesel engines

	ROG	CO	NOx	SO2	PM10	PM2.5
Total Daily (lb/day)	12.85	50.61	29.08	1.03	1.44	1.34
Total Annual 2020 (tpy)	0.74	2.12	1.69	0.07	0.09	0.08

Table M3F. Mitigated Off-Road Construction Equipment Emissions for JC Boyle (Alternative 3)

Maximum Daily Work Hours										8 hours																
Quantity	Equipment Description	Fuel Type	OFFROAD Category	Rating (hp)	Fuel Amount (gal)	Total Hours	Hours	Peak Daily 2020 Emission Factors (g/hp-hr or g/gal for on-highway sources)						Peak Daily Emissions (lbs/day)						2020 Emissions (tons per year)						
								VOC	CO	NOx	SOx	PM10	PM2.5	VOC	CO	NOx	SO2	PM10	PM2.5	VOC	CO	NOx	SO2	PM10	PM2.5	
1	Lattice boom crane, Manitowoc Crawler, 150T(US), 160'boom	Diesel	Cranes	335	17,680	1,600	8	0.04	0.29	0.08	0.00	0.00	0.00	0.22	1.73	0.47	0.01	0.02	0.02	0.02	0.17	0.05	0.00	0.00	0.00	0.00
2	Hydraulic yard crane, Grove 4x4x4, 52' boom, 13.6MT	Diesel	Cranes	130	3,256	800	8	0.05	1.11	0.10	0.00	0.00	0.00	0.22	5.10	0.46	0.01	0.02	0.02	0.01	0.13	0.01	0.00	0.00	0.00	0.00
1	Hydraulic excavator, 2.5 cy, long reach, Cat H120 Hoe Ram (3000)	Diesel	Excavators	321	9,612	712	8	0.06	0.39	0.10	0.00	0.00	0.00	0.32	2.19	0.59	0.01	0.02	0.02	0.01	0.10	0.03	0.00	0.00	0.00	0.00
2	Hydraulic excavator, 2.5 cy	Diesel	Excavators	321	51,332	3,808	8	0.06	0.39	0.10	0.00	0.00	0.00	0.64	4.39	1.18	0.02	0.04	0.04	0.08	0.52	0.14	0.00	0.01	0.00	0.00
1	Hydraulic excavator, 6 cy	Diesel	Excavators	513	11,014	488	8	0.06	0.43	0.12	0.00	0.00	0.00	0.57	3.92	1.06	0.02	0.04	0.04	0.02	0.12	0.03	0.00	0.00	0.00	0.00
2	Articulated wheel loader, Cat966, 5.0 cy	Diesel	Rubber Tired Loaders	246	11,912	1,504	8	0.06	0.49	0.13	0.00	0.00	0.00	0.52	4.25	1.12	0.03	0.04	0.04	0.02	0.20	0.05	0.00	0.00	0.00	0.00
5	Dump truck, Cat740, 22.8-30 cy, 38.1 MT	Diesel	Off-Highway Trucks	415	8,300	1,000	8	0.08	0.46	0.12	0.00	0.00	0.00	2.77	17.01	4.54	0.09	0.18	0.17	0.03	0.21	0.06	0.00	0.00	0.00	0.00
1	Crawler dozer, Cat238	Diesel	Crawler Tractors	238	9,280	1,000	8	0.07	0.56	0.15	0.00	0.01	0.01	0.30	2.33	0.61	0.01	0.02	0.02	0.02	0.15	0.04	0.00	0.00	0.00	0.00
1	Pick-up truck, 1/2 ton, on-highway 4x4	Diesel	N/A - MOBILE	160	3,072	1,600	8	3.60	7.91	4.61	0.10	0.64	0.39	0.12	0.27	0.16	0.00	0.02	0.01	0.01	0.03	0.02	0.00	0.00	0.00	0.00
1	Pick-up trucks, 1 ton, on-highway 4x4	Diesel	N/A - MOBILE	195	3,744	1,600	8	3.60	7.91	4.61	0.10	0.64	0.39	0.15	0.33	0.19	0.00	0.03	0.02	0.01	0.03	0.02	0.00	0.00	0.00	0.00
1	Water tanker, off-highway, 5000 gal	Diesel	Off-Highway Trucks	175	12,582	2,104	8	0.10	1.94	0.17	0.00	0.01	0.01	0.32	5.98	0.52	0.01	0.02	0.02	0.04	0.79	0.07	0.00	0.00	0.00	0.00
1	Engine generator, 6.5 KW	Diesel	N/A - AP42 3.3-1	13	1,495	2,136	8	1.14	3.03	14.06	0.93	1.00	0.94	0.26	0.69	3.22	0.21	0.23	0.21	0.03	0.09	0.43	0.03	0.03	0.03	
1	Engine generator, 10 KW	Gasoline	N/A - AP42 3.3-1	21	3,446	1,904	8	9.79	3.16	4.99	0.27	0.33	0.31	3.63	1.17	1.85	0.10	0.12	0.11	0.43	0.14	0.22	0.01	0.01	0.01	
1	Air compressor, 160 cfm, 100 psi	Diesel	Other Construction Equipment	60	2,888	1,072	8	0.07	1.63	0.68	0.00	0.01	0.01	0.08	1.72	0.72	0.00	0.01	0.01	0.01	0.12	0.05	0.00	0.00	0.00	0.00
1	Air compressor, 250 cfm, 100 psi	Diesel	Other Construction Equipment	80	3,087	1,072	8	0.07	1.63	0.68	0.00	0.01	0.01	0.10	2.30	0.96	0.00	0.01	0.01	0.01	0.15	0.06	0.00	0.00	0.00	0.00

Key:

CO = carbon monoxide

PM10 = inhalable particulate matter

g/gal = grams per gallon

PM2.5 = fine particulate matter

g/hp-hr = grams per horsepower-hour

ROG = reactive organic gases

hp = horsepower

SO2 = sulfur dioxide

lbs/day = pounds per day

tpy = tons per day

NOx = nitrogen oxides

Legend:

Onroad vehicle - emissions estimated by MOBILE6.2

Stationary source - emissions estimated by AP-42 for diesel engines

	VOC	CO	NOx	SO2	PM10	PM2.5
Total Daily (lb/day)	10.20	53.39	17.64	0.55	0.82	0.75
Total Annual 2020 (tpy)	0.76	2.95	1.27	0.05	0.07	0.06

Table M3G. Mitigated Daily Haul Truck Emissions
Alternative 3 - Partial Facilities Removal

Dam	Waste Material	Peak Daily Trips	Round Trip Distance (mi)	Road Conditions		Average		Daily Mitigated Emissions (lbs/day) - 2020												
				ADT	Average	PM10 Total	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM10 Paved Road Dust	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	PM2.5 Paved Road Dust					
J.C. Boyle (Oregon)	Earth	160	1	0.09	0.17	0.59	0.00	0.31	0.01	0.01	0.29	0.06	0.01	0.00	0.00	0.04				
	Concrete	50	3	0.09	0.16	0.56	0.00	0.29	0.01	0.01	0.27	0.05	0.01	0.00	0.00	0.04				
	Metal	10	44	0.26	0.46	1.64	0.01	0.85	0.03	0.03	0.79	0.16	0.03	0.01	0.01	0.12				
J.C. Boyle Subtotal				220	48	0.44	0.78	2.79	0.02	1.45	0.05	0.04	0.27	0.05	0.01	0.20				
Copco 1 (California)	Concrete	50	2	0.06	0.29	0.61	0.00	0.21	0.02	0.01	0.18	0.05	0.01	0.00	0.00	0.03				
	Metal	5	62	0.19	0.91	1.90	0.01	0.65	0.05	0.02	0.55	0.14	0.05	0.01	0.01	0.08				
	Copco 1 Subtotal		55	64	0.25	1.20	2.51	0.02	0.86	0.07	0.03	0.73	0.19	0.06	0.01	0.11				
Copco 2 (California)	Earth	0	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00				
	Concrete	50	2	0.06	0.29	0.61	0.00	0.21	0.02	0.01	0.18	0.05	0.01	0.00	0.00	0.03				
	Metal	15	58	0.53	2.54	5.32	0.03	1.82	0.14	0.07	0.55	0.40	0.13	0.02	0.02	0.23				
	Wood-stave planks	2	240	0.29	1.40	2.94	0.02	1.00	0.08	0.04	0.86	0.22	0.07	0.01	0.01	0.13				
Copco 2 Subtotal				67	302	0.88	4.24	8.87	0.06	3.03	0.23	0.12	0.59	0.67	0.21	0.04	0.39			
Iron Gate (California)	Earth	800	2	0.98	4.68	9.79	0.06	3.34	0.26	0.13	0.10	2.86	0.74	0.24	0.03	0.43				
	Concrete	50	2	0.06	0.29	0.61	0.00	0.21	0.02	0.01	0.18	0.05	0.01	0.00	0.00	0.03				
	Metal	5	54	0.16	0.79	1.65	0.01	0.56	0.04	0.02	0.48	0.12	0.04	0.01	0.01	0.07				
Iron Gate Subtotal				855	58	1.20	5.76	12.06	0.08	4.11	0.32	0.16	0.52	0.91	0.29	0.04	0.53			
				Grand Total	1,197	472	2.77	11.97	26.22	0.17	9.45	0.66	0.35	0.26	8.18	2.03	0.61	0.09	0.11	1.23
		California Total	977	424	2.34	11.19	23.44	0.15	7.99	0.61	0.30	0.24	6.84	1.77	0.56	0.08	0.10	1.03		
		Oregon Total	220	48	0.44	0.78	2.79	0.02	1.45	0.05	0.04	0.02	1.34	0.27	0.05	0.01	0.01	0.20		
		California %	82%	90%	84%	94%	89%	88%	85%	93%	87%	92%	84%	87%	93%	87%	92%	84%		
		Oregon %	18%	10%	16%	6%	11%	12%	15%	7%	13%	8%	16%	13%	7%	13%	8%	16%		

Source: U.S. Department of the Interior, Bureau of Reclamation. 2011. Detailed Plan for Dam Removal - Klamath River Dams. Klamath Hydroelectric Project, FERC License No. 2082, Oregon - California. June 15.

Notes:

1. Peak daily trips assumed to be the same as Alternative 2 unless a material (e.g., earth at Copco 2) is not disposed during Alternative 3.
2. Waste disposal quantities for building waste not provided for Alternative 3; therefore, buildings were not assumed to be demolished during this alternative.

Key:

CO = carbon monoxide

lbs/day = pounds per day

mi = miles

NOx = nitrogen oxides

PM10 = inhalable particulate matter

PM2.5 = fine particulate matter

ROG = reactive organic gases

SOx = sulfur oxides

Table M3H. Mitigated Annual Haul Truck Emissions
Alternative 3 - Partial Facilities Removal

Dam	Waste Material	Annual Trips	Round Trip Distance (mi)	Road Conditions		Average		Annual Mitigated Emissions (tons per year) - 2020							
				ADT	Average	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	PM2.5 Paved Road Dust	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	PM2.5 Paved Road Dust
J.C. Boyle	Earth	8,500	1	0.00	0.00	0.02	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00
	Concrete	1,300	3	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Metal	255	44	0.00	0.01	0.02	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00
	J.C. Boyle Subtotal	10,055	48	0.01	0.01	0.04	0.00	0.02	0.00	0.00	0.02	0.00	0.00	0.00	0.00
Copco 1 (California)	Concrete	3,710	2	0.00	0.01	0.02	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00
	Metal	65	62	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Copco 1 Subtotal	3,775	64	0.00	0.02	0.04	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Copco 2 (California)	Earth	0	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Concrete	150	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Metal	50	58	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Wood-stave planks	45	240	0.00	0.02	0.03	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00
	Copco 2 Subtotal	245	302	0.00	0.02	0.04	0.00	0.01	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Iron Gate (California)	Earth	60,000	2	0.04	0.18	0.37	0.00	0.13	0.01	0.00	0.11	0.03	0.01	0.00	0.02
	Concrete	500	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Metal	75	54	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Iron Gate Subtotal	60,575	58	0.04	0.18	0.38	0.00	0.13	0.01	0.00	0.11	0.03	0.01	0.00	0.02
Grand Total		74,650	472	0.05	0.23	0.50	0.00	0.18	0.01	0.01	0.01	0.16	0.04	0.01	0.00
	California Total	64,595	424	0.05	0.22	0.46	0.00	0.16	0.01	0.01	0.00	0.13	0.03	0.01	0.00
	Oregon Total	10,055	48	0.01	0.01	0.04	0.00	0.02	0.00	0.00	0.00	0.02	0.00	0.00	0.00
	California %	87%	90%	87%	95%	91%	90%	87%	94%	90%	94%	86%	89%	94%	94%
	Oregon %	13%	10%	13%	5%	9%	10%	13%	6%	10%	6%	14%	11%	6%	10%

Source: U.S. Department of the Interior, Bureau of Reclamation. 2011. Detailed Plan for Dam Removal - Klamath River Dams. Klamath Hydroelectric Project, FERC License No. 2082, Oregon - California. June 15.

Note:

Annual trips estimated from ratio of the quantity of waste disposed during Alternative 3 as compared to Alternative 2.

Key:

CO = carbon monoxide

PM2.5 = fine particulate matter

mi = miles

ROG = reactive organic gases

NOx = nitrogen oxides

SOx = sulfur oxides

PM10 = inhalable particulate matter

Table M4A. Summary of Daily Mitigated Off-Road Construction Emissions (Alternative 5)

Location	VOC	CO	NOx	SO2	PM10	PM2.5
Iron Gate	36	225	63	2	3	3
Copco 1	18	130	51	1	2	2
Copco 2	6	48	26	0	1	1
J.C. Boyle	6	45	16	0	1	1
Total	66	447	157	3	7	6
California %	91%	90%	90%	87%	89%	90%
Oregon %	9%	10%	10%	13%	11%	10%

Key:

CO = carbon monoxide

PM2.5 = fine particulate matter

NOx = nitrogen oxides

SO2 = sulfur dioxide

PM10 = inhalable particulate matter

VOC = volatile organic compounds

Table M4B. Summary of Annual Mitigated Off-Road Construction Emissions (Alternative 5)

Location	VOC	CO	NOx	SO2	PM10	PM2.5
Iron Gate	1.5	9.3	2.6	0.1	0.1	0.1
Copco 1	0.7	5.1	2.0	0.0	0.1	0.1
Copco 2	0.1	0.7	0.4	0.0	0.0	0.0
J.C. Boyle	0.2	1.4	0.6	0.0	0.0	0.0
Total	2.5	16.4	5.6	0.1	0.3	0.2
California %	91%	92%	90%	86%	88%	88%
Oregon %	9%	8%	10%	14%	12%	12%

Key:

CO = carbon monoxide

PM2.5 = fine particulate matter

NOx = nitrogen oxides

SO2 = sulfur dioxide

PM10 = inhalable particulate matter

VOC = volatile organic compounds

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Table M4C. Mitigated Off-Road Construction Equipment Emissions for Iron Gate Dam (Alternative 5)

Mitigated Off-Road Construction Equipment Emissions for Iron Gate Dam (Alternative 5)																						
2020 Emission Factors (g/hp-hr or g/gal for on-highway sources)																						
Quantity	Equipment Description	OFFROAD Category	Rating (hp)	Fuel Type	ROG	CO	NOx	SOx	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5
1	Crane - crawler, 150-200 ton	Cranes	335	Diesel	0.04	0.29	0.08	0.00	0.00	0.00	0.39	3.03	0.82	0.02	0.03	0.03	0.02	0.13	0.03	0.00	0.00	0.00
1	Crane - rough terrain hydraulic, 50 ton	Cranes	130	Diesel	0.05	1.11	0.10	0.00	0.00	0.00	0.19	4.46	0.40	0.01	0.02	0.01	0.01	0.19	0.02	0.00	0.00	0.00
4	Excavator - 180,000-240,000 lb, Hitachi ZX870 to EX1200	Excavators	646	Diesel	0.06	0.43	0.12	0.00	0.00	0.00	5.02	34.60	9.30	0.19	0.35	0.32	0.21	1.44	0.39	0.01	0.01	0.01
20	Dump truck - articulated, 35 ton, Cat 735	Off-Highway Trucks	435	Diesel	0.08	0.46	0.12	0.00	0.00	0.00	20.31	124.77	33.29	0.65	1.30	1.19	0.84	5.18	1.38	0.03	0.05	0.05
2	Dozer - D8	Rubber Tired Dozers	347	Diesel	0.07	0.45	0.12	0.00	0.00	0.00	1.48	9.59	2.57	0.05	0.10	0.09	0.06	0.40	0.11	0.00	0.00	0.00
1	Pick-up truck, 1/2 ton, on-highway 4x4	N/A - Onroad	191	Gasoline	2.59	28.49	3.08	0.09	0.83	0.57	0.19	2.11	0.23	0.01	0.06	0.04	0.01	0.09	0.01	0.00	0.00	0.00
1	Pick-up truck, 1/2 ton, on-highway 4x4	N/A - Onroad	160	Diesel	1.64	15.84	44.50	0.10	1.61	1.14	0.06	0.62	1.74	0.00	0.06	0.04	0.00	0.03	0.07	0.00	0.00	0.00
1	Pick-up truck, 1 ton, on-highway 4x4	N/A - Onroad	195	Diesel	1.64	15.84	44.50	0.10	1.61	1.14	0.08	0.76	2.12	0.00	0.08	0.05	0.00	0.03	0.09	0.00	0.00	0.00
1	Water tanker, off-highway, 5000 gal	Off-Highway Trucks	175	Diesel	0.10	1.94	0.17	0.00	0.01	0.01	0.56	10.47	0.91	0.02	0.04	0.04	0.02	0.43	0.04	0.00	0.00	0.00
1	Engine generator, 6.5 KW	N/A - Offroad diesel engine	13	Diesel	1.14	3.03	14.06	0.93	1.00	0.97	0.46	1.22	5.64	0.37	0.40	0.39	0.02	0.05	0.23	0.02	0.02	0.02
1	Engine generator, 10 KW	N/A - Offroad diesel engine	21	Gasoline	9.79	3.16	4.99	0.27	0.33	0.32	6.35	2.05	3.23	0.17	0.21	0.21	0.26	0.08	0.13	0.01	0.01	0.01
4	Submersible pump, 4" dia, 230 volt	Other Construction Equipment	175	Diesel	0.05	1.44	0.13	0.00	0.00	0.00	1.10	31.08	2.84	0.07	0.10	0.10	0.05	1.29	0.12	0.00	0.00	0.00

Key:

CO = carbon monoxide

g/gal = grams per gallon

g/hp-hr = grams per horsepower-hour

hp = horsepower

lbs/day = pounds per day

NOx = nitrogen oxides

PM10 = inhalable particulate matter

PM2.5 = fine particulate matter

ROG = reactive organic gases

SO2 = sulfur dioxide

tpy = tons per day

ROG	CO	NOx	SO2	PM10	PM2.5
Total Daily (lb/day)	36.18	224.75	63.11	1.57	2.75
Total Annual 2020 (tpy)	1.50	9.33	2.62	0.07	0.11

Legend:

Onroad vehicle - emissions estimated by EMFAC2007

Stationary source - emissions estimated by AP-42 for diesel engines

Table M4D. Mitigated Off-Road Construction Equipment Emissions for Copco 1 (Alternative 5)

Maximum Daily Work Hours

8

Dam Removal Duration

Start Date 12/30/2019

End Date 4/15/2020

78 (5 days/week)

Quantity	Primary	Secondary	Equipment Description	Rating (hp)	Fuel Type	2020 Emission Factors (g/hp-hr or g/gal for on-highway sources)						Peak Daily Emissions (lbs/day)						2020 Emissions (tons per year)						
						ROG	CO	NOx	SOx	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5	
1	1	1	Crane - crawler, 150-200 ton	335	Diesel	0.04	0.29	0.08	0.00	0.00	0.00	0.44	3.46	0.94	0.02	0.03	0.03	0.02	0.13	0.04	0.00	0.00	0.00	0.00
1	1	1	Crane - rough terrain hydraulic, 50 ton	130	Diesel	0.05	1.11	0.10	0.00	0.00	0.00	0.22	5.10	0.46	0.01	0.02	0.02	0.01	0.20	0.02	0.00	0.00	0.00	0.00
1	0		Excavator - hydraulic ram	321	Diesel	0.06	0.39	0.10	0.00	0.00	0.00	0.32	2.19	0.59	0.01	0.02	0.02	0.01	0.09	0.02	0.00	0.00	0.00	0.00
1	1		Excavator - 45,000-60,000 lb, Komatsu 220-350	219.5	Diesel	0.08	0.54	0.14	0.00	0.01	0.00	0.59	4.21	1.09	0.03	0.04	0.04	0.02	0.16	0.04	0.00	0.00	0.00	0.00
3	0		Excavator - <20,000 lb	168	Diesel	0.08	1.62	0.14	0.00	0.01	0.01	0.68	14.36	1.27	0.03	0.05	0.05	0.03	0.56	0.05	0.00	0.00	0.00	0.00
1	0		Loader - WA250 IT	138	Diesel	0.06	1.47	0.13	0.00	0.01	0.00	0.15	3.58	0.32	0.01	0.01	0.01	0.01	0.14	0.01	0.00	0.00	0.00	0.00
1	0		Loader - WA450	273	Diesel	0.05	0.38	0.10	0.00	0.00	0.00	0.23	1.82	0.49	0.01	0.02	0.02	0.01	0.07	0.02	0.00	0.00	0.00	0.00
2	0		Dump truck - articulated, 30 ton, Cat 730	325	Diesel	0.08	0.46	0.12	0.00	0.00	0.00	0.87	5.33	1.42	0.03	0.06	0.05	0.03	0.21	0.06	0.00	0.00	0.00	0.00
1	1		Pick-up truck, 1/2 ton, on-highway 4x4		Gasoline	2.59	28.49	3.08	0.09	0.83	0.57	0.66	7.32	0.79	0.02	0.21	0.15	0.03	0.29	0.03	0.00	0.01	0.01	
1	1		Pick-up truck, 1/2 ton, on-highway 4x4		Diesel	1.64	15.84	44.50	0.10	1.61	1.14	0.22	2.15	6.05	0.01	0.22	0.16	0.01	0.08	0.24	0.00	0.01	0.01	
1	1		Pick-up truck, 1 ton, on-highway 4x4		Diesel	1.64	15.84	44.50	0.10	1.61	1.14	0.27	2.62	7.37	0.02	0.27	0.19	0.01	0.10	0.29	0.00	0.01	0.01	
1	1		Pick-up truck, 3/4 ton, on-highway 4x4		Gasoline	2.59	28.49	3.08	0.09	0.83	0.57	0.99	10.93	1.18	0.03	0.32	0.22	0.04	0.43	0.05	0.00	0.01	0.01	
1	1		Water tanker, off-highway, 5000 gal	175	Diesel	0.10	1.94	0.17	0.00	0.01	0.01	0.63	11.97	1.04	0.02	0.04	0.04	0.02	0.47	0.04	0.00	0.00	0.00	
1	1		Engine generator, 6.5 KW	13	Diesel	1.14	3.03	14.06	0.93	1.00	0.97	0.52	1.39	6.45	0.43	0.46	0.45	0.02	0.05	0.25	0.02	0.02	0.02	
1	1		Engine generator, 10 KW	21	Gasoline	9.79	3.16	4.99	0.27	0.33	0.32	7.25	2.34	3.70	0.20	0.24	0.24	0.28	0.09	0.14	0.01	0.01	0.01	
4	4	4	Air compressor, 850-1200 cfm	106	Diesel	0.07	1.63	0.68	0.00	0.01	0.01	1.09	24.37	10.22	0.05	0.08	0.08	0.04	0.95	0.40	0.00	0.00	0.00	
4	4	4	Drills - air/hydraulic track, jackleg, or sinker	291	Diesel	0.06	0.50	0.14	0.00	0.00	0.00	2.35	20.38	5.55	0.11	0.20	0.18	0.09	0.79	0.22	0.00	0.01	0.01	
2	2	2	Submersible pump, 4" dia, 230 volt	53	Diesel	0.07	1.63	0.68	0.00	0.01	0.01	0.27	6.09	2.55	0.01	0.02	0.02	0.01	0.24	0.10	0.00	0.00	0.00	

Key:

CO = carbon monoxide

g/gal = grams per gallon

g/hp-hr = grams per horsepower-hour

hp = horsepower

Ibs/day = pounds per day

NOx = nitrogen oxides

PM10 = inhalable particulate matter

PM2.5 = fine particulate matter

ROG = reactive organic gases

SO2 = sulfur dioxide

tpy = tons per day

	ROG	CO	NOx	SO2	PM10	PM2.5
Total Daily (lb/day)	17.76	129.61	51.47	1.05	2.32	1.94
Total Annual 2020 (tpy)	0.69	5.05	2.01	0.04	0.09	0.08

Legend:

Onroad vehicle - emissions estimated by EMFAC2007

Stationary source - emissions estimated by AP-42 for diesel engines

Table M4E. Mitigated Off-Road Construction Equipment Emissions for Copco 2 (Alternative 5)

Quantity	Equipment Description	OFFROAD Category	Rating (hp)	Fuel Type	Fuel Amount (gal)	Total Hours	Peak Daily Hours	2020 Emission Factors (g/hp-hr or g/gal for on-highway sources)					Peak Daily Emissions (lbs/day)					2020 Emissions (tons per year)							
								ROG	CO	NOx	SOx	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5
1	Lattice boom crane, Manitowoc Crawler, 150T(US), 160'boom	Cranes	335	Diesel	4,862	440	8	0.04	0.29	0.08	0.00	0.00	0.00	0.22	1.73	0.47	0.01	0.02	0.02	0.01	0.05	0.01	0.00	0.00	0.00
2	Hydraulic yard crane, Grove 4x4x4, 13.6MT, 52' boom	Cranes	130	Diesel	2,670	656	8	0.05	1.11	0.10	0.00	0.00	0.00	0.22	5.10	0.46	0.01	0.02	0.02	0.00	0.10	0.01	0.00	0.00	0.00
1	Hydraulic excavator, 2.5 cy, long reach, Cat H120 Hoe Ram (3000 fib)	Excavators	321	Diesel	1,512	112	8	0.06	0.39	0.10	0.00	0.00	0.00	0.32	2.19	0.59	0.01	0.02	0.02	0.00	0.02	0.00	0.00	0.00	0.00
1	Hydraulic excavator, 2.5 cy	Excavators	321	Diesel	4,421	328	8	0.06	0.39	0.10	0.00	0.00	0.00	0.32	2.19	0.59	0.01	0.02	0.02	0.01	0.04	0.01	0.00	0.00	0.00
1	Articulated wheel loader, Cat966, 5.0 cy	Rubber Tired Loaders	246	Diesel	2,598	328	8	0.06	0.49	0.13	0.00	0.00	0.00	0.26	2.13	0.56	0.01	0.02	0.02	0.01	0.04	0.01	0.00	0.00	0.00
2	Dump truck, Cat740, 22.8-30 cy, 38.1 MT	Off-Highway Trucks	415	Diesel	3,718	448	8	0.08	0.46	0.12	0.00	0.00	0.00	1.11	6.80	1.81	0.04	0.07	0.07	0.02	0.10	0.03	0.00	0.00	0.00
1	Crawler dozer, Cat238	Crawler Tractors	238	Diesel	1,039	112	8	0.07	0.56	0.15	0.00	0.01	0.00	0.30	2.33	0.61	0.01	0.02	0.02	0.00	0.02	0.00	0.00	0.00	0.00
1	Pick-up truck, 1/2 ton, on-highway 4x4	N/A - Emfac	160	Diesel	845	440	8	1.64	15.84	44.50	0.10	1.61	1.14	0.06	0.54	1.51	0.00	0.05	0.04	0.00	0.01	0.04	0.00	0.00	0.00
1	Pick-up truck, 1 ton, on-highway 4x4	N/A - Emfac	195	Diesel	1,030	440	8	1.64	15.84	44.50	0.10	1.61	1.14	0.07	0.65	1.84	0.00	0.07	0.05	0.00	0.02	0.05	0.00	0.00	0.00
1	Water tanker, off-highway, 5000 gal	Off-Highway Trucks	175	Diesel	1,340	224	8	0.10	1.94	0.17	0.00	0.01	0.01	0.32	5.98	0.52	0.01	0.02	0.02	0.00	0.08	0.01	0.00	0.00	0.00
4	Concrete Mixer, 8 cy, rear discharge/Concrete pump truck	Other Construction Equipment	235	Diesel	5,709	704	8	0.04	0.39	0.11	0.00	0.00	0.00	0.68	6.44	1.76	0.04	0.06	0.06	0.01	0.07	0.02	0.00	0.00	0.00
1	Compactor, Cat, vibratory, self propelled, 84"	Rollers	138	Diesel	263	112	8	0.05	1.44	0.13	0.00	0.00	0.00	0.12	3.49	0.32	0.01	0.01	0.01	0.00	0.02	0.00	0.00	0.00	0.00
1	Engine generator, 6.5 KW	N/A - AP42 3.3-1	13	Diesel	280	400	8	1.14	3.03	14.06	0.93	1.00	0.97	0.26	0.69	3.22	0.21	0.23	0.22	0.01	0.02	0.08	0.01	0.01	0.01
1	Air compressor, 160 cfm, 100 psi	Other Construction Equipment	60	Diesel	242	112	8	0.07	1.63	0.68	0.00	0.01	0.01	0.08	1.72	0.72	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.00	0.00
1	Air compressor, 250 cfm, 100 psi	Other Construction Equipment	80	Diesel	323	112	8	0.07	1.63	0.68	0.00	0.01	0.01	0.10	2.30	0.96	0.00	0.01	0.01	0.00	0.02	0.01	0.00	0.00	0.00
1	Dump truck, on-highway 8x4, 18 cy	N/A - Emfac	450	Diesel	2,822	224	8	1.64	15.84	44.50	0.10	1.61	1.14	0.36	3.52	9.89	0.02	0.36	0.25	0.01	0.05	0.14	0.00	0.00	0.00
2	Portable generator 1 KW	N/A - AP42 3.3-1	2.75	Gasoline	112	800	8	9.79	3.16	4.99	0.27	0.33	0.30	0.95	0.31	0.48	0.03	0.03	0.03	0.02	0.01	0.01	0.00	0.00	0.00

Key:

CO = carbon monoxide

PM10 = inhalable particulate matter

g/gal = grams per gallon

PM2.5 = fine particulate matter

g/hp-hr = grams per horsepower-hour

ROG = reactive organic gases

hp = horsepower

SO2 = sulfur dioxide

lbs/day = pounds per day

tpy = tons per day

	ROG	CO	NOx	SO2	PM10	PM2.5
Total Daily (lb/day)	5.74	48.13	26.32	0.44	1.04	0.87
Total Annual 2020 (tpy)	0.1	0.7	0.4	0.0	0.0	0.0

