Appendix 24
Air Quality

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APPENDIX 24
Methodology for Air Quality and GHG Emissions Calculations

All Sites Reservoir Project (Project) alternatives (except for the Existing Conditions/No Project/No Action Condition) would involve the construction and operation of surface water storage reservoirs, and associated water intakes, conveyance facilities (canals, pipelines, tunnels, and pumping plants), service roads, dams, buildings, and recreation facilities. All action alternatives except Alternative C_1 include hydroelectric generation facilities.

24A.1 Construction Emissions

Construction would involve land clearing and grubbing, earthmoving for reservoir development, cut and fill operations, trenching, soil compaction, and grading. Construction-related activities would require extensive use of construction equipment, such as excavators, graders, scrapers, bulldozers, backhoes, and concrete mixing and pumping trucks. Haul trucks would be used to move borrow and/or spoils and other materials.

Construction-related emissions would arise from a variety of activities, including: (1) exhaust from fuel combustion in construction equipment, trucks, and worker vehicles; (2) generation of fugitive dust during land disturbance by equipment used for grading, excavation, road building, and other earth-moving activities; (3) fugitive dust from travel by construction equipment, haul trucks, and worker vehicles on paved and unpaved surfaces; and (4) fugitive dust from establishing quarries and borrow sites and from storing and handling materials.

24A.1.1 Estimation of Exhaust Emissions from Operation of Construction Equipment

Lists of the types and numbers of construction equipment and number of days required for construction of each Project feature for Alternative C were developed based on information provided by URS in a spreadsheet titled Equipment Spreadsheet 6-29-2011.xlsx (Barnes, 2011a, pers. comm.). For the emission calculations, the term ‘equipment-days’ was used to represent the result of multiplying the number of each type of equipment by the number of days that equipment would be in use. For example, if three bulldozers would operate for 30 days, this would represent 90 equipment-days for bulldozers. Equipment was assumed to operate 10 hours per day, except for the electric tunnel boring machine which was assumed to operate 24 hours per day. Additional information was provided by URS on May 8, 2012 regarding estimated equipment use and manpower for periodic Holthouse/Funks Reservoir sediment removal (Barnes, 2012, pers. comm.).

Emissions of criteria pollutants (nitrogen oxide [NO_x], particulate matter less than 10 microns in aerodynamic diameter [PM_{10}], reactive organic gases [ROG], sulfur oxide [SO_x], carbon monoxide, and particulate matter less than 2.5 microns in aerodynamic diameter) and carbon dioxide (CO_2) were estimated for combustion of fuels in construction equipment/vehicles, material transport trucks, and worker commutes. To calculate total equipment exhaust emissions for construction, equipment-specific hours of use were multiplied by equipment-specific load factors, horsepower ratings, and emission factors from the CalEEMod User's Guide, Appendix D (CAPCOA, 2016). Emissions from trucks operated within the construction area were estimated using the same methodology with off-highway truck emission

factors from the CalEEMod User's Guide, Appendix D (CAPCOA, 2016). Emissions from on- and off-road vehicles, including material transport trucks and worker commute vehicles, were estimated by multiplying the number of vehicle roundtrips by the number of roundtrip miles and by an EMFAC2014 emission factor (in units of pounds per mile) (ARB, 2014). Emissions for the construction years 2022 through 2030 were estimated using statewide-average emission factors for the year 2022. Emissions from concrete trucks, fuel trucks, and dump trucks operated within the construction area (i.e., not driving to the construction site from an offsite location) were estimated using off-highway truck emission factors. For example, this would include concrete trucks making trips from an on-site concrete batch plant to the pour location.

Equipment-specific hours of use were multiplied by equipment-specific emission factors to calculate total equipment emissions for construction of each Project feature. Total emissions for each Project feature were estimated by summing the results of the equipment emissions.

Information on the dates of construction start and finish, and the duration of construction for each Project feature, were obtained from the Concept Schedule for NODOS-Sites Reservoir provided by URS (Barnes, 2011b, pers. comm.). This schedule was used to estimate emissions for Alternatives A, B, C, and C_1. A different schedule to expedite construction was developed for construction of Alternative D (Herrin, 2017, pers. comm.), and that schedule was used in the emissions estimates for Alternative D. Average daily emissions rates, in units of pounds per day (lb/day), for construction of each Project feature were estimated by dividing the total emissions for construction of each Project feature by the construction duration in days for that feature. Based on the dates of construction start and finish, the years when construction of each feature would occur were identified. The average daily emission rates (in lb/day) estimated for each of the Project features that would be constructed in each identified construction year were summed to provide the average daily construction emission rates for the construction year. For periodic Holthouse/Funks Reservoir sediment removal, the average daily construction emission rates for each criteria pollutant (in lb/day) are the sum of the estimated emission rates for the equipment that would be used over the period of the activity divided by the duration in days, using an assumption of 167 days/activity.

To estimate emissions for the other alternatives, the following assumptions were used. The emissions estimates for construction of Alternatives B, C, and C_1 were assumed to be the same, because there would be only minor differences between the two alternatives with regard to overall construction requirements. For example, Alternative B does not include construction of the transmission line from the Pacific Gas and Electric Company line to the Sacramento River and there are no Delevan pipeline intake facilities, only a pipeline discharge facility. Alternative C_1 does not include hydropower generation or transmission equipment. However, these differences are not expected to result in substantial differences in the estimated construction emissions.

To estimate emissions for Alternative A reservoir and dams, URS engineering staff recommended an assumption that equipment use was directly related to material volumes for dam construction (Barnes, 2011a, pers. comm.). For Alternative A reservoir and dams, the values provided by URS for equipment-days for construction of the reservoir and dams under Alternative C were multiplied by a factor of 0.53, because the total volume of materials estimated for the smaller reservoir and dams is approximately 53 percent of that for the larger reservoir. One exception is the factor used in estimates of concrete use and associated greenhouse gas (GHG) emissions for the alternatives, where the factor used was 0.58 for Alternative A reservoir and dams (see Section 24A.1.4). Equipment use for construction of all of the other Project features was assumed to be the same for Alternatives A, B, C, and C_1. Equipment

use for construction of the other Project features was assumed to be the same for Alternatives D, however, a different schedule was used for estimation of construction emissions for Alternative D (Herrin, 2017, pers. comm.).

As summarized in emission calculation sheets, the average daily construction emission rates for each construction year in lb/day for each of the alternatives have been compared to the Tehama County Air Pollution Control District thresholds of significance of 137 lb/day for NO_x, ROG, and PM_{10} to evaluate the significance of the alternative's impacts on air quality.

24A.1.2 Estimation of Exhaust Emissions from On-road Vehicles

Emissions from on-road vehicles were estimated by multiplying the number of vehicle roundtrips by the number of roundtrips miles by an emission factor (in units of pounds per mile). Vehicle exhaust emissions were estimated using emission factors from the ARB's EMFAC2014 model for the Colusa County portion of the Sacramento Valley Air Basin for the year 2022 (ARB, 2014), assuming an annual temperature of 66°F and an annual relative humidity of 56%, per Table B-1 of CT-EMFAC: A Computer Model to Estimate Transportation Project Emissions (Wu et al., 2007). It was assumed highway trucks would travel an average roundtrip distance of 70 miles and construction workers would commute an average roundtrip distance of 80 miles.

24A.1.3 Estimation of Fugitive Dust Emissions

Fugitive dust would result from vehicle travel on unpaved and paved roads and soil disturbing activities, such as grading, and concrete batching. Fugitive dust from unpaved road travel, soil disturbing activities, and concrete batching would occur onsite, while fugitive dust from vehicle travel on paved roads would occur offsite. It was assumed that water trucks, dump trucks, and delivery trucks would travel an average distance of two miles per day on unpaved roads.

Fugitive dust emissions from vehicle travel on unpaved and paved roads were estimated using USEPA-approved emission factors and methodology published in AP-42 (USEPA, 2011 and USEPA, 2006). It was assumed that travel on unpaved roads would be limited to a speed of 15 miles per hour as a Project best management practice (BMP). Therefore, the unmitigated unpaved road emissions were reduced by 44 percent, the control efficiency from the URBEMIS2007 model, to account for the reduced vehicle speed.

Fugitive dust emissions from soil disturbance (for example, grading activities) were estimated based on the average emission factor of 10 lb per acre per day in URBEMIS2007. It was assumed that areas with soil disturbance would be watered daily as a Project BMP. Therefore, use of the average emission factor for disturbed areas (10 lb per acre per day) reflects a reduction of emissions by 50 percent when compared to the default disturbed area emission factor in URBEMIS2007 (20 lb per acre per day).

Fugitive dust emissions from concrete batch plant operations were estimated using USEPA-approved emission factors published in AP-42 (USEPA, 2006). The batch plants were assumed to have dust control equipment and were assumed to control dust emissions with an efficiency of 70% during sand and aggregate transfer. It was also assumed the truck loading process would include dust controls; therefore, the controlled truck loading emission factor was used. The source for the emission factors and control efficiency values was the Bay Area Air Quality Management District (BAAQMD) Permit Handbook, Section 11.5, Concrete Batch Plants (BAAQMD, 2009).

24A.1.4 Approach and Methodology for Concrete Estimates and GHG Emissions Estimates

GHG emissions from concrete used in each of the alternatives were calculated using the volume of concrete estimated to be used in the construction (Barnes, 2011a, pers. comm.). The volume of concrete used in each alternative was multiplied by a factor of 400 lb of carbon dioxide equivalent (CO2e) per cubic yard (cy) of concrete. This factor is derived from "Environmental Life Cycle Inventory of Portland Cement Concrete" (Portland Cement Association, 2003), which found that CO2 emissions from concrete range from 190 lb/cy to 500 lb/cy depending on the cement content of the concrete. Based on the types of concrete used for the Project, DWR has determined that a factor of 400 lb CO2e/cy would be used to estimate GHG emissions from concrete used on the Project.

Concrete quantities for the alternatives other than Alternative A (e.g., Alternatives B and C) were estimated using the equipment estimates spreadsheet developed by URS (Barnes, 2011a, pers. comm.). To estimate the concrete quantities associated with Alternative A, the ratio of concrete used to construct only the dams was compared between Alternative A and the other alternatives. Total cubic yards of concrete including concrete for the grout caps, slurry walls, and sacks of cement (5 sacks cement/cy of concrete for Type III cement) was summed for Sites Dam, Golden Gate Dam, and associated Saddle Dams for both Alternative A and the other alternatives. For Alternative A, the sum of the values provided by URS for concrete use for construction of the dams under the other alternatives was multiplied by a factor of 0.58, because the total volume of concrete estimated for the dams for the smaller reservoir under Alternative A is approximately 58 percent of that for the dams for the larger reservoir under Alternatives B, C, C_1, and D.

24A.2 Operations and Maintenance Emissions

Emissions associated with operations and maintenance of the alternatives depends on the size and type of facility, the number of employees and types of equipment, the increased traffic on the local and regional roadway network (including additional haul trucks and workers), and the level of operations activities. Emissions similar to those expected during construction, but at lower levels, would likely result from operations and maintenance of projects. For example, operational sources of fugitive dust would primarily be maintenance equipment and truck movement over paved and unpaved surfaces. Stationary sources, such as electrical generators, would be subject to permitting requirements to limit emissions. Required mitigation and operating conditions would be reflected in needed permits and approvals for the Project.

To estimate emissions from operations and maintenance activities, Project facilities were grouped to reflect activities, personnel, and equipment that might be shared to optimize efficiency. Emissions have been estimated for operations and maintenance of the following Project facilities:

- Pumping Plants, Intake and Outlet Facilities, Pumping and Generating Plants
- Reservoirs, Recreation Facilities, Dams, Roads, Bridges
- Electrical Substations and Transmission Lines
- Tunnels, Pipelines, and Canals

Estimates of the numbers and types of equipment, vehicles, and personnel needed for operations and maintenance of the facilities were provided by DWR (Bogener, 2011, pers. comm.). Equipment and personnel requirements for operations and maintenance of facilities were assumed to be the same for all of the Project alternatives. Calculations for recreational facilities assumed 200,000 recreational visitors

per year. Electricity generation and use rates varied for each of the alternatives, and GHG emissions associated with electricity were estimated separately (see below).

24A.2.1 Estimation of Exhaust and Fugitive Dust Emissions

Exhaust emissions from equipment and vehicles were estimated using the same methodology described above for construction. Equipment and personnel requirements for maintenance of facilities were assumed to be the same for all Project alternatives (A, B, C, C_1, and D). Maintenance activities include both routine activities and major inspections. Routine activities would occur on a daily basis throughout the year, whereas major inspections would occur annually. Exhaust emissions from construction-type equipment were calculated using load factors, horsepower, and emission factors from the CalEEMod User's Guide, Appendix D (CAPCOA, 2016). Emission factors for a motor boat and boat operated dredge were obtained from the OFFROAD2011 model, using the California Harbor Craft Emissions Inventory Database and California Barge and Dredge Emissions Inventory Database, respectively. Vehicle exhaust emissions were estimated using emission factors from the ARB's EMFAC2014 model for the Colusa County portion of the Sacramento Valley Air Basin).

Fugitive dust emissions for operations and maintenance were estimated for vehicle travel on paved and unpaved roads using the methodology described above for construction.

24A.2.2 Estimation of GHG Emissions from Electricity Generation

Emissions of GHGs associated with electricity generation and use in metric tons per year of CO_2e were estimated using predicted system-wide net generation and consumption of electricity for each alternative, in units of GigaWatt-hours per year, and emission factors for CO_2, methane, and nitrous oxide in units of pounds per MegaWatt-hour. The predicted system-wide net generation and consumption of electricity for each alternative was obtained from Table 31B-2, Power and Pumping Cost Reporting Metrics - Summary of All CVP, SWP, and Proposed Sites Facilities, Sites ADEIRS and FS Alternatives, dated January 27, 2017 (Chilmakuri, 2017, pers. comm.). The emission factors for the GHGs were obtained from The Climate Registry (TCR), General Reporting Protocol, Version 2.1, 2016 Climate Registry Default Emission Factors, Table 14.1, US Emission Factors by eGRID Subregion - updated to eGRID 2015 (2012 data) Version 1.0. eGRID 2015 Subregion WECC California (TCR, 2016).

24A.3 Spreadsheets and Tables

The following spreadsheets and tables provide the information used to estimate emissions (e.g., emission factors, numbers and types of equipment and vehicles, and assumptions) and present the results of the calculations. Tables include the following:

Emissions from Construction of Alternative A:

- Table 24A.A-1: Construction Emissions for Alternative A – Emission Summaries by Construction Year for Criteria Pollutants
- Table 24A.A-2: Construction NO_x Emissions for Alternative A by Project Feature
- Table 24A.A-3: Construction PM10 Emissions for Alternative A by Project Feature
- Table 24A.A-4: Construction PM2.5 Emissions for Alternative A by Project Feature
- Table 24A.A-5: Construction CO_2 Emissions for Alternative A by Project Feature
- Table 24A.A-6: Construction ROG Emissions for Alternative A by Project Feature
- Table 24A.A-7: Construction SO_x Emissions for Alternative A by Project Feature

- Table 24A.A-8: Construction CO Emissions for Alternative A by Project Feature
- Table 24A.A-9: Construction Equipment Emission Factors
- Table 24A.A-10: Equipment and Workforce for Construction of Project Features for Alternative A (2 pages)
- Table 24A.A-11: Concrete Batch Plant PM10 Emissions
- Table 24A.A-12: Construction Areas of Disturbance for Fugitive Dust Emissions Calculations
- Table 24A.A-13: Construction Emissions for Funks Reservoir Sediment Removal
- Table 24A.A-14: Comparison of Concrete for Alternatives
- Table 24A.A-15: Total GHG Emissions from Construction of Alternative A

Emissions from Construction of Alternatives B, C, and C_1:

- Table 24A.B-1: Construction Emissions for Alternatives B, C, and C_1 – Emission Summaries by Construction Year for Criteria Pollutants
- Table 24A.B-2: Construction NO_x Emissions for Alternatives B, C, and C_1 by Project Feature
- Table 24A.B-3: Construction PM10 Emissions for Alternatives B, C, and C_1 by Project Feature
- Table 24A.B-4: Construction PM2.5 Emissions for Alternatives B, C, and C_1 by Project Feature
- Table 24A.B-5: Construction CO_2 Emissions for Alternatives B, C, and C_1 by Project Feature
- Table 24A.B-6: Construction ROG Emissions for Alternatives B, C, and C_1 by Project Feature
- Table 24A.B-7: Construction SO_x Emissions for Alternatives B, C, and C_1 by Project Feature
- Table 24A.B-8: Construction CO Emissions for Alternatives B, C, and C_1 by Project Feature
- Table 24A.B-9: Construction Equipment Emission Factors
- Table 24A.B-10: Equipment and Workforce for Construction of Features for Alternatives B, C, and C_1 (2 pages)
- Table 24A.B-11: Concrete Batch Plant PM10 Emissions
- Table 24A.B-12: Construction Areas of Disturbance for Fugitive Dust Emissions Calculations
- Table 24A.B-13: Total GHG Emissions from Construction for Alternatives B, C, and C_1

GHG Emissions from Project Electricity Generation and Use for All Alternatives:

- Table 24A.C-1: Indirect GHG Emissions from Project Electricity Generation and Use – Emission Calculations
- Table 24A.C-2: Indirect GHG Emissions from Project Electricity Use for All Alternatives – Summary and Comparison

Emissions from Construction of Alternative D:

- Table 24A.D-1: Construction Emissions for Alternative D – Emission Summaries by Construction Year for Criteria Pollutants
- Table 24A.D-2: Construction NO_x Emissions for Alternative D by Project Feature
- Table 24A.D-3: Construction PM10 Emissions for Alternative D by Project Feature
- Table 24A.D-4: Construction PM2.5 Emissions for Alternative D by Project Feature
- Table 24A.D-5: Construction CO_2 Emissions for Alternative D by Project Feature
- Table 24A.D-6: Construction ROG Emissions for Alternative D by Project Feature
- Table 24A.D-7: Construction SO_x Emissions for Alternative D by Project Feature
- Table 24A.D-8: Construction CO Emissions for Alternative D by Project Feature
- Table 24A.D-9: Construction Equipment Emission Factors
- Table 24A.D-10: Equipment and Workforce for Construction of Features for Alternative D (2 pages)

- Table 24A.D-11: Concrete Batch Plant PM10 Emissions
- Table 24A.D-12: Construction Areas of Disturbance for Fugitive Dust Emissions Calculations
- Table 24A.D-13: Total GHG Emissions from Construction of Alternative D

Emissions from Operations and Maintenance of All Alternatives:

- Table 24A.E-1: Summary of Criteria Pollutant Emissions for Operations and Maintenance of All Alternatives
- Table 24A.E-2: Operations and Maintenance NO_x Emissions
- Table 24A.E-3: Operations and Maintenance PM10 Emissions
- Table 24A.E-4: Operations and Maintenance PM2.5 Emissions
- Table 24A.E-5: Operations and Maintenance ROG Emissions
- Table 24A.E-6: Operations and Maintenance CO Emissions
- Table 24A.E-7: Operations and Maintenance SO_x Emissions
- Table 24A.E-8: Operations and Maintenance CO_2 Emissions
- Table 24A.E-9: Operations and Maintenance Equipment and Workforce Assumptions
- Table 24A.E-10: Operations and Maintenance Equipment Emission Factors

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Chilmakuri, Chandra Sekhar, CH2M HILL. 2017. Personal communication (e-mail) to Pamela Vanderbilt, Principal Scientist, CH2M HILL, et al. Table 31B-2 Power and Pumping Cost Reporting Metrics – Summary of All CVP, SWP, and Proposed Sites Facilities. Sites ADEIRS and FS Alternatives. January 17.

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Emissions from Construction of Alternative A

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Table 24A.A-1
Construction Emissions for Alternative A - Emission Summaries by Construction Year for Criteria Pollutants

Proposed Project Construction Emissions for Alternative A

Average Daily Emission Rates for Criteria Pollutants by Year for Construction of Alternative A

Construction Year	Emissions (pounds per day)					
	NOx	**PM10**	**PM2.5**	**ROG**	**CO**	**SOx**
2022	**881**	**328**	65	84	620	2
2023	**1,549**	**680**	129	**151**	1,104	4
2024	**1,243**	**565**	109	122	897	3
2025	**1,260**	**569**	110	124	917	3
2026	**666**	**377**	69	67	501	2
2027	**206**	**203**	34	21	183	1
2028	**201**	**192**	33	21	172	1
2029	**167**	**174**	29	17	135	1
2030	33	19	3	4	37	0
Significance Threshold (lb/day)	137	137	n/a	137	n/a	n/a

Notes:

1. The average daily construction emission rates in lb/day for each construction year are the sum of the average daily emission rates estimated for each of the project features that would be constructed in the indicated construction year.

2. Bolded values indicate an exceedance of the significance threshold.

3. Significance Threshold is from TCAPCD Level C: Greater than 137 pounds per day of emissions. If emissions from a project would exceed the Level C thresholds, mitigation measures (BAMMs and SMMs), including off-site mitigation measures following the guidelines, may be required to reduce the overall air quality impacts of the project to a level of insignificance (TCAPCD, 2015).

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Table 24A.A-2
Construction NO_X Emissions for Alternative A by Project Feature

Proposed Project Construction NOx Emissions Alternative A

Equipment	NOx Emissions (pounds)												
	GCID Canal Intake & Headworks	**TRR**	**Sac River (Delevan) Intake & P/G Plant**	**TRR & Delevan Pipelines**	**TRR Pumping Plant**	**New Holthouse Reservoir**	**Inlet/Outlet Structure, Tunnel, Sites P/G Plant**	**Dams and Sites Inundation**	**Gravel Roads**	**Paved Roads & Bridge**	**Emergency Drawdown Tunnel**	**Recreation Facilities**	**Electrical Transmission & Switchyard Features**
Backhoe	0	0	0	0	0	0	0	0	0	3,079	0	0	0
Bobcat	0	0	0	0	0	0	0	0	0	0	0	667	0
Boom Truck	0	0	0	0	0	0	0	0	0	0	0	0	134
Bulldozer	240	6,398	8,749	23,175	8,749	102,507	13,217	70,608	2,095	73,370	13,217	871	60
Compactor	50	21	63	293	63	250	0	2,556	49	0	0	0	0
Concrete Pumper	0	0	48	0	48	88	141	496	0	129	141	0	13
Concrete Truck	783	0	2,087	416	2,087	883	5,168	1,723	0	11,268	5,168	331	773
Crane	0	0	1,046	7,845	1,046	0	1,831	0	0	5,230	1,831	0	2,479
Dump Truck	3,853	0	6,271	43,498	6,271	40	3,010	2,207	617	33,991	3,010	2,378	70
Excavator	0	0	0	888	0	0	0	0	0	58	0	0	0
Fuel Truck	1,681	928	1,671	4,852	1,671	2,860	2,769	9,434	467	5,649	2,769	1,565	286
Forklift	0	185	527	1,978	527	78	672	62	0	0	672	160	108
Generator	571	0	381	2,134	381	81	732	157	0	1,830	732	121	0
Grader	0	217	1,314	3,069	1,314	2,616	3,759	26,733	683	13,827	3,759	184	263
Highway Truck	0	0	0	0	0	0	0	0	0	0	0	0	0
Loader	726	575	473	5,044	473	579	1,512	7,140	155	4,670	1,512	597	389
Off-road Truck	0	7,626	0	0	0	7,475	0	74,028	0	22,878	0	0	0
Paver	87	52	0	0	0	0	0	0	13	210	0	58	0
Pile Driver	0	0	0	0	0	241	0	2,931	0	0	0	0	269
Roller	142	0	0	0	0	0	0	0	22	1,996	0	108	0
Scissor Lift	0	0	0	0	0	0	70	0	0	0	70	0	0
Scraper	1,543	7,289	13,024	153,535	13,024	128,113	34,544	40,290	1,643	97,661	34,544	0	0
Water Trucks	1,028	1,079	2,338	4,852	2,338	11,439	1,766	18,869	958	11,298	1,766	722	507
Welding Truck	0	0	0	1,829	0	0	538	0	0	0	538	0	0
Vehicles													
Highway Truck	748	770	1,936	7,166	1,936	4,959	4,299	27,431	0	5,512	4,299	504	891
Personnel Vehicles	319	411	1,910	496	1,910	2,203	424	3,825	520	1,684	406	260	1,092
Unpaved roads	411	502	809	3,294	809	1,729	1,233	8,830	78	4,207	1,233	278	409
Total Emissions (lbs)	**12,182**	**26,052**	**42,646**	**264,363**	**42,646**	**266,141**	**75,686**	**297,318**	**7,300**	**298,547**	**75,668**	**8,805**	**7,745**

Construction Duration (days)	743	487	1276	549	1276	826	485	2224	1403	1403	465	731	1445
Emissions (lb/day)	16.4	53.5	33.4	481.5	33.4	322.2	156.1	133.7	5.2	212.8	162.7	12.0	5.4

Daily Emissions (lb/day) in Year

													Total lb/day NOx for Features Constructed In the Indicated Year	***Year***
2022	16.4					322.2	156.1		5.2	212.8	162.7		5.4	880.73	2022
2023	16.4	53.5		481.5		322.2	156.1	133.7	5.2	212.8	162.7		5.4	1,549.45	2023
2024	16.4	53.5		481.5		322.2		133.7	5.2	212.8		12.0	5.4	1,242.72	2024
2025		53.5		481.5	33.4	322.2		133.7	5.2	212.8		12.0	5.4	1,259.74	2025
2026				481.5	33.4			133.7				12.0	5.4	666.05	2026
2027			33.4		33.4			133.7					5.4	205.89	2027
2028			33.4		33.4			133.7						200.53	2028
2029			33.4					133.7						167.11	2029
2030			33.4											33.42	2030
2031														-	2031

Sites Construction Alt A_03222017.xlsx, Detail NOx Emissions by Feature

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Table 24A.A-3
Construction PM10 Emissions for Alternative A by Project Feature

Proposed Project Construction PM10 Emissions Alternative A

Equipment	PM10 Emissions (pounds)												
	GCID Canal Intake & Headworks	**TRR**	**Sac River (Delevan) Intake & P/G Plant**	**TRR & Delevan Pipelines**	**TRR Pumping Plant**	**New Holthouse Reservoir**	**Inlet/Outlet Structure, Tunnel, Sites P/G Plant**	**Dams and Sites Inundation**	**Gravel Roads**	**Paved Roads & Bridge**	**Emergency Drawdown Tunnel**	**Recreation Facilities**	**Electrical Transmission & Switchyard Features**
Backhoe	0	0	0	0	0	0	0	0	0	165	0	0	0
Bobcat	0	0	0	0	0	0	0	0	0	0	0	41	0
Boom Truck	0	0	0	0	0	0	0	0	0	0	0	0	2
Bulldozer	9	241	330	874	330	3,868	499	2,664	79	2,769	499	33	2
Compactor	2	1	2	11	2	10	0	99	2	0	0	0	0
Concrete Pumper	0	0	2	0	2	3	5	19	0	5	5	0	1
Concrete Truck	28	0	76	15	76	32	187	62	0	408	187	12	28
Crane	0	0	43	326	43	0	76	0	0	217	76	0	103
Dump Truck	140	0	227	1,577	227	1	109	80	22	1,232	109	86	3
Excavator	0	0	0	43	0	0	0	0	0	3	0	0	0
Fuel Truck	61	34	61	176	61	104	100	342	17	205	100	57	10
Forklift	0	12	35	131	35	5	45	4	0	0	45	11	7
Generator	29	0	19	107	19	4	37	8	0	92	37	6	0
Grader	0	7	42	98	42	83	120	853	22	441	120	6	8
Highway Truck	0	0	0	0	0	0	0	0	0	0	0	0	0
Loader	24	19	16	170	16	19	51	240	5	157	51	20	13
Off-road Truck	0	276	0	0	0	271	0	2,683	0	829	0	0	0
Paver	4	3	0	0	0	0	0	0	1	10	0	3	0
Pile Driver	0	0	0	0	0	8	0	93	0	0	0	0	9
Roller	8	0	0	0	0	0	0	0	1	115	0	6	0
Scissor Lift	0	0	0	0	0	0	1	0	0	0	1	0	0
Scraper	60	284	507	5,974	507	4,985	1,344	1,568	64	3,800	1,344	0	0
Water Trucks	37	39	85	176	85	415	64	684	35	410	64	26	18
Welding Truck	0	0	0	80	0	0	23	0	0	0	23	0	0
Vehicles													
Highway Truck	107	110	277	1,026	277	710	616	3,928	0	789	616	72	128
Personnel Vehicles	559	720	3,343	869	3,343	3,856	742	6,695	910	2,948	712	455	1,911
Unpaved Roads	9,418	11,509	18,559	75,557	18,559	39,674	28,297	202,566	1,788	96,505	28,297	6,387	9,391
Fugitive PM Sources													
Concrete Batch Plant	15	0	10	10	10	10	42	6	0	15	42	5	10
Disturbed Areas	131	1,916	268	4,075	7	4,563	2,309	121,791	0	13,109	31	12,084	3,728
Total Emissions (lbs)	**10,632**	**15,171**	**23,902**	**91,294**	**23,640**	**58,622**	**34,668**	**344,387**	**2,945**	**124,224**	**32,359**	**19,311**	**15,373**

Notes:
1. Highway truck and personnel vehicle emissions include paved road dust emissions.
2. The unpaved road emissions include fugitive dust from travel over unpaved roads.

