



U.S. General Services Administration

Environmental Impact Statement for the Kenneth G. Ward (Lynden) and Sumas Land Ports of Entry Modernization and Expansion Projects Lynden and Sumas, Washington

Volume II – Appendix C Air Quality Calculations and Emissions – PART 1 Final



November 2024

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ACRONYMS

Acronym	Definition
AADT	Annual Average Daily Traffic
ACM	asbestos-containing material
ADA	Americans with Disabilities Act
AG	Agriculture
APE	area of potential effect
AST	aboveground storage tank
ASTM	American Society for Testing and Materials
BC	British Columbia
BCC	birds of conservation concern
BGEPA	Bald and Golden Eagle Protection Act
BMP	best management practices
BNSF	Burlington Northern Santa Fe Railroad
BTS	Bureau of Transportation Statistics
CAA	Clean Air Act
CBP	Customs and Border Protection
CBSA	Canada Border Services Agency
CCD	census county division
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CGP	Construction General Permit
CH ₄	methane
CO ₂	carbon dioxide
COG	Council of Government
COV	commercially owned vehicle
CWA	Clean Water Act
dB	decibels
DFA	Duty Free Americas
dBA	decibels on an A-weighted scale
DOSH	Division of Occupational Safety and Health
EIS	Environmental Impact Statement
EISA	Energy Independence and Security Act
EO	Executive Order
ESA	Environmental Site Assessment
FEMA	Federal Emergency Management Agency
FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
GHG	greenhouse gas
GMA	Growth Management Act
GSA	U.S. General Services Administration
GWP	global warming potential
HAP	hazardous air pollutant
HSS	highways of statewide significance
HUC	Hydrologic Unit Code
IDP	Inadvertent Discovery Plan

Acronym	Definition
IECC	International Energy Conservation Code
IPaC	Information for Planning and Consultation
LBP	lead-based paint
LEED®	Leadership in Energy and Environmental Design
LPOE	Land Port of Entry
LRR	Land Resource Region
LUST	leaking underground storage tank
MBTA	Migratory Bird Treaty Act
MLRA	Major Land Resource Area
mph	miles per hour
MPO	Metropolitan Planning Organization
msl	mean sea level
MTCA	Model Toxics Control Act
N ₂ O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NAICS	North American Industry Classification System
NEPA	National Environmental Policy Act
NESHAP	National Emission Standards for Hazardous Air Pollutants
NFIP	National Flood Insurance Program
NHPA	National Historic Preservation Act
NII	non-intrusive inspection
NO _x	nitrogen oxides
NPDES	National Pollutant Discharge Elimination System
NRCS	Natural Resources Conservation Service
NSPS	New Source Performance Standard
NSR	New Source Review
NWCAA	Northwest Clean Air Agency
O ₃	ozone
OSHA	Occupational Health and Safety Administration
PBS	Public Buildings Service
PCB	non-polychlorinated biphenyl
PDS	Program Development Study
PM _{2.5}	very fine particulate matter 2.5 micrometers or smaller
PM ₁₀	fine particulate matter 10 micrometers or smaller
POV	privately owned vehicle
ppm	parts per million
PPV	peak particle velocity
PSD	Prevention of Significant Deterioration
PSE	Puget Sound Energy
RCRA	Resources Conservation and Recovery Act of 1976
RCW	Revised Code of Washington
ROD	Record of Decision
ROI	region of influence
SC-GHG	social cost of greenhouse gases
SHPO	State Historic Preservation Officer
SIP	State Implementation Plan
SITES	Sustainable Sites Initiative

Acronym	Definition
SO ₂	sulfur dioxide
SPCC	spill prevention, control, and countermeasures
SR	State Route
STIP	State Transportation Improvement Program
SWPPP	stormwater pollution prevention plan
TC	Tourist Commercial
THPO	Tribal Historic Preservation Officer
TMDL	Total Maximum Daily Load
U.S.C	U.S. Code
USDA	U.S. Department of Agriculture
U.S. DOT	U.S. Department of Transportation
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey
UST	underground storage tank
VOC	volatile organic compound
vpd	vehicles per day
vph	vehicles per hour
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife
WHO	World Health Organization
WNHP	Washington Natural Heritage Program
WOTUS	Waters of the U.S.
WRIA	Water Resource Inventory Area
WSDOT	Washington State Department of Transportation
WSS	Web Soil Survey