Legend:

Onroad vehicle - emissions estimated by EMFAC2007

Stationary source - emissions estimated by AP-42 for diesel engines

Table M4F. Mitigated Off-Road Construction Equipment Emissions for JC Boyle (Alternative 5)

Quantity	Equipment Description	Fuel Type	OFFROAD Category	Rating (hp)	Fuel Amount (gal)	Total Hours	Peak Daily Hours	2020 Emission Factors (g/hp-hr or g/gal for on-highway sources)						Peak Daily Emissions (lbs/day)						2020 Emissions (tons per year)							
								VOC	CO	NOx	SOx	PM10	PM2.5	VOC	CO	NOx	SO2	PM10	PM2.5	VOC	CO	NOx	SO2	PM10	PM2.5		
	Note: Emission calculations assume that construction equipment meet California emission standards for MY2015 and newer equipment																										
1	Lattice boom crane, Manitowoc Crawler, 150T(US), 160'boom	Diesel	Cranes	335	10,696	968	8	0.04	0.29	0.08	0.00	0.00	0.00	0.22	1.73	0.47	0.01	0.02	0.02	0.01	0.10	0.03	0.00	0.00	0.00	0.00	
2	Hydraulic yard crane, Grove 4x4x4, 52' boom, 13.6MT	Diesel	Cranes	130	5,926	1,456	8	0.05	1.11	0.10	0.00	0.00	0.00	0.22	5.10	0.46	0.01	0.02	0.02	0.01	0.23	0.02	0.00	0.00	0.00	0.00	
1	Hydraulic excavator, 2.5 cy, long reach, Cat H120 Hoe Ram (3000	Diesel	Excavators	321	3,240	240	8	0.06	0.39	0.10	0.00	0.00	0.00	0.32	2.19	0.59	0.01	0.02	0.02	0.00	0.03	0.01	0.00	0.00	0.00	0.00	
1	Hydraulic excavator, 2.5 cy	Diesel	Excavators	321	9,813	728	8	0.06	0.39	0.10	0.00	0.00	0.00	0.32	2.19	0.59	0.01	0.02	0.02	0.01	0.10	0.03	0.00	0.00	0.00	0.00	
1	Articulated wheel loader, Cat966, 5.0 cy	Diesel	Rubber Tired Loaders	246	5,766	728	8	0.06	0.49	0.13	0.00	0.00	0.00	0.26	2.13	0.56	0.01	0.02	0.02	0.01	0.10	0.03	0.00	0.00	0.00	0.00	
2	Dump truck, Cat740, 22.8-30 cy, 38.1 MT	Diesel	Off-Highway Trucks	415	8,101	976	8	0.08	0.46	0.12	0.00	0.00	0.00	1.11	6.80	1.81	0.04	0.07	0.07	0.03	0.21	0.06	0.00	0.00	0.00	0.00	
1	Crawler dozer, Cat238	Diesel	Crawler Tractors	238	2,227	240	8	0.07	0.56	0.15	0.00	0.01	0.01	0.30	2.33	0.61	0.01	0.02	0.02	0.00	0.03	0.01	0.00	0.00	0.00	0.00	
1	Pick-up truck, 1/2 ton, on-highway 4x4	Diesel	N/A - MOBILE	160	1,859	968	8	3.60	7.91	4.61	0.10	0.64	0.39	0.12	0.27	0.16	0.00	0.02	0.01	0.01	0.02	0.01	0.00	0.00	0.00	0.00	
1	Pick-up trucks, 1 ton, on-highway 4x4	Diesel	N/A - MOBILE	195	2,265	968	8	3.60	7.91	4.61	0.10	0.64	0.39	0.15	0.33	0.19	0.00	0.03	0.02	0.01	0.02	0.01	0.00	0.00	0.00	0.00	
1	Water tanker, off-highway, 5000 gal	Diesel	Off-Highway Trucks	175	2,918	488	8	0.10	1.94	0.17	0.00	0.01	0.01	0.32	5.98	0.52	0.01	0.02	0.02	0.01	0.18	0.02	0.00	0.00	0.00	0.00	
4	Concrete Mixer, 8 cy, rear discharge/Concrete pump truck	Diesel	Other Construction Equipment	235	12,455	1,536	8	0.04	0.39	0.11	0.00	0.00	0.00	0.68	6.44	1.76	0.04	0.06	0.06	0.02	0.15	0.04	0.00	0.00	0.00	0.00	
1	Compactor, Cat, vibratory, self propelled, 84"	Diesel	Rollers	138	564	240	8	0.05	1.44	0.13	0.00	0.00	0.00	0.12	3.49	0.32	0.01	0.01	0.01	0.00	0.05	0.00	0.00	0.00	0.00	0.00	
1	Engine generator, 6.5 KW	Diesel	N/A - AP42 3.3-1	13	610	872	8	1.14	3.03	14.06	0.93	1.00	0.94	0.26	0.69	3.22	0.21	0.23	0.21	0.01	0.04	0.18	0.01	0.01	0.01	0.01	
1	Air compressor, 160 cfm, 100 psi	Diesel	Other Construction Equipment	60	647	240	8	0.07	1.63	0.68	0.00	0.01	0.01	0.08	1.72	0.72	0.00	0.01	0.01	0.00	0.03	0.01	0.00	0.00	0.00	0.00	
1	Air compressor, 250 cfm, 100 psi	Diesel	Other Construction Equipment	80	691	240	8	0.07	1.63	0.68	0.00	0.01	0.01	0.10	2.30	0.96	0.00	0.01	0.01	0.00	0.03	0.01	0.00	0.00	0.00	0.00	
1	Dump truck, on-highway 8x4, 18 cy	Diesel	N/A - MOBILE	450	6,149	488	8	2.06	3.65	13.08	0.10	0.53	0.30	0.46	0.81	2.91	0.02	0.12	0.07	0.01	0.02	0.09	0.00	0.00	0.00	0.00	0.00
2	Portable generator 1 KW	Gasoline	N/A - AP42 3.3-1	2.75	244	1,744	8	9.79	3.16	4.99	0.27	0.33	0.31	0.95	0.31	0.48	0.03	0.03	0.03	0.05	0.02	0.03	0.00	0.00	0.00	0.00	0.00

Key:

CO = carbon monoxide

PM10 = inhalable particulate matter

g/gal = grams per gallon

PM2.5 = fine particulate matter

g/hp-hr = grams per horsepower-hour

ROG = reactive organic gases

hp = horsepower

SO2 = sulfur dioxide

lbs/day = pounds per day

tpy = tons per day

NOx = nitrogen oxides

VOC	CO	NOx	SO2	PM10	PM2.5
Total Daily (lb/day)	5.98	44.82	16.34	0.44	0.73
Total Annual 2020 (tpy)	0.22	1.37	0.57	0.02	0.03

Legend:

Onroad vehicle - emissions estimated by MOBILE6.2

Stationary source - emissions estimated by AP-42 for diesel engines

Table M5A. Summary of EMFAC2007 Emission Factors (Mitigated)

Source	Emission Factors (g/mi) - 2020														
	ROG	TOG	CO	NOx	SOx	PM10 Total	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	CO2	CH4
Construction Workers	0.202	0.235	4.201	0.439	0.004	0.041	0.021	0.008	0.013	0.026	0.019	0.002	0.005	455.772	0.030
Pick-up Trucks (Gasoline)	0.148	0.166	1.627	0.176	0.005	0.048	0.027	0.008	0.013	0.032	0.025	0.002	0.005	503.223	0.017
Pick-up Trucks (Diesel)	0.056	0.064	0.543	1.526	0.003	0.055	0.035	0.008	0.013	0.039	0.032	0.002	0.005	345.726	0.003
Heavy-Duty Diesel Trucks	0.277	0.315	1.325	2.776	0.018	0.137	0.073	0.036	0.028	0.088	0.067	0.009	0.012	1878.225	0.013

Source	Emission Factors (g/gal) - 2020														
	ROG	TOG	CO	NOx	SOx	PM10 Total	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	CO2	CH4
Pick-up Trucks (Gasoline)	2.588	2.900	28.488	3.079	0.085	0.834	0.474	0.140	0.220	0.569	0.440	0.035	0.094	8813.455	0.301
Pick-up Trucks (Diesel)	1.637	1.863	15.842	44.502	0.096	1.607	1.008	0.233	0.366	1.142	0.927	0.058	0.157	10079.999	0.076
Heavy-Duty Gasoline Vehicles	7.368	8.928	539.818	71.403	0.085	0.722	0.178	0.162	0.382	0.573	0.041	0.164	0.369	7987.455	1.462
Heavy-Duty Diesel Trucks	1.485	1.690	7.113	14.897	0.096	0.734	0.390	0.193	0.151	0.472	0.358	0.048	0.065	10079.997	0.069

Notes:

Construction workers emissions only include LDA, LDT1, and LDT2 vehicle types, based on guidance from URBEMIS2007 User's Guide.

CO2 emission factors for construction workers adjusted to reflect the Pavley and LCFS using CARB's Pavley post-processor.

Pick-up trucks use LDT2 emission factors.

Key:

CH4 = methane

PM10 = inhalable particulate matter

CO = carbon monoxide

PM2.5 = fine particulate matter

CO2 = carbon dioxide

ROG = reactive organic gases

g/mi = grams per mile

SOx = sulfur oxides

NOx = nitrogen oxides

TOG = total organic gases

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Table M6A. Summary of Daily Unmitigated Emissions

	Peak Daily Emissions (lb/day)					
	ROG	CO	NOx	SOx	PM10	PM2.5
Grand Total						
Alternative 2	131	584	650	9	503	248
Alternative 3	128	570	625	9	484	244
Alternative 4	11	63	59	4	11	6
Alternative 5	117	552	620	7	399	225

Threshold	250	2,500	250	250	250	250
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Key:

CO = carbon monoxide

PM2.5 = fine particulate matter

lb/day = pounds per day

ROG = reactive organic gases

NOx = nitrogen oxides

SOx = sulfur oxides

PM10 = inhalable particulate matter

Table M6B. Alternative 2 Daily Unmitigated Emissions Summary (pounds per day)

	Peak Daily Emissions (lb/day)					
	ROG	CO	NOx	SOx	PM10	PM2.5
Iron Gate						
Construction Equipment	63	248	313	2	12	11
Haul Trucks	3	12	34	0	5	2
Employee Commuting	1	11	1	0	4	1
Fugitive Dust - Unpaved Roads	--	--	--	--	31	3
Fugitive Dust - Materials	--	--	--	--	157	33
TOTAL	67	272	348	2	210	50
Copco 1						
Construction Equipment	26	159	117	1	6	5
Haul Trucks	1	4	11	0	2	1
Employee Commuting	1	13	1	0	3	1
Fugitive Dust - Unpaved Roads	--	--	--	--	2	0
Fugitive Dust - Materials	--	--	--	--	161	159
TOTAL	27	176	129	1	174	165
Copco 2						
Construction Equipment	19	56	80	1	4	3
Haul Trucks	3	12	32	0	5	2
Employee Commuting	1	16	2	0	2	0
Fugitive Dust - Unpaved Roads	--	--	--	--	4	0
Fugitive Dust - Materials	--	--	--	--	3	1
TOTAL	22	83	113	1	17	6
JC Boyle						
Construction Equipment	13	22	54	5	9	8
Haul Trucks	1	1	4	0	2	0
Employee Commuting	2	31	1	0	2	0
Fugitive Dust - Unpaved Roads	--	--	--	--	5	1
Fugitive Dust - Materials	--	--	--	--	84	17
TOTAL	15	54	60	5	103	27
Grand Total	131	584	650	9	503	248
California Total	116	531	590	4	401	221
Oregon Total	15	54	60	5	103	27

Peak Daily	104	409	521	8	330	83
California Total	89	355	461	3	227	56
Oregon Total	15	54	60	5	103	27

Note:

Peak daily emissions do not include Copco 1.

Key:

CO = carbon monoxide

lb/day = pounds per day

NOx = nitrogen oxides

PM10 = inhalable particulate matter

PM2.5 = fine particulate matter

ROG = reactive organic gases

SOx = sulfur oxides

Table M6C. Alternative 3 Daily Unmitigated Emissions Summary (pounds per day)

	Peak Daily Emissions (lb/day)					
	ROG	CO	NOx	SOx	PM10	PM2.5
Iron Gate						
Construction Equipment	63	248	313	2	12	11
Haul Trucks	2	11	30	0	5	1
Employee Commuting	1	11	1	0	4	1
Fugitive Dust - Unpaved Roads	--	--	--	--	31	3
Fugitive Dust - Materials	--	--	--	--	156	33
TOTAL	66	270	344	2	208	49
Copco 1						
Construction Equipment	26	159	117	1	6	5
Haul Trucks	1	2	6	0	1	0
Employee Commuting	1	11	1	0	3	1
Fugitive Dust - Unpaved Roads	--	--	--	--	2	0
Fugitive Dust - Materials	--	--	--	--	159	158
TOTAL	27	173	124	1	171	165
Copco 2						
Construction Equipment	19	56	80	1	4	3
Haul Trucks	2	8	22	0	3	1
Employee Commuting	1	16	2	0	2	0
Fugitive Dust - Unpaved Roads	--	--	--	--	2	0
Fugitive Dust - Materials	--	--	--	--	1	0
TOTAL	21	80	103	1	12	5
J.C. Boyle						
Construction Equipment	12	19	49	5	8	7
Haul Trucks	0	1	3	0	1	0
Employee Commuting	1	28	1	0	2	0
Fugitive Dust - Unpaved Roads	--	--	--	--	5	1
Fugitive Dust - Materials	--	--	--	--	77	16
TOTAL	14	48	53	5	94	25
Grand Total	128	570	625	9	484	244
California Total	115	522	571	4	390	219
Oregon Total	14	48	53	5	94	25
Peak Daily	101	397	500	8	314	79
California Total	88	349	447	3	220	54
Oregon Total	14	48	53	5	94	25

Note:

Peak daily emissions do not include Copco 1.

Key:

CO = carbon monoxide

lb/day = pounds per day

NOx = nitrogen oxides

PM10 = inhalable particulate matter

PM2.5 = fine particulate matter

ROG = reactive organic gases

SOx = sulfur oxides

Table M6D. Alternative 4 Unmitigated Daily Emissions Summary (pounds per day)

	Peak Daily Emissions (lb/day)					
	ROG	CO	NOx	SOx	PM10	PM2.5
Iron Gate	2023					
Construction Equipment	10	54	52	0	2	2
Haul Trucks	1	3	7	0	1	0
Employee Commuting	1	6	1	0	2	0
Fugitive Dust - Unpaved Roads	--	--	--	--	--	--
Fugitive Dust - Materials	--	--	--	--	2	0
TOTAL	11	63	59	0	8	3
Copco 1	2025					
Construction Equipment	9	51	37	0	2	1
Haul Trucks	1	3	7	0	2	0
Employee Commuting	1	4	0	0	1	0
Fugitive Dust - Unpaved Roads	--	--	--	--	--	--
Fugitive Dust - Materials	--	--	--	--	1	0
TOTAL	10	58	45	0	5	2
Copco 2	2024					
Construction Equipment	9	51	42	0	2	2
Haul Trucks	1	3	8	0	2	0
Employee Commuting	0	3	0	0	1	0
Fugitive Dust - Unpaved Roads	--	--	--	--	--	--
Fugitive Dust - Materials	--	--	--	--	0	0
TOTAL	10	58	50	0	5	2
J.C. Boyle	2022					
Construction Equipment	8	14	45	3	6	5
Haul Trucks	1	1	5	0	3	1
Employee Commuting	0	0	0	0	1	0
Fugitive Dust - Unpaved Roads	--	--	--	--	--	--
Fugitive Dust - Materials	--	--	--	--	1	0
TOTAL	9	16	50	4	11	6
Maximum Daily Emissions	11	63	59	4	11	6

Key:

CO = carbon monoxide

PM2.5 = fine particulate matter

lb/day = pounds per day

ROG = reactive organic gases

NOx = nitrogen oxides

SOx = sulfur oxides

PM10 = inhalable particulate matter

Table M6E. Alternative 5 Unmitigated Daily Emissions Summary (pounds per day)

	Peak Daily Emissions (lb/day)					
	ROG	CO	NOx	SOx	PM10	PM2.5
Iron Gate						
Construction Equipment	63	248	313	2	12	11
Haul Trucks	2	11	30	0	5	1
Employee Commuting	1	22	2	0	5	1
Fugitive Dust - Unpaved Roads	--	--	--	--	31	3
Fugitive Dust - Materials	--	--	--	--	157	33
TOTAL	67	282	345	2	209	49
Copco 1						
Construction Equipment	26	159	117	1	6	5
Haul Trucks	1	4	11	0	2	1
Employee Commuting	1	16	2	0	3	1
Fugitive Dust - Unpaved Roads	--	--	--	--	2	0
Fugitive Dust - Materials	--	--	--	--	160	159
TOTAL	28	179	129	1	173	165
Copco 2						
Construction Equipment	11	52	70	0	3	3
Haul Trucks	1	4	12	0	2	1
Employee Commuting	0	4	0	0	1	0
Fugitive Dust - Unpaved Roads	--	--	--	--	--	--
Fugitive Dust - Materials	--	--	--	--	0	0
TOTAL	12	61	82	0	6	4
J.C. Boyle						
Construction Equipment	8	18	56	4	6	6
Haul Trucks	1	2	6	0	3	1
Employee Commuting	1	12	0	0	1	0
Fugitive Dust - Unpaved Roads	--	--	--	--	--	--
Fugitive Dust - Materials	--	--	--	--	1	0
TOTAL	10	32	63	4	11	7
Grand Total	117	552	620	7	399	225
California Total	107	521	557	3	388	218
Oregon Total	10	32	63	4	11	7
Peak Daily	89	374	490	6	226	60
California Total	79	342	428	2	215	53
Oregon Total	10	32	63	4	11	7

Note:

Peak daily emissions do not include Copco 1.

CO = carbon monoxide

lb/day = pounds per day

NOx = nitrogen oxides

PM10 = inhalable particulate matter

PM2.5 = fine particulate matter

ROG = reactive organic gases

SOx = sulfur oxides

Table M6F. Summary of Unmitigated Annual Emissions

	2020 Annual Emissions (tpy)					
	ROG	CO	NOx	SOx	PM10	PM2.5
Alternative 2	6	24	28	1	20	11
Alternative 3	6	23	26	0	20	11
Alternative 4	2	10	5	0	2	1
Alternative 5	4	20	22	0	18	10

Key:

CO = carbon monoxide

ROG = reactive organic gases

NOx = nitrogen oxides

SOx = sulfur oxides

PM10 = inhalable particulate matter

tpy = tons per year

PM2.5 = fine particulate matter

Table M6G. Alternative 2 Unmitigated Annual Emissions Summary (tons per year)

2020 Annual Emissions (tpy)						
	ROG	CO	NOx	SOx	PM10	PM2.5
Iron Gate						
Construction Equipment	3	10	13	0	1	0
Haul Trucks	0	0	1	0	0	0
Employee Commuting	0	0	0	0	0	0
Fugitive Dust - Unpaved Roads	--	--	--	--	1	0
Fugitive Dust - Materials	--	--	--	--	8	2
TOTAL	3	11	14	0	10	2
Copco 1						
Construction Equipment	1	6	5	0	0	0
Haul Trucks	0	0	0	0	0	0
Employee Commuting	0	0	0	0	0	0
Fugitive Dust - Unpaved Roads	--	--	--	--	0	0
Fugitive Dust - Materials	--	--	--	--	7	7
TOTAL	1	7	5	0	8	7
Copco 2						
Construction Equipment	1	3	4	0	0	0
Haul Trucks	0	0	0	0	0	0
Employee Commuting	0	1	0	0	0	0
Fugitive Dust - Unpaved Roads	--	--	--	--	0	0
Fugitive Dust - Materials	--	--	--	--	0	0
TOTAL	1	3	5	0	0	0
JC Boyle						
Construction Equipment	1	2	5	0	1	1
Haul Trucks	0	0	0	0	0	0
Employee Commuting	0	1	0	0	0	0
Fugitive Dust - Unpaved Roads	--	--	--	--	0	0
Fugitive Dust - Materials	--	--	--	--	2	0
TOTAL	1	3	5	0	3	1
Project Total	6	24	28	1	20	11
California Total	5	21	23	0	18	10
Oregon Total	1	3	5	0	3	1

Key:

CO = carbon monoxide

ROG = reactive organic gases

NOx = nitrogen oxides

SOx = sulfur oxides

PM10 = inhalable particulate matter

tpy = tons per year

PM2.5 = fine particulate matter

Table M6H. Alternative 3 Unmitigated Annual Emissions Summary (tons per year)

	2020 Annual Emissions (tpy)					
	ROG	CO	NOx	SOx	PM10	PM2.5
Iron Gate						
Construction Equipment	3	10	13	0	1	0
Haul Trucks	0	0	1	0	0	0
Employee Commuting	0	0	0	0	0	0
Fugitive Dust - Unpaved Roads	--	--	--	--	1	0
Fugitive Dust - Materials	--	--	--	--	8	2
TOTAL	3	11	14	0	10	2
Copco 1						
Construction Equipment	1	6	5	0	0	0
Haul Trucks	0	0	0	0	0	0
Employee Commuting	0	0	0	0	0	0
Fugitive Dust - Unpaved Roads	--	--	--	--	0	0
Fugitive Dust - Materials	--	--	--	--	7	7
TOTAL	1	7	5	0	7	7
Copco 2						
Construction Equipment	1	2	4	0	0	0
Haul Trucks	0	0	0	0	0	0
Employee Commuting	0	1	0	0	0	0
Fugitive Dust - Unpaved Roads	--	--	--	--	0	0
Fugitive Dust - Materials	--	--	--	--	0	0
TOTAL	1	3	4	0	0	0
J.C. Boyle						
Construction Equipment	1	1	3	0	0	0
Haul Trucks	0	0	0	0	0	0
Employee Commuting	0	1	0	0	0	0
Fugitive Dust - Unpaved Roads	--	--	--	--	0	0
Fugitive Dust - Materials	--	--	--	--	2	0
TOTAL	1	2	3	0	2	1
Project Total	6	23	26	0	20	11
California Total	5	21	23	0	17	10
Oregon Total	1	2	3	0	2	1

Key:

CO = carbon monoxide

ROG = reactive organic gases

NOx = nitrogen oxides

SOx = sulfur oxides

PM10 = inhalable particulate matter

tpy = tons per year

PM2.5 = fine particulate matter

Table M6I. Alternative 4 Unmitigated Annual Emissions Summary (tons per year)

	Annual Emissions (tpy)					
	ROG	CO	NOx	SOx	PM10	PM2.5
Iron Gate	2023					
Construction Equipment	1	4	4	0	0	0
Haul Trucks	0	0	0	0	0	0
Employee Commuting	1	6	1	0	2	0
Fugitive Dust - Unpaved Roads	--	--	--	--	--	--
Fugitive Dust - Materials	--	--	--	--	0	0
TOTAL	2	10	5	0	2	1
Copco 1	2025					
Construction Equipment	1	3	3	0	0	0
Haul Trucks	0	0	0	0	0	0
Employee Commuting	1	4	0	0	1	0
Fugitive Dust - Unpaved Roads	--	--	--	--	--	--
Fugitive Dust - Materials	--	--	--	--	0	0
TOTAL	1	7	3	0	2	0
Copco 2	2024					
Construction Equipment	0	1	1	0	0	0
Haul Trucks	0	0	0	0	0	0
Employee Commuting	0	3	0	0	1	0
Fugitive Dust - Unpaved Roads	--	--	--	--	--	--
Fugitive Dust - Materials	--	--	--	--	0	0
TOTAL	1	4	1	0	1	0
J.C. Boyle	2022					
Construction Equipment	0	0	1	0	0	0
Haul Trucks	0	0	0	0	0	0
Employee Commuting	0	0	0	0	1	0
Fugitive Dust - Unpaved Roads	--	--	--	--	--	--
Fugitive Dust - Materials	--	--	--	--	0	0
TOTAL	0	0	2	0	1	0
Maximum	2	10	5	0	2	1

Key:

CO = carbon monoxide

NOx = nitrogen oxides

PM10 = inhalable particulate matter

PM2.5 = fine particulate matter

ROG = reactive organic gases

SOx = sulfur oxides

tpy = tons per year

Table M6J. Alternative 5 Unmitigated Annual Emissions Summary (tons per year)

		2020 Annual Emissions (tpy)					
		ROG	CO	NOx	SOx	PM10	PM2.5
Iron Gate							
Construction Equipment		3	10	13	0	1	0
Haul Trucks		0	0	1	0	0	0
Employee Commuting		0	1	0	0	0	0
Fugitive Dust - Unpaved Roads		--	--	--	--	1	0
Fugitive Dust - Materials		--	--	--	--	8	2
TOTAL		3	12	14	0	10	2
Copco 1							
Construction Equipment		1	6	5	0	0	0
Haul Trucks		0	0	0	0	0	0
Employee Commuting		0	1	0	0	0	0
Fugitive Dust - Unpaved Roads		--	--	--	--	0	0
Fugitive Dust - Materials		--	--	--	--	7	7
TOTAL		1	7	5	0	8	7
Copco 2							
Construction Equipment		0	1	1	0	0	0
Haul Trucks		0	0	0	0	0	0
Employee Commuting		0	0	0	0	0	0
Fugitive Dust - Unpaved Roads		--	--	--	--	--	--
Fugitive Dust - Materials		--	--	--	--	0	0
TOTAL		0	1	1	0	0	0
J.C. Boyle							
Construction Equipment		0	1	2	0	0	0
Haul Trucks		0	0	0	0	0	0
Employee Commuting		0	0	0	0	0	0
Fugitive Dust - Unpaved Roads		--	--	--	--	--	--
Fugitive Dust - Materials		--	--	--	--	0	0
TOTAL		0	1	2	0	0	0
Project Total		4	20	22	0	18	10
California Total		4	19	20	0	17	10
Oregon Total		0	1	2	0	0	0

Key:

CO = carbon monoxide

ROG = reactive organic gases

NOx = nitrogen oxides

SOx = sulfur oxides

PM10 = inhalable particulate matter

tpy = tons per year

PM2.5 = fine particulate matter

Table M7A. Summary of Daily Unmitigated Off-Road Construction Emissions (Alternative 2)

Location	VOC	CO	NOx	SO2	PM10	PM2.5
Iron Gate	63	248	313	2	12	11
Copco 1	26	159	117	1	6	5
Copco 2	19	56	80	1	4	3
J.C. Boyle	13	22	54	5	9	8
Total	121	485	564	9	30	28
California %	90%	96%	90%	41%	72%	71%
Oregon %	10%	4%	10%	59%	28%	29%

Key:

CO = carbon monoxide

PM2.5 = fine particulate matter

NOx = nitrogen oxides

SO2 = sulfur dioxide

PM10 = inhalable particulate matter

VOC = volatile organic compounds

Table M7B. Summary of Annual Unmitigated Off-Road Construction Emissions (Alternative 2)

Location	VOC	CO	NOx	SO2	PM10	PM2.5
Iron Gate	2.6	10.3	13.0	0.1	0.5	0.5
Copco 1	1.0	6.2	4.6	0.0	0.2	0.2
Copco 2	1.1	2.8	4.2	0.1	0.2	0.2
J.C. Boyle	1.1	1.9	4.6	0.4	0.6	0.6
Total	5.8	21.3	26.5	0.6	1.6	1.5
California %	81%	91%	82%	31%	59%	59%
Oregon %	19%	9%	18%	69%	41%	41%

Key:

CO = carbon monoxide

PM2.5 = fine particulate matter

NOx = nitrogen oxides

SO2 = sulfur dioxide

PM10 = inhalable particulate matter

VOC = volatile organic compounds

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Table M7C. Unmitigated Off-Road Construction Equipment Emissions for Iron Gate Dam (Alternative 2)

Maximum Daily Work Hours					14 hours																	
Dam Removal Duration																						
					Start Date	6/1/2020																
					End Date	9/23/2020																
					83 days	(5 days/week)				99 days	(6 days/week)											
2020 Emission Factors (g/hp-hr or g/gal for on-highway)																						
Quantity	Equipment Description	OFFROAD Category	Rating (hp)	Fuel Type	ROG	CO	NOx	SOx	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5
1	Crane - crawler, 150-200 ton	Cranes	335	Diesel	0.10	0.35	0.64	0.00	0.02	0.02	1.02	3.60	6.59	0.02	0.24	0.22	0.04	0.15	0.27	0.00	0.01	0.01
1	Crane - rough terrain hydraulic, 50 ton	Cranes	130	Diesel	0.17	1.23	1.05	0.00	0.06	0.05	0.67	4.94	4.22	0.01	0.23	0.21	0.03	0.21	0.18	0.00	0.01	0.01
4	Excavator - 180,000-240,000 lb, Hitachi ZX870 to EX1200	Excavators	646	Diesel	0.12	0.46	0.61	0.00	0.02	0.02	9.60	36.68	49.01	0.19	1.77	1.63	0.40	1.52	2.03	0.01	0.07	0.07
20	Dump truck - articulated, 35 ton, Cat 735	Off-Highway Trucks	435	Diesel	0.14	0.49	0.68	0.00	0.02	0.02	36.27	132.59	182.31	0.65	6.66	6.13	1.51	5.50	7.57	0.03	0.28	0.25
2	Dozer - D8	Rubber Tired Dozers	347	Diesel	0.21	0.84	1.53	0.00	0.06	0.06	4.45	18.05	32.69	0.05	1.31	1.20	0.18	0.75	1.36	0.00	0.05	0.05
1	Pick-up truck, 1/2 ton, on-highway 4x4	N/A - Onroad	191	Gasoline	2.76	59.09	7.36	0.09	0.90	0.64	0.20	4.38	0.54	0.01	0.07	0.05	0.01	0.18	0.02	0.00	0.00	0.00
1	Pick-up truck, 1/2 ton, on-highway 4x4	N/A - Onroad	160	Diesel	2.34	18.31	43.09	0.10	2.11	1.61	0.09	0.72	1.69	0.00	0.08	0.06	0.00	0.03	0.07	0.00	0.00	0.00
1	Pick-up truck, 1 ton, on-highway 4x4	N/A - Onroad	195	Diesel	2.34	18.31	43.09	0.10	2.11	1.61	0.11	0.87	2.06	0.00	0.10	0.08	0.00	0.04	0.09	0.00	0.00	0.00
1	Water tanker, off-highway, 5000 gal	Off-Highway Trucks	175	Diesel	0.22	1.95	1.18	0.00	0.06	0.06	1.17	10.55	6.39	0.02	0.33	0.30	0.05	0.44	0.27	0.00	0.01	0.01
1	Engine generator, 6.5 KW	N/A - Offroad diesel engine	13	Diesel	1.14	3.03	14.06	0.93	1.00	0.97	0.46	1.22	5.64	0.37	0.40	0.39	0.02	0.05	0.23	0.02	0.02	0.02
1	Engine generator, 10 KW	N/A - Offroad diesel engine	21	Gasoline	9.79	3.16	4.99	0.27	0.33	0.32	6.35	2.05	3.23	0.17	0.21	0.21	0.26	0.08	0.13	0.01	0.01	0.01
4	Submersible pump, 4" dia, 230 volt	Other Construction Equipment	175	Diesel	0.14	1.52	0.89	0.00	0.04	0.04	2.93	32.78	19.12	0.07	0.92	0.90	0.12	1.36	0.79	0.00	0.04	0.04