Construction Duration (days)	743	487	1276	549	1276	826	485	2224	1403	1403	465	731	1445
Emissions (lb/day)	14.3	31.2	18.7	166.3	18.5	71.0	71.5	154.9	2.1	88.5	69.6	26.4	10.6

Daily Emissions (lb/day) in Year														***Total lb/day PM10 for Features Constructed In the Indicated Year***	***Year***
2022	14.3					71.0	71.5		2.1	88.5	69.6		10.6	327.63	2022
2023	14.3	31.2		166.3		71.0	71.5	154.9	2.1	88.5	69.6		10.6	679.92	2023
2024	14.3	31.2		166.3		71.0		154.9	2.1	88.5		26.4	10.6	565.27	2024
2025		31.2		166.3	18.5	71.0		154.9	2.1	88.5		26.4	10.6	569.49	2025
2026				166.3	18.5			154.9				26.4	10.6	376.72	2026
2027			18.7		18.5			154.9					10.6	202.75	2027
2028			18.7		18.5			154.9						192.11	2028
2029			18.7					154.9						173.58	2029
2030			18.7											18.73	2030
2031														-	2031

Table 24A.A-4
Construction PM2.5 Emissions for Alternative A by Project Feature

Proposed Project
Construction PM2.5 Emissions
Alternative A

Equipment	PM2.5 Emissions (pounds)												
	GCID Canal Intake & Headworks	**TRR**	**Sac River (Delevan) Intake & P/G Plant**	**TRR & Delevan Pipelines**	**TRR Pumping Plant**	**New Holthouse Reservoir**	**Inlet/Outlet Structure, Tunnel, Sites P/G Plant**	**Dams and Sites Inundation**	**Gravel Roads**	**Paved Roads & Bridge**	**Emergency Drawdown Tunnel**	**Recreation Facilities**	**Electrical Transmission & Switchyard Features**
Backhoe	0	0	0	0	0	0	0	0	0	152	0	0	0
Bobcat	0	0	0	0	0	0	0	0	0	0	0	38	0
Boom Truck	0	0	0	0	0	0	0	0	0	0	0	0	2
Bulldozer	8	223	304	806	304	3,566	460	2,456	73	2,553	460	30	2
Compactor	2	1	2	11	2	10	0	99	2	0	0	0	0
Concrete Pumper	0	0	2	0	2	3	5	19	0	5	5	0	1
Concrete Truck	26	0	70	14	70	30	173	58	0	378	173	11	26
Crane	0	0	40	299	40	0	70	0	0	199	70	0	95
Dump Truck	129	0	210	1,460	210	1	101	74	21	1,141	101	80	2
Excavator	0	0	0	40	0	0	0	0	0	3	0	0	0
Fuel Truck	56	31	56	163	56	96	93	317	16	190	93	53	10
Forklift	0	11	32	121	32	5	41	4	0	0	41	10	7
Generator	29	0	19	107	19	4	37	8	0	92	37	6	0
Grader	0	6	39	90	39	77	110	784	20	405	110	5	8
Highway Truck	0	0	0	0	0	0	0	0	0	0	0	0	0
Loader	22	18	15	155	15	18	46	219	5	143	46	18	12
Off-road Truck	0	256	0	0	0	251	0	2,485	0	768	0	0	0
Paver	4	2	0	0	0	0	0	0	1	9	0	3	0
Pile Driver	0	0	0	0	0	7	0	86	0	0	0	0	8
Roller	8	0	0	0	0	0	0	0	1	106	0	6	0
Scissor Lift	0	0	0	0	0	0	1	0	0	0	1	0	0
Scraper	55	261	466	5,494	466	4,584	1,236	1,442	59	3,494	1,236	0	0
Water Trucks	35	36	78	163	78	384	59	633	32	379	59	24	17
Welding Truck	0	0	0	80	0	0	23	0	0	0	23	0	0
Vehicles													
Highway Truck	35	36	90	333	90	231	200	1,275	0	256	200	23	41
Personnel Vehicles	169	218	1,013	263	1,013	1,169	225	2,029	276	893	216	138	579
Unpaved Roads	943	1,153	1,859	7,568	1,859	3,974	2,834	20,290	179	9,667	2,834	640	941
Fugitive PM Sources													
Concrete Batch Plant	4	0	3	3	3	3	12	2	0	4	12	2	3
Disturbed Areas	27	399	56	847	1	949	480	25,333	0	2,727	6	2,514	775
Total Emissions (lbs)	**1,553**	**2,650**	**4,355**	**18,017**	**4,300**	**15,361**	**6,209**	**57,612**	**683**	**23,565**	**5,725**	**3,600**	**2,528**

Notes:

1. Highway truck and personnel vehicle emissions include paved road dust emissions.
2. The unpaved road emissions include fugitive dust from travel over unpaved roads.
3. $PM_{2.5}$ fugitive dust emissions were calculated following the *SCAQMD Particulate Matter (PM) 2.5 Significance Thresholds and Calculation Methodology*, October 2006 (SCAQMD, 2006). For concrete batch plant operations (loading/unloading bulk materials), it is assumed that 29.2% of the PM_{10} would be $PM_{2.5}$. For construction fugitive dust sources, it is assumed that 20.8% of the PM_{10} would be $PM_{2.5}$.

Construction Duration (days)	743	487	1276	549	1276	826	485	2224	1403	1403	465	731	1445
Emissions (lb/day)	2.1	5.4	3.4	32.8	3.4	18.6	12.8	25.9	0.5	16.8	12.3	4.9	1.7

Daily Emissions (lb/day) in Year														***Total lb/day PM2.5 for Features Constructed In the Indicated Year***	***Year***
2022	2.1					18.6	12.8		0.5	16.8	12.3		1.7	64.83	2022
2023	2.1	5.4		32.8		18.6	12.8	25.9	0.5	16.8	12.3		1.7	129.00	2023
2024	2.1	5.4		32.8		18.6		25.9	0.5	16.8		4.9	1.7	108.81	2024
2025		5.4		32.8	3.4	18.6		25.9	0.5	16.8		4.9	1.7	110.09	2025
2026				32.8	3.4			25.9				4.9	1.7	68.77	2026
2027			3.4		3.4			25.9					1.7	34.44	2027
2028			3.4		3.4			25.9						32.69	2028
2029			3.4					25.9						29.32	2029
2030			3.4											3.41	2030
2031														-	2031

Table 24A.A-5
Construction CO_2 Emissions for Alternative A by Project Feature

Proposed Project Construction CO2 Emissions Alternative A

Equipment	CO2 Emissions (pounds)												
	GCID Canal Intake & Headworks	TRR	Sac River (Delevan) Intake & P/G Plant	TRR & Delevan Pipelines	TRR Pumping Plant	New Holthouse Reservoir	Inlet/Outlet Structure, Tunnel, Sites P/G Plant	Dams and Sites Inundation	Gravel Roads	Paved Roads & Bridge	Emergency Drawdown Tunnel	Recreation Facilities	Electrical Transmission & Switchyard Features
Backhoe	0	0	0	0	0	0	0	0	0	553,517	0	0	0
Bobcat	0	0	0	0	0	0	0	0	0	0	0	97,966	0
Boom Truck	0	0	0	0	0	0	0	0	0	0	0	0	39,028
Bulldozer	30,361	808,356	1,105,322	2,927,918	1,105,322	12,950,771	1,669,843	8,920,567	264,708	9,269,526	1,669,843	110,058	7,590
Compactor	6,853	2,845	8,620	40,254	8,620	34,306	0	350,628	6,723	0	0	0	0
Concrete Pumper	0	0	6,567	0	6,567	12,124	19,322	68,037	0	17,680	19,322	0	1,831
Concrete Truck	249,398	0	665,061	132,692	665,061	281,372	1,646,666	549,059	0	3,590,691	1,646,666	105,515	246,201
Crane	0	0	139,705	1,047,789	139,705	0	244,484	0	0	698,526	244,484	0	331,101
Dump Truck	1,227,805	0	1,998,381	13,860,771	1,998,381	12,790	959,223	703,270	196,641	10,831,225	959,223	757,786	22,382
Excavator	0	0	0	250,003	0	0	0	0	0	16,250	0	0	0
Fuel Truck	535,566	295,760	532,369	1,545,948	532,369	911,262	882,485	3,006,268	148,680	1,800,142	882,485	498,796	91,126
Forklift	0	25,905	74,014	277,553	74,014	10,917	94,368	8,728	0	0	94,368	22,389	15,173
Generator	121,490	0	80,993	454,029	80,993	17,133	155,756	33,433	0	389,390	155,756	25,700	0
Grader	0	26,452	160,317	374,340	160,317	319,031	458,507	3,260,648	83,365	1,686,535	458,507	22,444	32,063
Highway Truck	0	0	0	0	0	0	0	0	0	0	0	0	0
Loader	145,357	115,074	94,633	1,009,928	94,633	115,831	302,827	1,429,639	31,040	934,979	302,827	119,617	77,978
Off-road Truck	0	2,430,031	0	0	0	2,382,070	0	23,589,209	0	7,290,094	0	0	0
Paver	18,779	11,381	0	0	0	0	0	0	2,845	45,525	0	12,519	0
Pile Driver	0	0	0	0	0	97,064	0	1,181,397	0	0	0	0	108,484
Roller	20,963	0	0	0	0	0	0	0	3,176	293,803	0	15,881	0
Scissor Lift	0	0	0	0	0	0	20,327	0	0	0	20,327	0	0
Scraper	253,621	1,198,269	2,141,080	25,240,848	2,141,080	21,061,607	5,678,915	6,623,563	270,162	16,055,340	5,678,915	0	0
Water Trucks	327,734	343,722	744,996	1,545,948	744,996	3,645,047	562,744	6,012,537	305,353	3,600,283	562,744	230,213	161,469
Welding Truck	0	0	0	259,343	0	0	76,247	0	0	0	76,247	0	0
Vehicles													
Highway Truck	812,409	836,303	2,102,705	7,782,397	2,102,705	5,385,791	4,668,960	29,790,832	0	5,986,735	4,668,960	547,181	967,722
Personnel Vehicles	1,042,219	1,342,691	6,233,677	1,619,849	6,233,677	7,191,588	1,384,095	12,486,105	1,696,563	5,496,863	1,327,019	848,596	3,564,596
Unpaved roads	101,370	123,876	199,761	813,276	199,761	427,040	304,583	2,180,366	19,243	1,038,758	304,583	68,746	101,086
Concrete													
Concrete Batch Plant	4,326,154	0	11,384,615	2,276,923	11,384,615	4,876,513	29,578,000	10,225,965	0	38,176,410	29,578,000	1,801,026	3,301,538
Total Emissions (lbs)	**9,220,079**	**7,560,665**	**27,672,817**	**61,459,808**	**27,672,817**	**59,732,257**	**48,707,352**	**110,420,253**	**3,028,498**	**107,772,273**	**48,650,276**	**5,284,433**	**9,069,369**
Total Emissions (metric tons)	**4,182**	**3,429**	**12,552**	**27,878**	**12,552**	**27,094**	**22,093**	**50,086**	**1,374**	**48,885**	**22,067**	**2,397**	**4,114**
CONSTRUCTION TOTAL (metric tons)	**238,704**												
Construction Duration (days)	743	487	1276	549	1276	826	485	2224	1403	1403	465	731	1445
Emissions (lb/day)	12409.3	15525.0	21687.2	111948.6	21687.2	72315.1	100427.5	49649.4	2158.6	76815.6	104624.2	7229.0	6276.4

Ave. Annual Emissions (mt/yr) in Year

														Total mt/yr CO2 for Features Constructed In the Indicated Year	***Year***
2022	1394.1					6773.5	11046.7		343.4	12221.2	11033.7		685.6	43,498.20	2022
2023	1394.1	1143.2		6969.4		6773.5	11046.7	7155.1	343.4	12221.2	11033.7		685.6	58,765.90	2023
2024	1394.1	1143.2		6969.4		6773.5		7155.1	343.4	12221.2		799.0	685.6	37,484.53	2024
2025		1143.2		6969.4	3138.0	6773.5		7155.1	343.4	12221.2		799.0	685.6	39,228.53	2025
2026				6969.4	3138.0			7155.1				799.0	685.6	18,747.23	2026
2027			3138.0		3138.0			7155.1					685.6	14,116.85	2027
2028			3138.0		3138.0			7155.1						13,431.22	2028
2029			3138.0					7155.1						10,293.17	2029
2030			3138.0											3,138.05	2030
2031														-	2031

	CONSTRUCTION TOTAL (metric tons)
238,703.68	

Table 24A.A-6
Construction ROG Emissions for Alternative A by Project Feature

Proposed Project Construction ROG Emissions Alternative A

Equipment	ROG Emissions (pounds)												
	GCID Canal Intake & Headworks	TRR	Sac River (Delevan) Intake & P/G Plant	TRR & Delevan Pipelines	TRR Pumping Plant	New Holthouse Reservoir	Inlet/Outlet Structure, Tunnel, Sites P/G Plant	Dams and Sites Inundation	Gravel Roads	Paved Roads & Bridge	Emergency Drawdown Tunnel	Recreation Facilities	Electrical Transmission & Switchyard Features
Backhoe	0	0	0	0	0	0	0	0	0	302	0	0	0
Bobcat	0	0	0	0	0	0	0	0	0	0	0	71	0
Boom Truck	0	0	0	0	0	0	0	0	0	0	0	0	9
Bulldozer	20	524	716	1,898	716	8,394	1,082	5,782	172	6,008	1,082	71	5
Compactor	8	3	10	47	10	40	0	408	8	0	0	0	0
Concrete Pumper	0	0	8	0	8	14	22	79	0	21	22	0	2
Concrete Truck	103	0	275	55	275	116	680	227	0	1,483	680	44	102
Crane	0	0	93	700	93	0	163	0	0	467	163	0	221
Dump Truck	507	0	825	5,723	825	5	396	290	81	4,472	396	313	9
Excavator	0	0	0	101	0	0	0	0	0	7	0	0	0
Fuel Truck	221	122	220	638	220	376	364	1,241	61	743	364	206	38
Forklift	0	20	57	213	57	8	72	7	0	0	72	17	12
Generator	64	0	43	240	43	9	82	18	0	206	82	14	0
Grader	0	17	104	242	104	207	297	2,111	54	1,092	297	15	21
Highway Truck	0	0	0	0	0	0	0	0	0	0	0	0	0
Loader	70	55	46	486	46	56	146	688	15	450	146	58	38
Off-road Truck	0	1,003	0	0	0	984	0	9,740	0	3,010	0	0	0
Paver	9	5	0	0	0	0	0	0	1	21	0	6	0
Pile Driver	0	0	0	0	0	24	0	290	0	0	0	0	27
Roller	14	0	0	0	0	0	0	0	2	192	0	10	0
Scissor Lift	0	0	0	0	0	0	5	0	0	0	5	0	0
Scraper	141	668	1,194	14,081	1,194	11,750	3,168	3,695	151	8,957	3,168	0	0
Water Trucks	135	142	308	638	308	1,505	232	2,482	126	1,486	232	95	67
Welding Truck	0	0	0	346	0	0	102	0	0	0	102	0	0
Vehicles													
Highway Truck	50	51	128	474	128	328	285	1,816	0	365	285	33	59
Personnel Vehicles	72	93	430	112	430	496	95	861	117	379	92	59	246
Unpaved roads	15	19	31	124	31	65	47	333	3	159	47	11	15
Total Emissions (lbs)	**1,429**	**2,723**	**4,487**	**26,119**	**4,487**	**24,377**	**7,239**	**30,067**	**791**	**29,819**	**7,235**	**1,021**	**869**

Construction Duration (days)	743	487	1276	549	1276	826	485	2224	1403	1403	465	731	1445
Emissions (lb/day)	1.9	5.6	3.5	47.6	3.5	29.5	14.9	13.5	0.6	21.3	15.6	1.4	0.6

Daily Emissions (lb/day) in Year														*Total lb/day ROG for Features Constructed In the Indicated Year*	*Year*
2022	1.9					29.5	14.9		0.6	21.3	15.6		0.6	84.34	2022
2023	1.9	5.6		47.6		29.5	14.9	13.5	0.6	21.3	15.6		0.6	151.03	2023
2024	1.9	5.6		47.6		29.5		13.5	0.6	21.3		1.4	0.6	121.94	2024
2025		5.6		47.6	3.5	29.5		13.5	0.6	21.3		1.4	0.6	123.53	2025
2026				47.6	3.5			13.5				1.4	0.6	66.61	2026
2027			3.5		3.5			13.5					0.6	21.15	2027
2028			3.5		3.5			13.5						20.55	2028
2029			3.5					13.5						17.04	2029
2030			3.5											3.52	2030
2031														-	2031

Table 24A.A-7
Construction SOx Emissions for Alternative A by Project Feature

Proposed Project Construction SOx Emissions Alternative A

Equipment	SOx Emissions (pounds)												
	GCID Canal Intake & Headworks	TRR	Sac River (Delevan) Intake & P/G Plant	TRR & Delevan Pipelines	TRR Pumping Plant	New Holthouse Reservoir	Inlet/Outlet Structure, Tunnel, Sites P/G Plant	Dams and Sites Inundation	Gravel Roads	Paved Roads & Bridge	Emergency Drawdown Tunnel	Recreation Facilities	Electrical Transmission & Switchyard Features
Backhoe	0	0	0	0	0	0	0	0	0	6	0	0	0
Bobcat	0	0	0	0	0	0	0	0	0	0	0	1	0
Boom Truck	0	0	0	0	0	0	0	0	0	0	0	0	0
Bulldozer	0	9	12	31	12	137	18	94	3	98	18	1	0
Compactor	0	0	0	1	0	0	0	5	0	0	0	0	0
Concrete Pumper	0	0	0	0	0	0	0	1	0	0	0	0	0
Concrete Truck	3	0	7	1	7	3	17	6	0	38	17	1	3
Crane	0	0	1	11	1	0	3	0	0	7	3	0	4
Dump Truck	13	0	21	146	21	0	10	7	2	114	10	8	0
Excavator	0	0	0	3	0	0	0	0	0	0	0	0	0
Fuel Truck	6	3	6	16	6	10	9	32	2	19	9	5	1
Forklift	0	0	1	3	1	0	1	0	0	0	1	0	0
Generator	1	0	1	5	1	0	2	0	0	4	2	0	0
Grader	0	0	2	4	2	3	5	34	1	18	5	0	0
Highway Truck	0	0	0	0	0	0	0	0	0	0	0	0	0
Loader	2	1	1	11	1	1	3	15	0	10	3	1	1
Off-road Truck	0	26	0	0	0	25	0	248	0	77	0	0	0
Paver	0	0	0	0	0	0	0	0	0	0	0	0	0
Pile Driver	0	0	0	0	0	1	0	13	0	0	0	0	1
Roller	0	0	0	0	0	0	0	0	0	3	0	0	0
Scissor Lift	0	0	0	0	0	0	0	0	0	0	0	0	0
Scraper	3	13	23	267	23	223	60	70	3	170	60	0	0
Water Trucks	3	4	8	16	8	38	6	63	3	38	6	2	2
Welding Truck	0	0	0	3	0	0	1	0	0	0	1	0	0
Vehicles													
Highway Truck	8	8	20	74	20	51	45	284	0	57	45	5	9
Personnel Vehicles	10	13	63	16	63	72	14	125	17	55	13	9	36
Unpaved roads	1	1	2	8	2	4	3	21	0	10	3	1	1
Total Emissions (lbs)	**50**	**78**	**166**	**616**	**166**	**570**	**196**	**1,020**	**31**	**725**	**196**	**36**	**58**

Construction Duration (days)	743	487	1276	549	1276	826	485	2224	1403	1403	465	731	1445
Emissions (lb/day)	0.1	0.2	0.1	1.1	0.1	0.7	0.4	0.5	0.0	0.5	0.4	0.0	0.0

Daily Emissions (lb/day) in Year

														Total lb/day SOx for Features Constructed In the Indicated Year	***Year***
2022	0.1					0.7	0.4		0.0	0.5	0.4		0.0	2.16	2022
2023	0.1	0.2		1.1		0.7	0.4	0.5	0.0	0.5	0.4		0.0	3.90	2023
2024	0.1	0.2		1.1		0.7		0.5	0.0	0.5		0.0	0.0	3.13	2024
2025		0.2		1.1	0.1	0.7		0.5	0.0	0.5		0.0	0.0	3.19	2025
2026				1.1	0.1			0.5				0.0	0.0	1.80	2026
2027			0.1		0.1			0.5					0.0	0.76	2027
2028			0.1		0.1			0.5						0.72	2028
2029			0.1					0.5						0.59	2029
2030			0.1											0.13	2030
2031														-	2031

Table 24A.A-8
Construction CO Emissions for Alternative A by Project Feature

Proposed Project Construction CO Emissions Alternative A

Equipment	CO Emissions (pounds)												
	GCID Canal Intake & Headworks	TRR	Sac River (Delevan) Intake & P/G Plant	TRR & Delevan Pipelines	TRR Pumping Plant	New Holthouse Reservoir	Inlet/Outlet Structure, Tunnel, Sites P/G Plant	Dams and Sites Inundation	Gravel Roads	Paved Roads & Bridge	Emergency Drawdown Tunnel	Recreation Facilities	Electrical Transmission & Switchyard Features
Backhoe	0	0	0	0	0	0	0	0	0	4,112	0	0	0
Bobcat	0	0	0	0	0	0	0	0	0	0	0	765	0
Boom Truck	0	0	0	0	0	0	0	0	0	0	0	0	263
Bulldozer	93	2,465	3,371	8,929	3,371	39,496	5,092	27,205	807	28,269	5,092	336	23
Compactor	42	17	53	246	53	209	0	2,140	41	0	0	0	0
Concrete Pumper	0	0	40	0	40	74	118	415	0	108	118	0	11
Concrete Truck	655	0	1,747	348	1,747	739	4,324	1,442	0	9,429	4,324	277	647
Crane	0	0	473	3,548	473	0	828	0	0	2,365	828	0	1,121
Dump Truck	3,224	0	5,248	36,400	5,248	34	2,519	1,847	516	28,444	2,519	1,990	59
Excavator	0	0	0	1,628	0	0	0	0	0	106	0	0	0
Fuel Truck	1,406	777	1,398	4,060	1,398	2,393	2,317	7,895	390	4,727	2,317	1,310	239
Forklift	0	202	577	2,163	577	85	736	68	0	0	736	175	118
Generator	717	0	478	2,679	478	101	919	197	0	2,297	919	152	0
Grader	0	71	430	1,005	430	857	1,231	8,754	224	4,528	1,231	60	86
Highway Truck	0	0	0	0	0	0	0	0	0	0	0	0	0
Loader	367	291	239	2,553	239	293	766	3,614	78	2,364	766	302	197
Off-road Truck	0	6,381	0	0	0	6,256	0	61,947	0	19,144	0	0	0
Paver	119	72	0	0	0	0	0	0	18	288	0	79	0
Pile Driver	0	0	0	0	0	217	0	2,640	0	0	0	0	242
Roller	153	0	0	0	0	0	0	0	23	2,151	0	116	0
Scissor Lift	0	0	0	0	0	0	137	0	0	0	137	0	0
Scraper	1,100	5,196	9,285	109,455	9,285	91,332	24,626	28,722	1,172	69,623	24,626	0	0
Water Trucks	861	903	1,956	4,060	1,956	9,572	1,478	15,789	802	9,455	1,478	605	424
Welding Truck	0	0	0	2,120	0	0	623	0	0	0	623	0	0
Vehicles													
Highway Truck	292	301	756	2,800	756	1,938	1,680	10,717	0	2,154	1,680	197	348
Personnel Vehicles	3,522	4,538	21,067	5,474	21,067	24,304	4,678	42,197	5,734	18,577	4,485	2,868	12,046
Unpaved roads	91	112	180	734	180	385	275	1,967	17	937	275	62	91
Total Emissions (lbs)	**12,643**	**21,326**	**47,298**	**188,201**	**47,298**	**178,283**	**52,346**	**217,558**	**9,823**	**209,079**	**52,153**	**9,293**	**15,916**

Construction Duration (days)	743	487	1276	549	1276	826	485	2224	1403	1403	465	731	1445
Emissions (lb/day)	17.0	43.8	37.1	342.8	37.1	215.8	107.9	97.8	7.0	149.0	112.2	12.7	11.0

Daily Emissions (lb/day) in Year														***Total lb/day CO for Features Constructed In the Indicated Year***	***Year***
2022	17.0					215.8	107.9		7.0	149.0	112.2		11.0	619.98	2022
2023	17.0	43.8		342.8		215.8	107.9	97.8	7.0	149.0	112.2		11.0	1,104.40	2023
2024	17.0	43.8		342.8		215.8		97.8	7.0	149.0		12.7	11.0	897.03	2024
2025		43.8		342.8	37.1	215.8		97.8	7.0	149.0		12.7	11.0	917.08	2025
2026				342.8	37.1			97.8				12.7	11.0	501.42	2026
2027			37.1		37.1			97.8					11.0	182.97	2027
2028			37.1		37.1			97.8						171.96	2028
2029			37.1					97.8						134.89	2029
2030			37.1											37.07	2030
2031														-	2031

Table 24A.A9
Construction Equipment Emission Factors

Proposed Project Construction - Emission Factors

Construction Equipment Emission Factors

Project Equipment Type	Equipment Type from OFFROAD	Load Factor	Horsepower	Emission Factors (g/bhp hr)						
				NOx	PM10	CO2	ROG	SOx	CO	PM2.5
Backhoe	Tractor/Loader/Backhoe	0.37	97	2.647	0.142	475.898	0.260	0.005	3.536	0.131
Bobcat	Other General Industrial	0.34	88	3.200	0.199	470.000	0.339	0.005	3.668	0.183
Boom Truck	Aerial Lift	0.31	63	1.627	0.030	472.114	0.105	0.005	3.176	0.028
Bulldozer	Crawler Tractor	0.43	212	3.737	0.141	472.098	0.306	0.005	1.440	0.130
Compactor	Plate Compactor	0.43	8	4.142	0.161	568.299	0.661	0.008	3.469	0.161
Concrete Pumper	Cement and Mortar Mixer	0.56	9	4.142	0.161	568.299	0.661	0.008	3.470	0.161
Concrete Truck	Off-Highway Truck	0.38	402	1.490	0.054	474.714	0.196	0.005	1.247	0.050
Crane	Crane	0.29	231	3.541	0.147	472.983	0.316	0.005	1.602	0.135
Dump Truck	Off-Highway Truck	0.38	402	1.490	0.054	474.714	0.196	0.005	1.247	0.050
Excavator	Excavator	0.38	158	1.678	0.081	472.192	0.191	0.005	3.074	0.075
Fuel Truck	Off-Highway Truck	0.38	402	1.490	0.054	474.714	0.196	0.005	1.247	0.050
Forklift	Forklift	0.20	89	3.360	0.223	471.529	0.362	0.005	3.675	0.205
Generator	Generator set	0.74	84	2.671	0.134	568.299	0.301	0.006	3.353	0.134
Grader	Grader	0.41	187	3.888	0.124	474.239	0.307	0.005	1.273	0.114
Highway Truck	Estimated with EMFAC2014 emission factors and by assuming 10 one-way trips per equipment day (5 round trips)									
Loader	Rubber Tired Loader	0.36	203	2.347	0.079	469.904	0.226	0.005	1.188	0.072
Off-road Truck	Off-Highway Truck	0.38	402	1.490	0.054	474.714	0.196	0.005	1.247	0.050
Paver	Paver	0.42	130	2.180	0.104	472.760	0.215	0.005	2.995	0.095
Pile Driver	Bore/Drill Rig	0.50	221	1.163	0.037	468.760	0.115	0.005	1.047	0.034
Roller	Roller	0.38	80	3.219	0.186	473.929	0.310	0.005	3.470	0.171
Scissor Lift	Aerial Lift	0.31	63	1.627	0.030	472.114	0.105	0.005	3.176	0.028
Scraper	Scraper	0.48	367	2.879	0.112	473.230	0.264	0.005	2.052	0.103
Water Trucks	Off-Highway Truck	0.38	402	1.490	0.054	474.714	0.196	0.005	1.247	0.050
Welding Truck	Welder	0.45	46	4.007	0.175	568.299	0.758	0.007	4.645	0.175
1. Load factors, horsepower, and emission factors from the CalEEMod User's Guide, Appendix D (CAPCOA, 2016).										
2. The emission factors are for the year 2022.										
3. It was assumed emissions from concrete trucks, fuel trucks, dump trucks, and water trucks would be represented using the Off-highway truck emission factors. These trucks would primarily travel within the construction area, for example, concrete trucks making trips from an onsite concrete batch plant to the pour location.										

Vehicle Emission Factors

Vehicle	Vehicle Type in EMFAC2007	Emission Factors (lb/mile)						
		NOx	PM10	CO2	ROG	SOx	CO	PM2.5
Personnel at 15 mph	Passenger Vehicles, Gasoline	0.0003	0.0001	1.1866	0.0001	0.0000	0.0030	0.0001
Personnel at 35 mph	Passenger Vehicles, Gasoline	0.0002	0.0001	0.6046	0.0000	0.0000	0.0020	0.0000
Truck at 15 mph	Heavy-Heavy Duty Diesel	0.0191	0.0002	4.7281	0.0007	0.0000	0.0043	0.0001
Truck at 35 mph	Heavy-Heavy Duty Diesel	0.0031	0.0002	3.4135	0.0002	0.0000	0.0012	0.0001
Vehicle	**Vehicle Type in EMFAC2007**	**Emission Factors (g/mile)**						
		NOx	**PM10**	**CO2**	**ROG**	**SOx**	**CO**	**PM2.5**
Personnel at 15 mph	Passenger Vehicles, Gasoline	0.1197	0.0502	538.2616	0.0532	0.0054	1.3475	0.0228
Personnel at 35 mph	Passenger Vehicles, Gasoline	0.0840	0.0466	274.2555	0.0189	0.0028	0.9268	0.0195
Truck at 15 mph	Heavy-Heavy Duty Diesel	8.6853	0.1063	2144.6550	0.3278	0.0205	1.9347	0.0437
Truck at 35 mph	Heavy-Heavy Duty Diesel	1.4257	0.1037	1548.3552	0.0944	0.0148	0.5570	0.0412

1. It was assumed that 'non-personnel' trips are diesel truck trips.

2. Emission factors from the ARB's EMFAC2014 model for the Colusa County portion of the Sacramento Valley Air Basin for the year 2022, assuming an annual temperature of 66°F and an annual relative humidity of 56%, per Table B-1 of *CT-EMFAC: A Computer Model to Estimate Transportation Project Emissions* (Wu, et al, 2007). UC Davis.

3. It was assumed that diesel trucks would be ten years old or newer, based on the ARB's *Staff Assessment of the Impact of the Economy on California Trucking Activity and Emissions 2006-2014*, December 2009. Therefore, the model year in EMFAC2014 was changed to 2012 through 2022, rather than the default of 1978 through 2023, and the emission factors by model year were arithmetically averaged.

4. Passenger vehicles were assumed to be comprised of 50% light-duty automobiles, 25% category 1 light-duty trucks, and 25% category 2 light-duty trucks, consistent with the CalEEMod User's Guide, Appendix A (CAPCOA, 2016).

5. It was assumed that vehicles would travel at an average speed of 35 mph offsite and 15 mph on unpaved roads.

6. The PM10 and PM2.5 emission factors include tire and brake wear.

Calculation of Paved Road Emission Factor

Paved Roads emission factor from AP-42, Section 13.2.1: P*aved Roads* (1/11)

$E = [k(sL)^{0.91} * (W)^{1.02}]$

where:	PM10	PM2.5	
k =	1.0	0.25	particle size multiplier, g/VMT [Table 13.2-1.1]
sL =	0.03	0.03	road surface silt loading (g/m^2) [Table 13.2.1-2]
W =	2.4	2.4	vehicle weight [tons, from CalEEMOD CalEEMod User's Guide, Appendix A (CAPCOA, 2016)]
$E_{(PM10)}$=	0.100	0.025	g/VMT

Calculation of Unpaved Road Emission Factor

PM10

Emission Factor [lb/mi] = 1.5 x (silt content [%] / 12)$^{0.9}$ x (average vehicle weight [tons] / 3)$^{0.45}$ x (365-P)/365

Reference: AP-42, Section 13.2.2, November 2006

Parameter	Value
Average Vehicle Weight (tons)	8
Silt Content (%)	4.3
P, Number of days with Precip >0.01 inches	56
Emission Factor (lb/mile)	0.44

Reference for Silt Content: AP-42, Section 13.2.2, Table 13.2.2-1, Average for a Service Road

Precipitation days taken directly from CalEEMod for Colusa County.