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C.1 Lynden LPOE Construction Air Quality Emissions

Construction	Building (approx. sq ft)	Pavement (sq ft)	Project Area (ac)
Alternative 2	106200	57000	14.49
Alternative 3	106200	57000	10.3

Demolition	Building (approx. sq ft)	Pavement (sq ft)
Alternative 2	20,000	219106.8
Alternative 3	40,000	295772.4

C.1.1 Alternative 2

Phase lengths for an approx. 3 ac building (in days)

Demolition	20
Site Prep	3
Grading	6
Construction	220
Coating	10
Paving	10

Months Years
 13 1.1

Source: https://www.caleemod.com/documents/user-guide/05_Appendix%20D.pdf

Equipment List and Hours for 15 ac site

Phase	Equipment	No.	Hours/day of equipment use	Days	Hours
Demolition	Excavators	3	8	20	480
Demolition	Rubber tired dozers	2	8	20	320
Demolition	Concrete/industrial saws	1	8	20	160
Demolition	Tractors/loaders/backhoes	0	0	20	0
Site Prep	Graders	0	0	3	0
Site Prep	Tractors/loaders/backhoes	4	8	3	96
Site Prep	Rubber tired dozers	3	8	3	72
Site Prep	Scrapers	0	0	3	0
Grading	Rubber tired dozers	1	8	6	48
Grading	Concrete/industrial saws	0	0	6	0
Grading	Tractors/loaders/backhoes	2	8	6	96
Grading	Graders	1	8	6	48
Grading	Excavators	2	8	6	96
Grading	Scrapers	2	8	6	96
Construction	Cranes	1	7	220	1540
Construction	Forklifts	3	8	220	5280
Construction	Tractors/loaders/backhoes	3	7	220	4620
Construction	Welders	1	8	220	1760
Construction	Generator sets	1	8	220	1760
Coating	Air compressors	1	6	10	60
Paving	Pavers	2	8	10	160
Paving	Cement and Mortar Mixers	0	0	10	0
Paving	Rollers	2	8	10	160
Paving	Tractors/loaders/backhoes	0	0	10	0
Paving	Paving equipment	2	8	10	160

Source: https://www.caleemod.com/documents/user-guide/05_Appendix%20D.pdf

C.1.1.1 Construction Equipment Emissions

Equipment hours are multiplied by Emissions Factors (Efs) then converted from grams/hr to tons/hr

Gasoline Equipment Emission Factors					
CO (g/hr)	NO2 (g/hr)	SO2 (g/hr)	PM10 (g/hr)	PM2.5 (g/hr)	VOC (g/hp-hr)
795	7.44	0.0194	6.21	5.72	0.035

Emissions (tons/year)									
Fuel	Equipment	Equipment Hours	CO	NO2	SO2	PM10	PM2.5	VOC	Equipment HP (for VOC)
Gasoline	Air compressors	60	0.007	0.000	0.000	0.000	0.000	0.000	75

Diesel Equipment Emission Factors					
CO (g/day)	NO2 (g/day)	SO2 (g/day)	PM10 (g/day)	PM2.5 (g/day)	VOC (g/hp-hr)
160	300	0.507	23.1	22.4	0.035

Emissions (tons/year)									
Fuel	Equipment	Equipment Hours	CO	NO2	SO2	PM10	PM2.5	VOC	Equipment HP (for VOC)
Diesel	Cement and Mortar Mixers	0	0	0	0	0	0	0	
Diesel	Concrete/industrial saws	160	0.004	0.007	0.000	0.001	0.000	0	
Diesel	Cranes	1540	0.034	0.064	0.000	0.005	0.005	0.014	231
Diesel	Excavators	576	0.013	0.024	0.000	0.002	0.002	0.004	158
Diesel	Forklifts	5280	0.117	0.220	0.000	0.017	0.016	0.018	89
Diesel	Generator sets	1760	0.039	0.073	0.000	0.006	0.005	0.006	84
Diesel	Graders	48	0.001	0.002	0.000	0.000	0.000	0.000	187
Diesel	Pavers	160	0.004	0.007	0.000	0.001	0.000	0.001	130
Diesel	Paving equipment	160	0.004	0.007	0.000	0.001	0.000	0.001	132
Diesel	Rollers	160	0.004	0.007	0.000	0.001	0.000	0.000	80
Diesel	Rubber tired dozers	440	0.010	0.018	0.000	0.001	0.001	0.004	247
Diesel	Scrapers	96	0.002	0.004	0.000	0.000	0.000	0.001	367
Diesel	Tractors/loaders/backhoes	4812	0.107	0.201	0.000	0.015	0.015	0.018	97
Diesel	Welders	1760	0.039	0.073	0.000	0.006	0.005	0.003	46
	Tons of pollutant		0.383	0.706	0.001	0.054	0.053	0.071	