Key:

CO = carbon monoxide

PM10 = inhalable particulate matter

g/gal = grams per gallon

PM2.5 = fine particulate matter

g/hp-hr = grams per horsepower-hour

ROG = reactive organic gases

hp = horsepower

SO2 = sulfur dioxide

lbs/day = pounds per day

tpy = tons per day

NOx = nitrogen oxides

Legend:

Onroad vehicle - emissions estimated by EMFAC2007

Stationary source - emissions estimated by AP-42 for diesel engines

	ROG	CO	NOx	SO2	PM10	PM2.5
Total Daily (lb/day)	63.33	248.42	313.49	1.56	12.32	11.37
Total Annual 2020 (tpy)	2.6	10.3	13.0	0.1	0.5	0.5

Table M7D. Unmitigated Off-Road Construction Equipment Emissions for Copco 1 (Alternative 2)

Maximum Daily Work Hours

8

Dam Removal Duration

Start Date 12/30/2019

End Date 4/15/2020

78

Quantity		Equipment Description	OFFROAD Category	Rating (hp)	Fuel	2020 Emission Factors (g/hp-hr or g/gal for on-highway)						Peak Daily Emissions (lbs/day)						2020 Emissions (tons per year)					
Primary	Secondary					ROG	CO	NOx	SOx	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5
1	1	Crane - crawler, 150-200 ton	Cranes	335	Diesel	0.10	0.35	0.64	0.00	0.02	0.02	1.17	4.11	7.54	0.02	0.28	0.25	0.05	0.16	0.29	0.00	0.01	0.01
1	1	Crane - rough terrain hydraulic, 50 ton	Cranes	130	Diesel	0.17	1.23	1.05	0.00	0.06	0.05	0.77	5.65	4.82	0.01	0.26	0.24	0.03	0.22	0.19	0.00	0.01	0.01
1	0	Excavator - hydraulic ram	Excavators	321	Diesel	0.11	0.42	0.55	0.00	0.02	0.02	0.62	2.36	3.10	0.01	0.11	0.10	0.02	0.09	0.12	0.00	0.00	0.00
1	1	Excavator - 45,000-60,000 lb, Komatsu 220-350	Excavators	219.5	Diesel	0.15	0.59	0.82	0.00	0.03	0.03	1.16	4.60	6.31	0.03	0.22	0.20	0.05	0.18	0.25	0.00	0.01	0.01
3	0	Excavator - <20,000 lb	Excavators	168	Diesel	0.18	1.72	1.00	0.00	0.05	0.05	1.62	15.28	8.91	0.03	0.45	0.41	0.06	0.60	0.35	0.00	0.02	0.02
1	0	Loader - WA250 IT	Rubber Tired Loaders	138	Diesel	0.20	1.61	1.22	0.00	0.07	0.06	0.48	3.92	2.96	0.01	0.16	0.15	0.02	0.15	0.12	0.00	0.01	0.01
1	0	Loader - WA450	Rubber Tired Loaders	273	Diesel	0.12	0.45	0.73	0.00	0.03	0.02	0.57	2.19	3.50	0.01	0.13	0.12	0.02	0.09	0.14	0.00	0.00	0.00
2	0	Dump truck - articulated, 30 ton, Cat 730	Off-Highway Trucks	325	Diesel	0.14	0.49	0.68	0.00	0.02	0.02	1.55	5.66	7.78	0.03	0.28	0.26	0.06	0.22	0.30	0.00	0.01	0.01
1	1	Pick-up truck, 1/2 ton, on-highway 4x4	N/A - Onroad		Gasoline	2.76	59.09	7.36	0.09	0.90	0.64	0.71	15.18	1.89	0.02	0.23	0.16	0.03	0.59	0.07	0.00	0.01	0.01
1	1	Pick-up truck, 1/2 ton, on-highway 4x4	N/A - Onroad		Diesel	2.34	18.31	43.09	0.10	2.11	1.61	0.32	2.49	5.86	0.01	0.29	0.22	0.01	0.10	0.23	0.00	0.01	0.01
1	1	Pick-up truck, 1 ton, on-highway 4x4	N/A - Onroad		Diesel	2.34	18.31	43.09	0.10	2.11	1.61	0.39	3.03	7.14	0.02	0.35	0.27	0.02	0.12	0.28	0.00	0.01	0.01
1	1	Pick-up truck, 3/4 ton, on-highway 4x4	N/A - Onroad		Gasoline	2.76	59.09	7.36	0.09	0.90	0.64	1.06	22.67	2.82	0.03	0.35	0.24	0.04	0.88	0.11	0.00	0.01	0.01
1	1	Water tanker, off-highway, 5000 gal	Off-Highway Trucks	175	Diesel	0.22	1.95	1.18	0.00	0.06	0.06	1.34	12.05	7.30	0.02	0.37	0.34	0.05	0.47	0.28	0.00	0.01	0.01
1	1	Engine generator, 6.5 KW	N/A - Offroad diesel engine	13	Diesel	1.14	3.03	14.06	0.93	1.00	0.97	0.52	1.39	6.45	0.43	0.46	0.45	0.02	0.05	0.25	0.02	0.02	0.02
1	1	Engine generator, 10 KW	N/A - Offroad diesel engine	21	Gasoline	9.79	3.16	4.99	0.27	0.33	0.32	7.25	2.34	3.70	0.20	0.24	0.24	0.28	0.09	0.14	0.01	0.01	0.01
4	4	Air compressor, 850-1200 cfm	Other Construction Equipment	106	Diesel	0.19	1.92	1.45	0.00	0.08	0.07	2.83	28.69	21.67	0.05	1.12	1.10	0.11	1.12	0.85	0.00	0.04	0.04
4	4	Drills - air/hydraulic track, jackleg, or sinker	Bore/Drill Rigs	291	Diesel	0.07	0.50	0.24	0.00	0.01	0.01	2.91	20.51	9.75	0.11	0.27	0.25	0.11	0.80	0.38	0.00	0.01	0.01
2	2	Submersible pump, 4" dia, 230 volt	Other Construction Equipment	53	Diesel	0.19	1.92	1.45	0.00	0.08	0.07	0.71	7.17	5.42	0.01	0.28	0.27	0.03	0.28	0.21	0.00	0.01	0.01

Key:

CO = carbon monoxide

PM10 = inhalable particulate matter

g/gal = grams per gallon

PM2.5 = fine particulate matter

g/hp-hr = grams per horsepower-hour

ROG = reactive organic gases

hp = horsepower

SO2 = sulfur dioxide

lbs/day = pounds per day

tpy = tons per day

	ROG	CO	NOx	SO2	PM10	PM2.5
Total Daily (lb/day)	25.97	159.30	116.91	1.05	5.85	5.27
Total Annual 2020 (tpy)	1.01	6.21	4.56	0.04	0.23	0.21

Legend:

Onroad vehicle - emissions estimated by EMFAC2007

Stationary source - emissions estimated by AP-42 for diesel engines

Table M7E. Unmitigated Off-Road Construction Equipment Emissions for Copco 2 (Alternative 2)

Quantity	Equipment Description	OFFROAD Category	Rating (hp)	Fuel Type	Fuel Amount (gal)	Total Hours	Peak Daily Hours	2020 Emission Factors (g/hp-hr or g/gal for on-highway sources)					Peak Daily Emissions (lbs/day)					2020 Emissions (tons per year)							
								ROG	CO	NOx	SOx	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5
1	Lattice boom crane, Manitowoc Crawler, 150T(US), 160'boom	Cranes	335	Diesel	12,111	1,096	8	0.10	0.35	0.64	0.00	0.02	0.02	0.58	2.06	3.77	0.01	0.14	0.13	0.04	0.14	0.26	0.00	0.01	0.01
2	Hydraulic yard crane, Grove 4x4x4, 13.6MT, 52' boom	Cranes	130	Diesel	7,749	1,904	8	0.17	1.23	1.05	0.00	0.06	0.05	0.77	5.65	4.82	0.01	0.26	0.24	0.05	0.34	0.29	0.00	0.02	0.01
2	Hydraulic excavator, 2.5 cy, long reach, Cat H120 Hoe Ram (3000 flb)	Excavators	321	Diesel	24,408	1,808	8	0.11	0.42	0.55	0.00	0.02	0.02	1.23	4.71	6.20	0.02	0.23	0.21	0.07	0.27	0.35	0.00	0.01	0.01
2	Hydraulic excavator, 2.5 cy	Excavators	321	Diesel	29,548	2,192	8	0.11	0.42	0.55	0.00	0.02	0.02	1.23	4.71	6.20	0.02	0.23	0.21	0.08	0.32	0.42	0.00	0.02	0.01
2	Articulated wheel loader, Cat966, 5.0 cy	Rubber Tired Loaders	246	Diesel	17,361	2,192	8	0.15	0.57	1.02	0.00	0.04	0.03	1.33	4.97	8.86	0.03	0.30	0.28	0.09	0.34	0.61	0.00	0.02	0.02
1	Articulated wheel loader, Cat988, 8.2 cy	Rubber Tired Loaders	475	Diesel	1,946	128	8	0.12	0.45	0.73	0.00	0.03	0.02	0.99	3.81	6.08	0.02	0.22	0.20	0.01	0.03	0.05	0.00	0.00	0.00
2	Dump truck, Cat740, 22.8-30 cy, 38.1 MT	Off-Highway Trucks	415	Diesel	11,686	1,408	8	0.14	0.49	0.68	0.00	0.02	0.02	1.98	7.23	9.94	0.04	0.36	0.33	0.09	0.32	0.44	0.00	0.02	0.01
1	Crawler dozer, Cat238	Crawler Tractors	238	Diesel	4,677	504	8	0.22	0.72	1.57	0.00	0.06	0.05	0.90	3.02	6.57	0.01	0.24	0.22	0.03	0.10	0.21	0.00	0.01	0.01
2	Pick-up truck, 1/2 ton, on-highway 4x4	N/A - Emfac	160	Diesel	4,209	2,192	8	2.34	18.31	43.09	0.10	2.11	1.61	0.16	1.24	2.92	0.01	0.14	0.11	0.01	0.08	0.20	0.00	0.01	0.01
1	Pick-up truck, 1 ton, on-highway 4x4	N/A - Emfac	195	Diesel	2,565	1,096	8	2.34	18.31	43.09	0.10	2.11	1.61	0.10	0.76	1.78	0.00	0.09	0.07	0.01	0.05	0.12	0.00	0.01	0.00
1	Water tanker, off-highway, 5000 gal	Off-Highway Trucks	175	Diesel	191	32	8	0.22	1.95	1.18	0.00	0.06	0.06	0.67	6.03	3.65	0.01	0.19	0.17	0.00	0.01	0.01	0.00	0.00	0.00
3	Engine generator, 6.5 KW	N/A - AP42 3.3-1	13	Diesel	2,302	3,288	8	1.14	3.03	14.06	0.93	1.00	0.97	0.78	2.08	9.67	0.64	0.69	0.67	0.05	0.14	0.66	0.04	0.05	0.05
2	Engine generator, 10 KW	N/A - AP42 3.3-1	21	Gasoline	3,968	2,192	8	9.79	3.16	4.99	0.27	0.33	0.32	7.25	2.34	3.70	0.20	0.24	0.24	0.50	0.16	0.25	0.01	0.02	0.02
1	Air compressor, 160 cfm, 100 psi	Other Construction Equipment	60	Diesel	2,367	1,096	8	0.19	1.92	1.45	0.00	0.08	0.07	0.20	2.03	1.53	0.00	0.08	0.08	0.01	0.14	0.11	0.00	0.01	0.01
2	Air compressor, 250 cfm, 100 psi	Other Construction Equipment	80	Diesel	6,313	2,192	8	0.19	1.92	1.45	0.00	0.08	0.07	0.53	5.41	4.09	0.01	0.21	0.21	0.04	0.37	0.28	0.00	0.01	0.01

Key:

CO = carbon monoxide

PM10 = inhalable particulate matter

g/gal = grams per gallon

PM2.5 = fine particulate matter

g/hp-hr = grams per horsepower-hour

ROG = reactive organic gases

hp = horsepower

SO2 = sulfur dioxide

lbs/day = pounds per day

tpy = tons per day

Legend:

Onroad vehicle - emissions estimated by EMFAC2007

Stationary source - emissions estimated by AP-42 for diesel engines

	ROG	CO	NOx	SO2	PM10	PM2.5
Total Daily (lb/day)	18.71	56.05	79.77	1.03	3.62	3.36
Total Annual 2020 (tpy)	1.07	2.81	4.25	0.07	0.20	0.19

Table M7F. Unmitigated Off-Road Construction Equipment Emissions for JC Boyle (Alternative 2)

Quantity	Equipment Description	Fuel Type	NONROAD Category	Rating (hp)	Fuel Amount (gal)	Total Hours	Hours	2020 Emission Factors (g/hp-hr or g/gal for on-highway sources)						Peak Daily Emissions (lbs/day)						2020 Emissions (tons per year)					
								VOC	CO	NOx	SOx	PM10	PM2.5	VOC	CO	NOx	SO2	PM10	PM2.5	VOC	CO	NOx	SO2	PM10	PM2.5
1	Lattice boom crane, Manitowoc Crawler, 150T(US), 160'boom	Diesel	Diesel Cranes	335	23,603	2,136	8	0.07	0.21	0.79	0.04	0.06	0.06	0.43	1.23	4.64	0.24	0.37	0.35	0.06	0.16	0.62	0.03	0.05	0.05
2	Hydraulic yard crane, Grove 4x4x4, 52' boom, 13.6MT	Diesel	Diesel Cranes	130	3,256	800	8	0.07	0.14	0.48	0.04	0.07	0.06	0.32	0.62	2.19	0.18	0.31	0.29	0.01	0.02	0.05	0.00	0.01	0.01
2	Hydraulic excavator, 2.5 cy, long reach, Cat H120 Hoe Ram (3000 ft)	Diesel	Diesel Excavators	321	57,672	4,272	8	0.09	0.22	0.59	0.05	0.09	0.08	0.98	2.53	6.65	0.59	0.99	0.93	0.13	0.34	0.89	0.08	0.13	0.12
2	Hydraulic excavator, 2.5 cy	Diesel	Diesel Excavators	321	57,587	4,272	8	0.09	0.22	0.59	0.05	0.09	0.08	0.98	2.53	6.65	0.59	0.99	0.93	0.13	0.34	0.89	0.08	0.13	0.12
1	Hydraulic excavator, 6 cy	Diesel	Diesel Excavators	513	11,014	488	8	0.09	0.22	0.59	0.05	0.09	0.08	0.78	2.02	5.32	0.47	0.79	0.75	0.02	0.06	0.16	0.01	0.02	0.02
2	Articulated wheel loader, Cat966, 5.0 cy	Diesel	Diesel Rubber Tire Loaders	246	11,912	1,504	8	0.09	0.18	0.56	0.05	0.09	0.08	0.79	1.55	4.84	0.45	0.76	0.71	0.04	0.07	0.23	0.02	0.04	0.03
5	Dump truck, Cat740, 22.8-30 cy, 38.1 MT	Diesel	Diesel Off-highway Trucks	415	16,600	2,000	8	0.08	0.12	0.31	0.05	0.08	0.07	3.04	4.22	11.32	1.81	2.83	2.65	0.08	0.11	0.28	0.05	0.07	0.07
1	Crawler dozer, Cat238	Diesel	Diesel Crawler Tractors	238	9,280	1,000	8	0.09	0.12	0.40	0.05	0.08	0.08	0.36	0.51	1.67	0.21	0.34	0.31	0.02	0.03	0.10	0.01	0.02	0.02
1	Pick-up truck, 1/2 ton, on-highway 4x4	Diesel	N/A - MOBILE	160	3,072	1,600	8	3.60	7.91	4.61	0.10	0.64	0.39	0.12	0.27	0.16	0.00	0.02	0.01	0.01	0.03	0.02	0.00	0.00	0.00
1	Pick-up trucks, 1 ton, on-highway 4x4	Diesel	N/A - MOBILE	195	3,744	1,600	8	3.60	7.91	4.61	0.10	0.64	0.39	0.15	0.33	0.19	0.00	0.03	0.02	0.01	0.03	0.02	0.00	0.00	0.00
1	Water tanker, off-highway, 5000 gal	Diesel	Diesel Off-highway Trucks	175	12,582	2,104	8	0.08	0.09	0.19	0.05	0.07	0.07	0.25	0.27	0.60	0.15	0.23	0.22	0.03	0.04	0.08	0.02	0.03	0.03
1	Engine generator, 6.5 KW	Diesel	N/A - AP42 3.3-1	13	1,495	2,136	8	1.14	3.03	14.06	0.93	1.00	0.94	0.26	0.69	3.22	0.21	0.23	0.21	0.03	0.09	0.43	0.03	0.03	0.03
1	Engine generator, 10 KW	Gasoline	N/A - AP42 3.3-1	21	3,446	1,904	8	9.79	3.16	4.99	0.27	0.33	0.31	3.63	1.17	1.85	0.10	0.12	0.11	0.43	0.14	0.22	0.01	0.01	0.01
1	Air compressor, 160 cfm, 100 psi	Diesel	Diesel Other Construction Equipment	60	5,754	2,136	8	0.12	0.88	1.94	0.06	0.14	0.13	0.13	0.94	2.05	0.07	0.15	0.14	0.02	0.12	0.27	0.01	0.02	0.02
2	Air compressor, 250 cfm, 100 psi	Diesel	Diesel Other Construction Equipment	80	12,303	4,272	8	0.12	0.97	1.00	0.06	0.17	0.16	0.34	2.75	2.81	0.17	0.49	0.46	0.05	0.37	0.38	0.02	0.06	0.06

Key:

CO = carbon monoxide

PM10 = inhalable particulate matter

g/gal = grams per gallon

PM2.5 = fine particulate matter

g/hp-hr = grams per horsepower-hour

ROG = reactive organic gases

hp = horsepower

SO2 = sulfur dioxide

lbs/day = pounds per day

tpy = tons per day

NOx = nitrogen oxides

Legend:

Onroad vehicle - emissions estimated by MOBILE6.2

Stationary source - emissions estimated by AP-42 for diesel engines

	VOC	CO	NOx	SO2	PM10	PM2.5
Total Daily (lb/day)	12.56	21.61	54.16	5.25	8.66	8.10
Total Annual 2020 (tpy)	1.08	1.95	4.64	0.38	0.64	0.60

Table M7G. Unmitigated Construction Worker Commute Emissions
Alternative 2 - Full Dam Removal

Round-Trip Commute Distance: 30 miles

Dam	Peak Workers	Duration (Days)	State
J.C. Boyle	45	47	Oregon
Copco 1	56	78	California
Copco 2	40	69	California
Iron Gate	80	83	California

1 2 3 4

Road Conditions	Average ADT	Average
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Dam	Peak Daily Emissions, lbs/day (2020)													
	ROG	CO	NOx	SOx	PM10 Total	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM10 Road Dust	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	PM2.5 Road Dust
J.C. Boyle	1.50	30.67	1.18	0.03	2.48	0.01	0.02	0.04	2.41	0.39	0.01	0.01	0.02	0.36
Copco 1	0.60	12.50	1.31	0.01	3.12	0.06	0.02	0.04	3.00	0.53	0.06	0.01	0.02	0.45
Copco 2	0.75	15.56	1.63	0.02	2.30	0.08	0.03	0.05	2.14	0.42	0.07	0.01	0.02	0.32
Iron Gate	0.53	11.11	1.16	0.01	4.39	0.05	0.02	0.03	4.29	0.71	0.05	0.01	0.01	0.64
Total	3.38	69.85	5.28	0.07	12.29	0.20	0.10	0.15	11.84	2.06	0.19	0.02	0.07	1.78
California %	56%	56%	78%	62%	80%	94%	76%	76%	80%	81%	94%	76%	76%	80%
Oregon %	44%	44%	22%	38%	20%	6%	24%	24%	20%	19%	6%	24%	24%	20%

Dam	Annual Emissions, tons/year (2020)													
	ROG	CO	NOx	SOx	PM10 Total	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM10 Road Dust	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	PM2.5 Road Dust
J.C. Boyle	0.04	0.72	0.03	0.00	0.06	0.00	0.00	0.00	0.06	0.01	0.00	0.00	0.00	0.01
Copco 1	0.02	0.49	0.05	0.00	0.12	0.00	0.00	0.00	0.12	0.02	0.00	0.00	0.00	0.02
Copco 2	0.03	0.54	0.06	0.00	0.08	0.00	0.00	0.00	0.07	0.01	0.00	0.00	0.00	0.01
Iron Gate	0.02	0.46	0.05	0.00	0.18	0.00	0.00	0.00	0.18	0.03	0.00	0.00	0.00	0.03
Total	0.11	2.21	0.18	0.00	0.44	0.01	0.00	0.01	0.43	0.07	0.01	0.00	0.00	0.06
California %	67%	67%	85%	72%	87%	96%	83%	84%	87%	87%	96%	83%	84%	87%
Oregon %	33%	33%	15%	28%	13%	4%	17%	16%	13%	13%	4%	17%	16%	13%

Key:

ADT = average daily traffic

CO = carbon monoxide

Ibs/day = pounds per day

NOx = nitrogen oxides

PM10 = inhalable particulate matter

PM2.5 = fine particulate matter

ROG = reactive organic gases

SOx = sulfur oxides

Table M7H. Daily Unmitigated Haul Truck Emissions
Alternative 2 - Full Facilities Removal (Proposed Action)

Dam	Waste Material	Peak Daily Trips	Round Trip Distance (mi)	Road Conditions		Average ADT		Daily Emissions (lbs/day) - 2020									
				ROG	CO	NOx	SOx	PM10 Total	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM10 Paved Road Dust	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	PM2.5 Paved Road Dust
J.C. Boyle (Oregon)	Earth	160	1	0.09	0.17	0.59	0.00	0.31	0.01	0.01	0.00	0.29	0.06	0.01	0.00	0.00	0.04
	Concrete	50	3	0.09	0.16	0.56	0.00	0.29	0.01	0.01	0.00	0.27	0.05	0.01	0.00	0.00	0.04
	Metal	10	44	0.26	0.46	1.64	0.01	0.85	0.03	0.03	0.01	0.79	0.16	0.03	0.01	0.01	0.12
	Building Waste	10	44	0.26	0.46	1.64	0.01	0.85	0.03	0.03	0.01	0.79	0.16	0.03	0.01	0.01	0.12
J.C. Boyle Subtotal		230	92	0.70	1.23	4.42	0.03	2.30	0.08	0.07	0.03	2.13	0.42	0.07	0.02	0.01	0.32
Copco 1 (California)	Concrete	50	2	0.12	0.55	1.50	0.00	0.24	0.05	0.01	0.01	0.18	0.08	0.04	0.00	0.00	0.03
	Metal	5	62	0.39	1.71	4.64	0.01	0.75	0.15	0.02	0.02	0.55	0.24	0.14	0.01	0.01	0.08
	Building Waste	5	62	0.39	1.71	4.64	0.01	0.75	0.15	0.02	0.02	0.55	0.24	0.14	0.01	0.01	0.08
	Copco 1 Subtotal	60	126	0.899	3.966	10.782	0.029	1.736	0.348	0.057	0.045	1.286	0.547	0.320	0.014	0.019	0.193
Copco 2 (California)	Earth	50	2	0.12	0.55	1.50	0.00	0.24	0.05	0.01	0.01	0.18	0.08	0.04	0.00	0.00	0.03
	Concrete (dam)	50	2	0.12	0.55	1.50	0.00	0.24	0.05	0.01	0.01	0.18	0.08	0.04	0.00	0.00	0.03
	Concrete (plant)	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Metal (dam)	5	62	0.39	1.71	4.64	0.01	0.75	0.15	0.02	0.02	0.55	0.24	0.14	0.01	0.01	0.08
	Metal (plant)	10	56	0.70	3.08	8.39	0.02	1.35	0.27	0.04	0.03	1.00	0.43	0.25	0.01	0.01	0.15
	Building Waste	10	56	0.70	3.08	8.39	0.02	1.35	0.27	0.04	0.03	1.00	0.43	0.25	0.01	0.01	0.15
	Wood-stave planks	2	240	0.60	2.64	7.19	0.02	1.16	0.23	0.04	0.03	0.86	0.36	0.21	0.01	0.01	0.13
Copco 2 Subtotal		127	418	2.63	11.62	31.60	0.08	5.09	1.02	0.17	0.13	3.77	1.60	0.94	0.04	0.06	0.57
Iron Gate (California)	Earth	800	2	2.00	8.81	23.96	0.06	3.86	0.77	0.13	0.10	2.86	1.21	0.71	0.03	0.04	0.43
	Concrete	50	2	0.12	0.55	1.50	0.00	0.24	0.05	0.01	0.01	0.18	0.08	0.04	0.00	0.00	0.03
	Metal	5	54	0.34	1.49	4.04	0.01	0.65	0.13	0.02	0.02	0.48	0.20	0.12	0.01	0.01	0.07
	Building Waste	5	54	0.34	1.49	4.04	0.01	0.65	0.13	0.02	0.02	0.48	0.20	0.12	0.01	0.01	0.07
Iron Gate Subtotal		860	112	2.80	12.34	33.54	0.09	5.40	1.08	0.18	0.14	4.00	1.70	1.00	0.04	0.06	0.60
Grand Total		1,277	748	7.03	29.16	80.35	0.24	14.53	2.53	0.47	0.35	11.18	4.27	2.33	0.12	0.15	1.68
California Total		1047	656	6.33	27.93	75.92	0.20	12.22	2.45	0.40	0.32	9.05	3.85	2.25	0.10	0.14	1.36
Oregon Total		230	92	0.70	1.23	4.42	0.03	2.30	0.08	0.07	0.03	2.13	0.42	0.07	0.02	0.01	0.32
California %		82%	88%	90%	96%	94%	86%	84%	97%	85%	91%	81%	90%	97%	85%	91%	81%
Oregon %		18%	12%	10%	4%	6%	14%	16%	3%	15%	9%	19%	10%	3%	15%	9%	19%

Key:

ADT = average daily traffic

CO = carbon monoxide

Ibs/day = pounds per day

mi = miles

NOx = nitrogen oxides

PM10 = inhalable particulate matter

PM2.5 = fine particulate matter

ROG = reactive organic gases

SOx = sulfur oxides

**Table M7I. Annual Unmitigated Haul Truck Emissions
Alternative 2 - Full Facilities Removal (Proposed Action)**

Dam	Waste Material	Annual Trips	Round Trip Distance (mi)	Road Conditions		Average ADT		Annual Emissions (tons per year) - 2020											
				ROG	CO	NOx	SOx	PM10 Total	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM10 Paved Road Dust	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	PM2.5 Paved Road Dust		
J.C. Boyle	Earth	8,500	1	0.00	0.00	0.02	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00		
	Concrete	2,600	3	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00		
	Metal	430	44	0.01	0.01	0.04	0.00	0.02	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00		
	Building Waste	200	44	0.00	0.00	0.02	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00		
J.C. Boyle Subtotal		11,730	92	0.01	0.02	0.08	0.00	0.04	0.00	0.00	0.00	0.04	0.01	0.00	0.00	0.00	0.01		
Copco 1 (California)	Concrete	4,000	2	0.00	0.02	0.06	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00		
	Metal	170	62	0.01	0.03	0.08	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00		
	Building Waste	30	62	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	Copco 1 Subtotal	4,200	126	0.01	0.06	0.15	0.00	0.02	0.00	0.00	0.00	0.02	0.01	0.00	0.00	0.00	0.00		
Copco 2 (California)	Earth	90	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	Concrete (dam)	400	2	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	Concrete (plant)	0	0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	Metal (dam)	45	62	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	Metal (plant)	145	56	0.01	0.02	0.06	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00		
	Building Waste	60	56	0.00	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	Wood-stave planks	45	240	0.01	0.03	0.08	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00		
Copco 2 Subtotal		785	418	0.02	0.07	0.20	0.00	0.03	0.01	0.00	0.00	0.02	0.01	0.01	0.00	0.00	0.00		
Iron Gate (California)	Earth	60,000	2	0.07	0.33	0.90	0.00	0.14	0.03	0.00	0.00	0.11	0.05	0.03	0.00	0.00	0.02		
	Concrete	750	2	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	Metal	130	54	0.00	0.02	0.05	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00		
	Building Waste	40	54	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
Iron Gate Subtotal		60,920	112	0.08	0.36	0.98	0.00	0.16	0.03	0.01	0.00	0.12	0.05	0.03	0.00	0.00	0.02		
				Grand Total															
		77,635		748	0.12	0.51	1.41	0.00	0.26	0.04	0.01	0.01	0.20	0.08	0.04	0.00	0.00	0.03	
	California Total	65,905	656	0.11	0.49	1.33	0.00	0.21	0.04	0.01	0.01	0.16	0.07	0.04	0.00	0.00	0.02		
	Oregon Total	11,730	92	0.01	0.02	0.08	0.00	0.04	0.00	0.00	0.00	0.04	0.01	0.00	0.00	0.00	0.01		
	California %	85%	88%	90%	96%	94%	85%	83%	97%	85%	90%	80%	90%	97%	85%	90%	80%		
	Oregon %	15%	12%	10%	4%	6%	15%	17%	3%	15%	10%	20%	10%	3%	15%	10%	20%		

Key:

ADT = average daily traffic

CO = carbon monoxide

mi = miles

NOx = nitrogen oxides

PM10 = inhalable particulate matter

PM2.5 = fine particulate matter

ROG = reactive organic gases

SOx = sulfur oxides

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Table M7J. Unmitigated Fugitive Dust Emissions
Alternative 2 - Full Dam Removal

Phase	Unmitigated Peak Daily Emissions, lbs/day							Max	
	PM ₁₀				PM _{2.5}				
	Iron Gate	Copco 1	Copco 2	JC Boyle	Iron Gate	Copco 1	Copco 2	JC Boyle	PM ₁₀
Cut/Fill Activities	156.08	2.06	1.41	79.14	32.60	0.43	0.29	16.53	236.63
Building Demolition	0.91	0.68	1.35	4.52	0.19	0.14	0.28	0.94	6.78
Drilling and Blasting	n/a	158.32	n/a	n/a	n/a	158.32	n/a	n/a	0.00
Total	156.99	161.06	2.77	83.66	32.79	158.89	0.58	17.47	243.42

Note:

Copco 1 dam removal activities occur before remaining three dams; therefore, Copco 1 is not included in the maximum daily emissions.