The emission factor accounts for a 44% reduction assuming truck speeds are limited to 15 mph or less.

PM2.5

Emission Factor [lb/mi] = 0.15 x (silt content [%] / 12)$^{0.9}$ x (average vehicle weight [tons] / 3)$^{0.45}$ x (365-P)/365

Reference: AP-42, Section 13.2.2, November 2006

Parameter	$PM_{2.5}$
Average Vehicle Weight (tons)	8
Silt Content (%)	4.3
P, Number of days with Precip >0.01 inches	56
Emission Factor (lb/mile)	0.04

Reference for Silt Content: AP-42, Section 13.2.2, Table 13.2.2-1, Average for a Service Road

Precipitation days taken directly from CalEEMod for Colusa County.

The emission factor accounts for a 44% reduction assuming truck speeds are limited to 15 mph or less.

Disturbed Land Fugitive Dust Emission Factor

Emission Factor (lb/acre/day) 10

From URBEMIS2007 construction phase mass site grading.

Per URBEMIS2007 Appendix A, page A-6, the value assumes watering.

Table 24A.A-10
Equipment and Workforce for Construction of Project Features for Alternative A (2 pages)

Alternative A Project Features:	**Holthouse-Sites Connection Channel**			**TRR Reservoir**			**Sac River (Delevan) Intake & P/G Plant**			**TRR & Delevan Canals and Conduits**			**TRR Pumping Plant**			**New Holthouse Reservoir**			**Inlet/Outl**
Constr. Schedule (URS, 7/12/11, Updated to 2022 Start, and AECOM, 2/12/16)	**Duration (Days)**	**Start**	**Finish**	**Duration (Days)**	**Start**	**Finish**	**Duration (Days)**	**Start**	**Finish**	**Duration (Days)**	**Start**	**Finish**	**Duration (Days)**	**Start**	**Finish**	**Duration (Days)**	**Start**	**Finish**	**Duration (Days)**
	743	***7/3/2022***	***7/15/2024***	***487***	***7/2/2023***	***10/30/2025***	***1276***	***5/15/2027***	***11/8/2030***	**Delevan:**			***1276***	***12/18/2024***	***6/19/2028***	***826***	***4/1/2022***	***7/9/2025***	**243 (I/O)**
										459	***4/1/2024***	***7/2/2026***							**212 (Tunnel)**
										TRR:									***485***
										549	***7/2/2023***	***7/1/2026***							
Equipment	**Enter "1" if Equipment Type is in Use**	**Total Number of Equipment Days of Use (Spreadsheet 6/29/11)**	**Number of Hours of Use per Equipment Day**	**Enter "1" if Equipment Type is in Use**	**Total Number of Equipment Days of Use (Spreadsheet 6/29/11)**	**Number of Hours of Use per Equipment Day**	**Enter "1" if Equipment Type is in Use**	**Total Number of Equipment Days of Use (Spreadsheet 6/29/11)**	**Number of Hours of Use per Equipment Day**	**Enter "1" if Equipment Type is in Use**	**Total Number of Equipment Days of Use (Spreadsheet 6/29/11)**	**Number of Hours of Use per Equipment Day**	**Enter "1" if Equipment Type is in Use**	**Total Number of Equipment Days of Use (Spreadsheet 6/29/11)**	**Number of Hours of Use per Equipment Day**	**Enter "1" if Equipment Type is in Use**	**Total Number of Equipment Days of Use (Spreadsheet 6/29/11)**	**Number of Hours of Use per Equipment Day**	**Enter "1" if Equipment Type is in Use**
Asphalt Delivery Truck																			
Backhoe																			
Bobcat																			
Boom Truck																			
Bulldozer	1	32	10	1	852	10	1	1165	10	1	3086	10	1	1165	10	1	13650	10	1
Compactor	1	159	10	1	66	10	1	200	10	1	934	10	1	200	10	1	796	10	
Concrete Pumper							1	104	10				1	104	10	1	192	10	1
Concrete Truck	1	156	10				1	416	10	1	83	10	1	416	10	1	176	10	1
Crane							1	200	10	1	1500	10	1	200	10				1
Dump Truck	1	768	10				1	1250	10	1	8670	10	1	1250	10	1	8	10	1
Excavator										1	400	10							
Fuel Truck	1	335	10	1	185	10	1	333	10	1	967	10	1	333	10	1	570	10	1
Forklift				1	140	10	1	400	10	1	1500	10	1	400	10	1	59	10	1
Generator	1	156	10				1	104	10	1	583	10	1	104	10	1	22	10	1
Grader				1	33	10	1	200	10	1	467	10	1	200	10	1	398	10	1
Highway Truck	1	680	10	1	700	10	1	1760	10	1	6514	10	1	1760	10	1	4508	10	1
Loader	1	192	10	1	152	10	1	125	10	1	1334	10	1	125	10	1	153	10	1
Off-road Truck				1	1520	10										1	1490	10	
Paver	1	33	10	1	20	10													
Pile Driver/Drill Rig																1	85	10	
Roller	1	66	10																
Scissor Lift																			1
Scraper	1	138	10	1	652	10	1	1165	10	1	13734	10	1	1165	10	1	11460	10	1
Water Trucks	1	205	10	1	215	10	1	466	10	1	967	10	1	466	10	1	2280	10	1
Welding Truck										1	1000	10							1
Trips/Workforce	**Total number of round trips**	**Roundtrip distance (miles)**	**Maximum Daily Workforce Required For Const.**	**Total number of round trips**	**Roundtrip distance (miles)**	**Maximum Daily Workforce Required For Const.**	**Total number of round trips**	**Roundtrip distance (miles)**	**Maximum Daily Workforce Required For Const.**	**Total number of round trips**	**Roundtrip distance (miles)**	**Maximum Daily Workforce Required For Const.**	**Total number of round trips**	**Roundtrip distance (miles)**	**Maximum Daily Workforce Required For Const.**	**Total number of round trips**	**Roundtrip distance (miles)**	**Maximum Daily Workforce Required For Const.**	**Total number of round trips**
Highway Trucks	3400	70	29	3500	70	57	8800	70	101	32570	70	61	8800	70	101	22540	70	180	19540
Personnel	21547	80		27759	80		128876	80		33489	80		128876	80		148680	80		28615
Onsite Unpaved roads	10720	2		13100	2		21125	2		86005	2		21125	2		45160	2		32210

Number of truck roundtrips per equipment day = 5

Source: URS 2011.

Table 24A.A-10
Equipment and Workforce for Construction of Project Features for Alternative A (2 pages)

et Structure and Tunnel		Dams and Sites Inundation (Alternative A)			Gravel Roads			Paved Roads & Bridge			Emergency Drawdown Tunnel			Recreation Facilities			Electrical Transmission & Switchyard Features		
Start	**Finish**	**Duration (Days)**	**Start**	**Finish**	**Duration (Days)**	**Start**	**Finish**	**Duration (Days)**	**Start**	**Finish**	**Duration (Days)**	**Start**	**Finish**	**Duration (Days)**	**Start**	**Finish**	**Duration (Days)**	**Start**	**Finish**
1/1/2022	8/31/2022	885 (saddle)	7/2/2023	12/2/2025	*1403*	*1/1/2022*	*11/3/2025*	*1403*	*1/1/2022*	*11/3/2025*	*465*	*3/15/2022*	*12/25/2023*	*731*	*1/2/2024*	*1/1/2026*	*1445*	*3/15/2022*	*9/27/2027*
10/1/2022	4/30/2023	1949 (GG)	7/2/2023	11/1/2028															
1/1/2022	*4/30/2023*	792 (Sites)	7/2/2025	8/30/2029															
		2224	*7/2/2023*	*8/30/2029*															
Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	**Number of Hours of Use per Equipment Day**	**Enter "1" if Equipment Type is in Use**	**Total Number of Equipment Days of Use (Spreadsheet 6/29/11)**	**Number of Hours of Use per Equipment Day**	**Enter "1" if Equipment Type is in Use**	**Total Number of Equipment Days of Use (Spreadsheet 6/29/11)**	**Number of Hours of Use per Equipment Day**	**Enter "1" if Equipment Type is in Use**	**Total Number of Equipment Days of Use (Spreadsheet 6/29/11)**	**Number of Hours of Use per Equipment Day**	**Enter "1" if Equipment Type is in Use**	**Total Number of Equipment Days of Use (Spreadsheet 6/29/11)**	**Number of Hours of Use per Equipment Day**	**Enter "1" if Equipment Type is in Use**	**Total Number of Equipment Days of Use (Spreadsheet 6/29/11)**	**Number of Hours of Use per Equipmen t Day**	**Enter "1" if Equipment Type is in Use**	**Total Number of Equipment Days of Use (Spreadsheet: Equipment for Sediment May 2012)**	**Number of Hours of Use per Equipment Day**
								1	1470	10									
														1	316	10			
																	1	192	10
1760	10	1	9402	10	1	279	10	1	9770	10	1	1760	10	1	116	10	1	8	10
		1	8136	10	1	156	10												
306	10	1	1077	10				1	280	10	1	306	10				1	29	10
1030	10	1	343	10				1	2246	10	1	1030	10	1	66	10	1	154	10
350	10							1	1000	10	1	350	10				1	474	10
600	10	1	440	10	1	123	10	1	6775	10	1	600	10	1	474	10	1	14	10
								1	26	10									
552	10	1	1880	10	1	93	10	1	1126	10	1	552	10	1	312	10	1	57	10
510	10	1	47	10							1	510	10	1	121	10	1	82	10
200	10	1	43	10				1	500	10	1	200	10	1	33	10			
572	10	1	4068	10	1	104	10	1	2104	10	1	572	10	1	28	10	1	40	10
3908	10	1	24935	10				1	5011	10	1	3908	10	1	458	10	1	810	10
400	10	1	1888	10	1	41	10	1	1235	10	1	400	10	1	158	10	1	103	10
		1	14755	10				1	4560	10									
					1	5	10	1	80	10				1	22	10			
		1	1035	10					105								1	95	10
					1	10	10	1	925	10				1	50	10			
100	10										1	100	10						
3090	10	1	3604	10	1	147	10	1	8736	10	1	3090	10						
352	10	1	3761	10	1	191	10	1	2252	10	1	352	10	1	144	10	1	101	10
294	10										1	294	10						
Roundtrip distance (miles)	**Maximum Daily Workforce Required For Const.**	**Total number of round trips**	**Roundtrip distance (miles)**	**Maximum Daily Workforce Required For Const.**	**Total number of round trips**	**Roundtrip distance (miles)**	**Maximum Daily Workforce Required For Const.**	**Total number of round trips**	**Roundtrip distance (miles)**	**Maximum Daily Workforce Required For Const.**	**Total number of round trips**	**Roundtrip distance (miles)**	**Maximum Daily Workforce Required For Const.**	**Total number of round trips**	**Roundtrip distance (miles)**	**Maximum Daily Workforce Required For Const.**	**Total number of round trips**	**Roundtrip distance (miles)**	**Maximum Daily Workforce Required For Const.**
70	59	124677	70	116	0	70	25	25055	70	81	19540	70	59	2290	70	24	4050	70	51
80		258140	80		35075	80		113643	80		27435	80		17544	80		73695	80	
2		230577	2		2035	2		109850	2		32210	2		7270	2		10690	2	

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Table 24A.A-11
Concrete Batch Plant PM10 Emissions

Construction On-Site Concrete Batch Plant Emissions

Project Feature	Total Concrete Mass (tons)	Number of Days	Daily Rate (tons/day)	PM_{10} Emissions (lb/day)
Tunnel - Inlet and Outlet Including Sites Pump Plant	77,515	194	400	10.14
	44,030	38	1,159	27.79
	15,253	110	139	4.07
Emergency Drawdown Tunnel	77,515	194	400	10.14
	44,030	38	1,159	27.79
	15,253	110	139	4.07
Pipelines - Delevans and TRR	11,100	28	396	10.07
Dams & Sites Inundation	49,852	215	232	6.24
TRR Pump Plant	55,500	139	399	10.13
Funks Reservoir Modification	23,773	59	403	10.22
Sacramento River Intake & P/G Plant	55,500	139	399	10.13
Paved Roads & Bridges	186,110	310	600	14.81
GCID Canal & Headworks	21,090	35	603	14.86
Electrical Transmission and Switchyard Features	25,679	64	401	10.18
Recreation	8,780	44	200	5.49

Batch Plants Controlled Emission Factors[a]

Sand Transfer[b]	0.000297	lb PM_{10}/ton cement
Aggregate Transfer[b]	0.00099	lb PM_{10}/ton cement
Cement Unloading to Storage Silo	0.00034	lb PM_{10}/ton cement
Cement Supplement Unloading to Storage Silo	0.0049	lb PM_{10}/ton cement
Weigh Hopper Loading[b]	0.00072	lb PM_{10}/ton cement
Truck Loading[c]	0.016	lb PM_{10}/ton cement
Total	**0.023**	**lb PM_{10}/ton cement**

[a]Emission factors from AP-42, Section 11.12, June 2006

[b] The batch plants will have dust control equipment and was assumed to control dust emissions with an efficiency of 70% during sand and aggregate transfer.

Source for control efficiency: BAAQMD Permit Handbook, Section 11.5 Concrete Batch Plants, March 2009

[c] It was assumed the truck loading process would also include dust controls. Therefore, the controlled truck loading emission factor was used.

Concrete Batch Plant Storage Pile PM10 Emissions

Emission Factor:	1.7	lb PM_{10}/acre/day
Assumed Storage Pile Area	0.5	acres/day

Source: BAAQMD Permit Handbook, Section 11.5 Concrete Batch Plants, March 2009

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Table 24A.A-12
Construction Areas of Disturbance for Fugitive Dust Emissions Calculations

Proposed Project Disturbed Acres for Fugitive Dust Emission Calculations

Project Feature (File Name: ProjFacilitiesParcelsAcreages_9-23-11.xls)	Alternative	County	Total Project Feature Acreage (acres)	PM10 Emissions (lbs)	Construction Duration (days)	Project Duration (days)
1.27 MAF Sites Reservoir						
Alt A		Colusa Co	10,491.2	104,911.5		
		Glenn Co	1,600.3	16,002.9		
	Alt A	Total	**12,091.4**	120,914.4	2224	
1.81 MAF Sites Reservoir						
Alts B C C1		Colusa Co	12,046.1	120,460.8		
		Glenn Co	2,106.1	21,060.7		
	Alts B C C1	Total	**14,152.2**	141,521.5	2224	
Alt D		Colusa Co	12,046.1	120,460.8		
		Glenn Co	2,106.1	21,060.7		
	Alt D	Total	**14,152.2**	141,521.5	1410	
Golden Gates and Sites Dams						
Alt A	**Alt A**	Total	**50.4**	504.0	2224	
Alts B C C1	**Alts B C C1**	Total	**57.7**	577.0	2224	
Alt D	**Alt D**	Total	**57.7**	577.0	1410	
6 Saddle Dams						
Alt A		Colusa Co	0.0	-		
		Glenn Co	37.3	372.5		
	Alt A	Total	**37.3**	372.5	2224	
9 Saddle Dams						
Alts B C C1		Colusa Co	4.2	42.4		
		Glenn Co	94.0	939.7		
	Alts B C C1	Total	**98.2**	982.1	2224	
Alt D		Colusa Co	4.2	42.4		
		Glenn Co	94.0	939.7		
	Alt D	Total	**98.2**	982.1	1410	
Subtotal Sites Reservoir and Dams	***Alt A***	***Total***	***12179.1***	***121,790.9***	***2224***	
	Alts B C C1	***Total***	***14308.1***	***143,080.6***	***2224***	
	Alt D	***Total***	***14308.1***	***143,080.6***	***1410***	
5 Recreation Areas						
Alts A B C C1		Colusa Co	879.2	8,792.2		
		Glenn Co	329.2	3,292.1		
	Alts A B C C1	Total	**1208.4**	12,084.3	731	
Alt D (Conservative; Alt D has only 2 recreation areas)		Colusa Co	879.2	8,792.2		
		Glenn Co	329.2	3,292.1		
	Alt D	Total	**1208.4**	12,084.3	390	
Road Relocations and South Bridge						
A		Colusa Co	1025.6	10,256.2		
A		Glenn Co	270.3	2,703.3		
	Alt A	Total	**1296.0**	12,959.5	1403	
B C C1		Colusa Co	1031.4	10,313.8		
B C C1		Glenn Co	271.6	2,715.8		
	Alts B C C1	Total	**1303.0**	13,029.6	1403	
Alt D (Assumed same as Alts B C C1)		Colusa Co	1031.4	10,313.8		
		Glenn Co	271.6	2,715.8		
	Alt D	Total	**1303.0**	13,029.6	1403	
Sites Pumping Generating Plant & Electrical Switchyard						
Alts A B C C1	**Alts A B C C1**		**5.30**	53.0	485	
Alt D	**Alt D**		**5.30**	53.0	1180	
Tunnel from Sites Pum Gen to Intake Outfall						
Alts A B C C1	**Alts A B C C1**		**3.1**	30.6	485	
Alt D	**Alt D**		**3.1**	30.6	1180	
Sites Res Inlet Outlet Structure						
Alts A B C C1	**Alts A B C C1**		**204.2**	2,042.2	485	
Alt D	**Alt D**		**204.2**	2,042.2	1180	
Field Office Maint Yard						
Alts A B C C1	**Alts A B C C1**		**18.3**	183.4	485	
Alt D	**Alt D**		**18.3**	183.4	1180	
Existing Funks Reservoir Dredging						
Alts A B C C1 D	**Alts A B C C1 D**	No PM - WET	**228.4**	No PM - WET		
Holthouse Reservoir Complex						
Alts A B C C1	**Alts A B C C1**		**456.3**	4,563.0	826	
Alt D	**Alt D**		**456.3**	4,563.0	950	
GCID Canal Intake & Headworks						
& GCID Canal Connection to TRR			9.5	95.0		
Alts A B C C1			3.6	36.0		
	Alts A B C C1	Total	**13.10**	131.0	743	
Alt D			9.5	95.0		
			3.6	36.0		
	Alt D	Total	**13.10**	131.0	650	
TRR	**Alts A B C C1**		**191.6**	1,916.2	487	
	Alt D		**191.6**	1,916.2	530	
TRR PG Plant	**Alts A B C C1**		**0.7**	6.5	1276	
	Alt D		**0.7**	6.5	1525	
TRR Easement						
& TRR to Funks Cr Pipeline Easement			386.9	3,868.9		
Alts A B C C1			20.6	205.6		
	Alts A B C C1	Total	**407.5**	4,074.5	549	
Alt D			386.9	3,868.9		
			20.6	205.6		
	Alt D	Total	**407.5**	4,074.5	800	
Delevan Transmission Line						
Alt A	**Alt A**		**372.8**	3,727.8	1445	
Alt B	**Alt B**		**151.8**	1,518.2	1445	
Alt C C1	**Alt C C1**		**372.8**	3,727.6	1445	
Alt D	**Alt D**		**372.8**	3,727.6	1445	
Delevan Pipeline Intake Facilities						
& Delevan Pipeline Discharge Facility			19.2	191.5		
Alts A B C C1			7.7	76.6		
	Alts A B C C1	Total	**26.8**	268.1	549	
Alt D			19.2	191.5		
			7.7	76.6		
	Alt D	Total	**26.8**	268.1	1175	
Asphalt Plant						
Alts A B C C1 D	**Alts A B C C1 D**		**15.0**	149.6	100	
Concrete Plant						
Alts A B C C1 D	**Alts A B C C1 D**		**15.0**	149.6	100	
	Alt A	**Total**	**16,413.0**	**164,130.3**	**2224**	**3727**
	Alt B	**Total**	**18,328.0**	**183,280.5**	**2224**	**3727**
	Alt C C1	**Total**	**18,549.0**	**185,489.9**	**2224**	**3727**
	Alt D	**Total**	**18,549.0**	**185,489.9**	**1410**	**3369**

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Table 24A.A-13
Construction Emissions for Funks Reservoir Sediment Removal

Construction Emissions Calculations for Periodic Holthouse/Funks Reservoir Sediment Removal for Alternative A

New Feature: Holthouse/Funks Reservoir Sediment Removal

Emissions (pounds per day)					
NOx	**PM10**	**PM2.5**	**ROG**	**CO**	**SOx**
255.3	24.8	10.7	23.5	169.6	0.5

Details of these calculations are provided in the construction emission spreadsheets for Alternatives B, C, and C1 by Project Feature (Table 24A.B-2 through Table 24A.B-8).

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Table 24A.A-14
Comparison of Concrete for Alternatives

Proposed Project Comparison of Concrete for Alternatives

			Alt A	Alts B, C, C1, D	Ratio	
Sites Dam	Cement Type III	SK	10,400	12,100	1.16	0.86
	Grout Cap	CY	3,300	3,800	1.15	0.87
Golden Gate Dam	Cement Type III	SK	19,400	29,000	1.49	0.67
	Grout Cap	CY	6,700	10,000	1.49	0.67
Saddle Dam 1	Slurry Wall	CY	2,030		-	
Saddle Dam 2	Slurry Wall	CY		2,000		
Saddle Dam 3	Cement Type III	SK	8,900	17,300	1.94	0.51
	Grout Cap	CY	6,000	8,500	1.42	0.71
Saddle Dam 4						
Saddle Dam 5	Cement Type III	SK	2,700	8,500	3.15	0.32
	Grout Cap	CY	3,100	5,100	1.65	0.61
Saddle Dam 6	Cement Type III	SK		1,100		
	Grout Cap	CY		1,200		
Saddle Dam 7	Cement Type III	SK		2,100		
	Grout Cap	CY		2,300		
Saddle Dam 8a	Cement Type III	SK	2,200	9,900	4.50	0.22
	Grout Cap	CY	2,500	6,700	2.68	0.37
Saddle Dam 9						**0.58**
			67,230	119,600	1.78	
Inlet/Outlet Works	Tunnel-Reinforced	CY	3,000	3,000	1.00	
	Nonreinforced	CY	37,000	37,000	1.00	
	Contract Grouting	SK	3,000	3,000	1.00	
	Low Intake Mass Concrete	CY	20,000	20,000	1.00	
	Low Intake Structural Concete	CY	2,200	2,200	1.00	
	Low Intake precast Prestressed Concrete	CY	1,300	1,300	1.00	
	Cement	CWT	216,000	216,000	1.00	
Multi-Level Outworks	Tower Concrete	EA	2,750	3,250	1.18	
	Shaft Concrete	EA	950	950	1.00	
	Cement	CWT	22,000	22,000	1.00	
	Bridge Pier Concrete	CY	1,160	1,160	1.00	
	Bridge Light Weight Conrete	CY	215	248	1.15	
	Gate transition concrete	CY	392	5,000	12.76	
Access Road	Asphalt Concrete	Ton	1,900	1,900	1.00	
Sites P/G Plant	Asphalt Concrete	Ton	2,200	2,200	1.00	
	Structural Concrete	CY	102,000	91,800	0.90	
	Backfill Concrete	CY	5,400	4,860	0.90	
	Pneumatically Placed Mortar to 3 Inch Thick	SY	40,000	40,000	1.00	
	Cement	CWT	544,000	489,600	0.90	
Emergency Drawdown Bypass	Structural Concrete (includes cement)	CY	6,530	6,530	1.00	
Plant Access Road	Asphalt Concrete	TON	6,500	6,500	1.00	
Temporary Bypass TC Canal	12 ft RCP	LF	6,300	6,300	1.00	
	Concrete for Canal Connections	CY	320	320	1.00	
New Check Structure	Reinforced Concrete	CY	380	380	1.00	
Holthouse	Rolled Compacted Concrete (RCC) Spillway	CY	48,888	48,888	1.00	
	Spillway Top & Sides	CY	9,710	9,710	1.00	
	Spillway Base Slab	CY	4,166	4,166	1.00	
TRR Pump / Gen Plant	Reinforced Concrete P/G Plant	CY	30,000	30,000	1.00	
TRR Pipeline	Reinforced Concrete Encasement and Inlet/Outlet Structure	CY	2,000	2,000	1.00	
Delevan Pipeline	Reinforced Concrete Encasement and Inlet/Outlet Structure	CY	4,000	4,000	1.00	
Sacramento River P/G Plant	Reinforced Concrete P/G Plant	CY				
			1,124,261	1,064,262		
		TOTAL:	**1,191,491**	**1,183,862**		

For Dams

Total Sacks of Concrete	Alternative A	Alternative B & C	
Sacks	43,600	80,000	1.83
CY	8,720	16,000	1.83
CY - dams	23,630	39,600	1.68
Total CY	32,350	55,600	1.72

5 Sacks of 94# Type III cement in a CY

Alternative A - volume of concrete for Alternative A is less than Alternatives B and C for the dams

Ratio of Volume for Alt B/C to A =	1.72
Ratio of Volume for Alt A to Alt. B/C =	**0.58**

Alternative A

Project Feature	Total Concrete Mass (tons)	Total Concrete (CY)	GHG Emissions (lbs)	GHG Emissions (mt)
Tunnel - Inlet and Outlet Including Sites Pump Plant	136,798	73,945	29,578,000	13,416
Emergency Drawdown Tunnel	136,798	73,945	29,578,000	13,416
Pipelines - Delevans and TRR	11,100	5,692	2,276,923	1,033
Dams & Sites Inundation	49,852	25,565	10,225,965	4,638
TRR Pump Plant	55,500	28,462	11,384,615	5,164
Funks Reservoir Modification	23,773	12,191	4,876,513	2,212
Sacramento River Intake & P/G Plant	55,500	28,462	11,384,615	5,164
Paved Roads & Bridges	186,110	95,441	38,176,410	17,317
GCID Canal & Headworks	21,090	10,815	4,326,154	1,962
Electrical Transmission and Switchyard Features	25,679	13,880	5,552,000	2,518
Recreation	8,780	4,503	1,801,026	817
Total	710,980	372,901	149,160,222	67,658

Alternatives B, C, C1, D

Project Feature	Total Concrete Mass (tons)	Total Concrete (CY)	GHG Emissions (lbs)	GHG Emissions (mt)
Tunnel - Inlet and Outlet Including Sites Pump Plant	136,798	73,945	29,578,000	13,416
Emergency Drawdown Tunnel	136,798	73,945	29,578,000	13,416
Pipelines - Delevans and TRR	11,100	5,692	2,276,923	1,033
Dams & Sites Inundation	85,951	44,077	17,630,974	7,997
TRR Pump Plant	55,500	28,462	11,384,615	5,164
Funks Reservoir Modification	23,773	12,191	4,876,513	2,212
Sacramento River Intake & P/G Plant	55,500	28,462	11,384,615	5,164
Paved Roads & Bridges	186,110	95,441	38,176,410	17,317
GCID Canal & Headworks	21,090	10,815	4,326,154	1,962
Electrical Transmission and Switchyard Features	25,679	13,880	5,552,000	2,518
Recreation	8,780	4,503	1,801,026	817
Total	747,079	391,413	156,565,231	71,017

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Table 24A.A-15
Total GHG Emissions from Construction of Alternative A

Proposed Project Total GHG Emissions from Construction of Alternative A

Total mtCO2e Emissions from Construction Related Activities

Emissions from Mobile Construction Equipment (From Table 24A. A-5)	**Emissions From Concrete Production** (See Table Below)	**Total Construction Related Emissions**
172,066	66,637	238,704

Alternative A

Project Feature	Total Concrete Mass (tons)	Total Concrete (CY)	GHG Emissions (lbs)	GHG Emissions (mt)
Tunnel - Inlet and Outlet Including Sites Pump Plant	136,798	73,945	29,578,000	13,416
Emergency Drawdown Tunnel	136,798	73,945	29,578,000	13,416
Pipelines - Delevan and TRR	11,100	5,692	2,276,923	1,033
Dams & Sites Inundation	49,852	25,565	10,225,965	4,638
TRR Pump Plant	55,500	28,462	11,384,615	5,164
Funks Reservoir Modification	23,773	12,191	4,876,513	2,212
Sacramento River Intake & P/G Plant	55,500	28,462	11,384,615	5,164
Paved Roads & Bridges	186,110	95,441	38,176,410	17,317
GCID Canal & Headworks	21,090	10,815	4,326,154	1,962
Transmission Lines	25,679	8,254	3,301,538	1,498
Recreation	8,780	4,503	1,801,026	817
Total	710,980	367,274	146,909,760	66,637

1. Based on a study by the Portland Cement Association, CO2 emissions from concrete range from 190 lbs/cy to 500 lbs/cy, depending on the cement content of the concrete. Based on the types of concrete used for this project, DWR has determined the following factor to be appropriate for the project:

1 cy = 400 lbs CO_2e

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Emissions from Construction of Alternatives B and C

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Table 24A.B-1
Construction Emissions for Alternatives B, C, and C1 - Emission Summaries by Construction Year for Criteria Pollutants

Proposed Project Construction Emissions for Alternatives B, C, and C1

Average Daily Emission Rates for Criteria Pollutants by Year for Construction of Alternatives B, C, and C1

Construction Year	Emissions (pounds per day)					
	NOx	**PM10**	**PM2.5**	**ROG**	**CO**	**SOx**
2022	**881**	**328**	65	84	620	2
2023	**1,668**	**778**	144	**163**	1,191	4
2024	**1,361**	**664**	124	134	984	4
2025	**1,378**	**668**	125	136	1,004	4
2026	**785**	**475**	84	79	588	2
2027	**324**	**301**	49	33	270	1
2028	**319**	**290**	48	33	259	1
2029	**286**	**272**	44	29	222	1
2030	33	19	3	4	37	0
Significance Threshold (lb/day)	137	137	n/a	137	n/a	n/a

Notes:

1. The average daily construction emission rates in lb/day for each construction year are the sum of the average daily emission rates estimated for each of the project features that would be constructed in the indicated construction year.

2. Bolded values indicate an exceedance of the significance threshold.

3. Significance Threshold is from TCAPCD Level C: Greater than 137 pounds per day of emissions. If emissions from a project would exceed the Level C thresholds, mitigation measures (BAMMs and SMMs), including off-site mitigation measures following the guidelines, may be required to reduce the overall air quality impacts of the project to a level of insignificance (TCAPCD, 2015).