C.1.1.2 Demolition Hauling

158 pounds per sq ft Source: <https://www.epa.gov/sites/production/files/2017-09/documents/estimating2003buildingrelatedcandmaterialsamounts.pdf>
 1580 tons of C&D debris (estimated) for a 20 ksf building
 1.19 tons per cubic yard <https://www.sandiego.gov/sites/default/files/legacy/environmental-services/recycling/pdf/cdmaterialconversiontable.pdf>
 1328 cubic yard of C&D debris
 40.0 cy per truck
 66 estimated truck trips (one-way, 2 trips per load)
 50 miles per trip, assumed

158 pounds per sq ft Source: <https://www.epa.gov/sites/production/files/2017-09/documents/estimating2003buildingrelatedcandmaterialsamounts.pdf>
 17309.4372 tons of C&D debris (estimated) for 5.03 acre pavement
 0.7 tons per cubic yard
 24728 cubic yard of C&D debris
 40.0 cy per truck
 1236 estimated truck trips (one-way, 2 trips per load)
 50 miles per trip, assumed
 1303 total trips

C.1.1.3 Construction Waste Hauling, Vendors, and Worker Vehicles

4.3 pounds per sq ft typical waste generation, per <https://www.epa.gov/sites/production/files/2017-09/documents/estimating2003buildingrelatedcandmaterialsamounts.pdf>
 228.3 tons of C&D debris (estimated) for a 100k sf building
 1.19 tons per cubic yard <https://www.sandiego.gov/sites/default/files/legacy/environmental-services/recycling/pdf/cdmaterialconversiontable.pdf>
 192 cubic yard (cy) of C&D debris
 40.0 cy per truck
 10 waste hauling truck trips

Off-peak is considered demolition in this analysis

Phase		Daily Workers Onsite	Daily Vendors	Total Haul Trips
Off-peak		20	0	1308
Peak construction		65	45	10
Phase	Days	Worker Total	Vendor Total	Haul Trucks
Off-peak	183	3660	0	1303
Peak construction	730	47450	32850	10

Miles, roundtrip distance	20	50	50
			Distance is assumed

Off-peak	73200	0	65138.7463
Peak construction	949000	1642500	500
Vehicle-miles	1022200	1642500	65639

Vehicle Type	Emission Factor (g/mile)					
	CO	NOx	SO2	PM10	PM2.5	VOC
Passenger cars, gasoline	2.87	0.12	0.01	0.03	0.02	0.17
Passenger trucks, gasoline	5.02	0.31	0.01	0.05	0.03	0.28
Heavy trucks, diesel single-unit short haul	1.04	1.02	0.01	0.11	0.05	0.08

Vehicle Type	Vehicle-miles	Emissions (tons/year)					
		CO	NOx	SO2	PM10	PM2.5	VOC
Passenger cars, gasoline	511100	1.63	0.07	0.00	0.02	0.01	0.10
Passenger trucks, gasoline	511100	2.85	0.18	0.00	0.03	0.02	0.16
Heavy trucks, diesel single-unit short haul	1708139	1.97	1.93	0.01	0.20	0.10	0.15
Pollutant Totals, All Vehicles		6.83	2.89	0.02	0.31	0.18	0.48

C.1.1.4 Construction Dust

AP-42 EF for Total	
Suspended Particles	1.2 tons/acre/month
Total area	15 acres
Total TSP	17.4 tons
PM10	9.744 tons
PM2.5	5.22 tons
PM10 Total	10.1
PM2.5 Total	5.4

Calculating fugitive dust emissions by estimating multiplying AP-42 Total Suspended Particulates (TSP) EF with anticipated area to be graded. Please note the entire acreage is assumed to be graded to provide a conservative analysis.