Phase	Unmitigated Annual Emissions (tons/year) - 2020							Grand Total	
	PM ₁₀				PM _{2.5}				
	Iron Gate	Copco 1	Copco 2	JC Boyle	Iron Gate	Copco 1	Copco 2	JC Boyle	PM ₁₀
Cut/Fill Activities	7.73	0.08	0.05	1.86	1.61	0.02	0.01	0.39	9.71
Building Demolition	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.02
Drilling and Blasting	n/a	7.03	n/a	n/a	n/a	7.03	n/a	n/a	7.03
Total	7.73	7.11	0.05	1.87	1.61	7.04	0.01	0.39	16.76

Key:

Ibs/day = pounds per day

PM2.5 = fine particulate matter

PM10 = inhalable particulate matter

Table M7K. URBEMIS Model Inputs for Iron Gate
Alternative 2 - Full Dam Removal

Iron Gate

WASTE (DISPOSED OFFSITE) - CUT/FILL VOLUMES

Construction Phase	Fine Site Grading	
Phase Start Date	June 1, 2020	
Phase End Date	September 23, 2020	
Work Days/Week	5	
Cut/Fill	1,320,000 cy	<u>Mitigation</u>
Truck Capacity	22 cy	1,320,000 cy
Total Truck Trips	60,000	22 cy
Duration	83 days	60,000
Daily Trips	723 trips/day	99 days
Amount of onsite cut/fill	15,904 cubic yards/day	606 trips/day
		13,333 cubic yards/day

Note: Phase end date modified to calculate correct daily cut/fill rate.

Area	571,900 sq. ft.
	13.13 acres

BUILDING DEMOLITION

Building Waste	10,800 cf
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Start Date	June 1, 2020
End Date	June 7, 2020
Work Days/Week	5

Width	23.2 ft	
Length	23.2 ft	
Height	20.0 ft	(estimated)
Volume	10,800 ft ³	

Daily Volume to be Demolished Concurrently

Width	10.4 ft
Length	10.4 ft
Height	20.0 ft
Volume	2,160 ft ³

Table M7L. URBEMIS Model Inputs for Copco 1
Alternative 2 - Full Dam Removal

Copco 1

BUILDING DEMOLITION

Building Waste 8,100 cf

	Dam Removal	Demo
Start Date	December 30, 2019	December 30, 2019
End Date	April 15, 2020	January 3, 2020
Work Days/Week	5	

Total Volume to be Removed

Width	20.1 ft
Length	20.1 ft
Height	20.0 ft
Volume	8,100 ft ³

(estimated)

Daily Volume to be Demolished Concurrently

Width	9.0 ft
Length	9.0 ft
Height	20.0 ft
Volume	1,620 ft ³

*Removal assumed to occur during equipment mobilization
to allow construction equipment to access the site.*

Area 100,085 sq. ft.
2.30 acres

**Table M7M. URBEMIS Model Inputs for Copco 2
Alternative 2 - Full Dam Removal**

Copco 2

WASTE (DISPOSED OFFSITE) - CUT/FILL VOLUMES

Construction Phase	Fine Site Grading
Work Days/Week	5
Phase Start Date	April 24, 2020
Phase End Date	July 29, 2020
Cut/Fill	1,800 cy
Truck Capacity	22 cy
Total Truck Trips	82
Duration	69 days
Daily Trips	1 trips/day
Amount of onsite cut/fill	26.09 cubic yards/day

BUILDING DEMOLITION

Building Waste	16,200 cf
----------------	-----------

	Demo
Start Date	April 24, 2020
End Date	April 28, 2020
Work Days/Week	5

Total Volume to be Removed

Width	28.5 ft
Length	28.5 ft
Height	20.0 ft
Volume	16,200 ft3

(estimated)

Daily Volume to be Demolished Concurrently

Width	12.7 ft
Length	12.7 ft
Height	20.0 ft
Volume	3,240 ft3

Area	120,590 sq. ft.
	2.77 acres

Table M7N. URBEMIS Inputs for JC Boyle
Alternative 2 - Full Dam Removal

J.C. Boyle

WASTE (DISPOSED OFFSITE) - CUT/FILL VOLUMES

Construction Phase	Fine Site Grading
Phase Start Date	May 29, 2020
Phase End Date	August 3, 2020
Work Days/Week	5
Cut/Fill	168,000 cy
Truck Capacity	22 cy
Total Truck Trips	7,636
Duration	47 days
Daily Trips	162 trips/day
Amount of onsite cut/fill	3,574.47 cubic yards/day
<i>Cut/fill volume includes quantities for cofferdam (2,000 cy) and soil cover (13,000 cy)</i>	
Area	423,140 sq. ft. 9.71 acres

BUILDING DEMOLITION

Building Waste	54,000
Start Date	May 29, 2020
End Date	June 5, 2020
Work Days/Week	5
Width	52.0 ft
Length	52.0 ft
Height	20.0 ft
Volume	54,000 ft ³
Daily Volume to be Demolished Concurrently	
Width	23.2 ft
Length	23.2 ft
Height	20.0 ft
Volume	10,800 ft ³

Table M7O. Daily Unmitigated Fugitive Dust Emissions from Unpaved Roads
Alternative 2 - Full Facilities Removal /Proposed Action

Dam	Waste Material	Disposal Site	Haul Route	One-way Distance (mi)	Trips Daily	Emissions (lbs/day)			Total PM _{2.5}									
						Loaded PM ₁₀	Empty PM _{2.5}	PM ₁₀										
J.C. Boyle (Oregon)	Earth Concrete	Right abutment site D/S scour hole	Existing unpaved haul road	0.5	160	5	1	4	9									
			Existing unpaved canal road	1.5	50	5	1	4	9									
				2	210	10	1	7	1									
Copco 1 (California)	Concrete	Right abutment site	Improve unpaved access road	1	50	3	0	2	5									
			Improve unpaved access road															
			Improve unpaved access road															
Copco 2 (California)	Earth Concrete (dam)	Right abutment site Right abutment site	Improve unpaved access road Improve unpaved access road	1	50	3	0	2	6									
Iron Gate (California)	Earth Concrete	Spillway and Left abutment borrow sites Left abutment site	Existing unpaved access roads Existing unpaved access roads	2	100	7	1	5	12									
Dust Control Measures																		
Water Exposed Surfaces																		
2x daily					55%													
3x daily					69%													

(values from URBEMIS)
Watering Frequency
Notes: "Trips" are one-way.

Water control
2x daily
3x daily

Table M7P. Annual Unmitigated Fugitive Dust Emissions from Unpaved Roads
Alternative 2 - Full Facilities Removal / Proposed Action

Dam	Waste Material	Disposal Site	Haul Route	One-way Distance (mi)	Trips Total	Emissions (tons/year) - 2020			
						Loaded PM ₁₀	Empty PM ₁₀	Total PM ₁₀	
J.C. Boyle (Oregon)	Earth Concrete	Right abutment site D/S scour hole	Existing unpaved haul road	0.5	8,500	0.14	0.10	0.24	
			Existing unpaved canal road	1.5	2,600	0.13	0.09	0.22	
Copco 1 (California)	Concrete	Right abutment site	Improve unpaved access road	2	11,100	0	0	0	
						Water control	0	0	
Copco 2 (California)	Earth Concrete (dam)	Right abutment site Right abutment site	Improve unpaved access road	1	4,000	0.13	0.01	0.23	
			Improve unpaved access road	1	90	0.00	0.00	0.01	
Iron Gate (California)	Earth Concrete	Spillway and Left abutment borrow sites Left abutment site	Existing unpaved access roads	1	400	0.01	0.01	0.02	
			Existing unpaved access roads	2	490	0	0	0	
Dust Control Measures						Water control	0	0	
<u>Water Exposed Surfaces</u>									
2x daily		55%							
3x daily		69%							

(values from URBEMIS)
Watering Frequency
Notes: "Trips" are one-way
2x daily
3x daily

Table M7Q. Emission Factors for Unpaved Road Dust

Criteria Pollutants

Unpaved Road Dust Emission Factor

$$E = k(s/12)^a (W/3)^b$$

Vehicles traveling on unpaved surfaces at industrial sites

where:

k, a, and b = empirical constants

E = size-specific emission factor (lb/VMT)

s = surface material silt content (%)

W = mean vehicle weight (tons)

Typical silt content values

Haul road = 0.1 % (Lowest silt content from Emission Factor documentation)

Emission Factor Documentation for AP-42, Section 13.2.2: Unpaved Roads (September 1998)

Truck Weight (CAT 740 articulated truck)

Empty = 36.5 ton

Loaded = 80.0 ton

Constants for Equation

Constant	Industrial Roads	
	PM _{2.5}	PM ₁₀
k (lb/VMT)	0.15	1.5
a	0.9	0.9
b	0.45	0.45

Natural Mitigation Emission Factor

$$E_{ext} = E[(365 - P)/365]$$

where:

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

E = unpaved road dust emission factor

P = number of days in a year with at least 0.254 mm (0.01 in) of precipitation

P = 88.3 days (Klamath Falls SSW) http://www.ocs.orst.edu/county_climate/Klamath_files/Klamath.html#table2a
= 84 days (Siskiyou County) <http://www.foreclosuredeals.com/list/ca/siskiyou/foreclosure-auctions/>

Unmitigated Emission Factors (lb/VMT)

Type	Haul Roads	
	PM ₁₀	PM _{2.5}
Empty	0.1	0.01
Loaded	0.1	0.01

Natural Mitigated Emission Factors (lb/VMT) - Klamath County

Type	Haul Roads	
	PM ₁₀	PM _{2.5}
Empty	0.0	0.00
Loaded	0.1	0.01

Natural Mitigated Emission Factors (lb/VMT) - Siskiyou County

Type	Haul Roads	
	PM ₁₀	PM _{2.5}
Empty	0.0	0.00
Loaded	0.1	0.01

Table M8A. Summary of Daily Unmitigated Off-Road Construction Emissions (Alternative 3)

Location	VOC	CO	NOx	SO2	PM10	PM2.5
Iron Gate	63	248	313	2	12	11
Copco 1	26	159	117	1	6	5
Copco 2	19	56	80	1	4	3
J.C. Boyle	12	19	49	5	8	7
Total	120	483	560	9	30	27
California %	90%	96%	91%	43%	73%	73%
Oregon %	10%	4%	9%	57%	27%	27%

Key:

CO = carbon monoxide

PM2.5 = fine particulate matter

NOx = nitrogen oxides

SO2 = sulfur dioxide

PM10 = inhalable particulate matter

VOC = volatile organic compounds

Table M8B. Summary of Annual Unmitigated Off-Road Construction Emissions (Alternative 3)

	Alternative 3 Unmitigated 2020 Annual Emissions - Construction Equipment (tpy)					
	VOC	CO	NOx	SO2	PM10	PM2.5
Iron Gate	2.6	10.3	13.0	0.1	0.5	0.5
Copco 1	1.0	6.2	4.6	0.0	0.2	0.2
Copco 2	1.0	2.4	3.7	0.1	0.2	0.2
J.C. Boyle	0.9	1.2	3.1	0.3	0.4	0.4
Total	5.5	20.1	24.4	0.4	1.3	1.2
California %	84%	94%	87%	40%	69%	69%
Oregon %	16%	6%	13%	60%	31%	31%

Key:

CO = carbon monoxide

PM2.5 = fine particulate matter

NOx = nitrogen oxides

SO2 = sulfur dioxide

PM10 = inhalable particulate matter

VOC = volatile organic compounds

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Table M8C. Unmitigated Off-Road Construction Equipment Emissions for Iron Gate Dam (Alternative 3)

Maximum Daily Work Hours 14 hours																						
Dam Removal Duration																						
		Start Date 6/1/2020																				
End Date 9/23/2020																						
		83 days (5 days/week)																				
		99 days (6 days/week)																				
Quantity	Equipment Description	OFFROAD Category	Rating (hp)	Fuel Type	2020 Emission Factors (g/hp-hr or g/gal for on-highway sources)			Peak Daily Emissions (lbs/day)			2020 Emissions (tons per year)											
1	Crane - crawler, 150-200 ton	Cranes	335	Diesel	0.10	0.35	0.64	0.00	0.02	0.02	1.02	3.60	6.59	0.02	0.24	0.22	0.04	0.15	0.27	0.00	0.01	0.01
1	Crane - rough terrain hydraulic, 50 ton	Cranes	130	Diesel	0.17	1.23	1.05	0.00	0.06	0.05	0.67	4.94	4.22	0.01	0.23	0.21	0.03	0.21	0.18	0.00	0.01	0.01
4	Excavator - 180,000-240,000 lb, Hitachi ZX870 to EX120	Excavators	646	Diesel	0.12	0.46	0.61	0.00	0.02	0.02	9.60	36.68	49.01	0.19	1.77	1.63	0.40	1.52	2.03	0.01	0.07	0.07
20	Dump truck - articulated, 35 ton, Cat 735	Off-Highway Trucks	435	Diesel	0.14	0.49	0.68	0.00	0.02	0.02	36.27	132.59	182.31	0.65	6.66	6.13	1.51	5.50	7.57	0.03	0.28	0.25
2	Dozer - D8	Rubber Tired Dozers	347	Diesel	0.21	0.84	1.53	0.00	0.06	0.06	4.45	18.05	32.69	0.05	1.31	1.20	0.18	0.75	1.36	0.00	0.05	0.05
1	Pick-up truck, 1/2 ton, on-highway 4x4	N/A - Onroad	191	Gasoline	2.76	59.09	7.36	0.09	0.90	0.64	0.20	4.38	0.54	0.01	0.07	0.05	0.01	0.18	0.02	0.00	0.00	0.00
1	Pick-up truck, 1/2 ton, on-highway 4x4	N/A - Onroad	160	Diesel	2.34	18.31	43.09	0.10	2.11	1.61	0.09	0.72	1.69	0.00	0.08	0.06	0.00	0.03	0.07	0.00	0.00	0.00
1	Pick-up truck, 1 ton, on-highway 4x4	N/A - Onroad	195	Diesel	2.34	18.31	43.09	0.10	2.11	1.61	0.11	0.87	2.06	0.00	0.10	0.08	0.00	0.04	0.09	0.00	0.00	0.00
1	Water tanker, off-highway, 5000 gal	Off-Highway Trucks	175	Diesel	0.22	1.95	1.18	0.00	0.06	0.06	1.17	10.55	6.39	0.02	0.33	0.30	0.05	0.44	0.27	0.00	0.01	0.01
1	Engine generator, 6.5 KW	N/A - Offroad diesel engine	13	Diesel	1.14	3.03	14.06	0.93	1.00	0.97	0.46	1.22	5.64	0.37	0.40	0.39	0.02	0.05	0.23	0.02	0.02	0.02
1	Engine generator, 10 KW	N/A - Offroad diesel engine	21	Gasoline	9.79	3.16	4.99	0.27	0.33	0.32	6.35	2.05	3.23	0.17	0.21	0.21	0.26	0.08	0.13	0.01	0.01	0.01
4	Submersible pump, 4" dia, 230 volt	Other Construction Equipment	175	Diesel	0.14	1.52	0.89	0.00	0.04	0.04	2.93	32.78	19.12	0.07	0.92	0.90	0.12	1.36	0.79	0.00	0.04	0.04

Key:

CO = carbon monoxide

PM10 = inhalable particulate matter

g/gal = grams per gallon

PM2.5 = fine particulate matter

g/hp-hr = grams per horsepower-hour

ROG = reactive organic gases

hp = horsepower

SO2 = sulfur dioxide

lbs/day = pounds per day

tpy = tons per day

NOx = nitrogen oxides

	ROG	CO	NOx	SO2	PM10	PM2.5
Total Daily (lb/day)	63.33	248.42	313.49	1.56	12.32	11.37
Total Annual 2020 (tpy)	2.63	10.31	13.01	0.06	0.51	0.47

Legend:

Onroad vehicle - emissions estimated by EMFAC2007

Stationary source - emissions estimated by AP-42 for diesel engines

Table M8D. Unmitigated Off-Road Construction Equipment Emissions for Copco 1 (Alternative 3)

Maximum Daily Work Hours

8

Dam Removal Duration

Start Date 12/30/2019
End Date 4/15/2020
78 (5 days/week)

Quantity		Equipment Description	OFFROAD Category	Rating (hp)	Fuel Type	2020 Emission Factors (g/hp-hr or g/gal for on-highway)					Peak Daily Emissions (lbs/day)					2020 Emissions (tons per year)							
Primary	Secondary					ROG	CO	NOx	SOx	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5
1	1	Crane - crawler, 150-200 ton	Cranes	335	Diesel	0.10	0.35	0.64	0.00	0.02	0.02	1.17	4.11	7.54	0.02	0.28	0.25	0.05	0.16	0.29	0.00	0.01	0.01
1	1	Crane - rough terrain hydraulic, 50 ton	Cranes	130	Diesel	0.17	1.23	1.05	0.00	0.06	0.05	0.77	5.65	4.82	0.01	0.26	0.24	0.03	0.22	0.19	0.00	0.01	0.01
1	0	Excavator - hydraulic ram	Excavators	321	Diesel	0.11	0.42	0.55	0.00	0.02	0.02	0.62	2.36	3.10	0.01	0.11	0.10	0.02	0.09	0.12	0.00	0.00	0.00
1	1	Excavator - 45,000-60,000 lb, Komatsu 220-350	Excavators	219.5	Diesel	0.15	0.59	0.82	0.00	0.03	0.03	1.16	4.60	6.31	0.03	0.22	0.20	0.05	0.18	0.25	0.00	0.01	0.01
3	0	Excavator - <20,000 lb	Excavators	168	Diesel	0.18	1.72	1.00	0.00	0.05	0.05	1.62	15.28	8.91	0.03	0.45	0.41	0.06	0.60	0.35	0.00	0.02	0.02
1	0	Loader - WA250 IT	Rubber Tired Loaders	138	Diesel	0.20	1.61	1.22	0.00	0.07	0.06	0.48	3.92	2.96	0.01	0.16	0.15	0.02	0.15	0.12	0.00	0.01	0.01
1	0	Loader - WA450	Rubber Tired Loaders	273	Diesel	0.12	0.45	0.73	0.00	0.03	0.02	0.57	2.19	3.50	0.01	0.13	0.12	0.02	0.09	0.14	0.00	0.00	0.00
2	0	Dump truck - articulated, 30 ton, Cat 730	Off-Highway Trucks	325	Diesel	0.14	0.49	0.68	0.00	0.02	0.02	1.55	5.66	7.78	0.03	0.28	0.26	0.06	0.22	0.30	0.00	0.01	0.01
1	1	Pick-up truck, 1/2 ton, on-highway 4x4	N/A - Onroad		Gasoline	2.76	59.09	7.36	0.09	0.90	0.64	0.71	15.18	1.89	0.02	0.23	0.16	0.03	0.59	0.07	0.00	0.01	0.01
1	1	Pick-up truck, 1/2 ton, on-highway 4x4	N/A - Onroad		Diesel	2.34	18.31	43.09	0.10	2.11	1.61	0.32	2.49	5.86	0.01	0.29	0.22	0.01	0.10	0.23	0.00	0.01	0.01
1	1	Pick-up truck, 1 ton, on-highway 4x4	N/A - Onroad		Diesel	2.34	18.31	43.09	0.10	2.11	1.61	0.39	3.03	7.14	0.02	0.35	0.27	0.02	0.12	0.28	0.00	0.01	0.01
1	1	Pick-up truck, 3/4 ton, on-highway 4x4	N/A - Onroad		Gasoline	2.76	59.09	7.36	0.09	0.90	0.64	1.06	22.67	2.82	0.03	0.35	0.24	0.04	0.88	0.11	0.00	0.01	0.01
1	1	Water tanker, off-highway, 5000 gal	Off-Highway Trucks	175	Diesel	0.22	1.95	1.18	0.00	0.06	0.06	1.34	12.05	7.30	0.02	0.37	0.34	0.05	0.47	0.28	0.00	0.01	0.01
1	1	Engine generator, 6.5 KW	N/A - Offroad diesel engine	13	Diesel	1.14	3.03	14.06	0.93	1.00	0.97	0.52	1.39	6.45	0.43	0.46	0.45	0.02	0.05	0.25	0.02	0.02	0.02
1	1	Engine generator, 10 KW	N/A - Offroad diesel engine	21	Gasoline	9.79	3.16	4.99	0.27	0.33	0.32	7.25	2.34	3.70	0.20	0.24	0.24	0.28	0.09	0.14	0.01	0.01	0.01
4	4	Air compressor, 850-1200 cfm	Other Construction Equipment	106	Diesel	0.19	1.92	1.45	0.00	0.08	0.07	2.83	28.69	21.67	0.05	1.12	1.10	0.11	1.12	0.85	0.00	0.04	0.04
4	4	Drills - air/hydraulic track, jackleg, or sinker	Bore/Drill Rigs	291	Diesel	0.07	0.50	0.24	0.00	0.01	0.01	2.91	20.51	9.75	0.11	0.27	0.25	0.11	0.80	0.38	0.00	0.01	0.01
2	2	Submersible pump, 4" dia, 230 volt	Other Construction Equipment	53	Diesel	0.19	1.92	1.45	0.00	0.08	0.07	0.71	7.17	5.42	0.01	0.28	0.27	0.03	0.28	0.21	0.00	0.01	0.01

Key:

CO = carbon monoxide

PM10 = inhalable particulate matter

g/gal = grams per gallon

PM2.5 = fine particulate matter

g/hp-hr = grams per horsepower-hour

ROG = reactive organic gases

hp = horsepower

SO2 = sulfur dioxide

lbs/day = pounds per day

tpy = tons per day

Legend:

- Onroad vehicle - emissions estimated by EMFAC2007
- Stationary source - emissions estimated by AP-42 for diesel engines

	ROG	CO	NOx	SO2	PM10	PM2.5
Total Daily (lb/day)	25.97	159.30	116.91	1.05	5.85	5.27
Total Annual 2020 (tpy)	1.01	6.21	4.56	0.04	0.23	0.21

Table M8E. Unmitigated Off-Road Construction Equipment Emissions for Copco 2 (Alternative 3)

Quantity	Equipment Description	OFFROAD Category	Rating (hp)	Fuel Type	Fuel Amount (gal)	Total Hours	Peak Daily Hours	2020 Emission Factors (g/hp-hr or g/gal for on-highway sources)						Peak Daily Emissions (lbs/day)						2020 Emissions (tons per year)					
								ROG	CO	NOx	SOx	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5
1	Lattice boom crane, Manitowoc Crawler, 150T(US), 160'boom	Cranes	335	Diesel	9,989	904	8	0.10	0.35	0.64	0.00	0.02	0.02	0.58	2.06	3.77	0.01	0.14	0.13	0.03	0.12	0.21	0.00	0.01	0.01
2	Hydraulic yard crane, Grove 4x4x4, 13.6MT, 52' boom	Cranes	130	Diesel	7,749	1,904	8	0.17	1.23	1.05	0.00	0.06	0.05	0.77	5.65	4.82	0.01	0.26	0.24	0.05	0.34	0.29	0.00	0.02	0.01
2	Hydraulic excavator, 2.5 cy, long reach, Cat H120 Hoe Ram (3000 flb)	Excavators	321	Diesel	16,200	1,200	8	0.11	0.42	0.55	0.00	0.02	0.02	1.23	4.71	6.20	0.02	0.23	0.21	0.05	0.18	0.23	0.00	0.01	0.01
2	Hydraulic excavator, 2.5 cy	Excavators	321	Diesel	24,372	1,808	8	0.11	0.42	0.55	0.00	0.02	0.02	1.23	4.71	6.20	0.02	0.23	0.21	0.07	0.27	0.35	0.00	0.01	0.01
2	Articulated wheel loader, Cat966, 5.0 cy	Rubber Tired Loaders	246	Diesel	17,361	2,192	8	0.15	0.57	1.02	0.00	0.04	0.03	1.33	4.97	8.86	0.03	0.30	0.28	0.09	0.34	0.61	0.00	0.02	0.02
1	Articulated wheel loader, Cat988, 8.2 cy	Rubber Tired Loaders	475	Diesel	1,946	128	8	0.12	0.45	0.73	0.00	0.03	0.02	0.99	3.81	6.08	0.02	0.22	0.20	0.01	0.03	0.05	0.00	0.00	0.00
2	Dump truck, Cat740, 22.8-30 cy, 38.1 MT	Off-Highway Trucks	415	Diesel	7,702	928	8	0.14	0.49	0.68	0.00	0.02	0.02	1.98	7.23	9.94	0.04	0.36	0.33	0.06	0.21	0.29	0.00	0.01	0.01
1	Crawler dozer, Cat238	Crawler Tractors	238	Diesel	4,677	504	8	0.22	0.72	1.57	0.00	0.06	0.05	0.90	3.02	6.57	0.01	0.24	0.22	0.03	0.10	0.21	0.00	0.01	0.01
2	Pick-up truck, 1/2 ton, on-highway 4x4	N/A - Emfac	160	Diesel	4,209	2,192	8	2.34	18.31	43.09	0.10	2.11	1.61	0.16	1.24	2.92	0.01	0.14	0.11	0.01	0.08	0.20	0.00	0.01	0.01
1	Pick-up truck, 1 ton, on-highway 4x4	N/A - Emfac	195	Diesel	2,565	1,096	8	2.34	18.31	43.09	0.10	2.11	1.61	0.10	0.76	1.78	0.00	0.09	0.07	0.01	0.05	0.12	0.00	0.01	0.00
1	Water tanker, off-highway, 5000 gal	Off-Highway Trucks	175	Diesel	191	32	8	0.22	1.95	1.18	0.00	0.06	0.06	0.67	6.03	3.65	0.01	0.19	0.17	0.00	0.01	0.01	0.00	0.00	0.00
3	Engine generator, 6.5 KW	N/A - AP42 3.3-1	13	Diesel	2,302	3,288	8	1.14	3.03	14.06	0.93	1.00	0.97	0.78	2.08	9.67	0.64	0.69	0.67	0.05	0.14	0.66	0.04	0.05	0.05
2	Engine generator, 10 KW	N/A - AP42 3.3-1	21	Gasoline	3,968	2,192	8	9.79	3.16	4.99	0.27	0.33	0.32	7.25	2.34	3.70	0.20	0.24	0.24	0.50	0.16	0.25	0.01	0.02	0.02
1	Air compressor, 160 cfm, 100 psi	Other Construction Equipment	60	Diesel	1,572	728	8	0.19	1.92	1.45	0.00	0.08	0.07	0.20	2.03	1.53	0.00	0.08	0.08	0.01	0.09	0.07	0.00	0.00	0.00
2	Air compressor, 250 cfm, 100 psi	Other Construction Equipment	80	Diesel	4,193	1,456	8	0.19	1.92	1.45	0.00	0.08	0.07	0.53	5.41	4.09	0.01	0.21	0.21	0.02	0.25	0.19	0.00	0.01	0.01

Key:

CO = carbon monoxide

g/gal = grams per gallon

g/hp-hr = grams per horsepower-hour

hp = horsepower

lbs/day = pounds per day

tpy = tons per day

PM10 = inhalable particulate matter

PM2.5 = fine particulate matter

ROG = reactive organic gases

SO2 = sulfur dioxide

Legend:

Onroad vehicle - emissions estimated by EMFAC2007

Stationary source - emissions estimated by AP-42 for diesel engines

ROG	CO	NOx	SO2	PM10	PM2.5
Total Daily (lb/day)	18.71	56.05	79.77	1.03	3.62
Total Annual 2020 (tpy)	0.98	2.36	3.73	0.07	0.18

Table M8F. Unmitigated Off-Road Construction Equipment Emissions for JC Boyle (Alternative 3)

Quantity	Equipment Description	Fuel Type	NONROAD Category	Rating (hp)	Fuel Amount (gal)	Total Hours	Peak Daily Hours	2020 Emission Factors (g/hp-hr or g/gal for on-highway sources)						Peak Daily Emissions (lbs/day)						2020 Emissions (tons per year)					
								VOC	CO	NOx	SOx	PM10	PM2.5	VOC	CO	NOx	SO2	PM10	PM2.5	VOC	CO	NOx	SO2	PM10	PM2.5
1	Lattice boom crane, Manitowoc Crawler, 150T(US), 160'boom	Diesel	Diesel Cranes	335	17,680	1,600	8	0.07	0.21	0.79	0.04	0.06	0.06	0.43	1.23	4.64	0.24	0.37	0.35	0.04	0.12	0.46	0.02	0.04	0.04
2	Hydraulic yard crane, Grove 4x4x4, 52' boom, 13.6MT	Diesel	Diesel Cranes	130	3,256	800	8	0.07	0.14	0.48	0.04	0.07	0.06	0.32	0.62	2.19	0.18	0.31	0.29	0.01	0.02	0.05	0.00	0.01	0.01
1	Hydraulic excavator, 2.5 cy, long reach, Cat H120 Hoe Ram (3000)	Diesel	Diesel Excavators	321	9,612	712	8	0.09	0.22	0.59	0.05	0.09	0.08	0.49	1.26	3.33	0.30	0.50	0.47	0.02	0.06	0.15	0.01	0.02	0.02
2	Hydraulic excavator, 2.5 cy	Diesel	Diesel Excavators	321	51,332	3,808	8	0.09	0.22	0.59	0.05	0.09	0.08	0.98	2.53	6.65	0.59	0.99	0.93	0.12	0.30	0.79	0.07	0.12	0.11
1	Hydraulic excavator, 6 cy	Diesel	Diesel Excavators	513	11,014	488	8	0.09	0.22	0.59	0.05	0.09	0.08	0.78	2.02	5.32	0.47	0.79	0.75	0.02	0.06	0.16	0.01	0.02	0.02
2	Articulated wheel loader, Cat966, 5.0 cy	Diesel	Diesel Rubber Tire Loaders	246	11,912	1,504	8	0.09	0.18	0.56	0.05	0.09	0.08	0.79	1.55	4.84	0.45	0.76	0.71	0.04	0.07	0.23	0.02	0.04	0.03
5	Dump truck, Cat740, 22.8-30 cy, 38.1 MT	Diesel	Diesel Off-highway Trucks	415	8,300	1,000	8	0.08	0.12	0.31	0.05	0.08	0.07	3.04	4.22	11.32	1.81	2.83	2.65	0.04	0.05	0.14	0.02	0.04	0.03
1	Crawler dozer, Cat238	Diesel	Diesel Crawler Tractors	238	9,280	1,000	8	0.09	0.12	0.40	0.05	0.08	0.08	0.36	0.51	1.67	0.21	0.34	0.31	0.02	0.03	0.10	0.01	0.02	0.02
1	Pick-up truck, 1/2 ton, on-highway 4x4	Diesel	N/A - MOBILE	160	3,072	1,600	8	3.60	7.91	4.61	0.10	0.64	0.39	0.12	0.27	0.16	0.00	0.02	0.01	0.01	0.03	0.02	0.00	0.00	0.00
1	Pick-up trucks, 1 ton, on-highway 4x4	Diesel	N/A - MOBILE	195	3,744	1,600	8	3.60	7.91	4.61	0.10	0.64	0.39	0.15	0.33	0.19	0.00	0.03	0.02	0.01	0.03	0.02	0.00	0.00	0.00
1	Water tanker, off-highway, 5000 gal	Diesel	Diesel Off-highway Trucks	175	12,582	2,104	8	0.08	0.09	0.19	0.05	0.07	0.07	0.25	0.27	0.60	0.15	0.23	0.22	0.03	0.04	0.08	0.02	0.03	0.03
1	Engine generator, 6.5 KW	Diesel	N/A - AP42 3.3-1	13	1,495	2,136	8	1.14	3.03	14.06	0.93	1.00	0.94	0.26	0.69	3.22	0.21	0.23	0.21	0.03	0.09	0.43	0.03	0.03	0.03
1	Engine generator, 10 KW	Diesel	N/A - AP42 3.3-1	21	3,446	1,904	8	9.79	3.16	4.99	0.27	0.33	0.31	3.63	1.17	1.85	0.10	0.12	0.11	0.43	0.14	0.22	0.01	0.01	0.01
1	Air compressor, 160 cfm, 100 psi	Diesel	Diesel Other Construction Equipment	60	2,888	1,072	8	0.12	0.88	1.94	0.06	0.14	0.13	0.13	0.94	2.05	0.07	0.15	0.14	0.01	0.06	0.14	0.00	0.01	0.01
1	Air compressor, 250 cfm, 100 psi	Diesel	Diesel Other Construction Equipment	80	3,087	1,072	8	0.12	0.97	1.00	0.06	0.17	0.16	0.17	1.37	1.41	0.09	0.24	0.23	0.01	0.09	0.09	0.01	0.02	0.02