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Table 24A.B-2
Construction NOx Emissions for Alternatives B, C, and C1 by Project Feature

Proposed Project Construction NOx Emissions Alternative B/C/C1

Equipment	NOx Emissions (pounds)													
	GCID Canal Intake & Headworks	TRR	Sac River (Delevan) Intake & P/G Plant	TRR & Delevan Pipelines	TRR Pumping Plant	New Holthouse Reservoir	Inlet/Outlet Structure, Tunnel, Sites Pumping Plant	Dams and Sites Inundation	Gravel Roads	Paved Roads & Bridge	Emergency Drawdown Tunnel	Recreation Facilities	Funks Reservoirs Sediment Removal Periodic	Electrical Transmission & Switchyard Features
Backhoe	0	0	0	0	0	0	0	0	0	3,079	0	0	0	0
Bobcat	0	0	0	0	0	0	0	0	0	0	0	667	0	0
Boom Truck	0	0	0	0	0	0	0	0	0	0	0	0	0	134
Bulldozer	240	6,398	8,749	23,175	8,749	102,507	13,217	133,222	2,095	73,370	13,217	871	10,033	60
Compactor	50	21	63	293	63	250	0	4,822	49	0	0	0	0	0
Concrete Pumper	0	0	48	0	48	88	141	936	0	129	141	0	0	13
Concrete Truck	783	0	2,087	416	2,087	883	5,168	3,251	0	11,268	5,168	331	0	773
Crane	0	0	1,046	7,845	1,046	0	1,831	0	0	5,230	1,831	0	0	2,479
Dump Truck	3,853	0	6,271	43,498	6,271	40	3,010	4,164	617	33,991	3,010	2,378	0	70
Excavator	0	0	0	888	0	0	0	0	0	58	0	0	0	0
Fuel Truck	1,681	928	1,671	4,852	1,671	2,860	2,769	17,801	467	5,649	2,769	1,565	838	286
Forklift	0	185	527	1,978	527	78	672	117	0	0	672	160	0	108
Generator	571	0	381	2,134	381	81	732	296	0	1,830	732	121	0	0
Grader	0	217	1,314	3,069	1,314	2,616	3,759	50,439	683	13,827	3,759	184	0	263
Highway Truck	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Loader	726	575	473	5,044	473	579	1,512	13,472	155	4,670	1,512	597	0	389
Off-road Truck	0	7,626	0	0	0	7,475	0	139,675	0	22,878	0	0	0	0
Paver	87	52	0	0	0	0	0	0	13	210	0	58	0	0
Pile Driver	0	0	0	0	0	241	0	5,530	0	0	0	0	0	269
Roller	142	0	0	0	0	0	0	0	22	1,996	0	108	0	0
Scissor Lift	0	0	0	0	0	0	70	0	0	0	70	0	0	0
Scraper	1,543	7,289	13,024	153,535	13,024	128,113	34,544	76,018	1,643	97,661	34,544	0	29,871	0
Water Trucks	1,028	1,079	2,338	4,852	2,338	11,439	1,766	35,601	958	11,298	1,766	722	1,676	507
Welding Truck	0	0	0	1,829	0	0	538	0	0	0	538	0	0	0
Vehicles														
Highway Truck	748	770	1,936	7,166	1,936	4,959	4,299	51,756	0	5,512	4,299	504	18	891
Personnel Vehicles	319	411	1,910	496	1,910	2,203	424	7,217	520	1,684	406	260	94	1,092
Unpaved roads	411	502	809	3,294	809	1,729	1,233	16,660	78	4,207	1,233	278	102	409
Total Emissions (lbs)	**12,182**	**26,052**	**42,646**	**264,363**	**42,646**	**266,141**	**75,686**	**560,978**	**7,300**	**298,547**	**75,668**	**8,805**	**42,631**	**7,745**
Construction Duration (days)	743	487	1276	549	1276	826	485	2224	1403	1403	465	731	167	1445
Emissions (lb/day)	16.4	53.5	33.4	481.5	33.4	322.2	156.1	252.2	5.2	212.8	162.7	12.0	255.3	5.4

Daily Emissions (lb/day) in Year															*Total lb/day NOx for Features Constructed In the Indicated Year*	*Year*
2022	16.4					322.2	156.1		5.2	212.8	162.7			5.4	880.73	2022
2023	16.4	53.5		481.5		322.2	156.1	252.2	5.2	212.8	162.7			5.4	1,668.00	2023
2024	16.4	53.5		481.5		322.2		252.2	5.2	212.8		12.0		5.4	1,361.27	2024
2025		53.5		481.5	33.4	322.2		252.2	5.2	212.8		12.0		5.4	1,378.30	2025
2026				481.5	33.4			252.2				12.0		5.4	784.60	2026
2027			33.4		33.4			252.2						5.4	324.44	2027
2028			33.4		33.4			252.2							319.08	2028
2029			33.4					252.2							285.66	2029
2030			33.4												33.42	2030
2031															-	2031

Table 24A.B-3
Construction PM10 Emissions for Alternatives B,C, and C1 by Project Feature

Proposed Project
Construction
PM10 Emissions
Alternative B/C/C1

Equipment	PM10 Emissions (pounds)													
	GCID Canal Intake & Headworks	TRR	Sac River (Delevan) Intake & P/G Plant	TRR & Delevan Pipelines	TRR Pumping Plant	New Holthouse Reservoir	Inlet/Outlet Structure, Tunnel, Sites Pumping Plant	Dams and Sites Inundation	Gravel Roads	Paved Roads & Bridge	Emergency Drawdown Tunnel	Recreation Facilities	Funks Reservoirs Sediment Removal Periodic	Electrical Transmission & Switchyard Features
Backhoe	0	0	0	0	0	0	0	0	0	165	0	0	0	0
Bobcat	0	0	0	0	0	0	0	0	0	0	0	41	0	0
Boom Truck	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Bulldozer	9	241	330	874	330	3,868	499	5,027	79	2,769	499	33	379	2
Compactor	2	1	2	11	2	10	0	187	2	0	0	0	0	0
Concrete Pumper	0	0	2	0	2	3	5	36	0	5	5	0	0	1
Concrete Truck	28	0	76	15	76	32	187	118	0	408	187	12	0	28
Crane	0	0	43	326	43	0	76	0	0	217	76	0	0	103
Dump Truck	140	0	227	1,577	227	1	109	151	22	1,232	109	86	0	3
Excavator	0	0	0	43	0	0	0	0	0	3	0	0	0	0
Fuel Truck	61	34	61	176	61	104	100	645	17	205	100	57	30	10
Forklift	0	12	35	131	35	5	45	8	0	0	45	11	0	7
Generator	29	0	19	107	19	4	37	15	0	92	37	6	0	0
Grader	0	7	42	98	42	83	120	1,609	22	441	120	6	0	8
Highway Truck	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Loader	24	19	16	170	16	19	51	453	5	157	51	20	0	13
Off-road Truck	0	276	0	0	0	271	0	5,063	0	829	0	0	0	0
Paver	4	3	0	0	0	0	0	0	1	10	0	3	0	0
Pile Driver	0	0	0	0	0	8	0	176	0	0	0	0	0	9
Roller	8	0	0	0	0	0	0	0	1	115	0	6	0	0
Scissor Lift	0	0	0	0	0	0	1	0	0	0	1	0	0	0
Scraper	60	284	507	5,974	507	4,985	1,344	2,958	64	3,800	1,344	0	1,162	0
Water Trucks	37	39	85	176	85	415	64	1,290	35	410	64	26	61	18
Welding Truck	0	0	0	80	0	0	23	0	0	0	23	0	0	0
Vehicles														
Highway Truck	107	110	277	1,026	277	710	616	7,412	0	789	616	72	3	128
Personnel Vehicles	559	720	3,343	869	3,343	3,856	742	12,633	910	2,948	712	455	165	1,911
Unpaved Roads	9,418	11,509	18,559	75,557	18,559	39,674	28,297	382,200	1,788	96,505	28,297	6,387	2,341	9,391
Fugitive PM Sources														
Concrete Batch Plant	15	0	10	10	10	10	42	10	0	15	42	5	0	10
Disturbed Areas	131	1,916	268	4,075	7	4,563	2,309	143,081	0	13,179	31	12,084	0	3,728
Total Emissions (lbs)	**10,632**	**15,171**	**23,902**	**91,294**	**23,640**	**58,622**	**34,668**	**563,072**	**2,945**	**124,294**	**32,359**	**19,311**	**4,140**	**15,373**

1. Highway truck and personnel vehicle emissions include paved road dust emissions.
2. The unpaved road emissions include fugitive dust from travel over unpaved roads.

Construction Duration (days)	743	487	1276	549	1276	826	485	2224	1403	1403	465	731	167	1445
Emissions (lb/day)	14.3	31.2	18.7	166.3	18.5	71.0	71.5	253.2	2.1	88.6	69.6	26.4	24.8	10.6

Daily Emissions (lb/day) in Year

													Total lb/day PM10 for Features Constructed In the Indicated Year	***Year***
2022	14.3					71.0	71.5		2.1	88.6	69.6		10.6	327.68	2022
2023	14.3	31.2		166.3		71.0	71.5	253.2	2.1	88.6	69.6		10.6	778.30	2023
2024	14.3	31.2		166.3		71.0		253.2	2.1	88.6		26.4	10.6	663.65	2024
2025		31.2		166.3	18.5	71.0		253.2	2.1	88.6		26.4	10.6	667.87	2025
2026				166.3	18.5			253.2				26.4	10.6	475.05	2026
2027			18.7		18.5			253.2					10.6	301.08	2027
2028			18.7		18.5			253.2						290.44	2028
2029			18.7					253.2						271.91	2029
2030			18.7											18.73	2030
2031														-	2031

Table 24A.B-4
Construction PM2.5 Emissions for Alternatives B, C, and C1 by Project Feature

Proposed Project Construction PM2.5 Emissions Alternative B/C/C1

Equipment	PM2.5 Emissions (pounds)													
	GCID Canal Intake & Headworks	TRR	Sac River (Delevan) Intake & P/G Plant	TRR & Delevan Pipelines	TRR Pumping Plant	New Holthouse Reservoir	Inlet/Outlet Structure, Tunnel, Sites Pumping Plant	Dams and Sites Inundation	Gravel Roads	Paved Roads & Bridge	Emergency Drawdown Tunnel	Recreation Facilities	Funks Reservoirs Sediment Removal Periodic	Electrical Transmission & Switchyard Features
Backhoe	0	0	0	0	0	0	0	0	0	152	0	0	0	0
Bobcat	0	0	0	0	0	0	0	0	0	0	0	38	0	0
Boom Truck	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Bulldozer	8	223	304	806	304	3,566	460	4,635	73	2,553	460	30	349	2
Compactor	2	1	2	11	2	10	0	187	2	0	0	0	0	0
Concrete Pumper	0	0	2	0	2	3	5	36	0	5	5	0	0	1
Concrete Truck	26	0	70	14	70	30	173	109	0	378	173	11	0	26
Crane	0	0	40	299	40	0	70	0	0	199	70	0	0	95
Dump Truck	129	0	210	1,460	210	1	101	140	21	1,141	101	80	0	2
Excavator	0	0	0	40	0	0	0	0	0	3	0	0	0	0
Fuel Truck	56	31	56	163	56	96	93	597	16	190	93	53	28	10
Forklift	0	11	32	121	32	5	41	7	0	0	41	10	0	7
Generator	29	0	19	107	19	4	37	15	0	92	37	6	0	0
Grader	0	6	39	90	39	77	110	1,479	20	405	110	5	0	8
Highway Truck	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Loader	22	18	15	155	15	18	46	413	5	143	46	18	0	12
Off-road Truck	0	256	0	0	0	251	0	4,688	0	768	0	0	0	0
Paver	4	2	0	0	0	0	0	0	1	9	0	3	0	0
Pile Driver	0	0	0	0	0	7	0	162	0	0	0	0	0	8
Roller	8	0	0	0	0	0	0	0	1	106	0	6	0	0
Scissor Lift	0	0	0	0	0	0	1	0	0	0	1	0	0	0
Scraper	55	261	466	5,494	466	4,584	1,236	2,720	59	3,494	1,236	0	1,069	0
Water Trucks	35	36	78	163	78	384	59	1,195	32	379	59	24	56	17
Welding Truck	0	0	0	80	0	0	23	0	0	0	23	0	0	0
Vehicles														
Highway Truck	35	36	90	333	90	231	200	2,406	0	256	200	23	1	41
Personnel Vehicles	169	218	1,013	263	1,013	1,169	225	3,829	276	893	216	138	50	579
Unpaved Roads	943	1,153	1,859	7,568	1,859	3,974	2,834	38,283	179	9,667	2,834	640	235	941
Fugitive PM Sources														
Concrete Batch Plant	4	0	3	3	3	3	12	3	0	4	12	2	0	3
Disturbed Areas	27	399	56	847	1	949	480	29,761	0	2,741	6	2,514	0	775
Total Emissions (lbs)	**1,553**	**2,650**	**4,355**	**18,017**	**4,300**	**15,361**	**6,209**	**90,665**	**683**	**23,579**	**5,725**	**3,600**	**1,787**	**2,528**

1. Highway truck and personnel vehicle emissions include paved road dust emissions.
2. The unpaved road emissions include fugitive dust from travel over unpaved roads.
3. $PM_{2.5}$ fugitive dust emissions were calculated following the *SCAQMD Particulate Matter (PM) 2.5 Significance Thresholds and Calculation Methodology*, October 2006 (SCAQMD, 2006). For concrete batch plant operations (loading/unloading bulk materials), it is assumed that 29.2% of the PM_{10} would be $PM_{2.5}$. For construction fugitive dust sources, it is assumed that 20.8% of the PM_{10} would be $PM_{2.5}$.

Construction Duration (days)	743	487	1276	549	1276	826	485	2224	1403	1403	465	731	167	1445
Emissions (lb/day)	2.1	5.4	3.4	32.8	3.4	18.6	12.8	40.8	0.5	16.8	12.3	4.9	10.7	1.7

Daily Emissions (lb/day) in Year

														Total lb/day PM2.5 for Features Constructed In the Indicated Year	***Year***
2022	2.1					18.6	12.8		0.5	16.8	12.3		1.7	64.84	2022
2023	2.1	5.4		32.8		18.6	12.8	40.8	0.5	16.8	12.3		1.7	143.87	2023
2024	2.1	5.4		32.8		18.6		40.8	0.5	16.8		4.9	1.7	123.68	2024
2025		5.4		32.8	3.4	18.6		40.8	0.5	16.8		4.9	1.7	124.96	2025
2026				32.8	3.4			40.8				4.9	1.7	83.63	2026
2027			3.4		3.4			40.8					1.7	49.30	2027
2028			3.4		3.4			40.8						47.55	2028
2029			3.4					40.8						44.18	2029
2030			3.4											3.41	2030
2031														-	2031

Table 24A.B-5
Construction CO_2 Emissions for Alternatives B, C, and C1 by Project Feature

Proposed Project Construction CO2 Emissions Alternative B/C/C1

Equipment	CO2 Emissions (pounds)													
	GCID Canal Intake & Headworks	TRR	Sac River (Delevan) Intake & P/G Plant	TRR & Delevan Pipelines	TRR Pumping Plant	New Holthouse Reservoir	Inlet/Outlet Structure, Tunnel, Sites Pumping Plant	Dams and Sites Inundation	Gravel Roads	Paved Roads & Bridge	Emergency Drawdown Tunnel	Recreation Facilities	Funks Reservoirs Sediment Removal	Electrical Transmission & Switchyard Features
													Periodic	
Backhoe	0	0	0	0	0	0	0	0	0	553,517	0	0	0	0
Bobcat	0	0	0	0	0	0	0	0	0	0	0	97,966	0	0
Boom Truck	0	0	0	0	0	0	0	0	0	0	0	0	0	39,028
Bulldozer	30,361	808,356	1,105,322	2,927,918	1,105,322	12,950,771	1,669,843	16,831,258	264,708	9,269,526	1,669,843	110,058	1,267,563	7,590
Compactor	6,853	2,845	8,620	40,254	8,620	34,306	0	661,562	6,723	0	0	0	0	0
Concrete Pumper	0	0	6,567	0	6,567	12,124	19,322	128,372	0	17,680	19,322	0	0	1,831
Concrete Truck	249,398	0	665,061	132,692	665,061	281,372	1,646,666	1,035,961	0	3,590,691	1,646,666	105,515	0	246,201
Crane	0	0	139,705	1,047,789	139,705	0	244,484	0	0	698,526	244,484	0	0	331,101
Dump Truck	1,227,805	0	1,998,381	13,860,771	1,998,381	12,790	959,223	1,326,925	196,641	10,831,225	959,223	757,786	0	22,382
Excavator	0	0	0	250,003	0	0	0	0	0	16,250	0	0	0	0
Fuel Truck	535,566	295,760	532,369	1,545,948	532,369	911,262	882,485	5,672,205	148,680	1,800,142	882,485	498,796	266,984	91,126
Forklift	0	25,905	74,014	277,553	74,014	10,917	94,368	16,468	0	0	94,368	22,389	0	15,173
Generator	121,490	0	80,993	454,029	80,993	17,133	155,756	63,081	0	389,390	155,756	25,700	0	0
Grader	0	26,452	160,317	374,340	160,317	319,031	458,507	6,152,166	83,365	1,686,535	458,507	22,444	0	32,063
Highway Truck	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Loader	145,357	115,074	94,633	1,009,928	94,633	115,831	302,827	2,697,432	31,040	934,979	302,827	119,617	0	77,978
Off-road Truck	0	2,430,031	0	0	0	2,382,070	0	44,507,942	0	7,290,094	0	0	0	0
Paver	18,779	11,381	0	0	0	0	0	0	2,845	45,525	0	12,519	0	0
Pile Driver	0	0	0	0	0	97,064	0	2,229,051	0	0	0	0	0	108,484
Roller	20,963	0	0	0	0	0	0	0	3,176	293,803	0	15,881	0	0
Scissor Lift	0	0	0	0	0	0	20,327	0	0	0	20,327	0	0	0
Scraper	253,621	1,198,269	2,141,080	25,240,848	2,141,080	21,061,607	5,678,915	12,497,289	270,162	16,055,340	5,678,915	0	4,910,699	0
Water Trucks	327,734	343,722	744,996	1,545,948	744,996	3,645,047	562,744	11,344,409	305,353	3,600,283	562,744	230,213	533,967	161,469
Welding Truck	0	0	0	259,343	0	0	76,247	0	0	0	76,247	0	0	0
Vehicles														
Highway Truck	812,409	836,303	2,102,705	7,782,397	2,102,705	5,385,791	4,668,960	56,209,118	0	5,986,735	4,668,960	547,181	19,115	967,722
Personnel Vehicles	1,042,219	1,342,691	6,233,677	1,619,849	6,233,677	7,191,588	1,384,095	23,558,690	1,696,563	5,496,863	1,327,019	848,596	306,953	3,564,596
Unpaved roads	101,370	123,876	199,761	813,276	199,761	427,040	304,583	4,113,898	19,243	1,038,758	304,583	68,746	25,201	101,086
Concrete														
Concrete Batch Plant	4,560,000	0	12,000,000	2,400,000	12,000,000	5,140,000	29,578,000	18,584,000	-	40,240,000	29,578,000	1,898,400	-	5,552,000
Total Emissions (lbs)	**9,453,925**	**7,560,665**	**28,288,201**	**61,582,885**	**28,288,201**	**59,995,744**	**48,707,352**	**207,629,827**	**3,028,498**	**109,835,863**	**48,650,276**	**5,381,807**	**7,330,483**	**11,319,830**
Total Emissions (metric tons)	**4,288**	**3,429**	**12,831**	**27,934**	**12,831**	**27,214**	**22,093**	**94,179**	**1,374**	**49,821**	**22,067**	**2,441**	**3,325**	**5,135**
CONSTRUCTION TOTAL (metric tons)	**285,638**													

Construction Duration (days)	743	487	1276	549	1276	826	485	2224	1403	1403	465	731	167	1445
Emissions (lb/day)	12724.0	15525.0	22169.4	112172.8	22169.4	72634.1	100427.5	93358.7	2158.6	78286.4	104624.2	7362.3	43895.1	7833.8

Ave. Annual Emissions (mt/yr) in Year

													Total mt/yr CO2 for Features Constructed In the Indicated Year	*Year*
2022	1429.4					6803.4	11046.7		343.4	12455.2	11033.7		855.8	43,967.57	2022
2023	1429.4	1143.2		6983.4		6803.4	11046.7	13454.2	343.4	12455.2	11033.7		855.8	65,548.32	2023
2024	1429.4	1143.2		6983.4		6803.4		13454.2	343.4	12455.2		813.7	855.8	44,281.67	2024
2025		1143.2		6983.4	3207.8	6803.4		13454.2	343.4	12455.2		813.7	855.8	46,060.09	2025
2026				6983.4	3207.8			13454.2				813.7	855.8	25,314.91	2026
2027			3207.8		3207.8			13454.2					855.8	20,725.63	2027
2028			3207.8		3207.8			13454.2						19,869.87	2028
2029			3207.8					13454.2						16,662.03	2029
2030			3207.8											3,207.83	2030
2031														-	2031

285,637.92	**CONSTRUCTION TOTAL (metric tons)**

Table 24A.B-6
Construction ROG Emissions for Alternatives B, C and C1 by Project Feature

Proposed Project Construction ROG Emissions Alternative B/C/C1

Equipment	ROG Emissions (pounds)													
	GCID Canal Intake & Headworks	TRR	Sac River (Delevan) Intake & P/G Plant	TRR & Delevan Pipelines	TRR Pumping Plant	New Holthouse Reservoir	Inlet/Outlet Structure, Tunnel, Sites Pumping Plant	Dams and Sites Inundation	Gravel Roads	Paved Roads & Bridge	Emergency Drawdown Tunnel	Recreation Facilities	Funks Reservoirs Sediment Removal Periodic	Electrical Transmission & Switchyard Features
Backhoe	0	0	0	0	0	0	0	0	0	302	0	0	0	0
Bobcat	0	0	0	0	0	0	0	0	0	0	0	71	0	0
Boom Truck	0	0	0	0	0	0	0	0	0	0	0	0	0	9
Bulldozer	20	524	716	1,898	716	8,394	1,082	10,910	172	6,008	1,082	71	822	5
Compactor	8	3	10	47	10	40	0	769	8	0	0	0	0	0
Concrete Pumper	0	0	8	0	8	14	22	149	0	21	22	0	0	2
Concrete Truck	103	0	275	55	275	116	680	428	0	1,483	680	44	0	102
Crane	0	0	93	700	93	0	163	0	0	467	163	0	0	221
Dump Truck	507	0	825	5,723	825	5	396	548	81	4,472	396	313	0	9
Excavator	0	0	0	101	0	0	0	0	0	7	0	0	0	0
Fuel Truck	221	122	220	638	220	376	364	2,342	61	743	364	206	110	38
Forklift	0	20	57	213	57	8	72	13	0	0	72	17	0	12
Generator	64	0	43	240	43	9	82	33	0	206	82	14	0	0
Grader	0	17	104	242	104	207	297	3,983	54	1,092	297	15	0	21
Highway Truck	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Loader	70	55	46	486	46	56	146	1,297	15	450	146	58	0	38
Off-road Truck	0	1,003	0	0	0	984	0	18,376	0	3,010	0	0	0	0
Paver	9	5	0	0	0	0	0	0	1	21	0	6	0	0
Pile Driver	0	0	0	0	0	24	0	547	0	0	0	0	0	27
Roller	14	0	0	0	0	0	0	0	2	192	0	10	0	0
Scissor Lift	0	0	0	0	0	0	5	0	0	0	5	0	0	0
Scraper	141	668	1,194	14,081	1,194	11,750	3,168	6,972	151	8,957	3,168	0	2,740	0
Water Trucks	135	142	308	638	308	1,505	232	4,684	126	1,486	232	95	220	67
Welding Truck	0	0	0	346	0	0	102	0	0	0	102	0	0	0
Vehicles														
Highway Truck	50	51	128	474	128	328	285	3,426	0	365	285	33	1	59
Personnel Vehicles	72	93	430	112	430	496	95	1,625	117	379	92	59	21	246
Unpaved roads	15	19	31	124	31	65	47	629	3	159	47	11	4	15
Total Emissions (lbs)	**1,429**	**2,723**	**4,487**	**26,119**	**4,487**	**24,377**	**7,239**	**56,731**	**791**	**29,819**	**7,235**	**1,021**	**3,918**	**869**

Construction Duration (days)	743	487	1276	549	1276	826	485	2224	1403	1403	465	731	167	1445
Emissions (lb/day)	1.9	5.6	3.5	47.6	3.5	29.5	14.9	25.5	0.6	21.3	15.6	1.4	23.5	0.6

Daily Emissions (lb/day) in Year

													Total lb/day ROG for Features Constructed In the Indicated Year	***Year***
2022	1.9					29.5	14.9		0.6	21.3	15.6		0.6	84.34	2022
2023	1.9	5.6		47.6		29.5	14.9	25.5	0.6	21.3	15.6		0.6	163.02	2023
2024	1.9	5.6		47.6		29.5		25.5	0.6	21.3		1.4	0.6	133.93	2024
2025		5.6		47.6	3.5	29.5		25.5	0.6	21.3		1.4	0.6	135.52	2025
2026				47.6	3.5			25.5				1.4	0.6	78.60	2026
2027			3.5		3.5			25.5					0.6	33.14	2027
2028			3.5		3.5			25.5						32.54	2028
2029			3.5					25.5						29.02	2029
2030			3.5											3.52	2030
2031														-	2031

Table 24A.B-7
Construction SOx Emissions for Alternatives B, C, and C1 by Project Feature

Proposed Project Construction SOx Emissions Alternative B/C/C1

Equipment	SOx Emissions (pounds)													
	GCID Canal Intake & Headworks	TRR	Sac River (Delevan) Intake & P/G Plant	TRR & Delevan Pipelines	TRR Pumping Plant	New Holthouse Reservoir	Inlet/Outlet Structure, Tunnel, Sites Pumping Plant	Dams and Sites Inundation	Gravel Roads	Paved Roads & Bridge	Emergency Drawdown Tunnel	Recreation Facilities	Funks Reservoirs Sediment Removal Periodic	Electrical Transmission & Switchyard Features
Backhoe	0	0	0	0	0	0	0	0	0	6	0	0	0	0
Bobcat	0	0	0	0	0	0	0	0	0	0	0	1	0	0
Boom Truck	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Bulldozer	0	9	12	31	12	137	18	178	3	98	18	1	13	0
Compactor	0	0	0	1	0	0	0	9	0	0	0	0	0	0
Concrete Pumper	0	0	0	0	0	0	0	2	0	0	0	0	0	0
Concrete Truck	3	0	7	1	7	3	17	11	0	38	17	1	0	3
Crane	0	0	1	11	1	0	3	0	0	7	3	0	0	4
Dump Truck	13	0	21	146	21	0	10	14	2	114	10	8	0	0
Excavator	0	0	0	3	0	0	0	0	0	0	0	0	0	0
Fuel Truck	6	3	6	16	6	10	9	60	2	19	9	5	3	1
Forklift	0	0	1	3	1	0	1	0	0	0	1	0	0	0
Generator	1	0	1	5	1	0	2	1	0	4	2	0	0	0
Grader	0	0	2	4	2	3	5	65	1	18	5	0	0	0
Highway Truck	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Loader	2	1	1	11	1	1	3	29	0	10	3	1	0	1
Off-road Truck	0	26	0	0	0	25	0	469	0	77	0	0	0	0
Paver	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Pile Driver	0	0	0	0	0	1	0	24	0	0	0	0	0	1
Roller	0	0	0	0	0	0	0	0	0	3	0	0	0	0
Scissor Lift	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Scraper	3	13	23	267	23	223	60	132	3	170	60	0	52	0
Water Trucks	3	4	8	16	8	38	6	119	3	38	6	2	6	2
Welding Truck	0	0	0	3	0	0	1	0	0	0	1	0	0	0
Vehicles														
Highway Truck	8	8	20	74	20	51	45	536	0	57	45	5	0	9
Personnel Vehicles	10	13	63	16	63	72	14	236	17	55	13	9	3	36
Unpaved roads	1	1	2	8	2	4	3	39	0	10	3	1	0	1
Total Emissions (lbs)	**50**	**78**	**166**	**616**	**166**	**570**	**196**	**1,924**	**31**	**725**	**196**	**36**	**77**	**58**
Construction Duration (days)	743	487	1276	549	1276	826	485	2224	1403	1403	465	731	167	1445
Emissions (lb/day)	0.1	0.2	0.1	1.1	0.1	0.7	0.4	0.9	0.0	0.5	0.4	0.0	0.5	0.0

Daily Emissions (lb/day) in Year

													Total lb/day SOx for Features Constructed In the Indicated Year	*Year*
2022	0.1					0.7	0.4		0.0	0.5	0.4		2.16	2022
2023	0.1	0.2		1.1		0.7	0.4	0.9	0.0	0.5	0.4		4.31	2023
2024	0.1	0.2		1.1		0.7		0.9	0.0	0.5		0.0	3.53	2024
2025		0.2		1.1	0.1	0.7		0.9	0.0	0.5		0.0	3.60	2025
2026				1.1	0.1			0.9				0.0	2.21	2026
2027			0.1		0.1			0.9					1.17	2027
2028			0.1		0.1			0.9					1.13	2028
2029			0.1					0.9					1.00	2029
2030			0.1										0.13	2030
2031													-	2031

0.0	0.0
0.0	0.0
0.0	0.0
0.0	0.0
0.0	0.0
0.0	0.0

Sites Construction Alt B_Alt C_Alt C1_03222017.xlsx, Detail SOx Emissions by Feature

Table 24A.B-8
Construction CO Emissions for Alternatives B, C, and C1 by Project Feature

Proposed Project Construction CO Emissions Alternative B/C/C1

Equipment	CO Emissions (pounds)													
	GCID Canal Intake & Headworks	TRR	Sac River (Delevan) Intake & P/G Plant	TRR & Delevan Pipelines	TRR Pumping Plant	New Holthouse Reservoir	Inlet/Outlet Structure, Tunnel, Sites Pumping Plant	Dams and Sites Inundation	Gravel Roads	Paved Roads & Bridge	Emergency Drawdown Tunnel	Recreation Facilities	Funks Reservoirs Sediment Removal Periodic	Electrical Transmission & Switchyard Features
Backhoe	0	0	0	0	0	0	0	0	0	4,112	0	0	0	0
Bobcat	0	0	0	0	0	0	0	0	0	0	0	765	0	0
Boom Truck	0	0	0	0	0	0	0	0	0	0	0	0	0	263
Bulldozer	93	2,465	3,371	8,929	3,371	39,496	5,092	51,330	807	28,269	5,092	336	3,866	23
Compactor	42	17	53	246	53	209	0	4,038	41	0	0	0	0	0
Concrete Pumper	0	0	40	0	40	74	118	784	0	108	118	0	0	11
Concrete Truck	655	0	1,747	348	1,747	739	4,324	2,721	0	9,429	4,324	277	0	647
Crane	0	0	473	3,548	473	0	828	0	0	2,365	828	0	0	1,121
Dump Truck	3,224	0	5,248	36,400	5,248	34	2,519	3,485	516	28,444	2,519	1,990	0	59
Excavator	0	0	0	1,628	0	0	0	0	0	106	0	0	0	0
Fuel Truck	1,406	777	1,398	4,060	1,398	2,393	2,317	14,896	390	4,727	2,317	1,310	701	239
Forklift	0	202	577	2,163	577	85	736	128	0	0	736	175	0	118
Generator	717	0	478	2,679	478	101	919	372	0	2,297	919	152	0	0
Grader	0	71	430	1,005	430	857	1,231	16,518	224	4,528	1,231	60	0	86
Highway Truck	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Loader	367	291	239	2,553	239	293	766	6,820	78	2,364	766	302	0	197
Off-road Truck	0	6,381	0	0	0	6,256	0	116,882	0	19,144	0	0	0	0
Paver	119	72	0	0	0	0	0	0	18	288	0	79	0	0
Pile Driver	0	0	0	0	0	217	0	4,980	0	0	0	0	0	242
Roller	153	0	0	0	0	0	0	0	23	2,151	0	116	0	0
Scissor Lift	0	0	0	0	0	0	137	0	0	0	137	0	0	0
Scraper	1,100	5,196	9,285	109,455	9,285	91,332	24,626	54,193	1,172	69,623	24,626	0	21,295	0
Water Trucks	861	903	1,956	4,060	1,956	9,572	1,478	29,791	802	9,455	1,478	605	1,402	424
Welding Truck	0	0	0	2,120	0	0	623	0	0	0	623	0	0	0
Vehicles														
Highway Truck	292	301	756	2,800	756	1,938	1,680	20,221	0	2,154	1,680	197	7	348
Personnel Vehicles	3,522	4,538	21,067	5,474	21,067	24,304	4,678	79,616	5,734	18,577	4,485	2,868	1,037	12,046
Unpaved roads	91	112	180	734	180	385	275	3,711	17	937	275	62	23	91
Total Emissions (lbs)	**12,643**	**21,326**	**47,298**	**188,201**	**47,298**	**178,283**	**52,346**	**410,486**	**9,823**	**209,079**	**52,153**	**9,293**	**28,331**	**15,916**
Construction Duration (days)	743	487	1276	549	1276	826	485	2224	1403	1403	465	731	167	1445
Emissions (lb/day)	17.0	43.8	37.1	342.8	37.1	215.8	107.9	184.6	7.0	149.0	112.2	12.7	169.6	11.0