C.1.1.5 Air Quality Emissions Totals

Alt 2	CO	No2	PM10	PM2.5	SO2	VOC
Construction Equipment	0.38	0.71	0.05	0.05	0.00	0.07
Worker vehicles	4.48	0.25	0.05	0.03	0.01	0.26
Delivery and waste trucks	1.97	1.93	0.20	0.10	0.01	0.15
Fugitive dust			10.05	5.40		
Total	6.83	2.89	10.36	5.59	0.02	0.48

Construction	Building (approx. sq ft)	Pavement (sq ft)	Project Area (ac)
Alternative 2	106200	57000	14.49
Alternative 3	106200	57000	10.3

Demolition	Building (approx. sq ft)	Pavement (sq ft)
Alternative 2	20,000	219106.8
Alternative 3	40,000	295772.4

C.1.2 Alternative 3

Phase lengths for an approx. 3 ac building (in days)

Demolition	20
Site Prep	3
Grading	6
Construction	220
Coating	10
Paving	10

Months Years
 13 1.1

Source: https://www.caleemod.com/documents/user-guide/05_Appendix%20D.pdf

Equipment List and Vehicle Hours for 10 ac site

Phase	Equipment	No.	Hours/day/ equipment	Days	Hours
Demolition	Excavators	3	8	20	480
Demolition	Rubber tired dozers	2	8	20	320
Demolition	Concrete/industrial saws	1	8	20	160
Demolition	Tractors/loaders/backhoes	0	0	20	0
Site Prep	Graders	0	0	3	0
Site Prep	Tractors/loaders/backhoes	4	8	3	96
Site Prep	Rubber tired dozers	3	8	3	72
Site Prep	Scrapers	0	0	3	0
Grading	Rubber tired dozers	1	8	6	48
Grading	Concrete/industrial saws	0	0	6	0
Grading	Tractors/loaders/backhoes	3	8	6	144
Grading	Graders	1	8	6	48
Grading	Excavators	1	8	6	48
Grading	Scrapers	0	0	6	0
Construction	Cranes	1	7	220	1540
Construction	Forklifts	2	8	220	3520
Construction	Tractors/loaders/backhoes	1	7	220	1540
Construction	Welders	1	8	220	1760
Construction	Generator sets	1	8	220	1760
Coating	Air compressors	1	6	10	60
Paving	Pavers	2	8	10	160
Paving	Cement and Mortar Mixers	0	0	10	0
Paving	Rollers	2	8	10	160
Paving	Tractors/loaders/backhoes	0	0	10	0
Paving	Paving equipment	2	8	10	160

Source: https://www.caleemod.com/documents/user-guide/05_Appendix%20D.pdf

C.1.2.1 Construction Equipment Emissions

Equipment hours are multiplied by Emissions Factors (EFs) then converted from grams/hr to tons/hr

Gasoline Equipment Emission Factors					
CO (g/hr)	NO2 (g/hr)	SO2 (g/hr)	PM10 (g/hr)	PM2.5 (g/hr)	VOC (g/hp-hr)
795	7.44	0.0194	6.21	5.72	0.035

Emissions (tons/year)									
Fuel	Equipment	EFs	CO	NO2	SO2	PM10	PM2.5	VOC	Equipment HP (for VOC)
Gasoline	Air compressors	60	0.006625	0.000062	1.61667E-07	0.00005175	4.76667E-05	0.000175	75

Diesel Equipment Emission Factors					
CO (g/day)	NO2 (g/day)	SO2 (g/day)	PM10 (g/day)	PM2.5 (g/day)	VOC (g/hp-hr)
160	300	0.507	23.1	22.4	0.035