Key:

CO = carbon monoxide

PM10 = inhalable particulate matter

g/gal = grams per gallon

PM2.5 = fine particulate matter

g/hp-hr = grams per horsepower-hour

ROG = reactive organic gases

hp = horsepower

SO2 = sulfur dioxide

lbs/day = pounds per day

tpy = tons per day

NOx = nitrogen oxides

Legend:

Onroad vehicle - emissions estimated by MOBILE6.2

Stationary source - emissions estimated by AP-42 for diesel engines

	VOC	CO	NOx	SO2	PM10	PM2.5
Total Daily (lb/day)	11.90	18.97	49.43	4.87	7.92	7.41
Total Annual 2020 (tpy)	0.86	1.20	3.09	0.25	0.41	0.38

Table M8G. Unmitigated Construction Worker Commute Emissions
Alternative 3 - Partial Dam Removal

Round-Trip Commute Distance: 30 miles

Dam	Peak Workers	Duration (Days)	State
J.C. Boyle	41	47	Oregon
Copco 1	56	78	California
Copco 2	38	69	California
Iron Gate	80	83	California
1	2	3	4

Road Conditions	Average ADT	Average
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Dam	Peak Daily Emissions, lbs/day (2020)													
	ROG	CO	NOx	SOx	PM10 Total	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM10 Road Dust	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	PM2.5 Road Dust
J.C. Boyle	1.37	27.94	1.07	0.02	2.26	0.01	0.02	0.03	2.20	0.36	0.01	0.01	0.01	0.33
Copco 1	0.55	11.39	1.19	0.01	3.11	0.06	0.02	0.03	3.00	0.52	0.05	0.01	0.01	0.45
Copco 2	0.75	15.56	1.63	0.02	2.19	0.08	0.03	0.05	2.04	0.40	0.07	0.01	0.02	0.31
Iron Gate	0.51	10.56	1.10	0.01	4.39	0.05	0.02	0.03	4.29	0.71	0.05	0.01	0.01	0.64
Total	3.17	65.45	5.00	0.06	11.95	0.19	0.09	0.15	11.52	1.99	0.18	0.02	0.06	1.73
California %	57%	57%	79%	63%	81%	95%	77%	77%	81%	82%	95%	77%	77%	81%
Oregon %	43%	43%	21%	37%	19%	5%	23%	23%	19%	18%	5%	23%	23%	19%

Dam	Annual Emissions, tons/year (2020)													
	ROG	CO	NOx	SOx	PM10 Total	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM10 Road Dust	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	PM2.5 Road Dust
J.C. Boyle	0.03	0.66	0.03	0.00	0.05	0.00	0.00	0.00	0.05	0.01	0.00	0.00	0.00	0.01
Copco 1	0.02	0.44	0.05	0.00	0.12	0.00	0.00	0.00	0.12	0.02	0.00	0.00	0.00	0.02
Copco 2	0.03	0.54	0.06	0.00	0.08	0.00	0.00	0.00	0.07	0.01	0.00	0.00	0.00	0.01
Iron Gate	0.02	0.44	0.05	0.00	0.18	0.00	0.00	0.00	0.18	0.03	0.00	0.00	0.00	0.03
Total	0.10	2.08	0.17	0.00	0.43	0.01	0.00	0.01	0.42	0.07	0.01	0.00	0.00	0.06
California %	68%	68%	85%	73%	88%	97%	84%	84%	88%	88%	97%	84%	84%	88%
Oregon %	32%	32%	15%	27%	12%	3%	16%	16%	12%	12%	3%	16%	16%	12%

Key:

ADT = average daily traffic

CO = carbon monoxide

Ibs/day = pounds per day

NOx = nitrogen oxides

PM10 = inhalable particulate matter

PM2.5 = fine particulate matter

ROG = reactive organic gases

SOx = sulfur oxides

Table M8H. Daily Unmitigated Haul Truck Emissions
Alternative 3 - Partial Facilities Removal

Dam	Waste Material	Peak Daily Trips	Round Trip Distance (mi)	Road Conditions		Daily Emissions (lbs/day) - 2020												
				ADT	Average	PM10 Total	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM10 Paved Road Dust	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	PM2.5 Paved Road Dust			
J.C. Boyle (Oregon)	Earth	160	1	0.09	0.17	0.59	0.00	0.31	0.01	0.01	0.29	0.06	0.01	0.00	0.00	0.04		
	Concrete	50	3	0.09	0.16	0.56	0.00	0.29	0.01	0.01	0.27	0.05	0.01	0.00	0.00	0.04		
	Metal	10	44	0.26	0.46	1.64	0.01	0.85	0.03	0.03	0.79	0.16	0.03	0.01	0.01	0.12		
	J.C. Boyle Subtotal	220	48	0.44	0.78	2.79	0.02	1.45	0.05	0.04	1.34	0.27	0.05	0.01	0.01	0.20		
Copco 1 (California)	Concrete	50	2	0.12	0.55	1.50	0.00	0.24	0.05	0.01	0.18	0.08	0.04	0.00	0.00	0.03		
	Metal	5	62	0.39	1.71	4.64	0.01	0.75	0.15	0.02	0.55	0.24	0.14	0.01	0.01	0.08		
	Copco 1 Subtotal	55	64	0.51	2.26	6.14	0.02	0.99	0.20	0.03	0.73	0.31	0.18	0.01	0.01	0.11		
Copco 2 (California)	Earth	0	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		
	Concrete	50	2	0.12	0.55	1.50	0.00	0.24	0.05	0.01	0.18	0.08	0.04	0.00	0.00	0.03		
	Metal	15	58	1.09	4.79	13.03	0.03	2.10	0.42	0.07	1.55	0.66	0.39	0.02	0.02	0.23		
Copco 2 Subtotal	Wood-stave planks	2	240	0.60	2.64	7.19	0.02	1.16	0.23	0.04	0.86	0.36	0.21	0.01	0.01	0.13		
	Copco 2 Subtotal	67	302	1.81	7.99	21.71	0.06	3.50	0.70	0.12	2.59	1.10	0.64	0.03	0.04	0.39		
Iron Gate (California)	Earth	800	2	2.00	8.81	23.96	0.06	3.86	0.77	0.13	0.10	2.86	1.21	0.71	0.03	0.04	0.43	
	Concrete	50	2	0.12	0.55	1.50	0.00	0.24	0.05	0.01	0.18	0.08	0.04	0.00	0.00	0.03		
	Metal	5	54	0.34	1.49	4.04	0.01	0.65	0.13	0.02	0.48	0.20	0.12	0.01	0.01	0.07		
Iron Gate Subtotal	Iron Gate Subtotal	855	58	2.46	10.85	29.50	0.08	4.75	0.95	0.16	0.12	3.52	1.50	0.88	0.04	0.05	0.53	
	Grand Total	1,197	472	5.22	21.87	60.14	0.17	10.69	1.90	0.35	0.26	8.18	3.17	1.75	0.09	0.11	1.23	
	California Total	977	424	4.78	21.10	57.35	0.15	9.23	1.85	0.30	0.24	6.84	2.91	1.70	0.08	0.10	1.03	
	Oregon Total	220	48	0.44	0.78	2.79	0.02	1.45	0.05	0.04	0.02	1.34	0.27	0.05	0.01	0.01	0.20	
	California %	82%	90%	92%	96%	95%	88%	86%	97%	87%	92%	84%	92%	97%	87%	92%	84%	
	Oregon %	18%	10%	8%	4%	5%	12%	14%	3%	13%	8%	16%	8%	3%	13%	8%	16%	

Source: U.S. Department of the Interior, Bureau of Reclamation. 2011. Detailed Plan for Dam Removal - Klamath River Dams. Klamath Hydroelectric Project, FERC License No. 2082, Oregon - California. June 15.

Key:

ADT = average daily traffic

PM10 = inhalable particulate matter

CO = carbon monoxide

PM2.5 = fine particulate matter

Ibs/day = pounds per day

ROG = reactive organic gases

mi = miles

SOx = sulfur oxides

NOx = nitrogen oxides

Table M8I. Annual Unmitigated Haul Truck Emissions
Alternative 3 - Partial Facilities Removal

		Road Conditions		Annual Emissions (tons per year) - 2020															
Dam	Waste Material	Annual Trips	Round Trip Distance (mi)	ADT	Average	ROG	CO	NOx	SOx	PM10 Total	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM10 Paved Road Dust	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	PM2.5 Paved Road Dust
J.C. Boyle	Earth	8,500	1	0.00	0.00	0.02	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	Concrete	1,300	3	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Metal	255	44	0.00	0.01	0.02	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	J.C. Boyle Subtotal	10,055	48	0.01	0.01	0.04	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00
Copco 1 (California)	Concrete	3,710	2	0.00	0.02	0.06	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	Metal	65	62	0.00	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Copco 1 Subtotal		3,775	64	0.01	0.03	0.09	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Copco 2 (California)	Earth	0	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Concrete	150	2	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Metal	50	58	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Wood-stave planks	45	240	0.01	0.03	0.08	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Copco 2 Subtotal		245	302	0.01	0.04	0.10	0.00	0.02	0.00	0.00	0.00	0.00	0.00	0.01	0.01	0.00	0.00	0.00	0.00
Iron Gate (California)	Earth	60,000	2	0.07	0.33	0.90	0.00	0.14	0.03	0.00	0.00	0.00	0.00	0.11	0.05	0.03	0.00	0.00	0.02
	Concrete	500	2	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Metal	75	54	0.00	0.01	0.03	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Iron Gate Subtotal		60,575	58	0.08	0.34	0.94	0.00	0.15	0.03	0.00	0.00	0.00	0.00	0.11	0.05	0.03	0.00	0.00	0.02
	Grand Total	74,650	472	0.10	0.43	1.17	0.00	0.20	0.04	0.01	0.01	0.01	0.16	0.06	0.03	0.00	0.00	0.02	
	California Total	64,595	424	0.09	0.41	1.13	0.00	0.18	0.04	0.01	0.00	0.00	0.13	0.06	0.03	0.00	0.00	0.02	
	Oregon Total	10,055	48	0.01	0.01	0.04	0.00	0.02	0.00	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00	
	California %	87%	90%	93%	97%	96%	90%	89%	98%	90%	94%	86%	93%	98%	90%	94%	86%		
	Oregon %	13%	10%	7%	3%	4%	10%	11%	2%	10%	6%	14%	7%	2%	10%	6%	14%		

Source: U.S. Department of the Interior, Bureau of Reclamation. 2011. Detailed Plan for Dam Removal - Klamath River Dams. Klamath Hydroelectric Project, FERC License No. 2082, Oregon - California. June 15.

Note:

Annual trips estimated from ratio of the quantity of waste disposed during Alternative 3 as compared to Alternative 2.

Key:

ADT = average daily traffic

PM10 = inhalable particulate matter

CO = carbon monoxide

PM2.5 = fine particulate matter

mi = miles

ROG = reactive organic gases

NOx = nitrogen oxides

SOx = sulfur oxides

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Table M8J. Unmitigated Fugitive Dust Emissions

Alternative 3 - Partial Dam Removal

Phase	Peak Daily Emissions, lbs/day								Max	
	PM ₁₀				PM _{2.5}					
	Iron Gate	Copco 1	Copco 2	JC Boyle	Iron Gate	Copco 1	Copco 2	JC Boyle	PM ₁₀	PM _{2.5}
Cut/Fill Activities	155.73	0.46	0.79	77.10	32.52	0.10	0.17	16.10	233.63	48.79
Building Demolition	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.00	0.00
Drilling and Blasting	n/a	158.32	n/a	n/a	n/a	158.32	n/a	n/a	0.00	0.00
Total	155.73	158.78	0.79	77.10	32.52	158.41	0.17	16.10	233.63	48.79

Note:

Copco 1 dam removal activities occur before remaining three dams; therefore, Copco 1 is not included in the maximum daily emissions.

Phase	Annual Emissions (tons/year) - 2020								Grand Total	
	PM ₁₀				PM _{2.5}					
	Iron Gate	Copco 1	Copco 2	JC Boyle	Iron Gate	Copco 1	Copco 2	JC Boyle	PM ₁₀	PM _{2.5}
Cut/Fill Activities	7.71	0.02	0.03	1.81	1.61	0.00	0.01	0.38	9.57	2.00
Building Demolition	n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.00	0.00
Drilling and Blasting	n/a	7.03	n/a	n/a	n/a	7.03	n/a	n/a	7.03	7.03
Total	7.71	7.05	0.03	1.81	1.61	7.03	0.01	0.38	16.59	9.03

Key:

lbs/day = pounds per day

PM2.5 = fine particulate matter

PM10 = inhalable particulate matter

Table M8K. URBEMIS Model Inputs for Iron Gate
Alternative 3 - Partial Dam Removal

Iron Gate

WASTE (DISPOSED OFFSITE) - CUT/FILL VOLUMES

Construction Phase	Fine Site Grading
Phase Start Date	June 1, 2020
Phase End Date	September 23, 2020
Work Days/Week	5
Cut/Fill	1,320,000 cy
Truck Capacity	22 cy
Total Truck Trips	60,000
Duration	83 days
Daily Trips	723 trips/day
Amount of onsite cut/fill	15,904 cubic yards/day

Note: Phase end date modified to calculate correct daily cut/fill rate.

Area	509,600 sq. ft.
	11.70 acres

BUILDING DEMOLITION

Buildings will not be removed at Iron Gate

<u>Mitigation</u>
1,320,000 cy
22 cy
60,000
99 days
606 trips/day
13,333 cubic yards/day

Table M8L. URBEMIS Model Inputs for Copco 1
Alternative 3 - Partial Dam Removal

Copco 1

FUGITIVE DUST

Area	44,680 sq. ft.
	1.03 acres

**Table M8M. URBEMIS Model Inputs for Copco 2
Alternative 3 - Partial Dam Removal**

Copco 2

WASTE (DISPOSED OFFSITE) - CUT/FILL VOLUMES

Construction Phase Fine Site Grading
Work Days/Week 5

BUILDING DEMOLITION

Buildings will not be removed at Copco 2

Construct Left Side Cofferdam

Phase Start Date	April 24, 2020
Phase End Date	July 29, 2020
Cut/Fill	1,800 cy
Truck Capacity	22 cy
Total Truck Trips	82
Duration	69 days
Daily Trips	1 trips/day
Amount of onsite cut/fill	26.09 cubic yards/day

Area	24,890 sq. ft.
	0.57 acres

Table M8N. URBEMIS Inputs for JC Boyle
Alternative 3 - Partial Dam Removal

J.C. Boyle

WASTE (DISPOSED OFFSITE) - CUT/FILL VOLUMES		BUILDING DEMOLITION
Construction Phase	Fine Site Grading	
Phase Start Date	May 29, 2020	Buildings will not be demolished
Phase End Date	August 3, 2020	
Work Days/Week	5	
Cut/Fill	168,000 cy	
Truck Capacity	22 cy	
Total Truck Trips	7,636	
Duration	47 days	
Daily Trips	162 trips/day	
Amount of onsite cut/fill	3,574.47 cubic yards/day	
<i>Cut/fill volume includes quantities for cofferdam (2,000 cy) and soil cover (13,000 cy)</i>		
Area	223,930 sq. ft. 5.14 acres	

**Table M8O. Daily Unmitigated Fugitive Dust Emissions from Unpaved Roads
Alternative 3 - Partial Facilities Removal**

Dam	Waste Material	Disposal Site	Haul Route	One-way Distance (mi)	Trips Daily	Emissions (lbs/day)			Total PM _{2.5}
						Loaded PM ₁₀	Empty PM _{2.5}	PM ₁₀ PM _{2.5}	
J.C. Boyle (Oregon)	Earth Concrete	Right abutment site D/S scour hole	Existing unpaved haul road Existing unpaved canal road	0.5 1.5	160 50	5 1	4 0	9 0	1
Copco 1 (California)	Concrete	Right abutment site	Improve unpaved access road	2	210	10	1	7 1	18 2
Copco 2 (California)	Earth Concrete (dam)	Right abutment site Right abutment site	Improve unpaved access road Improve unpaved access road	1 1	50 50	3 0	2 0	Water control	5 1
Iron Gate (California)	Earth Concrete	Spillway and Left abutment borrow sites Left abutment site	Existing unpaved access roads Existing unpaved access roads	2	850	58	6	41 4	99 10
Dust Control Measures								Water control	2 0
<u>Water Exposed Surfaces</u>									
2x daily	55%								
3x daily	69%								

(values from URBEMIS)
Watering Frequency
Notes: "Trips" are one-way.

Table M8P. Annual Unmitigated Fugitive Dust Emissions from Unpaved Roads
Alternative 3 - Partial Facilities Removal

Dam	Waste Material	Disposal Site	Haul Route	One-way Distance (mi)	Trips Total	Emissions (tons/year) - 2020					
						Loaded PM ₁₀	Empty PM ₁₀	PM _{2.5}	PM ₁₀	PM _{2.5}	
J.C. Boyle (Oregon)	Earth	Right abutment site	Existing unpaved haul road	0.5	8,500	0	0	0	0	0	
		D/S scour hole	Existing unpaved canal road	1.5	1,300	0	0	0	0	0	
	Concrete			2	9,800	0	0.0	0	0	0	
Copco 1 (California)	Concrete	Right abutment site	Improve unpaved access road	1	3,710	0	0	0	0	0	
Copco 2 (California)	Earth	Right abutment site	Improve unpaved access road	1	0	0	0	0	0	0	
		Right abutment site	Improve unpaved access road	1	150	0	0	0	0	0	
	Concrete (dam)			2	150	0.0	0.00	0.0	0.00	0.00	
Iron Gate (California)	Earth	Spillway and Left abutment borrow sites Left abutment site	Existing unpaved access roads Existing unpaved access roads	1	60,000	2	1	0	3	0.3	
Dust Control Measures											
<u>Water Exposed Surfaces</u>											
2x daily											
3x daily											

Water Exposed Surfaces
2x daily
3x daily

55%
69%

(values from URBEMS)
Watering Frequency
Notes: "Trips" are one-way.

Table M8Q. Emission Factors for Unpaved Road Dust

Criteria Pollutants

Unpaved Road Dust Emission Factor

$$E = k(s/12)^a (W/3)^b$$

Vehicles traveling on unpaved surfaces at industrial sites

where:

k, a, and b = empirical constants

E = size-specific emission factor (lb/VMT)

s = surface material silt content (%)

W = mean vehicle weight (tons)

Typical silt content values

Haul road = 0.1 % (Lowest silt content from Emission Factor documentation)

Emission Factor Documentation for AP-42, Section 13.2.2: Unpaved Roads (September 1998)

Truck Weight (CAT 740 articulated truck)

Empty = 36.5 ton

Loaded = 80.0 ton

Constants for Equation

Constant	Industrial Roads	
	PM _{2.5}	PM ₁₀
k (lb/VMT)	0.15	1.5
a	0.9	0.9
b	0.45	0.45

Natural Mitigation Emission Factor

$$E_{ext} = E[(365 - P)/365]$$

where:

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

E = unpaved road dust emission factor

P = number of days in a year with at least 0.254 mm (0.01 in) of precipitation

P = 88.3 days (Klamath Falls SSW) http://www.ocs.orst.edu/county_climate/Klamath_files/Klamath.html#table2a
= 84 days (Siskiyou County) <http://www.foreclosuredeals.com/list/ca/siskiyou/foreclosure-auctions/>

Unmitigated Emission Factors (lb/VMT)

Type	Haul Roads	
	PM ₁₀	PM _{2.5}
Empty	0.1	0.01
Loaded	0.1	0.01

Natural Mitigated Emission Factors (lb/VMT) - Klamath County

Type	Haul Roads	
	PM ₁₀	PM _{2.5}
Empty	0.0	0.00
Loaded	0.1	0.01

Natural Mitigated Emission Factors (lb/VMT) - Siskiyou County

Type	Haul Roads	
	PM ₁₀	PM _{2.5}
Empty	0.0	0.00
Loaded	0.1	0.01

Table M9A. Summary of Daily Unmitigated Off-Road Construction Emissions (Alternative 4)

Location	Year	VOC	CO	NOx	SO2	PM10	PM2.5
Iron Gate	2023	10	54	52	0	2	2
Copco 1	2025	9	51	37	0	2	1
Copco 2	2024	9	51	42	0	2	2
J.C. Boyle	2022	8	14	45	3	6	5
Maximum		10	54	52	3	6	5

Key:

CO = carbon monoxide

PM2.5 = fine particulate matter

NOx = nitrogen oxides

SO2 = sulfur dioxide

PM10 = inhalable particulate matter

VOC = volatile organic compounds

Table M9B. Summary of Annual Unmitigated Off-Road Construction Emissions (Alternative 4)

Location	Year	Alternative 4 Unmitigated Annual Emissions - Construction Equipment (tpy)					
		VOC	CO	NOx	SO2	PM10	PM2.5
Iron Gate	2023	0.8	4.2	4.2	0.0	0.2	0.2
Copco 1	2025	0.6	3.2	2.6	0.0	0.1	0.1
Copco 2	2024	0.1	0.8	0.6	0.0	0.0	0.0
J.C. Boyle	2022	0.3	0.5	1.4	0.1	0.2	0.2
Maximum		0.8	4.2	4.2	0.1	0.2	0.2

Key:

CO = carbon monoxide

PM2.5 = fine particulate matter

NOx = nitrogen oxides

SO2 = sulfur dioxide

PM10 = inhalable particulate matter

VOC = volatile organic compounds

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Table M9C. Unmitigated Off-Road Construction Equipment Emissions for Iron Gate Dam (Alternative 4)

Quantity	Equipment Description	OFFROAD Category	Rating (hp)	Fuel Type	Fuel Amount (gal)	Total Hours	Hours	2023 Emission Factors (g/hp-hr or g/gal for on-highway sources)					Peak Daily Emissions (lbs/day)					2023 Emissions (tons per year)								
								ROG	CO	NOx	SOx	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5	
1	Lattice boom crane, Manitowoc Crawler, 150T(US), 160'boom	Cranes	335	Diesel	23,409	2,280	8	0.09	0.33	0.45	0.00	0.02	0.02	0.50	1.93	2.69	0.01	0.10	0.09	0.07	0.28	0.38	0.00	0.01	0.01	0.01
2	Hydraulic yard crane, Grove 4x4x4, 52' boom, 13.6MT	Cranes	130	Diesel	13,936	3,424	8	0.14	1.23	0.75	0.00	0.04	0.04	0.62	5.64	3.44	0.01	0.18	0.17	0.07	0.60	0.37	0.00	0.02	0.02	0.02
1	Hydraulic excavator, 2.5 cy, long reach, Cat H120 Hoe Ram (3000 flb)	Excavators	321	Diesel	7,668	568	8	0.09	0.41	0.36	0.00	0.01	0.01	0.53	2.32	2.06	0.01	0.07	0.07	0.02	0.08	0.07	0.00	0.00	0.00	0.00
1	Hydraulic excavator, 2.5 cy	Excavators	321	Diesel	23,078	1,712	8	0.09	0.41	0.36	0.00	0.01	0.01	0.53	2.32	2.06	0.01	0.07	0.07	0.06	0.25	0.22	0.00	0.01	0.01	0.01
1	Articulated wheel loader, Cat966, 5.0 cy	Rubber Tired Loaders	246	Diesel	13,559	1,712	8	0.13	0.56	0.71	0.00	0.02	0.02	0.57	2.42	3.06	0.01	0.11	0.10	0.06	0.26	0.33	0.00	0.01	0.01	0.01
2	Dump truck, Cat740, 22.8-30 cy, 38.1 MT	Off-Highway Trucks	415	Diesel	18,990	2,288	8	0.12	0.49	0.46	0.00	0.02	0.02	1.71	7.10	6.67	0.04	0.24	0.22	0.12	0.51	0.48	0.00	0.02	0.02	0.02
1	Crawler dozer, Cat238	Crawler Tractors	238	Diesel	5,271	568	8	0.18	0.68	1.17	0.00	0.04	0.04	0.77	2.85	4.93	0.01	0.18	0.16	0.03	0.10	0.17	0.00	0.01	0.01	0.01
1	Pick-up truck, 1/2 ton, on-highway 4x4	N/A - Emfac	191	Gasoline	8,276	2,280	8	2.02	45.35	5.56	0.09	0.91	0.64	0.13	2.90	0.36	0.01	0.06	0.04	0.02	0.41	0.05	0.00	0.01	0.01	0.01
1	Pick-up truck, 1/2 ton, on-highway 4x4	N/A - Emfac	160	Diesel	4,378	2,280	8	2.28	17.90	43.33	0.10	2.08	1.58	0.08	0.61	1.47	0.00	0.07	0.05	0.01	0.09	0.21	0.00	0.01	0.01	0.01
1	Pick-up truck, 1 ton, on-highway 4x4	N/A - Emfac	195	Diesel	5,335	2,280	8	2.28	17.90	43.33	0.10	2.08	1.58	0.09	0.74	1.79	0.00	0.09	0.07	0.01	0.11	0.25	0.00	0.01	0.01	0.01
1	Water tanker, off-highway, 5000 gal	Off-Highway Trucks	175	Diesel	6,841	1,144	8	0.18	1.95	0.79	0.00	0.04	0.04	0.55	6.02	2.45	0.01	0.12	0.11	0.04	0.43	0.18	0.00	0.01	0.01	0.01
5	Concrete Mixer, 8 cy, rear discharge/Concrete pump truck	Other Construction Equipment	235	Diesel	36,975	4,560	8	0.08	0.42	0.36	0.00	0.01	0.01	1.63	8.68	7.53	0.05	0.26	0.24	0.09	0.49	0.43	0.00	0.01	0.01	0.01
1	Compactor, Cat, vibratory, self propelled, 84"	Rollers	138	Diesel	1,335	568	8	0.16	1.58	0.98	0.00	0.05	0.05	0.39	3.85	2.40	0.01	0.13	0.12	0.01	0.14	0.09	0.00	0.00	0.00	0.00
1	Engine generator, 6.5 KW	N/A - AP42 3.3-1	13	Diesel	1,439	2,056	8	1.14	3.03	14.06	0.93	1.00	0.97	0.26	0.69	3.22	0.21	0.23	0.22	0.03	0.09	0.41	0.03	0.03	0.03	0.03
2	Portable generator 1 KW	N/A - AP42 3.3-1	2.75	Gasoline	576	4,112	8	9.79	3.16	4.99	0.27	0.33	0.32	0.95	0.31	0.48	0.03	0.03	0.03	0.12	0.04	0.06	0.00	0.00	0.00	0.00
1	Air compressor, 160 cfm, 100 psi	Other Construction Equipment	60	Diesel	1,227	568	8	0.11	1.52	0.59	0.00	0.03	0.03	0.12	1.61	0.62	0.00	0.03	0.03	0.00	0.06	0.02	0.00	0.00	0.00	0.00
1	Air compressor, 250 cfm, 100 psi	Other Construction Equipment	80	Diesel	1,636	568	8	0.11	1.52	0.59	0.00	0.03	0.03	0.16	2.14	0.83	0.00	0.04	0.04	0.01	0.08	0.03	0.00	0.00	0.00	0.00
1	Dump truck, on-highway 8x4, 18 cy	N/A - Emfac	450	Diesel	14,415	1,144	8	2.31	10.55	26.15	0.10	1.13	0.84	0.51	2.34	5.81	0.02	0.25	0.19	0.04	0.17	0.42	0.00	0.02	0.01	0.01

Key:

CO = carbon monoxide

PM10 = inhalable particulate matter

g/gal = grams per gallon

PM2.5 = fine particulate matter

ROG = reactive organic gases

ROG = reactive organic gases

hp = horsepower

SO2 = sulfur dioxide

Ibs/day = pounds per day

tpy = tons per day

NOx = nitrogen oxides

Legend:

Onroad vehicle - emissions estimated by EMFAC2007

Stationary source - emissions estimated by AP-42 for diesel engines

	ROG	CO	NOx	SO2	PM10	PM2.5
Total Daily (lb/day)	10.11	54.48	51.85	0.45	2.25	2.01
Total Annual 2023 (tpy)	0.82	4.17	4.17	0.05	0.19	0.17

Table M9D. Unmitigated Off-Road Construction Equipment Emissions for Copco 1 (Alternative 4)