Daily Emissions (lb/day) in Year

													Total lb/day CO for Features Constructed In the Indicated Year	***Year***
2022	17.0					215.8	107.9		7.0	149.0	112.2		11.0	619.98	2022
2023	17.0	43.8		342.8		215.8	107.9	184.6	7.0	149.0	112.2		11.0	1,191.15	2023
2024	17.0	43.8		342.8		215.8		184.6	7.0	149.0		12.7	11.0	983.77	2024
2025		43.8		342.8	37.1	215.8		184.6	7.0	149.0		12.7	11.0	1,003.83	2025
2026				342.8	37.1			184.6				12.7	11.0	588.17	2026
2027			37.1		37.1			184.6					11.0	269.72	2027
2028			37.1		37.1			184.6						258.71	2028
2029			37.1					184.6						221.64	2029
2030			37.1											37.07	2030
2031														-	2031

Table 24A.B-9
Construction Equipment Emission Factors

Proposed Project Construction - Emission Factors

Construction Equipment Emission Factors

Project Equipment Type	Equipment Type from OFFROAD	Load Factor	Horsepower	Emission Factors (g/bhp hr)						
				NOx	PM10	CO2	ROG	SOx	CO	PM2.5
Backhoe	Tractor/Loader/Backhoe	0.37	97	2.647	0.142	475.898	0.260	0.005	3.536	0.131
Bobcat	Other General Industrial	0.34	88	3.200	0.199	470.000	0.339	0.005	3.668	0.183
Boom Truck	Aerial Lift	0.31	63	1.627	0.030	472.114	0.105	0.005	3.176	0.028
Bulldozer	Crawler Tractor	0.43	212	3.737	0.141	472.098	0.306	0.005	1.440	0.130
Compactor	Plate Compactor	0.43	8	4.142	0.161	568.299	0.661	0.008	3.469	0.161
Compressor	Air Compressor	0.48	78	2.844	0.165	568.299	0.413	0.006	3.662	0.165
Concrete Pumper	Cement and Mortar Mixer	0.56	9	4.142	0.161	568.299	0.661	0.008	3.470	0.161
Concrete Truck	Off-Highway Truck	0.38	402	1.490	0.054	474.714	0.196	0.005	1.247	0.050
Crane	Crane	0.29	231	3.541	0.147	472.983	0.316	0.005	1.602	0.135
Dump Truck	Off-Highway Truck	0.38	402	1.490	0.054	474.714	0.196	0.005	1.247	0.050
Excavator	Excavator	0.38	158	1.678	0.081	472.192	0.191	0.005	3.074	0.075
Fuel Truck	Off-Highway Truck	0.38	402	1.490	0.054	474.714	0.196	0.005	1.247	0.050
Forklift	Forklift	0.20	89	3.360	0.223	471.529	0.362	0.005	3.675	0.205
Generator	Generator set	0.74	84	2.671	0.134	568.299	0.301	0.006	3.353	0.134
Grader	Grader	0.41	187	3.888	0.124	474.239	0.307	0.005	1.273	0.114
Highway Truck	Estimated with EMFAC2014 emission factors and by assuming 10 one-way trips per equipment day (5 round trips)									
Loader	Rubber Tired Loader	0.36	203	2.347	0.079	469.904	0.226	0.005	1.188	0.072
Off-road Truck	Off-Highway Truck	0.38	402	1.490	0.054	474.714	0.196	0.005	1.247	0.050
Paver	Paver	0.42	130	2.180	0.104	472.760	0.215	0.005	2.995	0.095
Pile Driver	Bore/Drill Rig	0.50	221	1.163	0.037	468.760	0.115	0.005	1.047	0.034
Roller	Roller	0.38	80	3.219	0.186	473.929	0.310	0.005	3.470	0.171
Scissor Lift	Aerial Lift	0.31	63	1.627	0.030	472.114	0.105	0.005	3.176	0.028
Scraper	Scraper	0.48	367	2.879	0.112	473.230	0.264	0.005	2.052	0.103
Water Trucks	Off-Highway Truck	0.38	402	1.490	0.054	474.714	0.196	0.005	1.247	0.050
Welding Truck	Welder	0.45	46	4.007	0.175	568.299	0.758	0.007	4.645	0.175

1. Load factors, horsepower, and emission factors from the CalEEMod User's Guide, Appendix D (CAPCOA, 2016).
2. The emission factors are for the year 2022.
3. It was assumed emissions from concrete trucks, fuel trucks, dump trucks, and water trucks would be represented using the Off-highway truck emission factors. These trucks would primarily travel within the construction area, for example, concrete trucks making trips from an onsite concrete batch plant to the pour location.

Vehicle Emission Factors

Vehicle	Vehicle Type in EMFAC2007	Emission Factors (lb/mile)						
		NOx	PM10	CO2	ROG	SOx	CO	PM2.5
Personnel at 15 mph	Passenger Vehicles, Gasoline	0.0003	0.0001	1.1866	0.0001	0.0000	0.0030	0.0001
Personnel at 35 mph	Passenger Vehicles, Gasoline	0.0002	0.0001	0.6046	0.0000	0.0000	0.0020	0.0000
Truck at 15 mph	Heavy-Heavy Duty Diesel	0.0191	0.0002	4.7281	0.0007	0.0000	0.0043	0.0001
Truck at 35 mph	Heavy-Heavy Duty Diesel	0.0031	0.0002	3.4135	0.0002	0.0000	0.0012	0.0001
Vehicle	**Vehicle Type in EMFAC2007**	**Emission Factors (g/mile)**						
		NOx	PM10	CO2	ROG	SOx	CO	PM2.5
Personnel at 15 mph	Passenger Vehicles, Gasoline	0.1197	0.0502	538.2616	0.0532	0.0054	1.3475	0.0228
Personnel at 35 mph	Passenger Vehicles, Gasoline	0.0840	0.0466	274.2555	0.0189	0.0028	0.9268	0.0195
Truck at 15 mph	Heavy-Heavy Duty Diesel	8.6853	0.1063	2144.6550	0.3278	0.0205	1.9347	0.0437
Truck at 35 mph	Heavy-Heavy Duty Diesel	1.4257	0.1037	1548.3552	0.0944	0.0148	0.5570	0.0412

1. It was assumed that 'non-personnel' trips are diesel truck trips.

2. Emission factors from the ARB's EMFAC2014 model for the Colusa County portion of the Sacramento Valley Air Basin for the year 2022, assuming an annual temperature of 66°F and an annual relative humidity of 56%, per Table B-1 of *CT-EMFAC: A Computer Model to Estimate Transportation Project Emissions* (Wu, et al, 2007). UC Davis.

3. It was assumed that diesel trucks would be ten years old or newer, based on the ARB's *Staff Assessment of the Impact of the Economy on California Trucking Activity and Emissions 2006-2014*, December 2009. Therefore, the model year in EMFAC2014 was changed to 2012 through 2022, rather than the default of 1978 through 2023, and the emission factors by model year were arithmetically averaged.

4. Passenger vehicles were assumed to be comprised of 50% light-duty automobiles, 25% category 1 light-duty trucks, and 25% category 2 light-duty trucks, consistent with the CalEEMod User's Guide, Appendix A (CAPCOA, 2016).
5. It was assumed that vehicles would travel at an average speed of 35 mph offsite and 15 mph on unpaved roads.
6. The PM10 and PM2.5 emission factors include tire and brake wear.

Calculation of Paved Road Emission Factor

Paved Roads emission factor from AP-42, Section 13.2.1: P*aved Roads* (1/11)

$$E = [k(sL)^{0.91} * (W)^{1.02}]$$

where:	PM10	PM2.5	
k =	1.0	0.25	particle size multiplier, g/VMT [Table 13.2-1.1]
sL =	0.03	0.03	road surface silt loading (g/m^2) [Table 13.2.1-2]
W =	2.4	2.4	vehicle weight [tons, from CalEEMOD CalEEMod User's Guide, Appendix A (CAPCOA, 2016)]
$E_{(PM10)}$=	0.100	0.025	g/VMT

Calculation of Unpaved Road Emission Factor
PM10

Emission Factor [lb/mi] = 1.5 x (silt content [%] / 12)$^{0.9}$ x (average vehicle weight [tons] / 3)$^{0.45}$ x (365-P)/365
Reference: AP-42, Section 13.2.2, November 2006

Parameter	Value
Average Vehicle Weight (tons)	8
Silt Content (%)	4.3
P, Number of days with Precip >0.01 inches	56
Emission Factor (lb/mile)	0.44

Reference for Silt Content: AP-42, Section 13.2.2, Table 13.2.2-1, Average for a Service Road
Precipitation days taken directly from CalEEMod for Colusa County.
The emission factor accounts for a 44% reduction assuming truck speeds are limited to 15 mph or less.

PM2.5

Emission Factor [lb/mi] = 0.15 x (silt content [%] / 12)$^{0.9}$ x (average vehicle weight [tons] / 3)$^{0.45\ x}$ (365-P)/365
Reference: AP-42, Section 13.2.2, November 2006

Parameter	$PM_{2.5}$
Average Vehicle Weight (tons)	8
Silt Content (%)	4.3
P, Number of days with Precip >0.01 inches	56
Emission Factor (lb/mile)	0.04

Reference for Silt Content: AP-42, Section 13.2.2, Table 13.2.2-1, Average for a Service Road
Precipitation days taken directly from CalEEMod for Colusa County.
The emission factor accounts for a 44% reduction assuming truck speeds are limited to 15 mph or less.

Disturbed Land Fugitive Dust Emission Factor

Emission Factor (lb/acre/day) 10 PM10
From URBEMIS2007 construction phase mass site grading.
Per URBEMIS2007 Appendix A, page A-6, the value assumes watering.

Table 24A.B-10
Equipment and Workforce for Construction of Features for Alternatives B, C, and C1 (2 pages)

Alts B/C/C1 Project Features:	Holthouse-Sites Connection Channel			TRR Reservoir			Sac River (Delevan) Intake & P/G Plant			TRR and Delevan Canals and Conduits			TRR Pumping Plant			New Holthouse Reservoir			Inlet/Outlet Structure and Tunnel		
Constr. Schedule (URS, 7/12/11, Updated to 2022 Start, and AECOM, 2/12/16)	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish
	743	*7/3/2022*	*7/15/2024*	*487*	*7/2/2023*	*10/30/2025*	*1276*	*5/15/2027*	*11/8/2030*	Delevan:			*1276*	*12/18/2024*	*6/19/2028*	*826*	*4/1/2022*	*7/9/2025*	243 (I/O)	1/1/2022	8/31/2022
										459	*4/1/2024*	*7/2/2026*							212 (Tunnel)	10/1/2022	4/30/2023
										TRR:									*485*	*1/1/2022*	*4/30/2023*
										549	*7/2/2023*	*7/1/2026*									
Equipment	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day
Asphalt Delivery Truck																					
Backhoe																					
Bobcat																					
Boom Truck																					
Bulldozer	1	32	10	1	852	10	1	1165	10	1	3086	10	1	1165	10	1	13650	10	1	1760	10
Compactor	1	159	10	1	66	10	1	200	10	1	934	10	1	200	10	1	796	10			
Concrete Pumper							1	104	10				1	104	10	1	192	10	1	306	10
Concrete Truck	1	156	10				1	416	10	1	83	10	1	416	10	1	176	10	1	1030	10
Crane							1	200	10	1	1500	10	1	200	10				1	350	10
Dump Truck	1	768	10				1	1250	10	1	8670	10	1	1250	10	1	8	10	1	600	10
Excavator										1	400	10									
Fuel Truck	1	335	10	1	185	10	1	333	10	1	967	10	1	333	10	1	570	10	1	552	10
Forklift				1	140	10	1	400	10	1	1500	10	1	400	10	1	59	10	1	510	10
Generator	1	156	10				1	104	10	1	583	10	1	104	10	1	22	10	1	200	10
Grader				1	33	10	1	200	10	1	467	10	1	200	10	1	398	10	1	572	10
Highway Truck	1	680	10	1	700	10	1	1760	10	1	6514	10	1	1760	10	1	4508	10	1	3908	10
Loader	1	192	10	1	152	10	1	125	10	1	1334	10	1	125	10	1	153	10	1	400	10
Off-road Truck				1	1520	10										1	1490	10			
Paver	1	33	10	1	20	10															
Pile Driver/Drill Rig																1	85	10			
Roller	1	66	10																		
Scissor Lift																			1	100	10
Scraper	1	138	10	1	652	10	1	1165	10	1	13734	10	1	1165	10	1	11460	10	1	3090	10
Water Trucks	1	205	10	1	215	10	1	466	10	1	967	10	1	466	10	1	2280	10	1	352	10
Welding Truck										1	1000	10							1	294	10
Trips/Workforce	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.
Highway Trucks	3400	70	29	3500	70	57	8800	70	101	32570	70	61	8800	70	101	22540	70	180	19540	70	59
Personnel	21547	80		27759	80		128876	80		33489	80		128876	80		148680	80		28615	80	
Onsite Unpaved roads	10720	2		13100	2		21125	2		86005	2		21125	2		45160	2		32210	2	

Number of truck roundtrips per equipment day

Source: URS 2011.

Table 24A.B-10
Equipment and Workforce for Construction of Features for Alternatives B, C, and C1 (2 pages)

Main Dams and Sites Inundation			Gravel Roads			Paved Roads & Bridge			Emergency Drawdown Tunnel			Recreation Facilities			Funks Reservoirs Sediment Removal			Electrical Transmission & Switchyard Features		
Duration (Days)	**Start**	**Finish**	**Duration (Days)**	**Start**	**Finish**	**Duration (Days)**	**Start**	**Finish**	**Duration (Days)**	**Start**	**Finish**	**Duration (Days)**	**Start**	**Finish**	**Duration (Days)**	**Start**	**Finish**	**Duration (Days)**	**Start**	**Finish**
885 (saddle)	7/2/2023	12/2/2025	*1403*	*1/1/2022*	*11/3/2025*	*1403*	*1/1/2022*	*11/3/2025*	*465*	*3/15/2022*	*12/25/2023*	*731*	*1/2/2024*	*1/1/2026*	*167*	*Periodic*	*Maintenance*	*1445*	*3/15/2022*	*9/27/2027*
1949 (GG)	7/2/2023	11/1/2028																		
792 (Sites)	7/2/2025	8/30/2029																		
2224	*7/2/2023*	*8/30/2029*																		
Enter "1" if Equipment Type is in Use	**Total Number of Equipment Days of Use (Spreadsheet 6/29/11)**	**Number of Hours of Use per Equipment Day**	**Enter "1" if Equipment Type is in Use**	**Total Number of Equipment Days of Use (Spreadsheet 6/29/11)**	**Number of Hours of Use per Equipment Day**	**Enter "1" if Equipment Type is in Use**	**Total Number of Equipment Days of Use (Spreadsheet 6/29/11)**	**Number of Hours of Use per Equipment Day**	**Enter "1" if Equipment Type is in Use**	**Total Number of Equipment Days of Use (Spreadsheet 6/29/11)**	**Number of Hours of Use per Equipment Day**	**Enter "1" if Equipment Type is in Use**	**Total Number of Equipment Days of Use (Spreadsheet 6/29/11)**	**Number of Hours of Use per Equipment Day**	**Enter "1" if Equipment Type is in Use**	**Total Number of Equipment Days of Use (Spreadsheet: Equipment for Sediment and Trans May 2012)**	**Number of Hours of Use per Equipment Day**	**Enter "1" if Equipment Type is in Use**	**Total Number of Equipment Days of Use (Spreadsheet: Equipment for Sediment and Trans May 2012)**	**Number of Hours of Use per Equipment Day**
						1	1470	10												
												1	316	10						
																		1	192	10
1	17740	10	1	279	10	1	9770	10	1	1760	10	1	116	10	1	1336	10	1	8	10
1	15350	10	1	156	10															
1	2033	10				1	280	10	1	306	10							1	29	10
1	648	10				1	2246	10	1	1030	10	1	66	10				1	154	10
						1	1000	10	1	350	10							1	474	10
1	830	10	1	123	10	1	6775	10	1	600	10	1	474	10				1	14	10
						1	26	10												
1	3548	10	1	93	10	1	1126	10	1	552	10	1	312	10	1	167	10	1	57	10
1	89	10							1	510	10	1	121	10				1	82	10
1	81	10				1	500	10	1	200	10	1	33	10						
1	7675	10	1	104	10	1	2104	10	1	572	10	1	28	10				1	40	10
1	47048	10				1	5011	10	1	3908	10	1	458	10	1	16	10	1	810	10
1	3563	10	1	41	10	1	1235	10	1	400	10	1	158	10				1	103	10
1	27840	10				1	4560	10												
			1	5	10	1	80	10				1	22	10						
1	1952	10					105											1	95	10
			1	10	10	1	925	10				1	50	10						
									1	100	10									
1	6800	10	1	147	10	1	8736	10	1	3090	10				1	2672	10			
1	7096	10	1	191	10	1	2252	10	1	352	10	1	144	10	1	334	10	1	101	10
									1	294	10									
Total number of round trips	**Roundtrip distance (miles)**	**Maximum Daily Workforce Required For Const.**	**Total number of round trips**	**Roundtrip distance (miles)**	**Maximum Daily Workforce Required For Const.**	**Total number of round trips**	**Roundtrip distance (miles)**	**Maximum Daily Workforce Required For Const.**	**Total number of round trips**	**Roundtrip distance (miles)**	**Maximum Daily Workforce Required For Const.**	**Total number of round trips**	**Roundtrip distance (miles)**	**Maximum Daily Workforce Required For Const.**	**Total number of round trips**	**Roundtrip distance (miles)**	**Maximum Daily Workforce Required For Const.**	**Total number of round trips**	**Roundtrip distance (miles)**	**Maximum Daily Workforce Required For Const.**
235240	70	219	0	70	25	25055	70	81	19540	70	59	2290	70	24	80	70	38	4050	70	51
487056	80		35075	80		113643	80		27435	80		17544	80		6346	80		73695	80	
435050	2		2035	2		109850	2		32210	2		7270	2		2665	2		10690	2	

Table 24A.B-11
Concrete Batch Plant PM10 Emissions

Construction On-Site Concrete Batch Plant Emissions

Project Feature	Total Concrete Mass (tons)	Number of Days	Daily Rate (tons/day)	PM_{10} Emissions (lb/day)
Tunnel - Inlet and Outlet Including Sites Pump Plant	77,515	194	400	10.14
	44,030	38	1,159	27.79
	15,253	110	139	4.07
Emergency Drawdown Tunnel	77,515	194	400	10.14
	44,030	38	1,159	27.79
	15,253	110	139	4.07
Pipelines - Delevans and TRR	11,100	28	396	10.07
Dams & Sites Inundation	85,951	215	400	10.14
TRR Pump Plant	55,500	139	399	10.13
Funks Reservoir Modification	23,773	59	403	10.22
Sacramento River Intake & P/G Plant	55,500	139	399	10.13
Paved Roads & Bridges	186,110	310	600	14.81
GCID Canal & Headworks	21,090	35	603	14.86
Electrical Transmission and Switchyard Features	25,679	64	401	10.18
Recreation	8,780	44	200	5.49

Batch Plants Controlled Emission Factors[a]

Sand Transfer[b]	0.000297	lb PM_{10}/ton cement
Aggregate Transfer[b]	0.00099	lb PM_{10}/ton cement
Cement Unloading to Storage Silo	0.00034	lb PM_{10}/ton cement
Cement Supplement Unloading to Storage Silo	0.0049	lb PM_{10}/ton cement
Weigh Hopper Loading[b]	0.00072	lb PM_{10}/ton cement
Truck Loading[c]	0.016	lb PM_{10}/ton cement
Total	**0.023**	**lb PM_{10}/ton cement**

[a]Emission factors from AP-42, Section 11.12, June 2006

[b] The batch plants will have dust control equipment and was assumed to control dust emissions with an efficiency of 70% during sand and aggregate transfer.

Source for control efficiency: BAAQMD Permit Handbook, Section 11.5 Concrete Batch Plants, March 2009

[c] It was assumed the truck loading process would also include dust controls. Therefore, the controlled truck loading emission factor was used.

Concrete Batch Plant Storage Pile PM10 Emissions

Emission Factor:	1.7	lb PM_{10}/acre/day
Assumed Storage Pile Area	0.5	acres/day

Source: BAAQMD Permit Handbook, Section 11.5 Concrete Batch Plants, March 2009

Table 24A.B-12
Construction Areas of Disturbance for Fugitive Dust Emissions Calculations

Proposed Project Disturbed Acres for Fugitive Dust Emission Calculations

Project Feature (File Name: ProjFacilitiesParcelsAcreages_9-23-11.xls)	Alternative	County	Total Project Feature Acreage (acres)	PM10 Emissions (lbs)	Construction Duration (days)	Project Duration (days)
1.27 MAF Sites Reservoir						
Alt A		Colusa Co	10,491.2	104,911.5		
		Glenn Co	1,600.3	16,002.9		
	Alt A	Total	**12,091.4**	120,914.4	2224	
1.81 MAF Sites Reservoir						
Alts B C C1		Colusa Co	12,046.1	120,460.8		
		Glenn Co	2,106.1	21,060.7		
	Alts B C C1	Total	**14,152.2**	141,521.5	2224	
Alt D		Colusa Co	12,046.1	120,460.8		
		Glenn Co	2,106.1	21,060.7		
	Alt D	Total	**14,152.2**	141,521.5	1410	
Golden Gates and Sites Dams						
Alt A	**Alt A**	Total	**50.4**	504.0	2224	
Alts B C C1	**Alts B C C1**	Total	**57.7**	577.0	2224	
Alt D	**Alt D**	Total	**57.7**	577.0	1410	
6 Saddle Dams						
Alt A		Colusa Co	0.0	-		
		Glenn Co	37.3	372.5		
	Alt A	Total	**37.3**	372.5	2224	
9 Saddle Dams						
Alts B C C1		Colusa Co	4.2	42.4		
		Glenn Co	94.0	939.7		
	Alts B C C1	Total	**98.2**	982.1	2224	
Alt D		Colusa Co	4.2	42.4		
		Glenn Co	94.0	939.7		
	Alt D	Total	**98.2**	982.1	1410	
Subtotal Sites Reservoir and Dams	***Alt A***	***Total***	***12179.1***	***121,790.9***	***2224***	
	Alts B C C1	***Total***	***14308.1***	***143,080.6***	***2224***	
	Alt D	***Total***	***14308.1***	***143,080.6***	***1410***	
5 Recreation Areas						
Alts A B C C1		Colusa Co	879.2	8,792.2		
		Glenn Co	329.2	3,292.1		
	Alts A B C C1	Total	**1208.4**	12,084.3	731	
Alt D (Conservative; Alt D has only 2 recreation areas)		Colusa Co	879.2	8,792.2		
		Glenn Co	329.2	3,292.1		
	Alt D	Total	**1208.4**	12,084.3	390	
Road Relocations and South Bridge						
A		Colusa Co	1025.6	10,256.2		
A		Glenn Co	270.3	2,703.3		
	Alt A	Total	**1296.0**	12,959.5	1403	
B C C1		Colusa Co	1031.4	10,313.8		
B C C1		Glenn Co	271.6	2,715.8		
	Alts B C C1	Total	**1303.0**	13,029.6	1403	
Alt D (Assumed same as Alts B C C1)		Colusa Co	1031.4	10,313.8		
		Glenn Co	271.6	2,715.8		
	Alt D	Total	**1303.0**	13,029.6	1403	
Sites Pumping Generating Plant & Electrical Switchyard						
Alts A B C C1	**Alts A B C C1**		**5.30**	53.0	485	
Alt D	**Alt D**		**5.30**	53.0	1180	
Tunnel from Sites Pum Gen to Intake Outfall						
Alts A B C C1	**Alts A B C C1**		**3.1**	30.6	485	
Alt D	**Alt D**		**3.1**	30.6	1180	
Sites Res Inlet Outlet Structure						
Alts A B C C1	**Alts A B C C1**		**204.2**	2,042.2	485	
Alt D	**Alt D**		**204.2**	2,042.2	1180	
Field Office Maint Yard						
Alts A B C C1	**Alts A B C C1**		**18.3**	183.4	485	
Alt D	**Alt D**		**18.3**	183.4	1180	
Existing Funks Reservoir Dredging						
Alts A B C C1 D	**Alts A B C C1 D**	No PM - WET	**228.4**	No PM - WET		
Holthouse Reservoir Complex						
Alts A B C C1	**Alts A B C C1**		**456.3**	4,563.0	826	
Alt D	**Alt D**		**456.3**	4,563.0	950	
GCID Canal Intake & Headworks						
& GCID Canal Connection to TRR			9.5	95.0		
Alts A B C C1			3.6	36.0		
	Alts A B C C1	Total	**13.10**	131.0	743	
Alt D			9.5	95.0		
			3.6	36.0		
	Alt D	Total	**13.10**	131.0	650	
TRR	**Alts A B C C1**		**191.6**	1,916.2	487	
	Alt D		**191.6**	1,916.2	530	
TRR PG Plant	**Alts A B C C1**		**0.7**	6.5	1276	
	Alt D		**0.7**	6.5	1525	
TRR Easement						
& TRR to Funks Cr Pipeline Easement			386.9	3,868.9		
Alts A B C C1			20.6	205.6		
	Alts A B C C1	Total	**407.5**	4,074.5	549	
Alt D			386.9	3,868.9		
			20.6	205.6		
	Alt D	Total	**407.5**	4,074.5	800	
Delevan Transmission Line						
Alt A	**Alt A**		**372.8**	3,727.8	1445	
Alt B	**Alt B**		**151.8**	1,518.2	1445	
Alt C C1	**Alt C C1**		**372.8**	3,727.6	1445	
Alt D	**Alt D**		**372.8**	3,727.6	1445	
Delevan Pipeline Intake Facilities						
& Delevan Pipeline Discharge Facility			19.2	191.5		
Alts A B C C1			7.7	76.6		
	Alts A B C C1	Total	**26.8**	268.1	549	
Alt D			19.2	191.5		
			7.7	76.6		
	Alt D	Total	**26.8**	268.1	1175	
Asphalt Plant						
Alts A B C C1 D	**Alts A B C C1 D**		**15.0**	149.6	100	
Concrete Plant						
Alts A B C C1 D	**Alts A B C C1 D**		**15.0**	149.6	100	
	Alt A	**Total**	**16,413.0**	**164,130.3**	**2224**	**3727**
	Alt B	**Total**	**18,328.0**	**183,280.5**	**2224**	**3727**
	Alt C C1	**Total**	**18,549.0**	**185,489.9**	**2224**	**3727**
	Alt D	**Total**	**18,549.0**	**185,489.9**	**1410**	**3369**

Table 24A.B-13
Total GHG Emissions from Construction of Alternatives B, C, and C1

Proposed Project Total GHG Emissions from Construction of Alternatives B, C, and C1

Total mtCO2e Emissions from Construction Related Activities

Emissions from Mobile Construction Equipment (From Table 24A. B-5)	**Emissions From Concrete Production** (See Table Below)	**Total Construction Related Emissions**
212,369	73,269	285,638

Alternatives B, C, and C1

Project Feature	Total Concrete Mass (tons)	Total Concrete (CY)	GHG Emissions (lbs)	GHG Emissions (mt)
Tunnel - Inlet and Outlet Including Sites Pump Plant	136,798	73,945	29,578,000	13,416
Emergency Drawdown Tunnel	136,798	73,945	29,578,000	13,416
Pipelines - Delevan and TRR	11,100	6,000	2,400,000	1,089
Dams & Sites Inundation	85,951	46,460	18,584,000	8,430
TRR Pump Plant	55,500	30,000	12,000,000	5,443
Funks Reservoir Modification	23,773	12,850	5,140,000	2,331
Sacramento River Intake & P/G Plant	55,500	30,000	12,000,000	5,443
Paved Roads & Bridges	186,110	100,600	40,240,000	18,253
GCID Canal & Headworks	21,090	11,400	4,560,000	2,068
Transmission Lines	25,679	13,880	5,552,000	2,518
Recreation	8,780	4,746	1,898,400	861
Total	747,079	403,826	161,530,400	73,269

1. Based on a study by the Portland Cement Association, CO2 emissions from concrete range from 190 lbs/cy to 500 lbs/cy, depending on the cement content of the concrete. Based on the types of concrete used for this project, DWR has determined the following factor to be appropriate for the project:

1 cy = 400 lbs CO_2e

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Emissions from Project Electricity Generation and Use for All Alternatives

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Table 24A.C-1
Indirect GHG Emissions from Project Electricity Generation and Use - Emission Calculations

	Net Electricity Use (Long Term)[a]	Units	CO2 Emission Factor (lb/MWh) [b]	CH4 Emission Factor (lb/MWh) [b]	N2O Emission Factor (lb/MWh) [b]	CO2 Emissions (mt/yr)	CH4 Emissions (mt/yr)	N2O Emissions (mt/yr)	Total CO2-e (mt/yr)
All Facilities (CVP, State Water Project, Proposed NODOS Facilities)									
Existing Conditions/No Project/No Action Condition	132	GWh/yr	650.31	3.11E-02	5.67E-03	**38,936.8**	**1.9**	**0.3**	**39,081.1**
NODOS Alternative A	499	GWh/yr	650.31	3.11E-02	5.67E-03	**147,192.8**	**7.0**	**1.3**	**147,738.5**
NODOS Alternative A minus Existing Conditions/No Project/No Action Condition	367	GWh/yr	650.31	3.11E-02	5.67E-03	**108,256.0**	**5.2**	**0.9**	**108,657.4**
NODOS Alternative B	498	GWh/yr	650.31	3.11E-02	5.67E-03	**146,897.9**	**7.0**	**1.3**	**147,442.4**
NODOS Alternative B minus Existing Conditions/No Project/No Action Condition	366	GWh/yr	650.31	3.11E-02	5.67E-03	**107,961.1**	**5.2**	**0.9**	**108,361.3**
NODOS Alternative C	543	GWh/yr	650.31	3.11E-02	5.67E-03	**160,171.8**	**7.7**	**1.4**	**160,765.5**
NODOS Alternative C minus Existing Conditions/No Project/No Action Condition	411	GWh/yr	650.31	3.11E-02	5.67E-03	**121,235.0**	**5.8**	**1.1**	**121,684.4**
NODOS Alternative C_1	700	GWh/yr	650.31	3.11E-02	5.67E-03	**206,482.9**	**9.9**	**1.8**	**207,248.4**
NODOS Alternative C_1 minus Existing Conditions/No Project/No Action Condition	568	GWh/yr	650.31	3.11E-02	5.67E-03	**167,546.1**	**8.0**	**1.5**	**168,167.3**
NODOS Alternative D	477	GWh/yr	650.31	3.11E-02	5.67E-03	**140,703.4**	**6.7**	**1.2**	**141,225.0**
NODOS Alternative D minus Existing Conditions/No Project/No Action Condition	345	GWh/yr	650.31	3.11E-02	5.67E-03	**101,766.6**	**4.9**	**0.9**	**102,143.8**

[a] Source: Table 31B-2, Power and Pumping Cost Reporting Metrics - Summary of All CVP, SWP and Proposed Sites Facilities, Sites ADEIRS and FS Alternatives, January 27, 2017. Negative values for net electricity generation in Table 31B-2 indicate net electricity use.

[b] Source for Emission Factors: The Climate Registry (TCR), General Reporting Protocol, Version 2.1, 2016 Climate Registry Default Emission Factors, Table 14.1, US Emission Factors by eGRID Subregion - updated to eGRID 2015 (2012 data) Version 1.0. eGRID 2015 Subregion WECC California. Table updated April 2016. Global Warming Potential values have been taken from the IPCC Second Assessment Report (SAR) (IPCC, 1996), because the California mandatory GHG reporting program uses SAR GWPs.

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Table 24A.C-2
Indirect GHG Emissions from Project Electricity Use for All Alternatives - Summary and Comparison

Alternative	Project Electricity Net Use [All Facilities (CVP, State Water Project, Proposed NODOS Facilities)] - Long Term (GWh/yr) [a]	Total GHG Emissions (mt/year CO_2e) [b]	Incremental Increase (Compared to Existing Conditions/No Project/No Action Condition) GHG Emissions (mt/year CO_2e)
Existing Conditions/No Project/No Action Condition	132	39,081.1	Not Applicable
Alternative A	499	147,738.5	108,657.4
Alternative B	498	147,442.4	108,361.3
Alternative C	543	160,765.5	121,684.4
Alternative C_1	700	207,248.4	168,167.3
Alternative D	477	141,225.0	102,143.8

[a] Source: Table 31B-2, Power and Pumping Cost Reporting Metrics - Summary of All CVP, SWP and Proposed Sites Facilities, Sites ADEIRS and FS Alternatives, January 27, 2017. Negative values for net electricity generation in Table 31B-2 indicate net electricity use.

[b] Source for Emission Factors: The Climate Registry (TCR), General Reporting Protocol, Version 2.1, 2016 Climate Registry Default Emission Factors, Table 14.1, US Emission Factors by eGRID Subregion - updated to eGRID 2015 (2012 data) Version 1.0. eGRID 2015 Subregion WECC California. Table updated April 2016.

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Emissions from Construction of Alternative D

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Table 24A.D-1
Construction Emissions for Alternative D - Emission Summaries by Construction Year for Criteria Pollutants

Proposed Project Construction Emissions for Alternative D

Average Daily Emission Rates for Criteria Pollutants by Year for Construction of Alternative D

Construction Year	Emissions (pounds per day)					
	NOx	**PM10**	**PM2.5**	**ROG**	**CO**	**SOx**
2022	**1,427**	**830**	148	**141**	1,047	4
2023	**1,492**	**860**	154	**147**	1,097	4
2024	**1,307**	**742**	132	129	964	4
2025	**1,288**	**725**	130	127	945	4
2026	**959**	**634**	109	96	713	3
2027	**741**	**544**	91	74	557	2
2028	**339**	137	26	34	275	1
2029	21	13	2	2	29	0
2030	21	13	2	2	29	0
Significance Threshold (lb/day)	137	137	n/a	137	n/a	n/a

Notes:

1. The average daily construction emission rates in lb/day for each construction year are the sum of the average daily emission rates estimated for each of the project features that would be constructed in the indicated construction year.

2. Bolded values indicate an exceedance of the significance threshold.

3. Significance Threshold is from TCAPCD Level C: Greater than 137 pounds per day of emissions. If emissions from a project would exceed the Level C thresholds, mitigation measures (BAMMs and SMMs), including off-site mitigation measures following the guidelines, may be required to reduce the overall air quality impacts of the project to a level of insignificance (TCAPCD, 2015).

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Table 24A.D-2
Construction NOx Emissions for Alternative D by Project Feature

Proposed Project Construction NOx Emissions Alternative D

Equipment	NOx Emissions (pounds)													
	GCID Canal Intake & Headworks	TRR	Sac River (Delevan) Intake & P/G Plant	TRR & Delevan Pipelines	TRR Pumping Plant	New Holthouse Reservoir	Inlet/Outlet Structure, Tunnel, Sites Pumping Plant	Dams and Sites Inundation	Gravel Roads	Paved Roads & Bridge	Emergency Drawdown Tunnel	Recreation Facilities	Funks Reservoirs Sediment Removal Periodic	Electrical Transmission & Switchyard Features
Backhoe										3,079				
Bobcat												667		
Boom Truck														134
Bulldozer	240	6,398	8,749	23,175	8,749	102,507	13,217	133,222	2,095	73,370	13,217	871	10,033	60
Compactor	50	21	63	293	63	250		4,822	49					
Concrete Pumper			48		48	88	141	936		129	141			13
Concrete Truck	783		2,087	416	2,087	883	5,168	3,251		11,268	5,168	331		773
Crane			1,046	7,845	1,046		1,831			5,230	1,831			2,479
Dump Truck	3,853		6,271	43,498	6,271	40	3,010	4,164	617	33,991	3,010	2,378		70
Excavator				888						58				
Fuel Truck	1,681	928	1,671	4,852	1,671	2,860	2,769	17,801	467	5,649	2,769	1,565	838	286
Forklift		185	527	1,978	527	78	672	117			672	160		108
Generator	571		381	2,134	381	81	732	296		1,830	732	121		
Grader		217	1,314	3,069	1,314	2,616	3,759	50,439	683	13,827	3,759	184		263
Highway Truck														
Loader	726	575	473	5,044	473	579	1,512	13,472	155	4,670	1,512	597		389
Off-road Truck		7,626				7,475		139,675		22,878				
Paver	87	52							13	210		58		
Pile Driver						241		5,530						269
Roller	142								22	1,996		108		
Scissor Lift							70				70			
Scraper	1,543	7,289	13,024	153,535	13,024	128,113	34,544	76,018	1,643	97,661	34,544		29,871	
Water Trucks	1,028	1,079	2,338	4,852	2,338	11,439	1,766	35,601	958	11,298	1,766	722	1,676	507
Welding Truck				1,829			538				538			
Vehicles														
Highway Truck	748	770	1,936	7,166	1,936	4,959	4,299	51,756	0	5,512	4,299	504	18	891
Personnel Vehicles	279	448	3,089	723	2,282	2,534	1,032	4,575	520	1,684	406	139	94	1,092
Unpaved roads	411	502	809	3,294	809	1,729	1,233	16,660	78	4,207	1,233	278	102	409
Total Emissions (lbs)	**12,142**	**26,089**	**43,825**	**264,590**	**43,019**	**266,472**	**76,293**	**558,337**	**7,300**	**298,547**	**75,668**	**8,683**	**42,631**	**7,745**
Construction Duration (days)	650	530	2064	1175	1525	950	1180	1410	1403	1403	465	390	167	1445
Emissions (lb/day)	18.7	49.2	21.2	225.2	28.2	280.5	64.7	396.0	5.2	212.8	162.7	22.3	**255.3**	**5.4**

Daily Emissions (lb/day) in Year															*Total lb/day NOx for Features Constructed In the Indicated Year*	*Year*
2022	18.7	49.2	21.2	225.2	28.2	280.5		396.0	5.2	212.8	162.7	22.3		5.4	1,427.36	2022
2023	18.7	49.2	21.2	225.2	28.2	280.5	64.7	396.0	5.2	212.8	162.7	22.3		5.4	1,492.01	2023
2024	18.7	49.2	21.2	225.2	28.2	280.5	64.7	396.0	5.2	212.8				5.4	1,307.02	2024
2025		49.2	21.2	225.2	28.2	280.5	64.7	396.0	5.2	212.8				5.4	1,288.34	2025
2026			21.2	225.2	28.2		64.7	396.0	5.2	212.8				5.4	958.62	2026
2027			21.2	225.2	28.2		64.7	396.0						5.4	740.62	2027
2028			21.2	225.2	28.2		64.7								339.28	2028
2029			21.2												21.23	2029
2030			21.2												21.23	2030

Table 24A.D-3
Construction PM10 Emissions for Alternative D by Project Feature

Proposed Project Construction PM10 Emissions Alternative D

Equipment	PM10 Emissions (pounds)													
	GCID Canal Intake & Headworks	TRR	Sac River (Delevan) Intake & P/G Plant	TRR & Delevan Pipelines	TRR Pumping Plant	New Holthouse Reservoir	Inlet/Outlet Structure, Tunnel, Sites Pumping Plant	Dams and Sites Inundation	Gravel Roads	Paved Roads & Bridge	Emergency Drawdown Tunnel	Recreation Facilities	Funks Reservoirs Sediment Removal Periodic	Electrical Transmission & Switchyard Features
Backhoe										165				
Bobcat												41		
Boom Truck														2
Bulldozer	9	241	330	874	330	3,868	499	5,027	79	2,769	499	33	379	2
Compactor	2	1	2	11	2	10		187	2					
Concrete Pumper			2		2	3	5	36		5	5			1
Concrete Truck	28		76	15	76	32	187	118		408	187	12		28
Crane			43	326	43		76			217	76			103
Dump Truck	140		227	1,577	227	1	109	151	22	1,232	109	86		3
Excavator				43						3				
Fuel Truck	61	34	61	176	61	104	100	645	17	205	100	57	30	10
Forklift		12	35	131	35	5	45	8			45	11		7
Generator	29		19	107	19	4	37	15		92	37	6		
Grader		7	42	98	42	83	120	1,609	22	441	120	6		8
Highway Truck														
Loader	24	19	16	170	16	19	51	453	5	157	51	20		13
Off-road Truck		276				271		5,063		829				
Paver	4	3							1	10		3		
Pile Driver						8		176						9
Roller	8								1	115		6		
Scissor Lift							1				1			
Scraper	60	284	507	5,974	507	4,985	1,344	2,958	64	3,800	1,344		1,162	
Water Trucks	37	39	85	176	85	415	64	1,290	35	410	64	26	61	18
Welding Truck				80			23				23			
Vehicles														
Highway Truck	107	110	277	1,026	277	710	616	7,412	0	789	616	72	3	128
Personnel Vehicles	489	784	5,407	1,266	3,995	4,435	1,806	8,009	910	2,948	712	243	165	1,911
Unpaved Roads	9,418	11,509	18,559	75,557	18,559	39,674	28,297	382,200	1,788	96,505	28,297	6,387	2,341	9,391
Fugitive PM Sources														
Concrete Batch Plant	15	0	10	10	10	10	42	10	0	15	42	5	0	10
Disturbed Areas	131	1,916	268	4,075	7	4,563	2,309	143,081	0	13,179	31	12,084	0	3,728
Total Emissions (lbs)	**10,562**	**15,235**	**25,966**	**91,691**	**24,292**	**59,201**	**35,732**	**558,448**	**2,945**	**124,294**	**32,359**	**19,099**	**4,140**	**15,373**

Notes:
1. Highway truck and personnel vehicle emissions include paved road dust emissions.
2. The unpaved road emissions include fugitive dust from travel over unpaved roads.

Construction Duration (days)	650	530	2064	1175	1525	950	1180	1410	1403	1403	465	390	167	1445
Emissions (lb/day)	16.2	28.7	12.6	78.0	15.9	62.3	30.3	396.1	2.1	88.6	69.6	49.0	24.8	**10.6**

Daily Emissions (lb/day) in Year														***Total lb/day PM10 for Features Constructed In the Indicated Year***	***Year***
2022	16.2	28.7	12.6	78.0	15.9	62.3		396.1	2.1	88.6	69.6	49.0		10.6	829.81	2022
2023	16.2	28.7	12.6	78.0	15.9	62.3	30.3	396.1	2.1	88.6	69.6	49.0		10.6	860.09	2023
2024	16.2	28.7	12.6	78.0	15.9	62.3	30.3	396.1	2.1	88.6				10.6	741.53	2024
2025		28.7	12.6	78.0	15.9	62.3	30.3	396.1	2.1	88.6				10.6	725.28	2025
2026			12.6	78.0	15.9		30.3	396.1	2.1	88.6				10.6	634.22	2026
2027			12.6	78.0	15.9		30.3	396.1						10.6	543.53	2027
2028			12.6	78.0	15.9		30.3								136.83	2028
2029			12.6												12.58	2029
2030			12.6												12.58	2030

Table 24A.D-4
Construction PM2.5 Emissions for Alternative D by Project Feature

Proposed Project Construction PM2.5 Emissions Alternative D

Equipment	PM2.5 Emissions (pounds)													
	GCID Canal Intake & Headworks	TRR	Sac River (Delevan) Intake & P/G Plant	TRR & Delevan Pipelines	TRR Pumping Plant	New Holthouse Reservoir	Inlet/Outlet Structure, Tunnel, Sites Pumping Plant	Dams and Sites Inundation	Gravel Roads	Paved Roads & Bridge	Emergency Drawdown Tunnel	Recreation Facilities	Funks Reservoirs Sediment Removal Periodic	Electrical Transmission & Switchyard Features
Backhoe	0	0	0	0	0	0	0	0	0	152	0	0	0	
Bobcat	0	0	0	0	0	0	0	0	0	0	0	38	0	
Boom Truck	0	0	0	0	0	0	0	0	0	0	0	0	0	2
Bulldozer	8	223	304	806	304	3,566	460	4,635	73	2,553	460	30	349	2
Compactor	0	0	0	1	0	1	0	19	0	0	0	0	0	
Concrete Pumper	0	0	2	0	2	3	5	36	0	5	5	0	0	1
Concrete Truck	26	0	70	14	70	30	173	109	0	378	173	11	0	26
Crane			40	299	40		70			199	70			95
Dump Truck	129		210	1,460	210	1	101	140	21	1,141	101	80		2
Excavator				40						3				
Fuel Truck	56	31	56	163	56	96	93	597	16	190	93	53	28	10
Forklift		11	32	121	32	5	41	7			41	10		7
Generator	29		19	107	19	4	37	15		92	37	6		
Grader		6	39	90	39	77	110	1,479	20	405	110	5		8
Highway Truck														
Loader	22	18	15	155	15	18	46	413	5	143	46	18		12
Off-road Truck		256				251		4,688		768				
Paver	4	2							1	9		3		
Pile Driver						7		162						8
Roller	8								1	106		6		
Scissor Lift							1				1			
Scraper	55	261	466	5,494	466	4,584	1,236	2,720	59	3,494	1,236		1,069	
Water Trucks	35	36	78	163	78	384	59	1,195	32	379	59	24	56	17
Welding Truck				80			23				23			
Vehicles														
Highway Truck	35	36	90	333	90	231	200	2,406	0	256	200	23	1	41
Personnel Vehicles	148	237	1,639	384	1,211	1,344	547	2,427	276	893	216	74	50	579
Unpaved Roads	943	1,153	1,859	7,568	1,859	3,974	2,834	38,283	179	9,667	2,834	640	235	941
Fugitive PM Sources														
Concrete Batch Plant	4	0	3	3	3	3	3	3	0	4	3	2	0	3
Disturbed Areas	27	399	56	847	1	949	480	29,761	0	2,741	6	2,514	0	775
Total Emissions (lbs)	**1,530**	**2,669**	**4,978**	**18,127**	**4,496**	**15,528**	**6,522**	**89,095**	**682**	**23,579**	**5,716**	**3,536**	**1,787**	**2,528**

Notes:

1. Highway truck and personnel vehicle emissions include paved road dust emissions.
2. The unpaved road emissions include fugitive dust from travel over unpaved roads.

3. $PM_{2.5}$ fugitive dust emissions were calculated following the SCAQMD Particulate Matter (PM) 2.5 Significance Thresholds and Calculation Methodology, October 2006 (SCAQMD, 2006). For concrete batch plant operations (loading/unloading bulk materials), it is assumed that 29.2% of the PM10 would be PM2.5. For construction fugitive dust sources, it is assumed that 20.8% of the PM_{10} would be $PM_{2.5}$.

Construction Duration (days)	650	530	2064	1175	1525	950	1180	1410	1403	1403	465	390	167	1445
Emissions (lb/day)	2.4	5.0	2.4	15.4	2.9	16.3	5.5	63.2	0.5	16.8	12.3	9.1	10.7	**1.7**

Daily Emissions (lb/day) in Year

2022	2.4	5.0	2.4	15.4	2.9	16.3		63.2	0.5	16.8	12.3	9.1		1.7	148.11	2022
2023	2.4	5.0	2.4	15.4	2.9	16.3	5.5	63.2	0.5	16.8	12.3	9.1		1.7	153.64	2023
2024	2.4	5.0	2.4	15.4	2.9	16.3	5.5	63.2	0.5	16.8				1.7	132.28	2024
2025		5.0	2.4	15.4	2.9	16.3	5.5	63.2	0.5	16.8				1.7	129.92	2025
2026			2.4	15.4	2.9		5.5	63.2	0.5	16.8				1.7	108.54	2026
2027			2.4	15.4	2.9		5.5	63.2						1.7	91.25	2027
2028			2.4	15.4	2.9		5.5								26.31	2028
2029			2.4												2.41	2029
2030			2.4												2.41	2030

Total lb/day PM2.5 for Features Constructed In the Indicated Year | ***Year***

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Table 24A.D-5
Construction CO_2 Emissions for Alternative D by Project Feature

Proposed Project Construction CO2 Emissions Alternative D

Equipment	CO2 Emissions (pounds)													
	GCID Canal Intake & Headworks	TRR	Sac River (Delevan) Intake & P/G Plant	TRR & Delevan Pipelines	TRR Pumping Plant	New Holthouse Reservoir	Inlet/Outlet Structure, Tunnel, Sites Pumping Plant	Dams and Sites Inundation	Gravel Roads	Paved Roads & Bridge	Emergency Drawdown Tunnel	Recreation Facilities	Funks Reservoirs Sediment Removal	Electrical Transmission & Switchyard Features
													Periodic	
Backhoe										553,517				
Bobcat												97,966		
Boom Truck														39,028
Bulldozer	30,361	808,356	1,105,322	2,927,918	1,105,322	12,950,771	1,669,843	16,831,258	264,708	9,269,526	1,669,843	110,058	1,267,563	7,590
Compactor	6,853	2,845	8,620	40,254	8,620	34,306		661,562	6,723					
Concrete Pumper			6,567		6,567	12,124	19,322	128,372		17,680	19,322			1,831
Concrete Truck	249,398		665,061	132,692	665,061	281,372	1,646,666	1,035,961		3,590,691	1,646,666	105,515		246,201
Crane			139,705	1,047,789	139,705		244,484			698,526	244,484			331,101
Dump Truck	1,227,805		1,998,381	13,860,771	1,998,381	12,790	959,223	1,326,925	196,641	10,831,225	959,223	757,786		22,382
Excavator				250,003						16,250				
Fuel Truck	535,566	295,760	532,369	1,545,948	532,369	911,262	882,485	5,672,205	148,680	1,800,142	882,485	498,796	266,984	91,126
Forklift		25,905	74,014	277,553	74,014	10,917	94,368	16,468			94,368	22,389		15,173
Generator	121,490		80,993	454,029	80,993	17,133	155,756	63,081		389,390	155,756	25,700		
Grader		26,452	160,317	374,340	160,317	319,031	458,507	6,152,166	83,365	1,686,535	458,507	22,444		32,063
Highway Truck														
Loader	145,357	115,074	94,633	1,009,928	94,633	115,831	302,827	2,697,432	31,040	934,979	302,827	119,617		77,978
Off-road Truck		2,430,031				2,382,070		44,507,942		7,290,094				
Paver	18,779	11,381							2,845	45,525		12,519		
Pile Driver						97,064		2,229,051						108,484
Roller	20,963								3,176	293,803		15,881		
Scissor Lift							20,327				20,327			
Scraper	253,621	1,198,269	2,141,080	25,240,848	2,141,080	21,061,607	5,678,915	12,497,289	270,162	16,055,340	5,678,915		4,910,699	
Water Trucks	327,734	343,722	744,996	1,545,948	744,996	3,645,047	562,744	11,344,409	305,353	3,600,283	562,744	230,213	533,967	161,469
Welding Truck				259,343			76,247				76,247			
Vehicles														
Highway Truck	812,409	836,303	2,102,705	7,782,397	2,102,705	5,385,791	4,668,960	56,209,118	0	5,986,735	4,668,960	547,181	19,115	967,722
Personnel Vehicles	911,766	1,461,245	10,083,314	2,360,435	7,450,123	8,271,197	3,367,490	14,936,040	1,696,563	5,496,863	1,327,019	452,739	306,953	3,564,596
Unpaved roads	101,370	123,876	199,761	813,276	199,761	427,040	304,583	4,113,898	19,243	1,038,758	304,583	68,746	25,201	101,086
Concrete														
Concrete Batch Plant	4,560,000	0	12,000,000	2,400,000	12,000,000	5,140,000	29,578,000	18,584,000	0	40,240,000	29,578,000	1,898,400	0	5,552,000
Total Emissions (lbs)	**9,323,473**	**7,679,219**	**32,137,839**	**62,323,471**	**29,504,648**	**61,075,353**	**50,690,746**	**199,007,177**	**3,028,498**	**109,835,863**	**48,650,276**	**4,985,951**	**7,330,483**	**11,319,830**
Total Emissions (metric tons)	**4,229**	**3,483**	**14,577**	**28,269**	**13,383**	**27,703**	**22,993**	**90,268**	**1,374**	**49,821**	**22,067**	**2,262**	**3,325**	**5,135**
CONSTRUCTION TOTAL (metric tons)	**285,565**													
Construction Duration (days)	650	530	2064	1175	1525	950	1180	1410	1403	1403	465	390	167	1445
Emissions (lb/day)	14343.8	14489.1	15570.7	53041.3	19347.3	64289.8	42958.3	141139.8	2158.6	78286.4	104624.2	12784.5	43895.1	7833.8

Ave. Annual Emissions (mt/yr) in Year

2022	1409.7	870.8	1619.7	4038.5	1911.9	6925.8		15044.7	274.7	9964.2	11033.7	1130.8	855.8	55,080.30
2023	1409.7	870.8	1619.7	4038.5	1911.9	6925.8	3832.2	15044.7	274.7	9964.2	11033.7	1130.8	855.8	58,912.46
2024	1409.7	870.8	1619.7	4038.5	1911.9	6925.8	3832.2	15044.7	274.7	9964.2			855.8	46,747.95
2025		870.8	1619.7	4038.5	1911.9	6925.8	3832.2	15044.7	274.7	9964.2			855.8	45,338.27
2026			1619.7	4038.5	1911.9		3832.2	15044.7	274.7	9964.2			855.8	37,541.62
2027			1619.7	4038.5	1911.9		3832.2	15044.7					855.8	27,302.72
2028			1619.7	4038.5	1911.9		3832.2							11,402.25
2029			1619.7											1,619.72
2030			1619.7											1,619.72

Total mt/yr CO2 for Features Constructed In the Indicated Year	***Year***

285,565.02	**CONSTRUCTION TOTAL (metric tons)**

Table 24A.D-6
Construction ROG Emissions for Alternative D by Project Feature

Proposed Project Construction ROG Emissions Alternative D

Equipment	ROG Emissions (pounds)													
	GCID Canal Intake & Headworks	**TRR**	**Sac River (Delevan) Intake & P/G Plant**	**TRR & Delevan Pipelines**	**TRR Pumping Plant**	**New Holthouse Reservoir**	**Inlet/Outlet Structure, Tunnel, Sites Pumping Plant**	**Dams and Sites Inundation**	**Gravel Roads**	**Paved Roads & Bridge**	**Emergency Drawdown Tunnel**	**Recreation Facilities**	**Funks Reservoirs Sediment Removal** Periodic	**Electrical Transmission & Switchyard Features**
Backhoe										302				
Bobcat												71		
Boom Truck														9
Bulldozer	20	524	716	1,898	716	8,394	1,082	10,910	172	6,008	1,082	71	822	5
Compactor	8	3	10	47	10	40		769	8					
Concrete Pumper			8		8	14	22	149		21	22			2
Concrete Truck	103		275	55	275	116	680	428		1,483	680	44		102
Crane			93	700	93		163			467	163			221
Dump Truck	507		825	5,723	825	5	396	548	81	4,472	396	313		9
Excavator				101						7				
Fuel Truck	221	122	220	638	220	376	364	2,342	61	743	364	206	110	38
Forklift		20	57	213	57	8	72	13			72	17		12
Generator	64		43	240	43	9	82	33		206	82	14		
Grader		17	104	242	104	207	297	3,983	54	1,092	297	15		21
Highway Truck														
Loader	70	55	46	486	46	56	146	1,297	15	450	146	58		38
Off-road Truck		1,003				984		18,376		3,010				
Paver	9	5							1	21		6		
Pile Driver						24		547						27
Roller	14								2	192		10		
Scissor Lift							5				5			
Scraper	141	668	1,194	14,081	1,194	11,750	3,168	6,972	151	8,957	3,168		2,740	
Water Trucks	135	142	308	638	308	1,505	232	4,684	126	1,486	232	95	220	67
Welding Truck				346			102				102			
Vehicles														
Highway Truck	50	51	128	474	128	328	285	3,426	0	365	285	33	1	59
Personnel Vehicles	63	101	695	163	514	570	232	1,030	117	379	92	31	21	246
Unpaved roads	15	19	31	124	31	65	47	629	3	159	47	11	4	15
Total Emissions (lbs)	**1,420**	**2,731**	**4,752**	**26,170**	**4,570**	**24,452**	**7,376**	**56,136**	**791**	**29,819**	**7,235**	**993**	**3,918**	**869**
Construction Duration (days)	650	530	2064	1175	1525	950	1180	1410	1403	1403	465	390	167	1445
Emissions (lb/day)	2.2	5.2	2.3	22.3	3.0	25.7	6.3	39.8	0.6	21.3	15.6	2.5	**23.5**	**0.6**

Daily Emissions (lb/day) in Year														***Total lb/day ROG for Features Constructed In the Indicated Year***	***Year***
2022	2.2	5.2	2.3	22.3	3.0	25.7		39.8	0.6	21.3	15.6	2.5	0.6	140.99	2022
2023	2.2	5.2	2.3	22.3	3.0	25.7	6.3	39.8	0.6	21.3	15.6	2.5	0.6	147.24	2023
2024	2.2	5.2	2.3	22.3	3.0	25.7	6.3	39.8	0.6	21.3			0.6	129.13	2024
2025		5.2	2.3	22.3	3.0	25.7	6.3	39.8	0.6	21.3			0.6	126.95	2025
2026			2.3	22.3	3.0		6.3	39.8	0.6	21.3			0.6	96.05	2026
2027			2.3	22.3	3.0		6.3	39.8					0.6	74.24	2027
2028			2.3	22.3	3.0		6.3							33.82	2028
2029			2.3											2.30	2029
2030			2.3											2.30	2030

Table 24A.D-7
Construction SOx Emissions for Alternative D by Project Feature

Proposed Project Construction SOx Emissions Alternative D

Equipment	SOx Emissions (pounds)													
	GCID Canal Intake & Headworks	TRR	Sac River (Delevan) Intake & P/G Plant	TRR & Delevan Pipelines	TRR Pumping Plant	New Holthouse Reservoir	Inlet/Outlet Structure, Tunnel, Sites Pumping Plant	Dams and Sites Inundation	Gravel Roads	Paved Roads & Bridge	Emergency Drawdown Tunnel	Recreation Facilities	Funks Reservoirs Sediment Removal Periodic	Electrical Transmission & Switchyard Features
Backhoe										6				
Bobcat												1		
Boom Truck														0
Bulldozer	0	9	12	31	12	137	18	178	3	98	18	1	13	0
Compactor	0	0	0	1	0	0		9	0					
Concrete Pumper			0		0	0	0	2		0	0			0
Concrete Truck	3		7	1	7	3	17	11		38	17	1		3
Crane			1	11	1		3			7	3			4
Dump Truck	13		21	146	21	0	10	14	2	114	10	8		0
Excavator				3						0				
Fuel Truck	6	3	6	16	6	10	9	60	2	19	9	5	3	1
Forklift		0	1	3	1	0	1	0			1	0		0
Generator	1		1	5	1	0	2	1		4	2	0		
Grader		0	2	4	2	3	5	65	1	18	5	0		0
Highway Truck														
Loader	2	1	1	11	1	1	3	29	0	10	3	1		1
Off-road Truck		26				25		469		77				
Paver	0	0							0	0		0		
Pile Driver						1		24						1
Roller	0								0	3		0		
Scissor Lift							0				0			
Scraper	3	13	23	267	23	223	60	132	3	170	60		52	
Water Trucks	3	4	8	16	8	38	6	119	3	38	6	2	6	2
Welding Truck				3			1				1			
Vehicles														
Highway Truck	8	8	20	74	20	51	45	536	0	57	45	5	0	9
Personnel Vehicles	9	15	101	24	75	83	34	150	17	55	13	5	3	36
Unpaved roads	1	1	2	8	2	4	3	39	0	10	3	1	0	1
Total Emissions (lbs)	**49**	**79**	**205**	**623**	**179**	**581**	**216**	**1,838**	**31**	**725**	**196**	**32**	**77**	**58**
Construction Duration (days)	650	530	2064	1175	1525	950	1180	1410	1403	1403	465	390	167	1445
Emissions (lb/day)	0.1	0.1	0.1	0.5	0.1	0.6	0.2	1.3	0.0	0.5	0.4	0.1	**0.5**	**0.0**