Quantity	Equipment Description	OFFROAD Category	Rating (hp)	Fuel Type	Fuel Amount (gal)	Total Hours	Peak Daily Hours	2025 Emission Factors (g/hp-hr or g/gal for on-highway sources)					Peak Daily Emissions (lbs/day)					2025 Emissions (tons per year)								
								ROG	CO	NOx	SOx	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5	
1	Lattice boom crane, Manitowoc Crawler, 150T(US), 160'boom	Cranes	335	Diesel	20,951	1,896	8	0.08	0.32	0.36	0.00	0.01	0.01	0.46	1.89	2.13	0.01	0.08	0.07	0.05	0.22	0.25	0.00	0.01	0.01	
2	Hydraulic yard crane, Grove 4x4x4, 52' boom, 13.6MT	Cranes	130	Diesel	11,591	2,848	8	0.12	1.23	0.60	0.00	0.03	0.03	0.55	5.63	2.73	0.01	0.14	0.13	0.05	0.50	0.24	0.00	0.01	0.01	
1	Hydraulic excavator, 2.5 cy, long reach, Cat H120 Hoe Ram (3000 flb)	Excavators	321	Diesel	6,372	472	8	0.09	0.41	0.28	0.00	0.01	0.01	0.49	2.31	1.59	0.01	0.05	0.05	0.01	0.07	0.05	0.00	0.00	0.00	0.00
1	Hydraulic excavator, 2.5 cy	Excavators	321	Diesel	19,196	1,424	8	0.09	0.41	0.28	0.00	0.01	0.01	0.49	2.31	1.59	0.01	0.05	0.05	0.04	0.21	0.14	0.00	0.00	0.00	
1	Articulated wheel loader, Cat966, 5.0 cy	Rubber Tired Loaders	246	Diesel	11,278	1,424	8	0.12	0.55	0.55	0.00	0.02	0.02	0.52	2.39	2.39	0.01	0.08	0.08	0.05	0.21	0.21	0.00	0.01	0.01	
2	Dump truck, Cat740, 22.8-30 cy, 38.1 MT	Off-Highway Trucks	415	Diesel	7,902	952	8	0.11	0.48	0.35	0.00	0.01	0.01	1.57	7.06	5.14	0.04	0.18	0.17	0.05	0.21	0.15	0.00	0.01	0.00	
1	Crawler dozer, Cat238	Crawler Tractors	238	Diesel	4,380	472	8	0.17	0.66	0.96	0.00	0.03	0.03	0.70	2.79	4.04	0.01	0.15	0.13	0.02	0.08	0.12	0.00	0.00	0.00	
1	Pick-up truck, 1/2 ton, on-highway 4x4	N/A - Emfac	191	Gasoline	6,882	1,896	8	1.66	39.46	4.66	0.09	0.91	0.64	0.11	2.53	0.30	0.01	0.06	0.04	0.01	0.30	0.04	0.00	0.01	0.00	
1	Pick-up truck, 1/2 ton, on-highway 4x4	N/A - Emfac	160	Diesel	3,640	1,896	8	2.15	17.66	43.39	0.10	1.99	1.50	0.07	0.60	1.47	0.00	0.07	0.05	0.01	0.07	0.17	0.00	0.01	0.01	
1	Pick-up truck, 1 ton, on-highway 4x4	N/A - Emfac	195	Diesel	4,437	1,896	8	2.15	17.66	43.39	0.10	1.99	1.50	0.09	0.73	1.79	0.00	0.08	0.06	0.01	0.09	0.21	0.00	0.01	0.01	
1	Water tanker, off-highway, 5000 gal	Off-Highway Trucks	175	Diesel	5,693	952	8	0.16	1.95	0.62	0.00	0.03	0.03	0.50	6.02	1.90	0.01	0.09	0.08	0.03	0.36	0.11	0.00	0.01	0.00	
5	Concrete Mixer, 8 cy, rear discharge/Concrete pump truck	Other Construction Equipment	235	Diesel	43,151	5,320	8	0.07	0.42	0.27	0.00	0.01	0.01	1.49	8.65	5.70	0.05	0.19	0.17	0.10	0.58	0.38	0.00	0.01	0.01	
1	Compactor, Cat, vibratory, self propelled, 84"	Rollers	138	Diesel	1,109	472	8	0.14	1.58	0.78	0.00	0.04	0.04	0.35	3.84	1.91	0.01	0.10	0.09	0.01	0.11	0.06	0.00	0.00	0.00	
1	Engine generator, 6.5 KW	N/A - AP42 3.3-1	13	Diesel	1,193	1,704	8	1.14	3.03	14.06	0.93	1.00	0.97	0.26	0.69	3.22	0.21	0.23	0.22	0.03	0.07	0.34	0.02	0.02	0.02	
2	Portable generator 1 KW	N/A - AP42 3.3-1	2.75	Gasoline	477	3,408	8	9.79	3.16	4.99	0.27	0.33	0.32	0.95	0.31	0.48	0.03	0.03	0.03	0.10	0.03	0.05	0.00	0.00	0.00	
1	Air compressor, 160 cfm, 100 psi	Other Construction Equipment	60	Diesel	1,020	472	8	0.10	1.52	0.45	0.00	0.02	0.02	0.11	1.61	0.47	0.00	0.02	0.02	0.00	0.05	0.01	0.00	0.00	0.00	
1	Air compressor, 250 cfm, 100 psi	Other Construction Equipment	80	Diesel	1,359	472	8	0.10	1.52	0.45	0.00	0.02	0.02	0.14	2.14	0.63	0.00	0.03	0.03	0.00	0.06	0.02	0.00	0.00	0.00	
1	Dump truck, on-highway 8x4, 18 cy	N/A - Emfac	450	Diesel	11,995	952	8	2.05	9.58	22.68	0.10	0.99	0.71	0.46	2.13	5.04	0.02	0.22	0.16	0.03	0.13	0.30	0.00	0.01	0.01	

Key:

CO = carbon monoxide

g/gal = grams per gallon

g/hp-hr = grams per horsepower-hour

hp = horsepower

lbs/day = pounds per day

NOx = nitrogen oxides

	ROG	CO	NOx	SO2	PM10	PM2.5
Total Daily (lb/day)	9.28	51.49	37.49	0.43	1.63	1.48
Total Annual 2025 (tpy)	0.61	3.22	2.57	0.04	0.12	0.11

Legend:

Onroad vehicle - emissions estimated by EMFAC2007

Stationary source - emissions estimated by AP-42 for diesel engines

Table M9E. Unmitigated Off-Road Construction Equipment Emissions for Copco 2 (Alternative 4)

Quantity	Equipment Description	OFFROAD Category	Rating (hp)	Fuel Type	Fuel Amount (gal)	Total Hours	Peak Daily Hours	2024 Emission Factors (g/hp-hr or g/gal for on-highway sources)					Peak Daily Emissions (lbs/day)					2024 Emissions (tons per year)								
								ROG	CO	NOx	SOx	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5	
1	Lattice boom crane, Manitowoc Crawler, 150T(US), 160'boom	Cranes	335	Diesel	4,862	440	8	0.08	0.32	0.40	0.00	0.01	0.01	0.48	1.91	2.39	0.01	0.09	0.08	0.01	0.05	0.07	0.00	0.00	0.00	0.00
2	Hydraulic yard crane, Grove 4x4x4, 13.6MT, 52' boom	Cranes	130	Diesel	2,670	656	8	0.13	1.23	0.67	0.00	0.04	0.03	0.58	5.63	3.06	0.01	0.16	0.15	0.01	0.12	0.06	0.00	0.00	0.00	0.00
1	Hydraulic excavator, 2.5 cy, long reach, Cat H120 Hoe Ram (3000 fib)	Excavators	321	Diesel	1,512	112	8	0.09	0.41	0.32	0.00	0.01	0.01	0.51	2.31	1.81	0.01	0.06	0.06	0.00	0.02	0.01	0.00	0.00	0.00	0.00
1	Hydraulic excavator, 2.5 cy	Excavators	321	Diesel	4,421	328	8	0.09	0.41	0.32	0.00	0.01	0.01	0.51	2.31	1.81	0.01	0.06	0.06	0.01	0.05	0.04	0.00	0.00	0.00	0.00
1	Articulated wheel loader, Cat966, 5.0 cy	Rubber Tired Loaders	246	Diesel	2,598	328	8	0.13	0.55	0.62	0.00	0.02	0.02	0.54	2.41	2.71	0.01	0.10	0.09	0.01	0.05	0.06	0.00	0.00	0.00	0.00
2	Dump truck, Cat740, 22.8-30 cy, 38.1 MT	Off-Highway Trucks	415	Diesel	3,718	448	8	0.11	0.48	0.40	0.00	0.01	0.01	1.63	7.08	5.86	0.04	0.21	0.19	0.02	0.10	0.08	0.00	0.00	0.00	0.00
1	Crawler dozer, Cat238	Crawler Tractors	238	Diesel	1,039	112	8	0.17	0.67	1.06	0.00	0.04	0.04	0.73	2.82	4.47	0.01	0.16	0.15	0.01	0.02	0.03	0.00	0.00	0.00	0.00
1	Pick-up truck, 1/2 ton, on-highway 4x4	N/A - Emfac	160	Diesel	845	440	8	1.82	42.10	5.08	0.09	0.91	0.64	0.06	1.43	0.17	0.00	0.03	0.02	0.00	0.04	0.00	0.00	0.00	0.00	
1	Pick-up truck, 1 ton, on-highway 4x4	N/A - Emfac	195	Diesel	1,030	440	8	1.82	42.10	5.08	0.09	0.91	0.64	0.08	1.74	0.21	0.00	0.04	0.03	0.00	0.05	0.01	0.00	0.00	0.00	
1	Water tanker, off-highway, 5000 gal	Off-Highway Trucks	175	Diesel	1,340	224	8	0.17	1.95	0.70	0.00	0.03	0.03	0.52	6.02	2.16	0.01	0.10	0.10	0.01	0.08	0.03	0.00	0.00	0.00	0.00
4	Concrete Mixer, 8 cy, rear discharge/Concrete pump truck	Other Construction Equipment	235	Diesel	5,709	704	8	0.08	0.42	0.32	0.00	0.01	0.01	1.24	6.93	5.24	0.04	0.18	0.16	0.01	0.08	0.06	0.00	0.00	0.00	0.00
1	Compactor, Cat, vibratory, self propelled, 84"	Rollers	138	Diesel	263	112	8	0.15	1.58	0.88	0.00	0.05	0.04	0.37	3.84	2.14	0.01	0.11	0.10	0.00	0.03	0.01	0.00	0.00	0.00	0.00
1	Engine generator, 6.5 KW	N/A - AP42 3.3-1	13	Diesel	280	400	8	1.14	3.03	14.06	0.93	1.00	0.97	0.26	0.69	3.22	0.21	0.23	0.22	0.01	0.02	0.08	0.01	0.01	0.01	0.01
2	Portable generator 1 KW	N/A - AP42 3.3-1	2.75	Gasoline	112	800	8	9.79	3.16	4.99	0.27	0.33	0.32	0.95	0.31	0.48	0.03	0.03	0.03	0.02	0.01	0.01	0.00	0.00	0.00	0.00
1	Air compressor, 160 cfm, 100 psi	Other Construction Equipment	60	Diesel	242	112	8	0.11	1.52	0.51	0.00	0.02	0.02	0.11	1.61	0.54	0.00	0.02	0.02	0.00	0.01	0.00	0.00	0.00	0.00	0.00
1	Air compressor, 250 cfm, 100 psi	Other Construction Equipment	80	Diesel	323	112	8	0.11	1.52	0.51	0.00	0.02	0.02	0.15	2.14	0.72	0.00	0.03	0.03	0.00	0.01	0.01	0.00	0.00	0.00	0.00
1	Dump truck, on-highway 8x4, 18 cy	N/A - Emfac	450	Diesel	2,822	224	8	2.16	10.00	24.18	0.10	1.05	0.77	0.48	2.22	5.37	0.02	0.23	0.17	0.01	0.03	0.08	0.00	0.00	0.00	0.00

Key:

CO = carbon monoxide

PM10 = inhalable particulate matter

g/gal = grams per gallon

PM2.5 = fine particulate matter

g/hp-hr = grams per horsepower-hour

ROG = reactive organic gases

hp = horsepower

SO2 = sulfur dioxide

lbs/day = pounds per day

tpy = tons per day

NOx = nitrogen oxides

	ROG	CO	NOx	SO2	PM10	PM2.5
Total Daily (lb/day)	9.21	51.40	42.36	0.44	1.85	1.66
Total Annual 2024 (tpy)	0.14	0.76	0.64	0.01	0.03	0.03

Legend:

Onroad vehicle - emissions estimated by EMFAC2007

Stationary source - emissions estimated by AP-42 for diesel engines

Table M9F. Unmitigated Off-Road Construction Equipment Emissions for JC Boyle (Alternative 4)

Quantity	Equipment Description	Fuel Type	NONROAD Category	Rating (hp)	Fuel Amount (gal)	Total Hours	Peak Daily Hours	2022 Emission Factors (g/hp-hr or g/gal for on-highway sources)						Peak Daily Emissions (lbs/day)						2022 Emissions (tons per year)					
								VOC	CO	NOx	SOx	PM10	PM2.5	VOC	CO	NOx	SO2	PM10	PM2.5	VOC	CO	NOx	SO2	PM10	PM2.5
1	Lattice boom crane, Manitowoc Crawler, 150T(US), 160'boom	Diesel	Diesel Cranes	335	10,696	968	8	0.07	0.16	0.60	0.04	0.06	0.06	0.40	0.97	3.57	0.23	0.36	0.34	0.02	0.06	0.22	0.01	0.02	0.02
2	Hydraulic yard crane, Grove 4x4x4, 52' boom, 13.6MT	Diesel	Diesel Cranes	130	5,926	1,456	8	0.06	0.09	0.32	0.04	0.06	0.06	0.30	0.41	1.49	0.17	0.28	0.26	0.01	0.02	0.07	0.01	0.01	0.01
1	Hydraulic excavator, 2.5 cy, long reach, Cat H120 Hoe Ram (3000	Diesel	Diesel Excavators	321	3,240	240	8	0.08	0.15	0.41	0.05	0.08	0.08	0.48	0.86	2.30	0.29	0.46	0.43	0.01	0.01	0.03	0.00	0.01	0.01
1	Hydraulic excavator, 2.5 cy	Diesel	Diesel Excavators	321	9,813	728	8	0.08	0.15	0.41	0.05	0.08	0.08	0.48	0.86	2.30	0.29	0.46	0.43	0.02	0.04	0.10	0.01	0.02	0.02
1	Articulated wheel loader, Cat966, 5.0 cy	Diesel	Diesel Rubber Tire Loaders	246	5,766	728	8	0.09	0.12	0.38	0.05	0.08	0.08	0.37	0.53	1.66	0.22	0.35	0.33	0.02	0.02	0.08	0.01	0.02	0.01
2	Dump truck, Cat740, 22.8-30 cy, 38.1 MT	Diesel	Diesel Off-highway Trucks	415	8,101	976	8	0.08	0.09	0.22	0.05	0.08	0.07	1.21	1.38	3.17	0.72	1.10	1.03	0.04	0.04	0.10	0.02	0.03	0.03
1	Crawler dozer, Cat238	Diesel	Diesel Crawler Tractors	238	2,227	240	8	0.08	0.09	0.26	0.05	0.08	0.07	0.35	0.40	1.09	0.21	0.32	0.30	0.01	0.01	0.02	0.00	0.00	0.00
1	Pick-up truck, 1/2 ton, on-highway 4x4	Diesel	N/A - MOBILE	160	1,859	968	8	3.13	7.29	3.89	0.10	0.59	0.35	0.11	0.25	0.13	0.00	0.02	0.01	0.01	0.01	0.01	0.00	0.00	0.00
1	Pick-up trucks, 1 ton, on-highway 4x4	Diesel	N/A - MOBILE	195	2,265	968	8	3.13	7.29	3.89	0.10	0.59	0.35	0.13	0.30	0.16	0.00	0.02	0.01	0.01	0.02	0.01	0.00	0.00	0.00
1	Water tanker, off-highway, 5000 gal	Diesel	Diesel Off-highway Trucks	175	2,918	488	8	0.08	0.08	0.17	0.05	0.07	0.07	0.25	0.26	0.52	0.15	0.23	0.21	0.01	0.01	0.02	0.00	0.01	0.01
4	Concrete Mixer, 8 cy, rear discharge/Concrete pump truck	Diesel	Diesel Cement & Mortar Mixers	235	12,455	1,536	8	0.11	0.27	1.13	0.04	0.08	0.07	1.74	4.45	18.67	0.69	1.30	1.22	0.04	0.11	0.45	0.02	0.03	0.03
1	Compactor, Cat, vibratory, self propelled, 84"	Diesel	Diesel Rollers	138	564	240	8	0.09	0.16	0.41	0.05	0.09	0.08	0.21	0.40	0.99	0.12	0.22	0.20	0.00	0.01	0.01	0.00	0.00	0.00
1	Engine generator, 6.5 KW	Diesel	N/A - AP42 3.3-1	13	610	872	8	1.14	3.03	14.06	0.93	1.00	0.94	0.26	0.69	3.22	0.21	0.23	0.21	0.01	0.04	0.18	0.01	0.01	0.01
2	Portable generator 1 KW	Gasoline	N/A - AP42 3.3-2	2.75	244	1,744	8	9.79	3.16	4.99	0.27	0.33	0.31	0.95	0.31	0.48	0.03	0.03	0.03	0.05	0.02	0.03	0.00	0.00	0.00
1	Air compressor, 160 cfm, 100 psi	Diesel	Diesel Other Construction Equipment	60	647	240	8	0.11	0.67	1.87	0.06	0.12	0.11	0.11	0.71	1.97	0.06	0.13	0.12	0.00	0.01	0.03	0.00	0.00	0.00
1	Air compressor, 250 cfm, 100 psi	Diesel	Diesel Other Construction Equipment	80	691	240	8	0.10	0.73	0.73	0.06	0.14	0.13	0.15	1.03	1.03	0.08	0.20	0.19	0.00	0.02	0.02	0.00	0.00	0.00
1	Dump truck, on-highway 8x4, 18 cy	Diesel	N/A - MOBILE	450	6,149	488	8	2.00	3.07	10.18	0.10	0.49	0.26	0.44	0.68	2.26	0.02	0.11	0.06	0.01	0.02	0.07	0.00	0.00	0.00

Key:

CO = carbon monoxide

g/gal = grams per gallon

g/hp-hr = grams per horsepower-hour

hp = horsepower

lbs/day = pounds per day

NOx = nitrogen oxides

Legend:

Onroad vehicle - emissions estimated by MOBILE6.2

Stationary source - emissions estimated by AP-42 for diesel engines

	VOC	CO	NOx	SO2	PM10	PM2.5
Total Daily (lb/day)	7.94	14.48	45.03	3.50	5.82	5.39
Total Annual 2022 (tpy)	0.28	0.46	1.42	0.11	0.18	0.17

Table M9G. Unmitigated Construction Worker Commute Emissions
Alternative 4 - Fish Passage at Four Dams

Round-Trip Commute Distance: 30 miles

Dam	Peak Workers	Duration (Days)	State
J.C. Boyle	20	179	Oregon
Copco 1	25	270	California
Copco 2	20	101	California
Iron Gate	30	344	California
1	2	3	4

Road Condition	Average ADT	Average
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Dam	Year	Peak Daily Emissions, lbs/day													
		ROG	CO	NOx	SOx	PM10 Total	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM10 Road Dust	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	PM2.5 Road Dust
J.C. Boyle	2022	0.00	0.00	0.00	0.00	1.07	0.00	0.00	0.00	1.07	0.16	0.00	0.00	0.00	0.16
Copco 1	2025	0.53	3.80	0.41	0.01	1.40	0.03	0.01	0.02	1.34	0.24	0.03	0.00	0.01	0.20
Copco 2	2024	0.47	3.38	0.37	0.01	1.12	0.03	0.01	0.02	1.07	0.19	0.02	0.00	0.01	0.16
Iron Gate	2023	0.77	5.69	0.62	0.01	1.69	0.04	0.02	0.02	1.61	0.29	0.04	0.00	0.01	0.24
Maximum		0.77	5.69	0.62	0.01	1.69	0.04	0.02	0.02	1.61	0.29	0.04	0.00	0.01	0.24

Dam	Year	Annual Emissions, tons/year													
		ROG	CO	NOx	SOx	PM10 Total	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM10 Road Dust	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	PM2.5 Road Dust
J.C. Boyle	2022	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.10	0.01	0.00	0.00	0.00	0.01
Copco 1	2025	0.07	0.51	0.06	0.00	0.19	0.00	0.00	0.00	0.18	0.03	0.00	0.00	0.00	0.03
Copco 2	2024	0.02	0.17	0.02	0.00	0.06	0.00	0.00	0.00	0.05	0.01	0.00	0.00	0.00	0.01
Iron Gate	2023	0.13	0.98	0.11	0.00	0.29	0.01	0.00	0.00	0.28	0.05	0.01	0.00	0.00	0.04
Total		0.23	1.66	0.18	0.00	0.63	0.01	0.01	0.01	0.61	0.11	0.01	0.00	0.00	0.09

Key:

ADT = average daily traffic

CO = carbon monoxide

lbs/day = pounds per day

NOx = nitrogen oxides

PM10 = inhalable particulate matter

PM2.5 = fine particulate matter

ROG = reactive organic gases

SOx = sulfur oxides

Table M9H. Daily Unmitigated Haul Truck Emissions
Alternative 4 - Fish Passage at Four Dams

Dam	Waste Material	Peak Daily Trips	Round Trip Distance (mi)	Road Conditions		Average ADT		Daily Emissions (lbs/day)									
				ROG	CO	NOx	SOx	PM10 Total	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM10 Paved Road Dust	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	PM2.5 Paved Road Dust
J.C. Boyle (Oregon) 2022	Concrete	9	148	0.76	1.16	3.85	0.04	2.56	0.07	0.08	0.04	2.38	0.46	0.07	0.02	0.02	0.36
	Rebar	1	121	0.07	0.11	0.35	0.00	0.23	0.01	0.01	0.00	0.22	0.04	0.01	0.00	0.00	0.03
	Wood	1	121	0.07	0.11	0.35	0.00	0.23	0.01	0.01	0.00	0.22	0.04	0.01	0.00	0.00	0.03
	J.C. Boyle Subtotal	11	390	0.89	1.37	4.55	0.05	3.03	0.08	0.09	0.04	2.81	0.54	0.08	0.02	0.02	0.42
Copco 1 (California) 2025	Concrete	9	59	0.45	2.11	4.99	0.02	1.17	0.14	0.04	0.03	0.95	0.30	0.13	0.01	0.01	0.14
	Rebar	1	120	0.10	0.48	1.13	0.00	0.26	0.03	0.01	0.01	0.21	0.07	0.03	0.00	0.00	0.03
	Wood	1	120	0.10	0.48	1.13	0.00	0.26	0.03	0.01	0.01	0.21	0.07	0.03	0.00	0.00	0.03
	Copco 1 Subtotal	11	299	0.66	3.06	7.24	0.03	1.69	0.21	0.06	0.05	1.38	0.43	0.19	0.02	0.02	0.21
Copco 2 (California) 2024	Concrete	9	59	0.48	2.20	5.32	0.02	1.18	0.16	0.04	0.03	0.95	0.31	0.14	0.01	0.01	0.14
	Rebar	1	120	0.11	0.50	1.20	0.00	0.27	0.04	0.01	0.01	0.21	0.07	0.03	0.00	0.00	0.03
	Wood	1	120	0.11	0.50	1.20	0.00	0.27	0.04	0.01	0.01	0.21	0.07	0.03	0.00	0.00	0.03
	Copco 2 Subtotal	11	299	0.69	3.19	7.72	0.03	1.71	0.23	0.06	0.05	1.38	0.45	0.21	0.02	0.02	0.21
Iron Gate (California) 2023	Concrete	9	50	0.43	1.97	4.88	0.02	1.01	0.15	0.04	0.03	0.80	0.28	0.14	0.01	0.01	0.12
	Rebar	1	90	0.09	0.39	0.98	0.00	0.20	0.03	0.01	0.01	0.16	0.06	0.03	0.00	0.00	0.02
	Wood	1	90	0.09	0.39	0.98	0.00	0.20	0.03	0.01	0.01	0.16	0.06	0.03	0.00	0.00	0.02
	Iron Gate Subtotal	11	230	0.60	2.76	6.83	0.03	1.42	0.21	0.05	0.04	1.13	0.39	0.19	0.01	0.02	0.17
	Maximum	11	390	0.89	3.19	7.72	0.05	3.03	0.23	0.09	0.05	2.81	0.54	0.21	0.02	0.02	0.42

Key:

ADT = average daily traffic

CO = carbon monoxide

Ibs/day = pounds per day

mi = miles

NOx = nitrogen oxides

PM10 = inhalable particulate matter

PM2.5 = fine particulate matter

ROG = reactive organic gases

SOx = sulfur oxides

Table M9I. Annual Unmitigated Haul Truck Emissions
Alternative 4 - Fish Passage at Four Dams

Dam	Waste Material	Annual Trips	Round Trip Distance (mi)	Road Conditions		Annual Emissions (tons per year)									
				ADT	Average	PM10 Total	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM10 Paved Road Dust	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	PM2.5 Paved Road Dust
J.C. Boyle 2022	Concrete	488	148	0.02	0.03	0.10	0.00	0.07	0.00	0.00	0.06	0.01	0.00	0.00	0.01
	Rebar	8	121	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Wood	4	121	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	J.C. Boyle Subtotal	500	390	0.02	0.03	0.11	0.00	0.07	0.00	0.00	0.07	0.01	0.00	0.00	0.01
Copco 1 (California) 2025	Concrete	725	59	0.02	0.08	0.20	0.00	0.05	0.01	0.00	0.04	0.01	0.01	0.00	0.01
	Rebar	13	120	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Wood	6	120	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Copco 1 Subtotal	744	299	0.02	0.09	0.21	0.00	0.05	0.01	0.00	0.04	0.01	0.01	0.00	0.01
Copco 2 (California) 2024	Concrete	250	59	0.01	0.03	0.07	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00
	Rebar	4	120	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Wood	3	120	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Copco 2 Subtotal	257	299	0.01	0.03	0.08	0.00	0.02	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Iron Gate (California) 2023	Concrete	900	50	0.02	0.10	0.24	0.00	0.05	0.01	0.00	0.04	0.01	0.01	0.00	0.01
	Rebar	16	90	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Wood	9	90	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Iron Gate Subtotal	925	230	0.02	0.10	0.26	0.00	0.05	0.01	0.00	0.04	0.01	0.01	0.00	0.01
	Maximum	925	390	0.02	0.10	0.26	0.00	0.07	0.01	0.00	0.07	0.01	0.01	0.00	0.01

Key:

ADT = average daily traffic

CO = carbon monoxide

mi = miles

NOx = nitrogen oxides

PM10 = inhalable particulate matter

PM2.5 = fine particulate matter

ROG = reactive organic gases

SOx = sulfur oxides

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Table M9J. Unmitigated Fugitive Dust Emissions
Alternative 4 - Fish Passage at Four Dams

Phase	Year-->	Peak Daily Emissions, lbs/day								Maximum			
		PM ₁₀				PM _{2.5}							
		2023	2025	2024	2022	2023	2025	2024	2022				
		Iron Gate	Copco 1	Copco 2	JC Boyle	Iron Gate	Copco 1	Copco 2	JC Boyle	PM ₁₀	PM _{2.5}		
Cut/Fill Activities		2.27	0.64	0.44	0.92	0.47	0.13	0.09	0.19	2.27	0.47		
Building Demolition		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.00	0.00		
Drilling and Blasting		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.00	0.00		
Total		2.27	0.64	0.44	0.92	0.47	0.13	0.09	0.19	2.27	0.47		

Phase	Year-->	Annual Emissions (tons/year)								Maximum			
		PM ₁₀				PM _{2.5}							
		2023	2025	2024	2022	2023	2025	2024	2022				
		Iron Gate	Copco 1	Copco 2	JC Boyle	Iron Gate	Copco 1	Copco 2	JC Boyle	PM ₁₀	PM _{2.5}		
Cut/Fill Activities		0.30	0.07	0.02	0.06	0.06	0.01	0.00	0.01	0.30	0.06		
Building Demolition		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.00	0.00		
Drilling and Blasting		n/a	n/a	n/a	n/a	n/a	n/a	n/a	n/a	0.00	0.00		
Total		0.30	0.07	0.02	0.06	0.06	0.01	0.00	0.01	0.30	0.06		

Table M9K. URBEMIS Model Inputs for Iron Gate Alternative 4 - Fish Passage at Four Dams

Iron Gate

CONSTRUCTION EQUIPMENT FUGITIVE DUST		BUILDING DEMOLITION
Phase Start Date	1/1/2023	Buildings will not be removed at Iron Gate
Phase End Date	12/31/2023	
Area	222,530 sq. ft. 5.11 acres	
Workdays	260	

Table M9L. URBEMIS Model Inputs for Copco 1
Alternative 4 - Fish Passage at Four Dams

Copco 1

CONSTRUCTION EQUIPMENT FUGITIVE DUST BUILDING DEMOLITION

Phase Start Date	2/1/2025	No buildings will be demolished at Copco 1
Phase End Date	11/30/2025	
Area	63,780 sq. ft. 1.46 acres	
Workdays	215	

Table M9M. URBEMIS Model Inputs for Copco 2
Alternative 4 - Fish Passage at Four Dams

Copco 2

CONSTRUCTION EQUIPMENT FUGITIVE DUST BUILDING DEMOLITION

Phase Start Date	6/1/2024	
Phase End Date	9/30/2024	Buildings will not be removed at Copco 2
Area	43,490 sq. ft.	
	1.00 acres	

Note: Square feet adjusted to calculate acres correctly
(call with Scott Wright, 11/19/10)

Workdays	86
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**Table M9N. URBEMIS Inputs for JC Boyle
Alternative 4 - Fish Passage at Four Dams**

J.C. Boyle

CONSTRUCTION EQUIPMENT FUGITIVE DUST BUILDING DEMOLITION

Phase Start Date	5/1/2022	No buildings will be demolished at JC Boyle
Phase End Date	10/31/2022	
Area	90,810 sq. ft. 2.08 acres	
Workdays	131	

Table M10A. Summary of Daily Unmitigated Off-Road Construction Emissions (Alternative 5)

Location	VOC	CO	NOx	SO2	PM10	PM2.5
Iron Gate	63	248	313	2	12	11
Copco 1	26	159	117	1	6	5
Copco 2	11	52	70	0	3	3
J.C. Boyle	8	18	56	4	6	6
Total	109	478	557	7	27	25
California %	92%	96%	90%	46%	77%	77%
Oregon %	8%	4%	10%	54%	23%	23%

Key:

CO = carbon monoxide

PM2.5 = fine particulate matter

NOx = nitrogen oxides

SO2 = sulfur dioxide

PM10 = inhalable particulate matter

VOC = volatile organic compounds

Table M10B. Summary of Annual Unmitigated Off-Road Construction Emissions (Alternative 5)

Location	VOC	CO	NOx	SO2	PM10	PM2.5
Iron Gate	2.6	10.3	13.0	0.1	0.5	0.5
Copco 1	1.0	6.2	4.6	0.0	0.2	0.2
Copco 2	0.2	0.7	1.1	0.0	0.0	0.0
J.C. Boyle	0.3	0.6	1.8	0.1	0.2	0.2
Total	4.1	17.8	20.4	0.2	1.0	0.9
California %	93%	97%	91%	50%	80%	80%
Oregon %	7%	3%	9%	50%	20%	20%

Key:

CO = carbon monoxide

PM2.5 = fine particulate matter

NOx = nitrogen oxides

SO2 = sulfur dioxide

PM10 = inhalable particulate matter

VOC = volatile organic compounds

Table M10C. Unmitigated Off-Road Construction Equipment Emissions for Iron Gate Dam (Alternative 5)

Maximum Daily Work Hours 14 hours																									
Dam Removal Duration																									
Start Date 6/1/2020		End Date 9/23/2020		83 days (5 days/week)		99 days (6 days/week)																			
Quantity	Equipment Description	OFFROAD Category	Rating (hp)	Fuel Type	2020 Emission Factors (g/hp-hr or g/gal for on-highway sources)	ROG	CO	NOx	SOx	PM10	PM2.5	Peak Daily Emissions (lbs/day)	ROG	CO	NOx	SO2	PM10	PM2.5	2020 Emissions (tons per year)	ROG	CO	NOx	SO2	PM10	PM2.5
1	Crane - crawler, 150-200 ton	Cranes	335	Diesel	0.10	0.35	0.64	0.00	0.02	0.02	1.02	3.60	6.59	0.02	0.24	0.22	0.04	0.15	0.27	0.00	0.01	0.01			
1	Crane - rough terrain hydraulic, 50 ton	Cranes	130	Diesel	0.17	1.23	1.05	0.00	0.06	0.05	0.67	4.94	4.22	0.01	0.23	0.21	0.03	0.21	0.18	0.00	0.01	0.01			
4	Excavator - 180,000-240,000 lb, Hitachi ZX870 to EX120	Excavators	646	Diesel	0.12	0.46	0.61	0.00	0.02	0.02	9.60	36.68	49.01	0.19	1.77	1.63	0.40	1.52	2.03	0.01	0.07	0.07			
20	Dump truck - articulated, 35 ton, Cat 735	Off-Highway Trucks	435	Diesel	0.14	0.49	0.68	0.00	0.02	0.02	36.27	132.59	182.31	0.65	6.66	6.13	1.51	5.50	7.57	0.03	0.28	0.25			
2	Dozer - D8	Rubber Tired Dozers	347	Diesel	0.21	0.84	1.53	0.00	0.06	0.06	4.45	18.05	32.69	0.05	1.31	1.20	0.18	0.75	1.36	0.00	0.05	0.05			
1	Pick-up truck, 1/2 ton, on-highway 4x4	N/A - Onroad	191	Gasoline	2.76	59.09	7.36	0.09	0.90	0.64	0.20	4.38	0.54	0.01	0.07	0.05	0.01	0.18	0.02	0.00	0.00	0.00			
1	Pick-up truck, 1/2 ton, on-highway 4x4	N/A - Onroad	160	Diesel	2.34	18.31	43.09	0.10	2.11	1.61	0.09	0.72	1.69	0.00	0.08	0.06	0.00	0.03	0.07	0.00	0.00	0.00			
1	Pick-up truck, 1 ton, on-highway 4x4	N/A - Onroad	195	Diesel	2.34	18.31	43.09	0.10	2.11	1.61	0.11	0.87	2.06	0.00	0.10	0.08	0.00	0.04	0.09	0.00	0.00	0.00			
1	Water tanker, off-highway, 5000 gal	Off-Highway Trucks	175	Diesel	0.22	1.95	1.18	0.00	0.06	0.06	1.17	10.55	6.39	0.02	0.33	0.30	0.05	0.44	0.27	0.00	0.01	0.01			
1	Engine generator, 6.5 KW	N/A - Offroad diesel engine	13	Diesel	1.14	3.03	14.06	0.93	1.00	0.97	0.46	1.22	5.64	0.37	0.40	0.39	0.02	0.05	0.23	0.02	0.02	0.02			
1	Engine generator, 10 KW	N/A - Offroad diesel engine	21	Gasoline	9.79	3.16	4.99	0.27	0.33	0.32	6.35	2.05	3.23	0.17	0.21	0.21	0.26	0.08	0.13	0.01	0.01	0.01			
4	Submersible pump, 4" dia, 230 volt	Other Construction Equipment	175	Diesel	0.14	1.52	0.89	0.00	0.04	0.04	2.93	32.78	19.12	0.07	0.92	0.90	0.12	1.36	0.79	0.00	0.04	0.04			

Key:

CO = carbon monoxide

g/gal = grams per gallon

g/hp-hr = grams per horsepower-hour

hp = horsepower

lbs/day = pounds per day

NOx = nitrogen oxides

PM10 = inhalable particulate matter

PM2.5 = fine particulate matter

ROG = reactive organic gases

SO2 = sulfur dioxide

tpy = tons per day

	ROG	CO	NOx	SO2	PM10	PM2.5
Total Daily (lb/day)	63.33	248.42	313.49	1.56	12.32	11.37
Total Annual 2020 (tpy)	2.63	10.31	13.01	0.06	0.51	0.47

Legend:

Onroad vehicle - emissions estimated by EMFAC2007

Stationary source - emissions estimated by AP-42 for diesel engines

Table M10D. Unmitigated Off-Road Construction Equipment Emissions for Copco 1 (Alternative 5)

Maximum Daily Work Hours

8

Dam Removal Duration

12/30/2019

Start Date

4/15/2020

End Date

78 (5 days/week)

Quantity		Equipment Description	OFFROAD Category	Rating (hp)	Fuel	2020 Emission Factors (g/hp-hr or g/gal for on-highway)					Peak Daily Emissions (lbs/day)					2020 Emissions (tons per year)							
Primary	Secondary					ROG	CO	NOx	SOx	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5
1	1	Crane - crawler, 150-200 ton	Cranes	335	Diesel	0.10	0.35	0.64	0.00	0.02	0.02	1.17	4.11	7.54	0.02	0.28	0.25	0.05	0.16	0.29	0.00	0.01	0.01
1	1	Crane - rough terrain hydraulic, 50 ton	Cranes	130	Diesel	0.17	1.23	1.05	0.00	0.06	0.05	0.77	5.65	4.82	0.01	0.26	0.24	0.03	0.22	0.19	0.00	0.01	0.01
1	0	Excavator - hydraulic ram	Excavators	321	Diesel	0.11	0.42	0.55	0.00	0.02	0.02	0.62	2.36	3.10	0.01	0.11	0.10	0.02	0.09	0.12	0.00	0.00	0.00
1	1	Excavator - 45,000-60,000 lb, Komatsu 220-350	Excavators	219.5	Diesel	0.15	0.59	0.82	0.00	0.03	0.03	1.16	4.60	6.31	0.03	0.22	0.20	0.05	0.18	0.25	0.00	0.01	0.01
3	0	Excavator - <20,000 lb	Excavators	168	Diesel	0.18	1.72	1.00	0.00	0.05	0.05	1.62	15.28	8.91	0.03	0.45	0.41	0.06	0.60	0.35	0.00	0.02	0.02
1	0	Loader - WA250 IT	Rubber Tired Loaders	138	Diesel	0.20	1.61	1.22	0.00	0.07	0.06	0.48	3.92	2.96	0.01	0.16	0.15	0.02	0.15	0.12	0.00	0.01	0.01
1	0	Loader - WA450	Rubber Tired Loaders	273	Diesel	0.12	0.45	0.73	0.00	0.03	0.02	0.57	2.19	3.50	0.01	0.13	0.12	0.02	0.09	0.14	0.00	0.00	0.00
2	0	Dump truck - articulated, 30 ton, Cat 730	Off-Highway Trucks	325	Diesel	0.14	0.49	0.68	0.00	0.02	0.02	1.55	5.66	7.78	0.03	0.28	0.26	0.06	0.22	0.30	0.00	0.01	0.01
1	1	Pick-up truck, 1/2 ton, on-highway 4x4	N/A - Onroad		Gasoline	2.76	59.09	7.36	0.09	0.90	0.64	0.71	15.18	1.89	0.02	0.23	0.16	0.03	0.59	0.07	0.00	0.01	0.01
1	1	Pick-up truck, 1/2 ton, on-highway 4x4	N/A - Onroad		Diesel	2.34	18.31	43.09	0.10	2.11	1.61	0.32	2.49	5.86	0.01	0.29	0.22	0.01	0.10	0.23	0.00	0.01	0.01
1	1	Pick-up truck, 1 ton, on-highway 4x4	N/A - Onroad		Diesel	2.34	18.31	43.09	0.10	2.11	1.61	0.39	3.03	7.14	0.02	0.35	0.27	0.02	0.12	0.28	0.00	0.01	0.01
1	1	Pick-up truck, 3/4 ton, on-highway 4x4	N/A - Onroad		Gasoline	2.76	59.09	7.36	0.09	0.90	0.64	1.06	22.67	2.82	0.03	0.35	0.24	0.04	0.88	0.11	0.00	0.01	0.01
1	1	Water tanker, off-highway, 5000 gal	Off-Highway Trucks	175	Diesel	0.22	1.95	1.18	0.00	0.06	0.06	1.34	12.05	7.30	0.02	0.37	0.34	0.05	0.47	0.28	0.00	0.01	0.01
1	1	Engine generator, 6.5 KW	N/A - Offroad diesel engine	13	Diesel	1.14	3.03	14.06	0.93	1.00	0.97	0.52	1.39	6.45	0.43	0.46	0.45	0.02	0.05	0.25	0.02	0.02	0.02
1	1	Engine generator, 10 KW	N/A - Offroad diesel engine	21	Gasoline	9.79	3.16	4.99	0.27	0.33	0.32	7.25	2.34	3.70	0.20	0.24	0.24	0.28	0.09	0.14	0.01	0.01	0.01
4	4	Air compressor, 850-1200 cfm	Other Construction Equipment	106	Diesel	0.19	1.92	1.45	0.00	0.08	0.07	2.83	28.69	21.67	0.05	1.12	1.10	0.11	1.12	0.85	0.00	0.04	0.04
4	4	Drills - air/hydraulic track, jackleg, or sinker	Bore/Drill Rigs	291	Diesel	0.07	0.50	0.24	0.00	0.01	0.01	2.91	20.51	9.75	0.11	0.27	0.25	0.11	0.80	0.38	0.00	0.01	0.01
2	2	Submersible pump, 4" dia, 230 volt	Other Construction Equipment	53	Diesel	0.19	1.92	1.45	0.00	0.08	0.07	0.71	7.17	5.42	0.01	0.28	0.27	0.03	0.28	0.21	0.00	0.01	0.01

Key:

CO = carbon monoxide

g/gal = grams per gallon

g/hp-hr = grams per horsepower-hour

hp = horsepower

lbs/day = pounds per day

NOx = nitrogen oxides

PM10 = inhalable particulate matter

PM2.5 = fine particulate matter

ROG = reactive organic gases

SO2 = sulfur dioxide

tpy = tons per day

	ROG	CO	NOx	SO2	PM10	PM2.5
Total Daily (lb/day)	25.97	159.30	116.91	1.05	5.85	5.27
Total Annual 2020 (tpy)	1.01	6.21	4.56	0.04	0.23	0.21

Legend:

Onroad vehicle - emissions estimated by EMFAC2007

Stationary source - emissions estimated by AP-42 for diesel engines

Table M10E. Unmitigated Off-Road Construction Equipment Emissions for Copco 2 (Alternative 5)

Quantity	Equipment Description	OFFROAD Category	Rating (hp)	Fuel Type	Fuel Amount (gal)	Total Hours	Peak Daily Hours	2020 Emission Factors (g/hp-hr or g/gal for on-highway sources)						Peak Daily Emissions (lbs/day)					2020 Emissions (tons per year)						
								ROG	CO	NOx	SOx	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5	ROG	CO	NOx	SO2	PM10	PM2.5
1	Lattice boom crane, Manitowoc Crawler, 150T(US), 160'boom	Cranes	335	Diesel	4,862	440	8	0.10	0.35	0.64	0.00	0.02	0.02	0.58	2.06	3.77	0.01	0.14	0.13	0.02	0.06	0.10	0.00	0.00	0.00
2	Hydraulic yard crane, Grove 4x4x4, 13.6MT, 52' boom	Cranes	130	Diesel	2,670	656	8	0.17	1.23	1.05	0.00	0.06	0.05	0.77	5.65	4.82	0.01	0.26	0.24	0.02	0.12	0.10	0.00	0.01	0.00
1	Hydraulic excavator, 2.5 cy, long reach, Cat H120 Hoe Ram (3000 flb)	Excavators	321	Diesel	1,512	112	8	0.11	0.42	0.55	0.00	0.02	0.02	0.62	2.36	3.10	0.01	0.11	0.10	0.00	0.02	0.02	0.00	0.00	0.00
1	Hydraulic excavator, 2.5 cy	Excavators	321	Diesel	4,421	328	8	0.11	0.42	0.55	0.00	0.02	0.02	0.62	2.36	3.10	0.01	0.11	0.10	0.01	0.05	0.06	0.00	0.00	0.00
1	Articulated wheel loader, Cat966, 5.0 cy	Rubber Tired Loaders	246	Diesel	2,598	328	8	0.15	0.57	1.02	0.00	0.04	0.03	0.67	2.49	4.43	0.01	0.15	0.14	0.01	0.05	0.09	0.00	0.00	0.00
2	Dump truck, Cat740, 22.8-30 cy, 38.1 MT	Off-Highway Trucks	415	Diesel	3,718	448	8	0.14	0.49	0.68	0.00	0.02	0.02	1.98	7.23	9.94	0.04	0.36	0.33	0.03	0.10	0.14	0.00	0.01	0.00
1	Crawler dozer, Cat238	Crawler Tractors	238	Diesel	1,039	112	8	0.22	0.72	1.57	0.00	0.06	0.05	0.90	3.02	6.57	0.01	0.24	0.22	0.01	0.02	0.05	0.00	0.00	0.00
1	Pick-up truck, 1/2 ton, on-highway 4x4	N/A - Emfac	160	Diesel	845	440	8	2.34	18.31	43.09	0.10	2.11	1.61	0.08	0.62	1.46	0.00	0.07	0.05	0.00	0.02	0.04	0.00	0.00	0.00
1	Pick-up truck, 1 ton, on-highway 4x4	N/A - Emfac	195	Diesel	1,030	440	8	2.34	18.31	43.09	0.10	2.11	1.61	0.10	0.76	1.78	0.00	0.09	0.07	0.00	0.02	0.05	0.00	0.00	0.00
1	Water tanker, off-highway, 5000 gal	Off-Highway Trucks	175	Diesel	1,340	224	8	0.22	1.95	1.18	0.00	0.06	0.06	0.67	6.03	3.65	0.01	0.19	0.17	0.01	0.08	0.05	0.00	0.00	0.00
4	Concrete Mixer, 8 cy, rear discharge/Concrete pump truck	Other Construction Equipment	235	Diesel	5,709	704	8	0.09	0.42	0.55	0.00	0.02	0.02	1.52	7.03	9.12	0.04	0.32	0.29	0.02	0.08	0.10	0.00	0.00	0.00
1	Compactor, Cat, vibratory, self propelled, 84"	Rollers	138	Diesel	263	112	8	0.20	1.58	1.38	0.00	0.07	0.07	0.49	3.85	3.35	0.01	0.18	0.16	0.00	0.03	0.02	0.00	0.00	0.00
1	Engine generator, 6.5 KW	N/A - AP42 3.3-1	13	Diesel	280	400	8	1.14	3.03	14.06	0.93	1.00	0.97	0.26	0.69	3.22	0.21	0.23	0.22	0.01	0.02	0.08	0.01	0.01	0.01
1	Air compressor, 160 cfm, 100 psi	Other Construction Equipment	60	Diesel	242	112	8	0.19	1.92	1.45	0.00	0.08	0.07	0.20	2.03	1.53	0.00	0.08	0.07	0.00	0.01	0.01	0.00	0.00	0.00
1	Air compressor, 250 cfm, 100 psi	Other Construction Equipment	80	Diesel	323	112	8	0.19	1.92	1.45	0.00	0.08	0.07	0.27	2.71	2.04	0.01	0.11	0.10	0.00	0.02	0.01	0.00	0.00	0.00
1	Dump truck, on-highway 8x4, 18 cy	N/A - Emfac	450	Diesel	2,822	224	8	3.00	13.26	36.04	0.10	1.50	1.18	0.67	2.95	8.01	0.02	0.33	0.26	0.01	0.04	0.11	0.00	0.00	0.00
2	Portable generator 1 KW	N/A - AP42 3.3-1	2.75	Gasoline	112	800	8	9.79	3.16	4.99	0.27	0.33	0.30	0.95	0.31	0.48	0.03	0.03	0.03	0.02	0.01	0.01	0.00	0.00	0.00

Key:

CO = carbon monoxide

g/gal = grams per gallon

g/hp-hr = grams per horsepower-hour

hp = horsepower

lbs/day = pounds per day

tpy = tons per day

PM10 = inhalable particulate matter

PM2.5 = fine particulate matter

ROG = reactive organic gases

SO2 = sulfur dioxide

tpy = tons per day

Legend:

Onroad vehicle - emissions estimated by EMFAC2007

Stationary source - emissions estimated by AP-42 for diesel engines

	ROG	CO	NOx	SO2	PM10	PM2.5
Total Daily (lb/day)	11.33	52.12	70.38	0.44	3.01	2.71
Total Annual 2020 (tpy)	0.17	0.74	1.06	0.01	0.05	0.04

Table M10F. Unmitigated Off-Road Construction Equipment Emissions for JC Boyle (Alternative 5)

Quantity	Equipment Description	Fuel Type	NONROAD Category	Rating (hp)	Fuel Amount (gal)	Total Hours	Hours	Peak Daily 2020 Emission Factors (g/hp-hr or g/gal for on-highway sources)						Peak Daily Emissions (lbs/day)						2020 Emissions (tons per year)					
								VOC	CO	NOx	SOx	PM10	PM2.5	VOC	CO	NOx	SO2	PM10	PM2.5	VOC	CO	NOx	SO2	PM10	PM2.5
1	Lattice boom crane, Manitowoc Crawler, 150T(US), 160'boom	Diesel	Diesel Cranes	335	10,696	968	8	0.07	0.21	0.79	0.04	0.06	0.06	0.43	1.23	4.64	0.24	0.37	0.35	0.03	0.07	0.28	0.01	0.02	0.02
2	Hydraulic yard crane, Grove 4x4x4, 52' boom, 13.6MT	Diesel	Diesel Cranes	130	5,926	1,456	8	0.07	0.14	0.48	0.04	0.07	0.06	0.32	0.62	2.19	0.18	0.31	0.29	0.01	0.03	0.10	0.01	0.01	0.01
1	Hydraulic excavator, 2.5 cy, long reach, Cat H120 Hoe Ram (3000	Diesel	Diesel Excavators	321	3,240	240	8	0.09	0.22	0.59	0.05	0.09	0.08	0.49	1.26	3.33	0.30	0.50	0.47	0.01	0.02	0.05	0.00	0.01	0.01
1	Hydraulic excavator, 2.5 cy	Diesel	Diesel Excavators	321	9,813	728	8	0.09	0.22	0.59	0.05	0.09	0.08	0.49	1.26	3.33	0.30	0.50	0.47	0.02	0.06	0.15	0.01	0.02	0.02
1	Articulated wheel loader, Cat966, 5.0 cy	Diesel	Diesel Rubber Tire Loaders	246	5,766	728	8	0.09	0.18	0.56	0.05	0.09	0.08	0.39	0.77	2.42	0.22	0.38	0.36	0.02	0.04	0.11	0.01	0.02	0.02
2	Dump truck, Cat740, 22.8-30 cy, 38.1 MT	Diesel	Diesel Off-highway Trucks	415	8,101	976	8	0.08	0.12	0.31	0.05	0.08	0.07	1.22	1.69	4.53	0.72	1.13	1.06	0.04	0.05	0.14	0.02	0.03	0.03
1	Crawler dozer, Cat238	Diesel	Diesel Crawler Tractors	238	2,227	240	8	0.09	0.12	0.40	0.05	0.08	0.08	0.36	0.51	1.67	0.21	0.34	0.31	0.01	0.01	0.03	0.00	0.01	0.00
1	Pick-up truck, 1/2 ton, on-highway 4x4	Diesel	N/A - MOBILE	160	1,859	968	8	3.60	7.91	4.61	0.10	0.64	0.39	0.12	0.27	0.16	0.00	0.02	0.01	0.01	0.02	0.01	0.00	0.00	0.00
1	Pick-up trucks, 1 ton, on-highway 4x4	Diesel	N/A - MOBILE	195	2,265	968	8	3.60	7.91	4.61	0.10	0.64	0.39	0.15	0.33	0.19	0.00	0.03	0.02	0.01	0.02	0.01	0.00	0.00	0.00
1	Water tanker, off-highway, 5000 gal	Diesel	Diesel Off-highway Trucks	175	2,918	488	8	0.08	0.09	0.19	0.05	0.07	0.07	0.25	0.27	0.60	0.15	0.23	0.22	0.01	0.01	0.02	0.00	0.01	0.01
4	Concrete Mixer, 8 cy, rear discharge/Concrete pump truck	Diesel	Diesel Cement & Mortar Mixers	235	12,455	1,536	8	0.12	0.32	1.32	0.04	0.08	0.08	1.92	5.32	21.88	0.71	1.41	1.32	0.05	0.13	0.53	0.02	0.03	0.03
1	Compactor, Cat, vibratory, self propelled, 84"	Diesel	Diesel Rollers	138	564	240	8	0.09	0.26	0.62	0.05	0.11	0.10	0.23	0.64	1.50	0.13	0.27	0.25	0.00	0.01	0.02	0.00	0.00	0.00
1	Engine generator, 6.5 KW	Diesel	N/A - AP42 3.3-1	13	610	872	8	1.14	3.03	14.06	0.93	1.00	0.94	0.26	0.69	3.22	0.21	0.23	0.21	0.01	0.04	0.18	0.01	0.01	0.01
1	Air compressor, 160 cfm, 100 psi	Diesel	Diesel Other Construction Equipment	60	647	240	8	0.12	0.88	1.94	0.06	0.14	0.13	0.13	0.94	2.05	0.07	0.15	0.14	0.00	0.01	0.03	0.00	0.00	0.00
1	Air compressor, 250 cfm, 100 psi	Diesel	Diesel Other Construction Equipment	80	691	240	8	0.12	0.97	1.00	0.06	0.17	0.16	0.17	1.37	1.41	0.09	0.24	0.23	0.00	0.02	0.02	0.00	0.00	0.00
1	Dump truck, on-highway 8x4, 18 cy	Diesel	N/A - MOBILE	450	6,149	488	8	2.06	3.65	13.08	0.10	0.53	0.30	0.46	0.81	2.91	0.02	0.12	0.07	0.01	0.02	0.09	0.00	0.00	0.00
2	Portable generator 1 KW	Gasoline	N/A - AP42 3.3-1	2.75	244	1,744	8	9.79	3.16	4.99	0.27	0.33	0.31	0.95	0.31	0.48	0.03	0.03	0.03	0.05	0.02	0.03	0.00	0.00	0.00

Key:

CO = carbon monoxide

PM10 = inhalable particulate matter

g/gal = grams per gallon

PM2.5 = fine particulate matter

hp = horsepower

SO2 = sulfur dioxide

NOx = nitrogen oxides

Legend:

Onroad vehicle - emissions estimated by MOBILE6.2

Stationary source - emissions estimated by AP-42 for diesel engines

VOC	CO	NOx	SO2	PM10	PM2.5
Total Daily (lb/day)	8.34	18.29	56.49	3.58	6.25
Total Annual 2020 (tpy)	0.29	0.57	1.78	0.12	0.20

Table M10G. Unmitigated Construction Worker Commute Emissions
Alternative 5 - Fish Passage at Two Dams, Remove Copco 1 and Iron Gate

Round-Trip Commute Distance: 30 miles

Dam	Peak Workers	Duration (Days)	State
J.C. Boyle	17	47	Oregon
Copco 1	56	78	California
Copco 2	15	69	California
Iron Gate	80	83	California
1	2	3	4

Road Conditions	Average ADT	Average
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Dam	Peak Daily Emissions, lbs/day (2020)													
	ROG	CO	NOx	SOx	PM10 Total	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM10 Road Dust	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	PM2.5 Road Dust
J.C. Boyle	0.57	11.59	0.45	0.01	0.94	0.00	0.01	0.01	0.91	0.15	0.00	0.00	0.01	0.14
Copco 1	0.75	15.56	1.63	0.02	3.15	0.08	0.03	0.05	3.00	0.55	0.07	0.01	0.02	0.45
Copco 2	0.20	4.17	0.44	0.00	0.84	0.02	0.01	0.01	0.80	0.15	0.02	0.00	0.01	0.12
Iron Gate	1.07	22.23	2.32	0.02	4.50	0.11	0.04	0.07	4.29	0.78	0.10	0.01	0.03	0.64
Total	2.58	53.54	4.83	0.05	9.44	0.21	0.09	0.14	9.00	1.63	0.19	0.02	0.06	1.35
California %	78%	78%	91%	82%	90%	98%	90%	90%	90%	91%	98%	90%	90%	90%
Oregon %	22%	22%	9%	18%	10%	2%	10%	10%	10%	9%	2%	10%	10%	10%

Dam	Annual Emissions, tons/year (2020)													
	ROG	CO	NOx	SOx	PM10 Total	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM10 Road Dust	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	PM2.5 Road Dust
J.C. Boyle	0.01	0.27	0.01	0.00	0.02	0.00	0.00	0.00	0.02	0.00	0.00	0.00	0.00	0.00
Copco 1	0.03	0.61	0.06	0.00	0.12	0.00	0.00	0.00	0.12	0.02	0.00	0.00	0.00	0.02
Copco 2	0.01	0.14	0.02	0.00	0.03	0.00	0.00	0.00	0.03	0.01	0.00	0.00	0.00	0.00
Iron Gate	0.04	0.92	0.10	0.00	0.19	0.00	0.00	0.00	0.18	0.03	0.00	0.00	0.00	0.03
Total	0.09	1.95	0.19	0.00	0.36	0.01	0.00	0.01	0.34	0.06	0.01	0.00	0.00	0.05
California %	86%	86%	94%	89%	94%	99%	94%	94%	94%	94%	99%	94%	94%	94%
Oregon %	14%	14%	6%	11%	6%	1%	6%	6%	6%	6%	1%	6%	6%	6%

Key:

ADT = average daily traffic

CO = carbon monoxide

lbs/day = pounds per day

NOx = nitrogen oxides

PM10 = inhalable particulate matter

PM2.5 = fine particulate matter

ROG = reactive organic gases

SOx = sulfur oxides

Table M10H. Daily Unmitigated Haul Truck Emissions
Alternative 5 - Fish Passage at Two Dams, Remove Copco 1 and Iron Gate

Dam	Waste Material	Peak Daily Trips	Round Trip Distance (mi)	Road Conditions		Average ADT		Daily Emissions (lbs/day) - 2020									
				ROG	CO	NOx	SOx	PM10 Total	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM10 Paved Road Dust	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	PM2.5 Paved Road Dust
J.C. Boyle (Oregon)	Concrete (In)	9	148	0.78	1.38	4.95	0.04	2.58	0.09	0.08	0.04	2.38	0.47	0.08	0.02	0.02	0.36
	Rebar	1	121	0.07	0.13	0.45	0.00	0.23	0.01	0.01	0.00	0.22	0.04	0.01	0.00	0.00	0.03
	Wood	1	121	0.07	0.13	0.45	0.00	0.23	0.01	0.01	0.00	0.22	0.04	0.01	0.00	0.00	0.03
J.C. Boyle Subtotal		11	390	0.92	1.63	5.85	0.05	3.05	0.10	0.09	0.04	2.81	0.56	0.09	0.02	0.02	0.42
Copco 1 (California)	Concrete (Out)	50	2	0.12	0.55	1.50	0.00	0.24	0.05	0.01	0.01	0.18	0.08	0.04	0.00	0.00	0.03
	Metal	5	62	0.39	1.71	4.64	0.01	0.75	0.15	0.02	0.02	0.55	0.24	0.14	0.01	0.01	0.08
	Building Waste	5	62	0.39	1.71	4.64	0.01	0.75	0.15	0.02	0.02	0.55	0.24	0.14	0.01	0.01	0.08
Copco 1 Subtotal		60	126	0.90	3.97	10.78	0.03	1.74	0.35	0.06	0.04	1.29	0.55	0.32	0.01	0.02	0.19
Copco 2 (California)	Concrete (In)	9	59	0.66	2.92	7.95	0.02	1.28	0.26	0.04	0.03	0.95	0.40	0.24	0.01	0.01	0.14
	Rebar	1	120	0.15	0.66	1.80	0.00	0.29	0.06	0.01	0.01	0.21	0.09	0.05	0.00	0.00	0.03
	Wood	1	120	0.15	0.66	1.80	0.00	0.29	0.06	0.01	0.01	0.21	0.09	0.05	0.00	0.00	0.03
Copco 2 Subtotal		11	299	0.96	4.25	11.55	0.03	1.86	0.37	0.06	0.05	1.38	0.59	0.34	0.02	0.02	0.21
Iron Gate (California)	Earth	800	2	2.00	8.81	23.96	0.06	3.86	0.77	0.13	0.10	2.86	1.21	0.71	0.03	0.04	0.43
	Concrete (Out)	50	2	0.12	0.55	1.50	0.00	0.24	0.05	0.01	0.01	0.18	0.08	0.04	0.00	0.00	0.03
	Metal	5	54	0.34	1.49	4.04	0.01	0.65	0.13	0.02	0.02	0.48	0.20	0.12	0.01	0.01	0.07
Iron Gate Subtotal		860	112	2.46	10.85	29.50	0.08	4.75	0.95	0.16	0.12	3.52	1.50	0.88	0.04	0.05	0.53
Grand Total		942	927	5.24	20.69	57.68	0.18	11.39	1.78	0.37	0.26	8.99	3.18	1.63	0.09	0.11	1.35
California Total		931	537	4.32	19.06	51.83	0.14	8.34	1.67	0.27	0.22	6.18	2.63	1.54	0.07	0.09	0.93
Oregon Total		11	390	0.92	1.63	5.85	0.05	3.05	0.10	0.09	0.04	2.81	0.56	0.09	0.02	0.02	0.42
California %		99%	58%	82%	92%	90%	75%	73%	94%	75%	83%	69%	82%	94%	75%	83%	69%
Oregon %		1%	42%	18%	8%	10%	25%	27%	6%	25%	17%	31%	18%	6%	25%	17%	31%