Daily Emissions (lb/day) in Year

														Total lb/day SOx for Features Constructed In the Indicated Year	***Year***
2022	0.1	0.1	0.1	0.5	0.1	0.6		1.3	0.0	0.5	0.4	0.1	0.0	3.97	2022
2023	0.1	0.1	0.1	0.5	0.1	0.6	0.2	1.3	0.0	0.5	0.4	0.1	0.0	4.15	2023
2024	0.1	0.1	0.1	0.5	0.1	0.6	0.2	1.3	0.0	0.5			0.0	3.65	2024
2025		0.1	0.1	0.5	0.1	0.6	0.2	1.3	0.0	0.5			0.0	3.57	2025
2026			0.1	0.5	0.1		0.2	1.3	0.0	0.5			0.0	2.81	2026
2027			0.1	0.5	0.1		0.2	1.3					0.0	2.27	2027
2028			0.1	0.5	0.1		0.2							0.93	2028
2029			0.1											0.10	2029
2030			0.1											0.10	2030

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Table 24A.D-8
Construction CO Emissions for Alternative D by Project Feature

Proposed Project Construction CO Emissions Alternative D

Equipment	CO Emissions (pounds)													
	GCID Canal Intake & Headworks	TRR	Sac River (Delevan) Intake & P/G Plant	TRR & Delevan Pipelines	TRR Pumping Plant	New Holthouse Reservoir	Inlet/Outlet Structure, Tunnel, Sites Pumping Plant	Dams and Sites Inundation	Gravel Roads	Paved Roads & Bridge	Emergency Drawdown Tunnel	Recreation Facilities	Funks Reservoirs Sediment Removal	Electrical Transmission & Switchyard Features
													Periodic	
Backhoe										4,112				
Bobcat												765		
Boom Truck														263
Bulldozer	93	2,465	3,371	8,929	3,371	39,496	5,092	51,330	807	28,269	5,092	336	3,866	23
Compactor	42	17	53	246	53	209		4,038	41					
Concrete Pumper			40		40	74	118	784		108	118			11
Concrete Truck	655		1,747	348	1,747	739	4,324	2,721		9,429	4,324	277		647
Crane			473	3,548	473		828			2,365	828			1,121
Dump Truck	3,224		5,248	36,400	5,248	34	2,519	3,485	516	28,444	2,519	1,990		59
Excavator				1,628						106				
Fuel Truck	1,406	777	1,398	4,060	1,398	2,393	2,317	14,896	390	4,727	2,317	1,310	701	239
Forklift		202	577	2,163	577	85	736	128			736	175		118
Generator	717		478	2,679	478	101	919	372		2,297	919	152		
Grader		71	430	1,005	430	857	1,231	16,518	224	4,528	1,231	60		86
Highway Truck														
Loader	367	291	239	2,553	239	293	766	6,820	78	2,364	766	302		197
Off-road Truck		6,381				6,256		116,882		19,144				
Paver	119	72							18	288		79		
Pile Driver						217		4,980						242
Roller	153								23	2,151		116		
Scissor Lift							137				137			
Scraper	1,100	5,196	9,285	109,455	9,285	91,332	24,626	54,193	1,172	69,623	24,626		21,295	
Water Trucks	861	903	1,956	4,060	1,956	9,572	1,478	29,791	802	9,455	1,478	605	1,402	424
Welding Truck				2,120			623				623			
Vehicles														
Highway Truck	292	301	756	2,800	756	1,938	1,680	20,221	0	2,154	1,680	197	7	348
Personnel Vehicles	3,081	4,938	34,076	7,977	25,178	27,952	11,380	50,476	5,734	18,577	4,485	1,530	1,037	12,046
Unpaved roads	91	112	180	734	180	385	275	3,711	17	937	275	62	23	91
Total Emissions (lbs)	**12,202**	**21,726**	**60,308**	**190,703**	**51,409**	**181,932**	**59,049**	**381,346**	**9,823**	**209,079**	**52,153**	**7,955**	**28,331**	**15,916**
Construction Duration (days)	650	530	2064	1175	1525	950	1180	1410	1403	1403	465	390	167	1445
Emissions (lb/day)	18.8	41.0	29.2	162.3	33.7	191.5	50.0	270.5	7.0	149.0	112.2	20.4	**169.6**	**11.0**

Daily Emissions (lb/day) in Year															*Total lb/day CO for Features Constructed In the Indicated Year*	*Year*
2022	18.8	41.0	29.2	162.3	33.7	191.5		270.5	7.0	149.0	112.2	20.4		11.0	1,046.56	2022
2023	18.8	41.0	29.2	162.3	33.7	191.5	50.0	270.5	7.0	149.0	112.2	20.4		11.0	1,096.60	2023
2024	18.8	41.0	29.2	162.3	33.7	191.5	50.0	270.5	7.0	149.0				11.0	964.04	2024
2025		41.0	29.2	162.3	33.7	191.5	50.0	270.5	7.0	149.0				11.0	945.27	2025
2026			29.2	162.3	33.7		50.0	270.5	7.0	149.0				11.0	712.77	2026
2027			29.2	162.3	33.7		50.0	270.5						11.0	556.74	2027
2028			29.2	162.3	33.7		50.0								275.27	2028
2029			29.2												29.22	2029
2030			29.2												29.22	2030

Sites Construction Alt D_03282017.xlsx, Detail CO Emissions by Feature

Table 24A.D-9
Construction Equipment Emission Factors

Proposed Project Construction - Emission Factors

Construction Equipment Emission Factors

Project Equipment Type	Equipment Type from OFFROAD	Load Factor	Horsepower	Emission Factors (g/bhp hr)						
				NOx	PM10	CO2	ROG	SOx	CO	PM2.5
Backhoe	Tractor/Loader/Backhoe	0.37	97	2.647	0.142	475.898	0.260	0.005	3.536	0.131
Bobcat	Other General Industrial	0.34	88	3.200	0.199	470.000	0.339	0.005	3.668	0.183
Boom Truck	Aerial Lift	0.31	63	1.627	0.030	472.114	0.105	0.005	3.176	0.028
Bulldozer	Crawler Tractor	0.43	212	3.737	0.141	472.098	0.306	0.005	1.440	0.130
Compactor	Plate Compactor	0.43	8	4.142	0.161	568.299	0.661	0.008	3.469	0.016
Compressor	Air Compressor	0.48	78	2.844	0.165	568.299	0.413	0.006	3.662	0.165
Concrete Pumper	Cement and Mortar Mixer	0.56	9	4.142	0.161	568.299	0.661	0.008	3.470	0.161
Concrete Truck	Off-Highway Truck	0.38	402	1.490	0.054	474.714	0.196	0.005	1.247	0.050
Crane	Crane	0.29	231	3.541	0.147	472.983	0.316	0.005	1.602	0.135
Dump Truck	Off-Highway Truck	0.38	402	1.490	0.054	474.714	0.196	0.005	1.247	0.050
Excavator	Excavator	0.38	158	1.678	0.081	472.192	0.191	0.005	3.074	0.075
Fuel Truck	Off-Highway Truck	0.38	402	1.490	0.054	474.714	0.196	0.005	1.247	0.050
Forklift	Forklift	0.20	89	3.360	0.223	471.529	0.362	0.005	3.675	0.205
Generator	Generator set	0.74	84	2.671	0.134	568.299	0.301	0.006	3.353	0.134
Grader	Grader	0.41	187	3.888	0.124	474.239	0.307	0.005	1.273	0.114
Highway Truck	Estimated with EMFAC2014 emission factors and by assuming 10 one-way trips per equipment day (5 round trips)									
Loader	Rubber Tired Loader	0.36	203	2.347	0.079	469.904	0.226	0.005	1.188	0.072
Off-road Truck	Off-Highway Truck	0.38	402	1.490	0.054	474.714	0.196	0.005	1.247	0.050
Paver	Paver	0.42	130	2.180	0.104	472.760	0.215	0.005	2.995	0.095
Pile Driver	Bore/Drill Rig	0.50	221	1.163	0.037	468.760	0.115	0.005	1.047	0.034
Roller	Roller	0.38	80	3.219	0.186	473.929	0.310	0.005	3.470	0.171
Scissor Lift	Aerial Lift	0.31	63	1.627	0.030	472.114	0.105	0.005	3.176	0.028
Scraper	Scraper	0.48	367	2.879	0.112	473.230	0.264	0.005	2.052	0.103
Water Trucks	Off-Highway Truck	0.38	402	1.490	0.054	474.714	0.196	0.005	1.247	0.050
Welding Truck	Welder	0.45	46	4.007	0.175	568.299	0.758	0.007	4.645	0.175

1. Load factors, horsepower, and emission factors from the CalEEMod User's Guide, Appendix D (CAPCOA, 2016).

2. The emission factors are for the year 2022.

3. It was assumed emissions from concrete trucks, fuel trucks, dump trucks, and water trucks would be represented using the off-highway truck emission factors. These trucks would primarily travel within the construction area; for example, concrete trucks making trips from an onsite concrete batch plant to the pour location.

Vehicle Emission Factors

Vehicle	Vehicle Type in EMFAC2007	Emission Factors (lb/mile)						
		NOx	PM10	CO2	ROG	SOx	CO	PM2.5
Personnel at 15 mph	Passenger Vehicles, Gasoline	0.0003	0.0001	1.1866	0.0001	0.0000	0.0030	0.0001
Personnel at 35 mph	Passenger Vehicles, Gasoline	0.0002	0.0001	0.6046	0.0000	0.0000	0.0020	0.0000
Truck at 15 mph	Heavy-Heavy Duty Diesel	0.0191	0.0002	4.7281	0.0007	0.0000	0.0043	0.0001
Truck at 35 mph	Heavy-Heavy Duty Diesel	0.0031	0.0002	3.4135	0.0002	0.0000	0.0012	0.0001
Vehicle	**Vehicle Type in EMFAC2007**	**Emission Factors (g/mile)**						
		NOx	**PM10**	**CO2**	**ROG**	**SOx**	**CO**	**PM2.5**
Personnel at 15 mph	Passenger Vehicles, Gasoline	0.1197	0.0502	538.2616	0.0532	0.0054	1.3475	0.0228
Personnel at 35 mph	Passenger Vehicles, Gasoline	0.0840	0.0466	274.2555	0.0189	0.0028	0.9268	0.0195
Truck at 15 mph	Heavy-Heavy Duty Diesel	8.6853	0.1063	2144.6550	0.3278	0.0205	1.9347	0.0437
Truck at 35 mph	Heavy-Heavy Duty Diesel	1.4257	0.1037	1548.3552	0.0944	0.0148	0.5570	0.0412

1. It was assumed that 'non-personnel' trips are diesel truck trips.

2. Emission factors from the ARB's EMFAC2014 model for the Colusa County portion of the Sacramento Valley Air Basin for the year 2022, assuming an annual temperature of 66°F and an annual relative humidity of 56%, per Table B-1 of CT-EMFAC: A Computer Model to Estimate Transportation Project Emissions (Wu, et al, 2007). UC Davis.

3. It was assumed that diesel trucks would be ten years old or newer, based on the ARB's *Staff Assessment of the Impact of the Economy on California Trucking Activity and Emissions 2006-2014*, December 2009. Therefore, the model year in EMFAC2014 was changed to 2012 through 2022, rather than the default of 1978 through 2023, and the emission factors by model year were arithmetically averaged.

4. Passenger vehicles were assumed to be comprised of 50% light-duty automobiles, 25% category 1 light-duty trucks, and 25% category 2 light-duty trucks, consistent with the CalEEMod User's Guide, Appendix A (CAPCOA, 2016).

5. It was assumed that vehicles would travel at an average speed of 35 mph offsite and 15 mph on unpaved roads.

6. The PM10 and PM2.5 emission factors include tire and brake wear.

Calculation of Paved Road Emission Factor

Paved Roads emission factor from AP-42, Section 13.2.1: P*aved Roads* (1/11)

$E = [k(sL)^{0.91} * (W)^{1.02}]$

where:	PM10	PM2.5	
k =	1.0	0.25	particle size multiplier, g/VMT [Table 13.2.1-1]
sL =	0.03	0.03	road surface silt loading (g/m^2) [Table 13.2.1-2]
W =	2.4	2.4	vehicle weight [tons, from CalEEMOD CalEEMod User's Guide, Appendix A (CAPCOA, 2016)]
E =	0.100	0.025	g/VMT

Calculation of Unpaved Road Emission Factor

PM10

Emission Factor [lb/mi] = 1.5 x (silt content [%] / 12)$^{0.9}$ x (average vehicle weight [tons] / 3)$^{0.45}$ x (365-P)/365

Reference: AP-42, Section 13.2.2, November 2006

Parameter	Value
Average Vehicle Weight (tons)	8
Silt Content (%)	4.3
P, Number of days with Precip >0.01 inches	56
Emission Factor (lb/mile)	0.44

Reference for Silt Content: AP-42, Section 13.2.2, Table 13.2.2-1, Average for a Service Road

Precipitation days taken directly from CalEEMod for Colusa County.

The emission factor accounts for a 44% reduction assuming truck speeds are limited to 15 mph or less.

PM2.5

Emission Factor [lb/mi] = 0.15 x (silt content [%] / 12)$^{0.9}$ x (average vehicle weight [tons] / 3)$^{0.45\ x}$ (365-P)/365

Reference: AP-42, Section 13.2.2, November 2006

Parameter	$PM_{2.5}$
Average Vehicle Weight (tons)	8
Silt Content (%)	4.3
P, Number of days with Precip >0.01 inches	56
Emission Factor (lb/mile)	0.04

Reference for Silt Content: AP-42, Section 13.2.2, Table 13.2.2-1, Average for a Service Road

Precipitation days taken directly from CalEEMod for Colusa County.

The emission factor accounts for a 44% reduction assuming truck speeds are limited to 15 mph or less.

Disturbed Land Fugitive Dust Emission Factor

Emission Factor (lb/acre/day) 10 PM10

From URBEMIS2007 construction phase mass site grading.

Per URBEMIS2007 Appendix A, page A-6, the value assumes watering.

Table 24A.D-10
Equipment and Workforce for Construction of Features for Alternative D (2 pages)

2016 Project Activity	Construct Holthouse-Sites Connection Channel			TRR Reservoir			Sac River PGP			TRR and Delevan Canals and Conduits			TRR PGP			Dams General - Holthouse			I/O Structure/Tunnel		
Construction Schedule (2/12/16) (Used for Alt D)	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish
	650	*5/17/2022*	*11/11/2024*	*530*	*4/26/2022*	*5/6/2024*	*2064*	*3/15/2022*	*2/8/2030*	*Delevan:*			*1525*	*3/15/2022*	*1/17/2028*	*950*	*3/15/2022*	*11/3/2025*			
										1175	*3/15/2022*	*9/14/2026*									
										TRR:									*1180*	*7/11/2023*	*1/17/2028*
										800	*3/15/2022*	*4/7/2025*									
Equipment	**Enter "1" if Equipment Type is in Use**	**Total Number of Equipment Days of Use (Spreadsheet 6/29/11)**	**Number of Hours of Use per Equipment Day**	**Enter "1" if Equipment Type is in Use**	**Total Number of Equipment Days of Use (Spreadsheet 6/29/11)**	**Number of Hours of Use per Equipment Day**	**Enter "1" if Equipment Type is in Use**	**Total Number of Equipment Days of Use (Spreadsheet 6/29/11)**	**Number of Hours of Use per Equipment Day**	**Enter "1" if Equipment Type is in Use**	**Total Number of Equipment Days of Use (Spreadsheet 6/29/11)**	**Number of Hours of Use per Equipment Day**	**Enter "1" if Equipment Type is in Use**	**Total Number of Equipment Days of Use (Spreadsheet 6/29/11)**	**Number of Hours of Use per Equipment Day**	**Enter "1" if Equipment Type is in Use**	**Total Number of Equipment Days of Use (Spreadsheet 6/29/11)**	**Number of Hours of Use per Equipment Day**	**Enter "1" if Equipment Type is in Use**	**Total Number of Equipment Days of Use (Spreadsheet 6/29/11)**	**Number of Hours of Use per Equipment Day**
Asphalt Delivery Truck																					
Backhoe																					
Bobcat																					
Boom Truck																					
Bulldozer	1	32	10	1	852	10	1	1165	10	1	3086	10	1	1165	10	1	13650	10	1	1760	10
Compactor	1	159	10	1	66	10	1	200	10	1	934	10	1	200	10	1	796	10			
Concrete Pumper							1	104	10				1	104	10	1	192	10	1	306	10
Concrete Truck	1	156	10				1	416	10	1	83	10	1	416	10	1	176	10	1	1030	10
Crane							1	200	10	1	1500	10	1	200	10				1	350	10
Dump Truck	1	768	10				1	1250	10	1	8670	10	1	1250	10	1	8	10	1	600	10
Excavator										1	400	10									
Fuel Truck	1	335	10	1	185	10	1	333	10	1	967	10	1	333	10	1	570	10	1	552	10
Forklift				1	140	10	1	400	10	1	1500	10	1	400	10	1	59	10	1	510	10
Generator	1	156	10				1	104	10	1	583	10	1	104	10	1	22	10	1	200	10
Grader				1	33	10	1	200	10	1	467	10	1	200	10	1	398	10	1	572	10
Highway Truck	1	680	10	1	700	10	1	1760	10	1	6514	10	1	1760	10	1	4508	10	1	3908	10
Loader	1	192	10	1	152	10	1	125	10	1	1334	10	1	125	10	1	153	10	1	400	10
Off-road Truck				1	1520	10										1	1490	10			
Paver	1	33	10	1	20	10															
Pile Driver/Drill Rig																1	85	10			
Roller	1	66	10																		
Scissor Lift																			1	100	10
Scraper	1	138	10	1	652	10	1	1165	10	1	13734	10	1	1165	10	1	11460	10	1	3090	10
Water Trucks	1	205	10	1	215	10	1	466	10	1	967	10	1	466	10	1	2280	10	1	352	10
Welding Truck										1	1000	10							1	294	10
Trips/Workforce	**Total number of round trips**	**Roundtrip distance (miles)**	**Maximum Daily Workforce Required For Const.**	**Total number of round trips**	**Roundtrip distance (miles)**	**Maximum Daily Workforce Required For Const.**	**Total number of round trips**	**Roundtrip distance (miles)**	**Maximum Daily Workforce Required For Const.**	**Total number of round trips**	**Roundtrip distance (miles)**	**Maximum Daily Workforce Required For Const.**	**Total number of round trips**	**Roundtrip distance (miles)**	**Maximum Daily Workforce Required For Const.**	**Total number of round trips**	**Roundtrip distance (miles)**	**Maximum Daily Workforce Required For Const.**	**Total number of round trips**	**Roundtrip distance (miles)**	**Maximum Daily Workforce Required For Const.**
Highway Trucks	3400	70	29	3500	70	57	8800	70	101	32570	70	61	8800	70	101	22540	70	180	19540	70	59
Personnel	18850	80		30210	80		208464	80		48800	80		154025	80		171000	80		69620	80	
Onsite Unpaved roads	10720	2		13100	2		21125	2		86005	2		21125	2		45160	2		32210	2	

Number of truck roundtrips per equipment day = 5

Source: URS 2011.

Table 24A.D-10
Equipment and Workforce for Construction of Features for Alternative D (2 pages)

Main Dams			Gravel Roads			Paved Roads and South Bridge Construction			Emergency Drawdown Tunnel			Recreation Areas			Funks Reservoir Sediment Removal			Electrical Transmission & Switchyard Features		
Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish
841 (saddle)	*11/22/2022*	*2/10/2026*	*1403*	*3/15/2022*	*6/2/2026*	*1403*	*3/15/2022*	*6/2/2026*	*465*	*3/15/2022*	*12/25/2023*	*390*	*3/15/2022*	*9/11/2023*	*167*	*Periodic*	*Maintenance*	*1445*	*3/15/2022*	*9/27/2027*
1410 (GG)	*3/15/2022*	*8/9/2027*																		
695 (Sites)	*10/3/2023*	*6/1/2026*																		
1410	*3/15/2022*	*8/9/2027*																		
Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet: Equipment for Sediment and Trans May 2012)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet: Equipment for Sediment and Trans May 2012)	Number of Hours of Use per Equipment Day
						1	1470	10												
												1	316	10						
																		1	192	10
1	17740	10	1	279	10	1	9770	10	1	1760	10	1	116	10	1	1336	10	1	8	10
1	15350	10	1	156	10															
1	2033	10				1	280	10	1	306	10							1	29	10
1	648	10				1	2246	10	1	1030	10	1	66	10				1	154	10
						1	1000	10	1	350	10							1	474	10
1	830	10	1	123	10	1	6775	10	1	600	10	1	474	10				1	14	10
						1	26	10												
1	3548	10	1	93	10	1	1126	10	1	552	10	1	312	10	1	167	10	1	57	10
1	89	10							1	510	10	1	121	10				1	82	10
1	81	10				1	500	10	1	200	10	1	33	10						
1	7675	10	1	104	10	1	2104	10	1	572	10	1	28	10				1	40	10
1	47048	10				1	5011	10	1	3908	10	1	458	10	1	16	10	1	810	10
1	3563	10	1	41	10	1	1235	10	1	400	10	1	158	10				1	103	10
1	27840	10				1	4560	10												
			1	5	10	1	80	10				1	22	10						
1	1952	10					105											1	95	10
			1	10	10	1	925	10				1	50	10						
									1	100	10									
1	6800	10	1	147	10	1	8736	10	1	3090	10				1	2672	10			
1	7096	10	1	191	10	1	2252	10	1	352	10	1	144	10	1	334	10	1	101	10
									1	294	10									
Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.
235240	70	219	0	70	25	25055	70	81	19540	70	59	2290	70	24	80	70	38	4050	70	51
308790	80		35075	80		113643	80		27435	80		9360	80		6346	80		73695	80	
435050	2		2035	2		109850	2		32210	2		7270	2		2665	2		10690	2	

Table 24A.D-11
Concrete Batch Plant PM10 Emissions

Construction On-Site Concrete Batch Plant Emissions

Project Feature	Total Concrete Mass (tons)	Number of Days	Daily Rate (tons/day)	PM_{10} Emissions (lb/day)
Tunnel - Inlet and Outlet Including Sites Pump Plant	77,515	194	400	10.14
	44,030	38	1,159	27.79
	15,253	110	139	4.07
Emergency Drawdown Tunnel	77,515	194	400	10.14
	44,030	38	1,159	27.79
	15,253	110	139	4.07
Pipelines - Delevans and TRR	11,100	28	396	10.07
Dams & Sites Inundation	85,951	215	400	10.14
TRR Pump Plant	55,500	139	399	10.13
Funks Reservoir Modification	23,773	59	403	10.22
Sacramento River Intake & P/G Plant	55,500	139	399	10.13
Paved Roads & Bridges	186,110	310	600	14.81
GCID Canal & Headworks	21,090	35	603	14.86
Electrical Transmission and Switchyard Features	25,679	64	401	10.18
Recreation	8,780	44	200	5.49

Batch Plants Controlled Emission Factors[a]

Sand Transfer[b]	0.000297	lb PM_{10}/ton cement
Aggregate Transfer[b]	0.00099	lb PM_{10}/ton cement
Cement Unloading to Storage Silo	0.00034	lb PM_{10}/ton cement
Cement Supplement Unloading to Storage Silo	0.0049	lb PM_{10}/ton cement
Weigh Hopper Loading[b]	0.00072	lb PM_{10}/ton cement
Truck Loading[c]	0.016	lb PM_{10}/ton cement
Total	**0.023**	**lb PM_{10}/ton cement**

[a]Emission factors from AP-42, Section 11.12, June 2006

[b] The batch plants will have dust control equipment and was assumed to control dust emissions with an efficiency of 70% during sand and aggregate transfer.

Source for control efficiency: BAAQMD Permit Handbook, Section 11.5 Concrete Batch Plants, March 2009.

[c] It was assumed the truck loading process would also include dust controls. Therefore, the controlled truck loading emission factor was used.

Concrete Batch Plant Storage Pile PM10 Emissions

Emission Factor:	1.7	lb PM_{10}/acre/day
Assumed Storage Pile Area	0.5	acres/day

Source: BAAQMD Permit Handbook, Section 11.5 Concrete Batch Plants, March 2009

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Table 24A.D-12
Construction Areas of Disturbance for Fugitive Dust Emissions Calculations

Proposed Project Disturbed Acres for Fugitive Dust Emission Calculations

Project Feature (File Name: ProjFacilitiesParcelsAcreages_9-23-11.xls)	Alternative	County	Total Project Feature Acreage (acres)	PM10 Emissions (lbs)	Construction Duration (days)	Project Duration (days)
1.27 MAF Sites Reservoir						
Alt A		Colusa Co	10,491.2	104,911.5		
		Glenn Co	1,600.3	16,002.9		
	Alt A	Total	**12,091.4**	120,914.4	2224	
1.81 MAF Sites Reservoir						
Alts B C C1		Colusa Co	12,046.1	120,460.8		
		Glenn Co	2,106.1	21,060.7		
	Alts B C C1	Total	**14,152.2**	141,521.5	2224	
Alt D		Colusa Co	12,046.1	120,460.8		
		Glenn Co	2,106.1	21,060.7		
	Alt D	Total	**14,152.2**	141,521.5	1410	
Golden Gates and Sites Dams						
Alt A	**Alt A**	Total	**50.4**	504.0	2224	
Alts B C C1	**Alts B C C1**	Total	**57.7**	577.0	2224	
Alt D	**Alt D**	Total	**57.7**	577.0	1410	
6 Saddle Dams						
Alt A		Colusa Co	0.0	-		
		Glenn Co	37.3	372.5		
	Alt A	Total	**37.3**	372.5	2224	
9 Saddle Dams						
Alts B C C1		Colusa Co	4.2	42.4		
		Glenn Co	94.0	939.7		
	Alts B C C1	Total	**98.2**	982.1	2224	
Alt D		Colusa Co	4.2	42.4		
		Glenn Co	94.0	939.7		
	Alt D	Total	**98.2**	982.1	1410	
Subtotal Sites Reservoir and Dams	***Alt A***	***Total***	***12179.1***	***121,790.9***	***2224***	
	Alts B C C1	***Total***	***14308.1***	***143,080.6***	***2224***	
	Alt D	***Total***	***14308.1***	***143,080.6***	***1410***	
5 Recreation Areas						
Alts A B C C1		Colusa Co	879.2	8,792.2		
		Glenn Co	329.2	3,292.1		
	Alts A B C C1	Total	**1208.4**	12,084.3	731	
Alt D (Conservative; Alt D has only 2 recreation areas)		Colusa Co	879.2	8,792.2		
		Glenn Co	329.2	3,292.1		
	Alt D	Total	**1208.4**	12,084.3	390	
Road Relocations and South Bridge						
A		Colusa Co	1025.6	10,256.2		
A		Glenn Co	270.3	2,703.3		
	Alt A	Total	**1296.0**	12,959.5	1403	
B C C1		Colusa Co	1031.4	10,313.8		
B C C1		Glenn Co	271.6	2,715.8		
	Alts B C C1	Total	**1303.0**	13,029.6	1403	
Alt D (Assumed same as Alts B C C1)		Colusa Co	1031.4	10,313.8		
		Glenn Co	271.6	2,715.8		
	Alt D	Total	**1303.0**	13,029.6	1403	
Sites Pumping Generating Plant & Electrical Switchyard						
Alts A B C C1	**Alts A B C C1**		**5.30**	53.0	485	
Alt D	**Alt D**		**5.30**	53.0	1180	
Tunnel from Sites Pum Gen to Intake Outfall						
Alts A B C C1	**Alts A B C C1**		**3.1**	30.6	485	
Alt D	**Alt D**		**3.1**	30.6	1180	
Sites Res Inlet Outlet Structure						
Alts A B C C1	**Alts A B C C1**		**204.2**	2,042.2	485	
Alt D	**Alt D**		**204.2**	2,042.2	1180	
Field Office Maint Yard						
Alts A B C C1	**Alts A B C C1**		**18.3**	183.4	485	
Alt D	**Alt D**		**18.3**	183.4	1180	
Existing Funks Reservoir Dredging						
Alts A B C C1 D	**Alts A B C C1 D**	No PM - WET	**228.4**	No PM - WET		
Holthouse Reservoir Complex						
Alts A B C C1	**Alts A B C C1**		**456.3**	4,563.0	826	
Alt D	**Alt D**		**456.3**	4,563.0	950	
GCID Canal Intake & Headworks						
& GCID Canal Connection to TRR			9.5	95.0		
Alts A B C C1			3.6	36.0		
	Alts A B C C1	Total	**13.10**	131.0	743	
Alt D			9.5	95.0		
			3.6	36.0		
	Alt D	Total	**13.10**	131.0	650	
TRR	**Alts A B C C1**		**191.6**	1,916.2	487	
	Alt D		**191.6**	1,916.2	530	
TRR PG Plant	**Alts A B C C1**		**0.7**	6.5	1276	
	Alt D		**0.7**	6.5	1525	
TRR Easement						
& TRR to Funks Cr Pipeline Easement			386.9	3,868.9		
Alts A B C C1			20.6	205.6		
	Alts A B C C1	Total	**407.5**	4,074.5	549	
Alt D			386.9	3,868.9		
			20.6	205.6		
	Alt D	Total	**407.5**	4,074.5	800	
Delevan Transmission Line						
Alt A	**Alt A**		**372.8**	3,727.8	1445	
Alt B	**Alt B**		**151.8**	1,518.2	1445	
Alt C C1	**Alt C C1**		**372.8**	3,727.6	1445	
Alt D	**Alt D**		**372.8**	3,727.6	1445	
Delevan Pipeline Intake Facilities						
& Delevan Pipeline Discharge Facility			19.2	191.5		
Alts A B C C1			7.7	76.6		
	Alts A B C C1	Total	**26.8**	268.1	549	
Alt D			19.2	191.5		
			7.7	76.6		
	Alt D	Total	**26.8**	268.1	1175	
Asphalt Plant						
Alts A B C C1 D	**Alts A B C C1 D**		**15.0**	149.6	100	
Concrete Plant						
Alts A B C C1 D	**Alts A B C C1 D**		**15.0**	149.6	100	
	Alt A	**Total**	**16,413.0**	**164,130.3**	**2224**	**3727**
	Alt B	**Total**	**18,328.0**	**183,280.5**	**2224**	**3727**
	Alt C C1	**Total**	**18,549.0**	**185,489.9**	**2224**	**3727**
	Alt D	**Total**	**18,549.0**	**185,489.9**	**1410**	**3369**

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Table 24A.D-13
Total GHG Emissions from Construction of Alternative D

Proposed Project Total GHG Emissions from Construction of Alternative D

Total mtCO2e Emissions from Construction Related Activities

Emissions from Mobile Construction Equipment (From Table 24A.D-5)	**Emissions From Concrete Production** (See Table Below)	**Total Construction Related Emissions**
212,296	73,269	285,565

Alternative D

Project Feature	Total Concrete Mass (tons)	Total Concrete (CY)	GHG Emissions (lbs)	GHG Emissions (mt)
Tunnel - Inlet and Outlet Including Sites Pump Plant	136,798	73,945	29,578,000	13,416
Emergency Drawdown Tunnel	136,798	73,945	29,578,000	13,416
Pipelines - Delevan and TRR	11,100	6,000	2,400,000	1,089
Dams & Sites Inundation	85,951	46,460	18,584,000	8,430
TRR Pump Plant	55,500	30,000	12,000,000	5,443
Funks Reservoir Modification	23,773	12,850	5,140,000	2,331
Sacramento River Intake & P/G Plant	55,500	30,000	12,000,000	5,443
Paved Roads & Bridges	186,110	100,600	40,240,000	18,253
GCID Canal & Headworks	21,090	11,400	4,560,000	2,068
Transmission Lines	25,679	13,880	5,552,000	2,518
Recreation	8,780	4,746	1,898,400	861
Total	747,079	403,826	161,530,400	73,269

1. Based on a study by the Portland Cement Association, CO_2 emissions from concrete range from 190 lbs/cy to 500 lbs/cy, dependeing on the cement content of the concrete. Based on the types of concrete used for this project, DWR has determined the following factor to be appropriate for the project:

1 cy = 400 lbs CO_2e

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Emissions from Operations and Maintenance of All Alternatives

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Table 24A.E-1

Summary of Criteria Pollutant Emissions for Operations and Maintenance of All Alternatives

Summary of Average Daily O&M Emissions (lb/day)[1, 2, 3]						
	NOx	**PM10**	**PM2.5**	**ROG**	**CO**	**SOx**
Total Average Daily Emissions (lb/day)	**26**	**89**	13	4	102	0.3
TCAPCD Threshold (lb/day), Level A	**< 25**	**< 25**	-	< 25	-	-
Threshold Exceeded?	**Yes, subject to standard mitigation measures**	**Yes, subject to standard mitigation measures**	-	No	-	-
TCAPCD Threshold (lb/day), Level B	**> 25**	**> 25**	-	> 25	-	-
Threshold Exceeded?	**Yes, incorporate Best Available Mitigation Measures**	**Yes, incorporate Best Available Mitigation Measures**	-	No	-	-
TCAPCD Threshold (lb/day), Level C	> 137	> 137	-	> 137	-	-
Threshold Exceeded?	No	No	-	No	-	-

1. It was assumed that sedans/pickups would travel at a speed of 15 mph which equates to 3 roundtrips per hour at a distance of 5 miles per roundtrip.