Key:

ADT = average daily traffic

CO = carbon monoxide

lbs/day = pounds per day

mi = miles

NOx = nitrogen oxides

PM10 = inhalable particulate matter

PM2.5 = fine particulate matter

ROG = reactive organic gases

SOx = sulfur oxides

Table M10I. Annual Unmitigated Haul Truck Emissions
Alternative 5 - Fish Passage at Two Dams, Remove Copco 1 and Iron Gate

Dam	Waste Material	Annual Trips	Round Trip Distance (mi)	Road Conditions		Average	
				ADT	Average	ADT	Average

Dam	Waste Material	Annual Trips	Round Trip Distance (mi)	Annual Emissions (tons per year) - 2020													
				ROG	CO	NOx	SOx	PM10 Total	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM10 Paved Road Dust	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	PM2.5 Paved Road Dust
J.C. Boyle	Concrete (In)	350	148	0.02	0.03	0.10	0.00	0.05	0.00	0.00	0.00	0.05	0.01	0.00	0.00	0.00	0.01
	Rebar	6	121	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Wood	3	121	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	J.C. Boyle Subtotal	359	390	0.02	0.03	0.10	0.00	0.05	0.00	0.00	0.00	0.05	0.01	0.00	0.00	0.00	0.01
Copco 1 (California)	Concrete (Out)	4,000	2	0.00	0.02	0.06	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	Metal	170	62	0.01	0.03	0.08	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	Building Waste	30	62	0.00	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Copco 1 Subtotal	4,200	126	0.01	0.06	0.15	0.00	0.02	0.00	0.00	0.00	0.02	0.01	0.00	0.00	0.00	0.00
Copco 2 (California)	Concrete (In)	125	59	0.00	0.02	0.06	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	Rebar	2	120	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Wood	2	120	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Copco 2 Subtotal	129	299	0.00	0.02	0.06	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
Iron Gate (California)	Earth	60,000	2	0.07	0.33	0.90	0.00	0.14	0.03	0.00	0.00	0.11	0.05	0.03	0.00	0.00	0.02
	Concrete (Out)	750	2	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Metal	130	54	0.00	0.02	0.05	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00	0.00
	Building Waste	40	54	0.00	0.01	0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	Iron Gate Subtotal	60,920	112	0.08	0.36	0.98	0.00	0.16	0.03	0.01	0.00	0.12	0.05	0.03	0.00	0.00	0.02
	Grand Total	65,608	927	0.11	0.47	1.29	0.00	0.24	0.04	0.01	0.01	0.19	0.07	0.04	0.00	0.00	0.03
	California Total	65,249	537	0.10	0.44	1.19	0.00	0.19	0.04	0.01	0.00	0.14	0.06	0.04	0.00	0.00	0.02
	Oregon Total	359	390	0.02	0.03	0.10	0.00	0.05	0.00	0.00	0.00	0.05	0.01	0.00	0.00	0.00	0.01
	California %	99%	58%	86%	94%	92%	81%	79%	96%	80%	87%	75%	87%	96%	80%	87%	75%
	Oregon %	1%	42%	14%	6%	8%	19%	21%	4%	20%	13%	25%	13%	4%	20%	13%	25%

Key:

ADT = average daily traffic

PM10 = inhalable particulate matter

CO = carbon monoxide

PM2.5 = fine particulate matter

mi = miles

ROG = reactive organic gases

NOx = nitrogen oxides

SOx = sulfur oxides

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Table M10J. Unmitigated Fugitive Dust Emissions

Alternative 5 - Fish Passage at Two Dams, Remove Copco 1 and Iron Gate

Phase	Peak Daily Emissions, lbs/day								Max	
	PM ₁₀				PM _{2.5}					
	Iron Gate	Copco 1	Copco 2	JC Boyle	Iron Gate	Copco 1	Copco 2	JC Boyle	PM ₁₀	PM _{2.5}
Cut/Fill Activities	156.08	1.03	0.44	0.92	32.60	0.21	0.09	0.19	157.45	32.88
Building Demolition	0.91	0.68	n/a	n/a	0.19	0.14	n/a	n/a	0.91	0.19
Drilling and Blasting	n/a	158.32	n/a	n/a	n/a	158.32	n/a	n/a	0.00	0.00
Total	156.99	160.03	0.44	0.92	32.79	158.67	0.09	0.19	158.36	33.07

Phase	Annual Emissions (tons/year) - 2020								Grand Total	
	PM ₁₀				PM _{2.5}					
	Iron Gate	Copco 1	Copco 2	JC Boyle	Iron Gate	Copco 1	Copco 2	JC Boyle	PM ₁₀	PM _{2.5}
Cut/Fill Activities	7.73	0.04	0.02	0.02	1.61	0.01	0.00	0.00	7.80	1.63
Building Demolition	0.00	0.00	n/a	n/a	0.00	0.00	n/a	n/a	0.00	0.00
Drilling and Blasting	n/a	7.03	n/a	n/a	n/a	7.03	n/a	n/a	7.03	7.03
Total	7.73	7.07	0.02	0.02	1.61	7.04	0.00	0.00	14.83	8.66

Key:

lbs/day = pounds per day

PM10 = inhalable particulate matter

PM2.5 = fine particulate matter

Table M10K. URBEMIS Model Inputs for Iron Gate
Alternative 5 - Fish Passage at Two Dams, Remove Copco 1 and Iron Gate

Iron Gate

WASTE (DISPOSED OFFSITE) - CUT/FILL VOLUMES

Construction Phase	Fine Site Grading	
Phase Start Date	June 1, 2020	
Phase End Date	September 23, 2020	
Work Days/Week	5	
		<u>Mitigation</u>
Cut/Fill	1,320,000 cy	1,320,000 cy
Truck Capacity	20 cy	22 cy
Total Truck Trips	66,000	60,000
Duration	83 days	99 days
Daily Trips	795 trips/day	606 trips/day
Amount of onsite cut/fill	15,904 cubic yards/day	13,333 cubic yards/day
Area	571,900 sq. ft. 13.13 acres	

BUILDING DEMOLITION

Building Waste 10,800 cf

Start Date	June 1, 2020
End Date	June 7, 2020
Work Days/Week	5

Width	23.2 ft	
Length	23.2 ft	
Height	20.0 ft	(estimated)
Volume	10,800 ft ³	

Daily Volume to be Demolished Concurrently

Width	10.4 ft
Length	10.4 ft
Height	20.0 ft
Volume	2,160 ft ³

Table M10L. URBEMIS Model Inputs for Copco 1
Alternative 5 - Fish Passage at Two Dams, Remove Copco 1 and Iron Gate

Copco 1

BUILDING DEMOLITION

Building Waste 8,100 cf

	Dam Removal	Demo
Start Date	December 30, 2019	December 30, 2019
End Date	April 15, 2020	January 3, 2020
Work Days/Week	5	

Total Volume to be Removed

Width	20.1 ft
Length	20.1 ft
Height	20.0 ft
Volume	8,100 ft ³

(estimated)

Daily Volume to be Demolished Concurrently

Width	9.0 ft
Length	9.0 ft
Height	20.0 ft
Volume	1,620 ft ³

Area 100,085 sq. ft.
2.30 acres

Table M10M. URBEMIS Model Inputs for Copco 2
Alternative 5 - Fish Passage at Two Dams, Remove Copco 1 and Iron Gate

Copco 2

CONSTRUCTION EQUIPMENT FUGITIVE DUST		BUILDING DEMOLITION
Phase Start Date	4/24/2020	Buildings will not be removed at Copco 2
Phase End Date	7/29/2020	
Area	43,490 sq. ft. 1.00 acres	

Table M10N. URBEMIS Inputs for JC Boyle
Alternative 5 - Fish Passage at Two Dams, Remove Copco 1 and Iron Gate

J.C. Boyle

CONSTRUCTION EQUIPMENT FUGITIVE DUST		BUILDING DEMOLITION
Phase Start Date	5/29/2020	Buildings will not be removed at JC Boyle
Phase End Date	8/3/2020	
Area	90,810 sq. ft. 2.08 acres	

**Table M10O. Daily Unmitigated Fugitive Dust Emissions from Unpaved Roads
Alternative 5 - Fish Passage at Two Dams, Remove Copco 1 and Iron Gate**

Dam	Waste Material	Disposal Site	Haul Route	One-way Distance (mi)	Trips Daily	Emissions (lbs/day)					
						Loaded PM ₁₀	Loaded PM _{2.5}	Empty PM ₁₀	Empty PM _{2.5}	Total PM ₁₀	Total PM _{2.5}
Copco 1 (California)	Concrete	Right abutment site	Improve unpaved access road	1	50	3	0	2	0	6	1
Iron Gate (California)	Earth Concrete	Spillway and Left abutment borrow sites Left abutment site	Existing unpaved access roads Existing unpaved access roads	1 2	800 850	54 50 58	5 3 6	38 2 41	4 0 4	93 6 99	9 1 10
Dust Control Measures										Water control	31 3
Water Exposed Surfaces											
2x daily						55%					
3x daily						69%					

(values from URBEMIS)
Watering Frequency
Notes: "Trips" are one-way.
3x daily

**Table M10P. Annual Unmitigated Fugitive Dust Emissions from Unpaved Roads
Alternative 5 - Fish Passage at Two Dams, Remove Copco 1 and Iron Gate**

Dam	Waste Material	Disposal Site	Haul Route	One-way Distance (mi)	Trips Total	Emissions (tons/year) - 2020					
						Loaded PM ₁₀	Loaded PM _{2.5}	Empty PM ₁₀	Empty PM _{2.5}	Total PM ₁₀	Total PM _{2.5}
Copco 1 (California)	Concrete	Right abutment site	Improve unpaved access road	1	4,000	0	0	0	0	0	0
Iron Gate (California)	Earth Concrete	Spillway and Left abutment borrow sites Left abutment site	Existing unpaved access roads Existing unpaved access roads	1 1 2	60,000 750 60,750	2 0 2	0 0 0	1 0 1	0 0 0	3 0 3	0.3 0.0 0.0
Dust Control Measures								Water control	1	1	0

Water Exposed Surfaces
2x daily
3x daily
55%
69%

(values from URBEMIS)
Watering Frequency
Notes: "Trips" are one-way.

Water Exposed Surfaces
2x daily
3x daily
55%
69%

(values from URBEMIS)
Watering Frequency
Notes: "Trips" are one-way.

Table M10Q. Emission Factors for Unpaved Road Dust

Criteria Pollutants

Unpaved Road Dust Emission Factor

$$E = k(s/12)^a (W/3)^b$$

Vehicles traveling on unpaved surfaces at industrial sites

where:

k, a, and b = empirical constants

E = size-specific emission factor (lb/VMT)

s = surface material silt content (%)

W = mean vehicle weight (tons)

Typical silt content values

Haul road = 0.1 % (Lowest silt content from Emission Factor documentation)

Emission Factor Documentation for AP-42, Section 13.2.2: Unpaved Roads (September 1998)

Truck Weight (CAT 740 articulated truck)

Empty = 36.5 ton

Loaded = 80.0 ton

Constants for Equation

Constant	Industrial Roads	
	PM _{2.5}	PM ₁₀
k (lb/VMT)	0.15	1.5
a	0.9	0.9
b	0.45	0.45

Natural Mitigation Emission Factor

$$E_{ext} = E[(365 - P)/365]$$

where:

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

E = unpaved road dust emission factor

P = number of days in a year with at least 0.254 mm (0.01 in) of precipitation

P = 88.3 days (Klamath Falls SSW) http://www.ocs.orst.edu/county_climate/Klamath_files/Klamath.html#table2a
= 84 days (Siskiyou County) <http://www.foreclosuredeals.com/list/ca/siskiyou/foreclosure-auctions/>

Unmitigated Emission Factors (lb/VMT)

Unpaved Roads

Type	Haul Roads	
	PM ₁₀	PM _{2.5}
Empty	0.1	0.01
Loaded	0.1	0.01

Natural Mitigated Emission Factors (lb/VMT) - Klamath County

Type	Haul Roads	
	PM ₁₀	PM _{2.5}
Empty	0.0	0.00
Loaded	0.1	0.01

Natural Mitigated Emission Factors (lb/VMT) - Siskiyou County

Type	Haul Roads	
	PM ₁₀	PM _{2.5}
Empty	0.0	0.00
Loaded	0.1	0.01

Table M11A. Summary of Drilling and Blasting Emissions
Copco 1 - Demolition

Source	Daily Emissions (lbs/day)			
	CO	NOx	PM10	PM2.5
Blast Hole Drilling	--	--	146.9	146.9
Dust Entrainment from Blasting	--	--	11.4	11.4
Explosives Detonation	24.7	6.3	--	--
Total	24.7	6.3	158.3	158.3

Source	Annual Emissions (tons/year)			
	CO	NOx	PM10	PM2.5
Blast Hole Drilling	--	--	6.5	6.5
Dust Entrainment from Blasting	--	--	0.5	0.5
Explosives Detonation	1.1	0.3	--	--
Total	1.1	0.3	7.0	7.0

Note:

Emissions of other pollutants are negligible and are not reported.

Table M11B. Blasting Emission Calculations

Emission Factors

Activity	Emission Factor Source
Blast Hole Drilling	MDAQMD
Blasting	MDAQMD
Explosives Detonation	MDAQMD

Source:

Mojave Desert Air Quality Management District (MDAQMD). 2000. Emissions Inventory Guidance: Mineral Handling and Processing Industries. April 10
<http://www.mdaqmd.ca.gov/Modules>ShowDocument.aspx?documentid=401>

Blast Hole Drilling

$$E = E_f \times N$$

E = Particulate matter emissions rate in pounds per year

E_f = Emission factor in units of pounds of particulate per hole drilled

N = Number of blast holes drilled per year

$PM_{10} E_f$ = 0.68 pounds per hole

$PM_{2.5} E_f$ = 0.68 pounds per hole

Drilling Emissions			
Duration	Units	PM ₁₀	PM _{2.5}
Daily	lbs/day	147	147
Annual	tpy	7	7

Dust Entrainment from Blasting

$$E = k \times N \times 0.0005 \times A^{1.5}$$

E = Particulate matter emissions rate in pounds per year

k = Particulate matter size factor

N = Number of blasts per year

A = Horizontal area shifted by each blast in square feet

$k (PM_{10})$ 0.52

$k (PM_{2.5})$ 0.52

N 799 (annual)

9 (daily)

A 288 square feet

Blasting Emissions			
Duration	Units	PM ₁₀	PM _{2.5}
Daily	lbs/day	11	11
Annual	tpy	1	1

Table M11B. Blasting Emission Calculations (continued)

Criteria Emissions from Blasting Explosives

$$E = Ef \times A$$

E = Pollutant emissions rate in pounds per year
 Ef = Emission factor in units of pounds of pollutant per ton of explosives detonated
 A = Amount of explosive detonated throughout the year in tons

Emission Factors (lbs of pollutant per ton of explosive detonated)				
Explosive Type	Composition	CO	NOx	TOG
Black Powder	Potassium nitrate, charcoal, and sulfur	170	--	4.2
Smokeless Powder	Nitrocellulose	77	--	1.1
Dynamite, straight	Nitroglycerine, sodium nitrate, wood pulp, calcium carbonate	281	--	2.5
Dynamite, ammonia	Nitroglycerine, ammonium nitrate, sodium nitrate, wood pulp	63	--	1.3
Dynamite, gelatin	Nitroglycerine	104	53	0.7
ANFO	Ammonium nitrate, fuel oil	67	17	--
TNT	Trinitrotoluene	796	--	14.3
RDX	Cyclotrimethylenetrinitroamine	196	--	--
PETN	Pentaerythritol tetranitrate	297	--	--

Note:

VOC emissions are considered negligible for all explosives.

TSP, PM10, and PM2.5 emissions are subsumed within the dust entrainment estimations.

Quantity: 1.5 pounds explosive/cubic yard

Annual Debris/Waste:

Mass 69,179 tons/year
 Density 120 pounds/cubic foot
 Volume 42,703 cubic yards/year

Daily Debris/Waste:

Mass 797 tons/day
 Density 120 pounds/cubic foot
 Volume 492 cubic yards/day

Criteria Pollutant Emissions

Explosive Used: ANFO

Amount of explosive: 32.0 tons/year
 0.4 tons/day

Pollutant	Daily	Annual
	(lbs/day)	(tpy)
CO	24.7	1.1
NOx	6.3	0.3

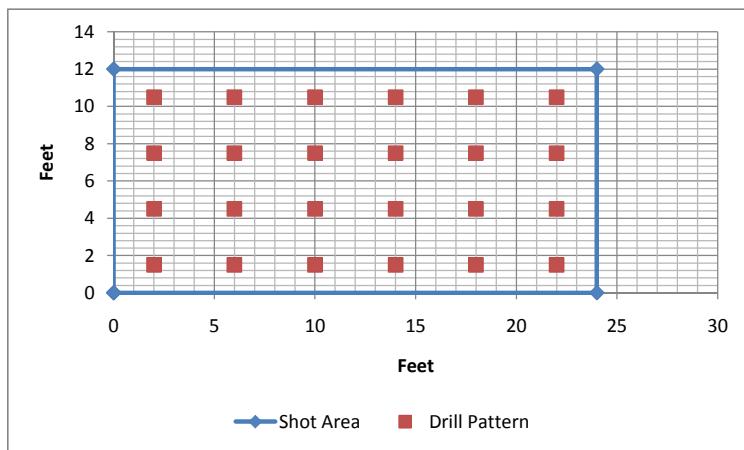
Table M11C. Blasting and Drilling Pattern

Copco 1 - Demolition

	Dimensions				Dimensions		
	Length (ft)	Width (ft)	Area (sq. ft.)		Length (ft)	Width (ft)	Area (sq. ft.)
Shot Length x Width	24	12	288	Shot Length x Width	40	20	800
Production Drill Pattern	4	3	12	Production Drill Pattern	4	3	12
Number of Holes per Shot	24			Number of Holes per Shot	67		
Weeks Needed	17			Weeks Needed	17		
Shots per Week	47			Shots per Week	47		
Shots per Day	9			Shots per Day	9		
Total Shots	799			Total Shots	799		
Daily Number of Holes	216			Daily Number of Holes	600		
Total Number of Holes	19,176			Total Number of Holes	53,267		

Note: Red text = calculated value

Source: Att No. 3 - Copco 1 Primary Dam Removal Assessment



General Procedures for Drilling and Blasting

- 1 Develop drill pattern (including number of holes to be drilled, depths and diameters of holes, etc.)
- 2 Develop sequence and pattern of multiple explosions (several small explosions comprise a single blast).
- 3 Blasting crews set the blasting caps, load the holes with explosives, stem the holes w/crushed stone, and connect each hole within the shot.

<http://www.mdandb.com/blastanatomy.cfm>

Table M12A. Summary of Unmitigated EMFAC2007 Emission Factors

Source	ROG	TOG	CO	NOx	SOx	Emission Factors (g/mi) - 2019									
						PM10 Total	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	CO2	CH4
Construction Workers	0.551	0.588	4.680	0.487	0.004	0.041	0.021	0.008	0.013	0.027	0.019	0.002	0.005	351.872	0.033
Pick-up Trucks (Gasoline)	0.442	0.476	3.714	0.465	0.005	0.052	0.031	0.008	0.013	0.037	0.029	0.002	0.005	503.354	0.031
Pick-up Trucks (Diesel)	0.082	0.094	0.638	1.477	0.003	0.074	0.053	0.008	0.013	0.056	0.049	0.002	0.005	346.620	0.004
Heavy-Duty Diesel Trucks	0.628	0.715	2.737	7.691	0.018	0.317	0.253	0.036	0.028	0.254	0.233	0.009	0.012	1901.576	0.029
Source	ROG	TOG	CO	NOx	SOx	Emission Factors (g/mi) - 2020									
						PM10 Total	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	CO2	CH4
Construction Workers	0.506	0.539	4.201	0.439	0.004	0.041	0.021	0.008	0.013	0.026	0.019	0.002	0.005	337.274	0.030
Pick-up Trucks (Gasoline)	0.413	0.444	3.396	0.423	0.005	0.052	0.031	0.008	0.013	0.037	0.029	0.002	0.005	503.380	0.029
Pick-up Trucks (Diesel)	0.081	0.092	0.630	1.482	0.003	0.073	0.052	0.008	0.013	0.055	0.048	0.002	0.005	346.726	0.004
Heavy-Duty Diesel Trucks	0.566	0.645	2.498	6.793	0.018	0.283	0.219	0.036	0.028	0.223	0.202	0.009	0.012	1899.853	0.026
Source	ROG	TOG	CO	NOx	SOx	Emission Factors (g/mi) - 2023									
						PM10 Total	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	CO2	CH4
Construction Workers	0.387	0.412	2.867	0.312	0.004	0.040	0.020	0.008	0.013	0.026	0.018	0.002	0.005	319.237	0.023
Pick-up Trucks (Gasoline)	0.344	0.370	2.600	0.319	0.005	0.052	0.032	0.008	0.013	0.037	0.029	0.002	0.005	503.455	0.024
Pick-up Trucks (Diesel)	0.078	0.089	0.617	1.492	0.003	0.072	0.051	0.008	0.013	0.055	0.047	0.002	0.005	347.164	0.004
Heavy-Duty Diesel Trucks	0.434	0.494	1.984	4.916	0.018	0.213	0.148	0.036	0.028	0.158	0.137	0.009	0.012	1895.307	0.020
Source	ROG	TOG	CO	NOx	SOx	Emission Factors (g/mi) - 2024									
						PM10 Total	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	CO2	CH4
Construction Workers	0.352	0.375	2.554	0.278	0.004	0.040	0.019	0.008	0.013	0.025	0.018	0.002	0.005	314.182	0.021
Pick-up Trucks (Gasoline)	0.325	0.349	2.412	0.291	0.005	0.052	0.032	0.008	0.013	0.037	0.029	0.002	0.005	503.489	0.023
Pick-up Trucks (Diesel)	0.076	0.086	0.611	1.493	0.003	0.070	0.050	0.008	0.013	0.053	0.046	0.002	0.005	347.107	0.004
Heavy-Duty Diesel Trucks	0.407	0.463	1.880	4.544	0.018	0.198	0.134	0.036	0.028	0.144	0.123	0.009	0.012	1894.343	0.019
Source	ROG	TOG	CO	NOx	SOx	Emission Factors (g/mi) - 2025									
						PM10 Total	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	CO2	CH4
Construction Workers	0.322	0.343	2.297	0.248	0.004	0.040	0.019	0.008	0.013	0.025	0.018	0.002	0.005	309.680	0.019
Pick-up Trucks (Gasoline)	0.309	0.332	2.260	0.267	0.005	0.052	0.032	0.008	0.013	0.037	0.029	0.002	0.005	503.549	0.022
Pick-up Trucks (Diesel)	0.074	0.084	0.608	1.493	0.003	0.068	0.048	0.008	0.013	0.051	0.044	0.002	0.005	346.702	0.003
Heavy-Duty Diesel Trucks	0.386	0.439	1.800	4.261	0.018	0.187	0.122	0.036	0.028	0.134	0.113	0.009	0.012	1893.663	0.018

Source	ROG	TOG	CO	NOx	SOx	Emission Factors (g/gal) - 2019									
						PM10 Total	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	CO2	CH4
Pick-up Trucks (Gasoline)	3.099	3.675	64.564	8.089	0.085	0.903	0.546	0.139	0.218	0.635	0.506	0.035	0.093	6853.123	0.535
Pick-up Trucks (Diesel)	2.391	2.721	18.554	42.953	0.096	2.139	1.542	0.233	0.365	1.633	1.419	0.058	0.156	7895.515	0.111
Heavy-Duty Gasoline Vehicles	38.397	41.971	1079.229	102.086	0.085	0.651	0.179	0.141	0.331	0.343	0.166	0.035	0.142	7040.659	3.104
Heavy-Duty Diesel Trucks	3.329	3.790	14.509	40.768	0.096	1.683	1.342	0.191	0.150	1.347	1.235	0.048	0.064	10080.002	0.155
Source	ROG	TOG	CO	NOx	SOx	Emission Factors (g/gal) - 2020									
						PM10 Total	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	CO2	CH4
Pick-up Trucks (Gasoline)	2.765	3.302	59.094	7.358	0.085	0.904	0.547	0.139	0.218	0.636	0.507	0.035	0.094	6624.024	0.501
Pick-up Trucks (Diesel)	2.340	2.664	18.312	43.091	0.096	2.110	1.512	0.233	0.365	1.606	1.391	0.0			

Table M12B. MOBILE6.2 Exhaust Emission Factors

Source	Emission Factors (g/mi) - 2019												
	VOC	CO	NOx	SOx	PM10 Total	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	CO2
Construction Worker	0.530	10.446	0.408	0.009	0.024	0.004	0.008	0.013	0.011	0.004	0.002	0.005	467.9
Pick-Up Trucks (Gasoline)	0.596	10.789	0.473	0.009	0.024	0.004	0.008	0.013	0.011	0.004	0.002	0.005	516.1
Pick-Up Trucks (Diesel)	0.228	0.486	0.295	0.006	0.039	0.018	0.008	0.013	0.024	0.017	0.002	0.005	598.7
Heavy-Duty Gasoline Vehicles	0.498	8.250	0.713	0.016	0.036	0.015	0.009	0.013	0.021	0.013	0.002	0.005	905.9
Heavy-Duty Diesel Trucks	0.271	0.517	1.921	0.013	0.072	0.033	0.026	0.013	0.042	0.030	0.007	0.005	1395.4
Emission Factors (g/mi) - 2020													
Source	VOC	CO	NOx	SOx	PM10 Total	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	CO2
Construction Worker	0.504	10.304	0.396	0.009	0.024	0.004	0.008	0.013	0.011	0.004	0.002	0.005	468.8
Pick-Up Trucks (Gasoline)	0.564	10.613	0.459	0.009	0.024	0.004	0.008	0.013	0.011	0.003	0.002	0.005	516.1
Pick-Up Trucks (Diesel)	0.212	0.465	0.271	0.006	0.038	0.017	0.008	0.013	0.023	0.016	0.002	0.005	598.7
Heavy-Duty Gasoline Vehicles	0.459	8.206	0.637	0.016	0.035	0.014	0.009	0.013	0.020	0.012	0.002	0.005	905.6
Heavy-Duty Diesel Trucks	0.266	0.470	1.686	0.013	0.069	0.030	0.026	0.013	0.039	0.027	0.007	0.005	1395.6
Emission Factors (g/mi) - 2022													
Source	VOC	CO	NOx	SOx	PM10 Total	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	CO2
Construction Worker	0.461	10.125	0.373	0.009	0.024	0.004	0.008	0.013	0.011	0.004	0.002	0.005	468.8
Pick-Up Trucks (Gasoline)	0.511	10.400	0.434	0.009	0.024	0.004	0.008	0.013	0.011	0.003	0.002	0.005	516.1
Pick-Up Trucks (Diesel)	0.184	0.429	0.229	0.006	0.035	0.014	0.008	0.013	0.021	0.013	0.002	0.005	598.7
Heavy-Duty Gasoline Vehicles	0.393	8.126	0.492	0.016	0.033	0.012	0.009	0.013	0.018	0.011	0.002	0.005	905.6
Heavy-Duty Diesel Trucks	0.257	0.396	1.312	0.013	0.063	0.024	0.026	0.013	0.034	0.022	0.007	0.005	1395.6

Source	Emission Factors (g/gal) - 2019												
	VOC	CO	NOx	SOx	PM10 Total	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	CO2
Construction Worker	10.379	204.664	7.998	0.168	0.477	0.075	0.157	0.245	0.213	0.070	0.039	0.104	9168.2
Pick-Up Trucks (Gasoline)	10.367	187.800	8.234	0.165	0.422	0.065	0.139	0.218	0.188	0.061	0.035	0.092	8983.0
Pick-Up Trucks (Diesel)	3.876	8.262	5.015	0.095	0.660	0.3111	0.136	0.213	0.410	0.286	0.034	0.090	10177.9
Heavy-Duty Gasoline Vehicles	4.893	81.036	7.008	0.161	0.351	0.143	0.085	0.123	0.203	0.130	0.021	0.052	8898.9
Heavy-Duty Diesel Trucks	2.102	4.017	14.910	0.101	0.559	0.257	0.204	0.097	0.329	0.236	0.051	0.041	10833.6
Emission Factors (g/gal) - 2020													
Source	VOC	CO	NOx	SOx	PM10 Total	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	CO2
Construction Worker	9.860	201.489	7.742	0.168	0.476	0.075	0.156	0.244	0.211	0.069	0.039	0.104	9166.8
Pick-Up Trucks (Gasoline)	9.815	184.734	7.997	0.165	0.422	0.065	0.139	0.218	0.187	0.060	0.035	0.092	8983.0
Pick-Up Trucks (Diesel)	3.604	7.905	4.607	0.095	0.638	0.289	0.136	0.213	0.389	0.265	0.034	0.090	10177.9
Heavy-Duty Gasoline Vehicles	4.514	80.624	6.264	0.161	0.342	0.134	0.085	0.123	0.194	0.121	0.021	0.052	8898.2
Heavy-Duty Diesel Trucks	2.061	3.647	13.079	0.101	0.532	0.230	0.204	0.097	0.304	0.212	0.051	0.041	10828.8
Emission Factors (g/gal) - 2022													
Source	VOC	CO	NOx	SOx	PM10 Total	PM10 Exhaust	PM10 Tire Wear	PM10 Brake Wear	PM2.5 Total	PM2.5 Exhaust	PM2.5 Tire Wear	PM2.5 Brake Wear	CO2
Construction Worker	9.011	197.974	7.299	0.168	0.475	0.074	0.156	0.244	0.211	0.069	0.039	0.104	9167.5
Pick-Up Trucks (Gasoline)	8.890	181.029	7.557	0.165	0.421	0.064	0.139	0.218	0.187	0.060	0.035	0.092	8983.9
Pick-Up Trucks (Diesel)	3.128	7.293	3.893	0.095	0.593	0.245	0.136	0.213	0.349	0.224	0.034	0.090	10177.9
Heavy-Duty Gasoline Vehicles	3.859	79.841	4.830	0.161	0.326	0.119	0.085	0.123	0.181	0.107	0.021	0.052	8898.2
Heavy-Duty Diesel Trucks	1.997	3.072	10.181	0.101	0.488	0.186	0.204	0.097	0.264	0.172	0.051	0.041	10828.8