2. There would be a total of 60 employees supporting work at all sites so the employee commute emissions are represented under the "Reservoirs, Recreation Facilities, Dams, Roads, Bridges" category but this covers all O&M employees.

3. Values include emissions for up to 200,000 recreational visitors per year. Assumes no off-road recreation.

Table 24A.E-2
Operations and Maintenance NOx Emissions

Sites Operations and Maintenance (O&M) NOx Emissions

Equipment	Emissions (lbs)			
	Reservoirs, Recreation Facilities, Dams, Roads, Bridges	**Pumping Plants, Intake and Outlet Facilities, Pumping and Generating Plants**	**Electrical Substations and Transmission Lines**	**Tunnels, Pipelines, and Canals**
Backhoe	347	87	3	2
Bobcat	84	84	3	2
Bulldozer	514	257	10	5
Dump Truck	373	93	0	4
Excavator	4	0	0	0
Portable Generator	120	120	0	120
Grader	7	7	0	0
4WD Vehicle	1,638	1,184	6	6
Tractor Mower	169	169	3	2
Pump Truck	54	0	0	0
Forklift	153	0	0	0
Front End Loader	70	0	0	0
Air Compressor	19	10	0	0
Water Trucks	90	0	0	0
Flatbed/Boom Truck	179	90	0	0
Portable Welder	67	17	0	17
Scissor Lift	10	3	0	0
ATV (4 WD Vehicle)	130	0	0	0
Motor Boat	280	93	0	2
Sedans/Pickups[1]	10	0	0	0
Longer Term Maintenance				
Dump Truck	21	90	0	0
Crane	0	99	0	0
Boat Operated Dredge	61	254	0	0
Vehicles				
Employee Commute[2]	206	-	-	-
Recreational Visitors[3]	1,878	-	-	-
Summary				
Total Emissions (lbs)	**6,483**	**2,656**	**26**	**158**
Duration (days)	365	365	365	365
Average Daily Emissions (lb/day)	17.8	7.3	0.1	0.4
Total Average Daily Emissions (lb/day)	**26**			
TCAPCD Threshold (lb/day), Level A	< 25			
Threshold Exceeded?	Yes, subject to standard mitigation measures			
TCAPCD Threshold (lb/day), Level B	> 25			
Threshold Exceeded?	Yes, incorporate Best Available Mitigation Measures			
TCAPCD Threshold (lb/day), Level C	> 137			
Threshold Exceeded?	No			

1. It was assumed that sedans/pickups would travel at a speed of 15 mph which equates to 3 roundtrips per hour at a distance of 5 miles per roundtrip.

2. There would be a total of 60 employees supporting work at all sites so the employee commute emissions are represented under the "Reservoirs, Recreation Facilities, Dams, Roads, Bridges" category but this covers all O&M employees.

3. Values include emissions for up to 200,000 recreational visitors per year. Assumes no off-road recreation.

Table 24A.E-3
Operations and Maintenance PM10 Emissions

Sites Operations and Maintenance (O&M) PM10 Emissions

Equipment	Emissions (lbs)			
	Reservoirs, Recreation Facilities, Dams, Roads, Bridges	**Pumping Plants, Intake and Outlet Facilities, Pumping and Generating Plants**	**Electrical Substations and Transmission Lines**	**Tunnels, Pipelines, and Canals**
Backhoe	14	3	0	0
Bobcat	4	4	0	0
Bulldozer	20	10	0	0
Dump Truck	13	3	0	0
Excavator	0	0	0	0
Portable Generator	5	5	0	5
Grader	0	0	0	0
4WD Vehicle	79	57	0	0
Tractor Mower	8	8	0	0
Pump Truck	2	0	0	0
Forklift	8	0	0	0
Front End Loader	2	0	0	0
Air Compressor	1	0	0	0
Water Trucks	3	0	0	0
Flatbed/Boom Truck	6	3	0	0
Portable Welder	2	1	0	1
Scissor Lift	0	0	0	0
ATV (4 WD Vehicle)	6	0	0	0
Motor Boat	12	4	0	0
Sedans/Pickups[1]	26,361	0	0	0
Longer Term Maintenance				
Dump Truck	1	3	0	0
Crane	0	4	0	0
Boat Operated Dredge	0	2	0	0
Vehicles				
Employee Commute[2]	567	-	-	-
Recreational Visitors[3]	5,180	-	-	-
Summary				
Total Emissions (lbs)	**32,297**	**108**	**1**	**6**
Duration (days)	365	365	365	365
Average Daily Emissions (lb/day)	88.5	0.3	0.0	0.0
Total Average Daily Emissions (lb/day)	**89**			
TCAPCD Threshold (lb/day), Level A	< 25			
Threshold Exceeded?	Yes			
TCAPCD Threshold (lb/day), Level B	> 25			
Threshold Exceeded?	Yes			
TCAPCD Threshold (lb/day), Level C	> 137			
Threshold Exceeded?	No			

1. It was assumed that sedans/pickups would travel at a speed of 15 mph, which equates to 3 roundtrips per hour at a distance of 5 miles per roundtrip, and that they could travel on paved or unpaved roads.

2. There would be a total of 60 employees supporting work at all sites, traveling only on paved roads, so the employee commute emissions are represented under the "Reservoirs, Recreation Facilities, Dams, Roads, Bridges" category but this covers all O&M employees.

3. Values include emissions for up to 200,000 recreational visitors per year, traveling only on paved roads. Assumes no off-road recreation.

Table 24A.E-4
Operations and Maintenance PM2.5 Emissions

Sites Operations and Maintenance (O&M) PM2.5 Emissions

Equipment	Emissions (lbs)			
	Reservoirs, Recreation Facilities, Dams, Roads, Bridges	**Pumping Plants, Intake and Outlet Facilities, Pumping and Generating Plants**	**Electrical Substations and Transmission Lines**	**Tunnels, Pipelines, and Canals**
Backhoe	13	3	0	0
Bobcat	4	4	0	0
Bulldozer	18	9	0	0
Dump Truck	12	3	0	0
Excavator	0	0	0	0
Portable Generator	5	5	0	5
Grader	0	0	0	0
4WD Vehicle	72	52	0	0
Tractor Mower	7	7	0	0
Pump Truck	2	0	0	0
Forklift	8	0	0	0
Front End Loader	2	0	0	0
Air Compressor	1	0	0	0
Water Trucks	3	0	0	0
Flatbed/Boom Truck	6	3	0	0
Portable Welder	2	1	0	1
Scissor Lift	0	0	0	0
ATV (4 WD Vehicle)	6	0	0	0
Motor Boat	12	4	0	0
Sedans/Pickups[1]	2,640	0	0	0
Longer Term Maintenance				
Dump Truck	1	3	0	0
Crane	0	4	0	0
Boat Operated Dredge	0	2	0	0
Vehicles				
Employee Commute[2]	171	-	-	-
Recreational Visitors[3]	1,566	-	-	-
Summary				
Total Emissions (lbs)	**4,551**	**100**	**1**	**6**
Duration (days)	365	365	365	365
Average Daily Emissions (lb/day)	12.5	0.3	0.0	0.0
Total Average Daily Emissions (lb/day)	**13**			
TCAPCD Threshold (lb/day), Level A	Not Applicable			
Threshold Exceeded?	Not Applicable			
TCAPCD Threshold (lb/day), Level B	Not Applicable			
Threshold Exceeded?	Not Applicable			
TCAPCD Threshold (lb/day), Level C	Not Applicable			
Threshold Exceeded?	Not Applicable			

1. It was assumed that sedans/pickups would travel at a speed of 15 mph, which equates to 3 roundtrips per hour at a distance of 5 miles per roundtrip, and that they could travel on paved or unpaved roads.

2. There would be a total of 60 employees supporting work at all sites, traveling only on paved roads, so the employee commute emissions are represented under the "Reservoirs, Recreation Facilities, Dams, Roads, Bridges" category but this covers all O&M employees.

3. Values include emissions for up to 200,000 recreational visitors per year, traveling only on paved roads. Assumes no off-road recreation.

Table 24A.E-5
Operations and Maintenance ROG Emissions

Sites Operations and Maintenance (O&M) ROG Emissions

Equipment	Emissions (lbs)			
	Reservoirs, Recreation Facilities, Dams, Roads, Bridges	**Pumping Plants, Intake and Outlet Facilities, Pumping and Generating Plants**	**Electrical Substations and Transmission Lines**	**Tunnels, Pipelines, and Canals**
Backhoe	34	9	0	0
Bobcat	9	9	0	0
Bulldozer	48	24	1	0
Dump Truck	62	15	0	1
Excavator	1	0	0	0
Portable Generator	13	13	0	13
Grader	1	1	0	0
4WD Vehicle	213	154	1	1
Tractor Mower	22	22	0	0
Pump Truck	9	0	0	0
Forklift	16	0	0	0
Front End Loader	9	0	0	0
Air Compressor	3	1	0	0
Water Trucks	15	0	0	0
Flatbed/Boom Truck	30	15	0	0
Portable Welder	11	3	0	3
Scissor Lift	1	0	0	0
ATV (4 WD Vehicle)	17	0	0	0
Motor Boat	113	38	0	1
Sedans/Pickups[1]	4	0	0	0
Longer Term Maintenance				
Dump Truck	4	15	0	0
Crane	0	10	0	0
Boat Operated Dredge	4	15	0	0
Vehicles				
Employee Commute[2]	44	-	-	-
Recreational Visitors[3]	403	-	-	-
Summary				
Total Emissions (lbs)	**1,083**	**343**	**3**	**19**
Duration (days)	365	365	365	365
Average Daily Emissions (lb/day)	3.0	0.9	0.0	0.1
Total Average Daily Emissions (lb/day)	**4**			
TCAPCD Threshold (lb/day), Level A	< 25			
Threshold Exceeded?	No			
TCAPCD Threshold (lb/day), Level B	> 25			
Threshold Exceeded?	No			
TCAPCD Threshold (lb/day), Level C	> 137			
Threshold Exceeded?	No			

1. It was assumed that sedans/pickups would travel at a speed of 15 mph which equates to 3 roundtrips per hour at a distance of 5 miles per roundtrip.

2. There would be a total of 60 employees supporting work at all sites so the employee commute emissions are represented under the "Reservoirs, Recreation Facilities, Dams, Roads, Bridges" category but this covers all O&M employees.

3. Values include emissions for up to 200,000 recreational visitors per year. Assumes no off-road recreation.

Table 24A.E-6
Operations and Maintenance CO Emissions

Sites Operations and Maintenance (O&M) CO Emissions

Equipment	Emissions (lbs)			
	Reservoirs, Recreation Facilities, Dams, Roads, Bridges	**Pumping Plants, Intake and Outlet Facilities, Pumping and Generating Plants**	**Electrical Substations and Transmission Lines**	**Tunnels, Pipelines, and Canals**
Backhoe	580	145	6	3
Bobcat	124	124	5	2
Bulldozer	273	137	5	3
Dump Truck	414	104	0	4
Excavator	10	0	0	0
Portable Generator	183	183	0	183
Grader	3	3	0	0
4WD Vehicle	3,818	2,759	15	15
Tractor Mower	393	393	8	4
Pump Truck	60	0	0	0
Forklift	213	0	0	0
Front End Loader	55	0	0	0
Air Compressor	30	15	0	0
Water Trucks	100	0	0	0
Flatbed/Boom Truck	199	100	0	0
Portable Welder	83	21	0	21
Scissor Lift	20	7	0	0
ATV (4 WD Vehicle)	302	0	0	0
Motor Boat	196	65	0	1
Sedans/Pickups[1]	123	0	0	0
Longer Term Maintenance				
Dump Truck	24	100	0	0
Crane	0	54	0	0
Boat Operated Dredge	41	172	0	0
Vehicles				
Employee Commute[2]	2,514	-	-	-
Recreational Visitors[3]	22,960	-	-	-
Summary				
Total Emissions (lbs)	**32,718**	**4,381**	**38**	**236**
Duration (days)	365	365	365	365
Average Daily Emissions (lb/day)	89.6	12.0	0.1	0.6
Total Average Daily Emissions (lb/day)	**102**			
TCAPCD Threshold (lb/day), Level A	Not Applicable			
Threshold Exceeded?	Not Applicable			
TCAPCD Threshold (lb/day), Level B	Not Applicable			
Threshold Exceeded?	Not Applicable			
TCAPCD Threshold (lb/day), Level C	Not Applicable			
Threshold Exceeded?	Not Applicable			

1. It was assumed that sedans/pickups would travel at a speed of 15 mph which equates to 3 roundtrips per hour at a distance of 5 miles per roundtrip.

2. There would be a total of 60 employees supporting work at all sites so the employee commute emissions are represented under the "Reservoirs, Recreation Facilities, Dams, Roads, Bridges" category but this covers all O&M employees.

3. Values include emissions for up to 200,000 recreational visitors per year. Assumes no off-road recreation.

Table 24A.E-7
Operations and Maintenance SOx Emissions

Sites Operations and Maintenance (O&M) SOx Emissions

Equipment	Emissions (lbs)			
	Reservoirs, Recreation Facilities, Dams, Roads, Bridges	**Pumping Plants, Intake and Outlet Facilities, Pumping and Generating Plants**	**Electrical Substations and Transmission Lines**	**Tunnels, Pipelines, and Canals**
Backhoe	1	0	0	0
Bobcat	0	0	0	0
Bulldozer	1	1	0	0
Dump Truck	2	0	0	0
Excavator	0	0	0	0
Portable Generator	0	0	0	0
Grader	0	0	0	0
4WD Vehicle	6	4	0	0
Tractor Mower	1	1	0	0
Pump Truck	0	0	0	0
Forklift	0	0	0	0
Front End Loader	0	0	0	0
Air Compressor	0	0	0	0
Water Trucks	0	0	0	0
Flatbed/Boom Truck	1	0	0	0
Portable Welder	0	0	0	0
Scissor Lift	0	0	0	0
ATV (4 WD Vehicle)	0	0	0	0
Motor Boat	0	0	0	0
Sedans/Pickups[1]	1	0	0	0
Longer Term Maintenance				
Dump Truck	0	0	0	0
Crane	0	0	0	0
Boat Operated Dredge	0	1	0	0
Vehicles				
Employee Commute[2]	9	-	-	-
Recreational Visitors[3]	81	-	-	-
Summary				
Total Emissions (lbs)	**105**	**9**	**0**	**0**
Duration (days)	365	365	365	365
Average Daily Emissions (lb/day)	0.3	0.0	0.0	0.0
Total Average Daily Emissions (lb/day)	**0**			
TCAPCD Threshold (lb/day), Level A	Not Applicable			
Threshold Exceeded?	Not Applicable			
TCAPCD Threshold (lb/day), Level B	Not Applicable			
Threshold Exceeded?	Not Applicable			
TCAPCD Threshold (lb/day), Level C	Not Applicable			
Threshold Exceeded?	Not Applicable			

1. It was assumed that sedans/pickups would travel at a speed of 15 mph which equates to 3 roundtrips per hour at a distance of 5 miles per roundtrip.

2. There would be a total of 60 employees supporting work at all sites so the employee commute emissions are represented under the "Reservoirs, Recreation Facilities, Dams, Roads, Bridges" category but this covers all O&M employees.

3. Values include emissions for up to 200,000 recreational visitors per year. Assumes no off-road recreation.

Table 24A.E-8

Operations and Maintenance CO_2 Emissions

Sites Operations and Maintenance (O&M) CO2 Emissions

Equipment	Emissions (lbs)			
	Reservoirs, Recreation Facilities, Dams, Roads, Bridges	**Pumping Plants, Intake and Outlet Facilities, Pumping and Generating Plants**	**Electrical Substations and Transmission Lines**	**Tunnels, Pipelines, and Canals**
Backhoe	78,533	19,633	755	378
Bobcat	16,121	16,121	620	310
Bulldozer	98,573	49,287	1,896	948
Dump Truck	166,355	41,589	0	1,600
Excavator	1,501	0	0	0
Portable Generator	31,151	31,151	0	31,151
Grader	1,280	1,280	0	0
4WD Vehicle	574,991	415,588	2,277	2,277
Tractor Mower	59,207	59,207	1,139	569
Pump Truck	23,994	0	0	0
Forklift	27,755	0	0	0
Front End Loader	22,710	0	0	0
Air Compressor	4,691	2,345	0	0
Water Trucks	39,989	0	0	0
Flatbed/Boom Truck	79,978	39,989	0	0
Portable Welder	10,374	2,593	0	2,593
Scissor Lift	3,049	1,016	0	0
ATV (4 WD Vehicle)	45,544	0	0	0
Motor Boat	29,903	9,968	0	192
Sedans/Pickups[1]	59,455	0	0	0
Longer Term Maintenance				
Dump Truck	9,597	39,989	0	0
Crane	0	17,463	0	0
Boat Operated Dredge	25,495	106,227	0	0
Vehicles				
Employee Commute[2]	884,565	-	-	-
Recreational Visitors[3]	8,078,222	-	-	-
Summary				
Total Emissions (lbs/year)	**10,373,034**	**853,448**	**6,687**	**40,018**

Subtotal Emissions (mt/year)	4705	387	3	18
Total Emissions (mt/year)	**5113**			

1. It was assumed that sedans/pickups would travel at a speed of 15 mph which equates to 3 roundtrips per hour at a distance of 5 miles per roundtrip.

2. There would be a total of 60 employees supporting work at all sites so the employee commute emissions are represented under the "Reservoirs, Recreation Facilities, Dams, Roads, Bridges" category but this covers all O&M employees.

3. Values include emissions for up to 200,000 recreational visitors per year. Assumes no off-road recreation.

Table 24A.E-9
Operations and Maintenance Equipment and Workforce Assumptions

Sites Reservoir

Operations and Maintenance Equipment Asssumptions

Equipment	Reservoirs, Recreation Facilities, Dams, Roads, Bridges		Pumping Plants, Intake and Outlet Facilities, Pumping and Generating Plants		Electrical Substations and Transmission Lines		Tunnels, Pipelines, and Canals		TOTAL Estimated Hours/Year of Use per Type of Equipment
	Average Number of Piece of Equipment	Estimated Hours/Year of Use per Piece of Equipment	Average Number of Piece of Equipment	Estimated Hours/Year of Use per Piece of Equipment	Average Number of Piece of Equipment	Estimated Hours/Year of Use per Piece of Equipment	Average Number of Piece of Equipment	Estimated Hours/Year of Use per Piece of Equipment	
Backhoe	4	520	1	520	1	20	1	10	2,630
Bobcat	1	520	1	520	1	20	1	10	1,070
Bulldozer	2	520	1	520	1	20	1	10	1,590
Dump Truck	1	1,040	1	260			1	10	1,310
Excavator	1	24							24
Portable Generator	4	100	4	100			4	100	1,200
Grader	1	16	1	16					32
4WD Vehicle	2	5,050	2	3,650	2	20	2	20	17,480
Tractor Mower	2	520	2	520	1	20	1	10	2,110
Pump truck	1	150							150
Fork lift	3	500							1,500
Front End Loader	1	300							300
Air compressor	2	50	1	50					150
Water truck	1	250							250
Flatbed/Boom truck	2	250	1	250					750
Portable welders	2	200	1	100			1	100	600
Scissor lift	1	150	1	50					200
ATV	4	200							800
Motor Boat	2	780	1	520			1	10	2,090
Sedans/Pickup*	4	1,000							4,000
Longer Term Maintenance	One dredge and 1 dump truck for 60 hours every 7 -10 years		One dredge, 1 crane, and 1 dump truck for 250 hours every year						
Dump Truck	1	60	1	250					310
Crane			1	250					250
Boat Operated Dredge	1	60	1	250					310

*Assume sedans/pickups drive onsite.

Vehicle Trips

Vehicle	Total number of round trips	Roundtrip distance (miles)	Average Workforce Required For O & M
Employee Commute	21,900	80	60 employees, 10 hr/day (Alts A & C)
Recreational Visitors	200,000	80	

Assumes 60 employees per day, 10 hours per day, 365 days per year.
Assumes up to 200,000 recreational visitors per year. Assumes no off-road recreation.

Source of O & M Equipment Assumptions: DWR 2011.

Sites Reservoir Operation and Maintenance - Emission Factors

O&M Equipment Emission Factors

Project Equipment Type	Equipment Type from OFFROAD	Load Factor	Horsepower	Emission Factors (g/bhp hr)						
				NOx	PM10	CO2	ROG	SOx	CO	PM2.5
Backhoe	Tractor/Loader/Backhoe	0.37	97	2.10918	0.085	477.188	0.209	0.005	3.52242	0.079
Bobcat	Other General Industrial	0.34	88	2.43889	0.118	469.9998	0.257	0.005	3.61204	0.109
Bulldozer	Crawler Tractor	0.43	212	2.46158	0.096	471.6224	0.232	0.005	1.30849	0.088
Crane	Crane	0.29	231	2.68128	0.114	472.9798	0.265	0.005	1.4697	0.105
Dump Truck	Off-Highway Truck	0.38	402	1.06379	0.038	474.9697	0.177	0.005	1.18233	0.035
Excavator	Excavator	0.38	158	1.15367	0.057	472.4964	0.158	0.005	3.078	0.052
Portable Generator	Generator set	0.74	84	2.185	0.087	568.299	0.243	0.006	3.338	0.087
Grader	Grader	0.41	187	2.55629	0.082	473.4704	0.23	0.005	1.17888	0.076
4 WD (ATV)	Off-Highway Tractor	0.44	124	1.34858	0.065	473.3021	0.175	0.005	3.14246	0.059
Tractor Mower	Off-Highway Tractor	0.44	124	1.34858	0.065	473.3021	0.175	0.005	3.14246	0.059
Pump Truck	Off-Highway Truck	0.38	402	1.06379	0.038	474.9697	0.177	0.005	1.18233	0.035
Forklift	Forklift	0.20	89	2.60732	0.14	471.5285	0.277	0.005	3.61138	0.128
Front End Loader	Rubber Tired Loader	0.36	203	1.44207	0.048	469.8711	0.177	0.005	1.1417	0.045
Air Compressor	Air Compressor	0.48	78	2.313	0.104	568.299	0.345	0.006	3.653	0.104
Water Trucks	Off-Highway Truck	0.38	402	1.06379	0.038	474.9697	0.177	0.005	1.18233	0.035
Flatbed/Boom Truck	Off-Highway Truck	0.38	402	1.06379	0.038	474.9697	0.177	0.005	1.18233	0.035
Portable Welder	Welder	0.45	46	3.676	0.112	568.299	0.602	0.007	4.524	0.112
Scissor Lift	Aerial Lift	0.31	63	1.51077	0.026	472.1142	0.099	0.005	3.16742	0.024
Motor Boat	Pilot Vessel	0.51	30	5.320	0.220	568.300	2.142	0.005	3.730	0.220
Boat Operated Dredge	Dredger	0.51	665	1.360	0.010	568.300	0.080	0.005	0.920	0.010

1. Load factors, horsepower, and emission factors from the *CalEEMod User's Guide*, Appendix D (CAPCOA, 2016).

2. The emission factors are for the year 2025, which was the closest year of emission factors available to the project's build-out year of 2027.

3. It was assumed emissions from pump trucks, dump trucks, boom trucks, and water trucks would be represented using the Off-highway truck emission factors. These trucks would primarily travel within the project area.

4. Emission factors for the motor boat and boat operated dredge were obtained from the OFFROAD2011 model, using the California Harbor Craft Emissions Inventory Database and California Barge and Dredge Emissions Inventory Database, respectively. Emission factors are for the year 2020, which was the closest year of emission factors available to the project's build-out year of 2027.

5. CO2 and SOx emission factors for the motor boat were not available, but instead conservatively set equal to those for the boat operated dredge.
6. The SOx emission factor was not available for the boat operated dredge, but it was assumed a diesel fuel content of 15 ppm would equate to an emission factor of 0.005 g/bhp hr, similar to other diesel-fueled construction equipment emission rates.

Vehicle Emission Factors

Vehicle	Vehicle Type in EMFAC2007	Emission Factors (lb/mile)						
		NOx	PM10	CO2	ROG	SOx	CO	PM2.5
Personnel at 15 mph	Passenger Vehicles, Gasoline	0.0002	0.0001	0.9909	0.0001	0.0000	0.0021	0.0000
Personnel at 35 mph	Passenger Vehicles, Gasoline	0.0001	0.0001	0.5049	0.0000	0.0000	0.0014	0.0000
Truck at 15 mph	Heavy-Heavy Duty Diesel	0.0187	0.0002	4.5561	0.0007	0.0000	0.0040	0.0001
Truck at 35 mph	Heavy-Heavy Duty Diesel	0.0022	0.0002	3.2903	0.0002	0.0000	0.0012	0.0001
Vehicle	**Vehicle Type in EMFAC2007**	**Emission Factors (g/mile)**						
		NOx	**PM10**	**CO2**	**ROG**	**SOx**	**CO**	**PM2.5**
Personnel at 15 mph	Passenger Vehicles, Gasoline	0.076	0.050	449.476	0.033	0.005	0.930	0.022
Personnel at 35 mph	Passenger Vehicles, Gasoline	0.053	0.046	229.018	0.011	0.002	0.651	0.019
Truck at 15 mph	Heavy-Heavy Duty Diesel	8.504	0.106	2066.644	0.309	0.020	1.827	0.043
Truck at 35 mph	Heavy-Heavy Duty Diesel	1.017	0.103	1492.484	0.089	0.014	0.526	0.041

1. It was assumed that 'non-personnel' trips are diesel truck trips.

2. Emission factors from the ARB's EMFAC2014 model for the Colusa County portion of the Sacramento Valley Air Basin for the year 2027, assuming an annual temperature of 66°F and an annual relative humidity of 56%, per Table B-1 of *CT-EMFAC: A Computer Model to Estimate Transportation Project Emissions* (UC Davis, 2007).

3. It was assumed that diesel trucks would be ten years old or newer, based on the ARB's *Staff Assessment of the Impact of the Economy on California Trucking Activity and Emissions 2006-2014*, December 2009. Therefore, the model year in EMFAC2014 was changed to 2017 through 2027, rather than the default of 1978-2023, and the emission factors by model year were arithmetically averaged.

4. Passenger vehicles were assumed to be comprised of 50% light-duty automobiles, 25% category 1 light-duty trucks, and 25% category 2 light-duty trucks, consistent with the *CalEEMod User's Guide*, Appendix A (CAPCOA, 2016).
5. It was assumed that vehicles would travel at an average speed of 35 mph offsite and 15 mph on unpaved roads. Assumes no off-road recreation.
6. The PM10 and PM2.5 emission factors include tire and brake wear.

Calculation of Paved Road Emission Factor

Paved Roads emission factor from AP-42, Section 13.2.1: P*aved Roads* (1/11)

$$E = [k(sL)^{0.91} * (W)^{1.02}]$$

where:	PM10	PM2.5	
k =	1.0	0.3	particle size multiplier, g/VMT [Table 13.2-1.1]
sL =	0.03	0.03	road surface silt loading (g/m^2) [Table 13.2.1-2]
W =	2.4	2.4	vehicle weight [tons, from CalEEMod User's Guide, Appendix A (CAPCOA, 2016)]
$E_{(PM10)}$=	0.100	0.025	g/VMT
$E_{(PM10)}$=	0.0002	0.0001	lb/VMT

Calculation of Unpaved Road Emission Factor

PM10

Emission Factor [lb/mi] = 1.5 x (silt content [%] / 12)$^{0.9}$ x (average vehicle weight [tons] / 3)$^{0.45}$ x (365-P)/365
Reference: AP-42, Section 13.2.2, November 2006

Parameter	Value
Average Vehicle Weight (tons)	8
Silt Content (%)	4.3
P, Number of days with Precip >0.01 inches	56
Emission Factor (lb/mile)	0.44

Reference for Silt Content: AP-42, Section 13.2.2, Table 13.2.2-1, Average for a Service Road.
Precipitation days taken directly from CalEEMod for Colusa County.
The emission factor accounts for a 44% reduction assuming truck speeds are limited to 15 mph or less.

PM2.5

Emission Factor [lb/mi] = 0.15 x (silt content [%] / 12)$^{0.9}$ x (average vehicle weight [tons] / 3)$^{0.45\ x}$ (365-P)/365
Reference: AP-42, Section 13.2.2, November 2006

Parameter	$PM_{2.5}$
Average Vehicle Weight (tons)	8
Silt Content (%)	4.3
P, Number of days with Precip >0.01 inches	56
Emission Factor (lb/mile)	0.04

Reference for Silt Content: AP-42, Section 13.2.2, Table 13.2.2-1, Average for a Service Road.
Precipitation days taken directly from CalEEMod for Colusa County.
The emission factor accounts for a 44% reduction assuming truck speeds are limited to 15 mph or less.