Emissions (tons/year)									
Fuel	Equipment	Equipment Hours	CO	NO2	SO2	PM10	PM2.5	VOC	Equipment HP (for VOC)
Diesel	Cement and Mortar Mixers	0	0	0	0	0	0	0	
Diesel	Concrete/industrial saws	160	0.003555556	0.00666667	1.12667E-05	0.00051333	0.000497778	0	
Diesel	Cranes	1540	0.034222222	0.06416667	0.000108442	0.00494083	0.004791111	0.013834333	231
Diesel	Excavators	528	0.011733333	0.022	0.00003718	0.001694	0.001642667	0.003244267	158
Diesel	Forklifts	3520	0.078222222	0.14666667	0.000247867	0.01129333	0.010951111	0.012183111	89
Diesel	Generator sets	1760	0.039111111	0.07333333	0.000123933	0.00564667	0.005475556	0.005749333	84
Diesel	Graders	48	0.001066667	0.002	0.00000338	0.000154	0.000149333	0.000349067	187
Diesel	Pavers	160	0.003555556	0.00666667	1.12667E-05	0.00051333	0.000497778	0.000808889	130
Diesel	Paving equipment	160	0.003555556	0.00666667	1.12667E-05	0.00051333	0.000497778	0.000821333	132
Diesel	Rollers	160	0.003555556	0.00666667	1.12667E-05	0.00051333	0.000497778	0.000497778	80
Diesel	Rubber tired dozers	440	0.009777778	0.01833333	3.09833E-05	0.00141167	0.001368889	0.004226444	247
Diesel	Scrapers	0	0	0	0	0	0	0	367
Diesel	Tractors/loaders/backhoes	1780	0.039555556	0.07416667	0.000125342	0.00571083	0.005537778	0.006714556	97
Diesel	Welders	1760	0.039111111	0.07333333	0.000123933	0.00564667	0.005475556	0.003148444	46
	Tons of pollutant		0.273647222	0.50072867	0.000846288	0.03860308	0.037430778	0.051752556	

C.1.2.2 Demolition Hauling

158 pounds per sq ft Source: <https://www.epa.gov/sites/production/files/2017-09/documents/estimating2003buildingrelatedcanddmaterialsamounds.pdf>
 3160 tons of C&D debris (estimated) for a 40 ksf building
 1.19 tons per cubic yard <https://www.sandiego.gov/sites/default/files/legacy/environmental-services/recycling/pdf/cdmaterialconversiontable.pdf>
 2655 cubic yard of C&D debris
 40.0 cy per truck
 133 estimated truck trips (one-way, 2 trips per load)
 50 miles per trip, assumed

158 pounds per sq ft Source: <https://www.epa.gov/sites/production/files/2017-09/documents/estimating2003buildingrelatedcanddmaterialsamounds.pdf>
 23366.0196 tons of C&D debris (estimated) for 6.79 acre pavement
 0.7 tons per cubic yard <https://www.sandiego.gov/sites/default/files/legacy/environmental-services/recycling/pdf/cdmaterialconversiontable.pdf>
 33380 cubic yard of C&D debris
 40.0 cy per truck
 1669 estimated truck trips (one-way, 2 trips per load)
 50 miles per trip, assumed
 1802 total trips

C.1.2.3 Construction Waste Hauling, Vendors, and Worker Vehicles

4.3 pounds per sq ft typical waste generation, per <https://www.epa.gov/sites/production/files/2017-09/documents/estimating2003buildingrelatedcanddmaterialsamounds.pdf>
 228.3 tons of C&D debris (estimated) for a 100k sf building
 1.19 tons per cubic yard <https://www.sandiego.gov/sites/default/files/legacy/environmental-services/recycling/pdf/cdmaterialconversiontable.pdf>
 192 cubic yard (cy) of C&D debris
 40.0 cy per truck
 10 waste hauling truck trips

Off-peak is considered demolition in this analysis

Phase	Daily Worker Trip	Daily Vendor Trip	Total Haul Trips	
Off-peak	20	0	1802	
Peak construction	65	45	10	
Phase	Days	Worker Total	Vendor Total	Haul Trucks
Off-peak	183	3660	0	1802
Peak construction	730	47450	32850	10
Miles, roundtrip distance	20	50	50	Distance is assumed
Off-peak	73200	0	90088.72546	
Peak construction	949000	1642500	500	
Vehicle-miles	1022200	1642500	90589	

Vehicle Type	Emission Factor (g/mile)					
	CO	NOx	SO2	PM10	PM2.5	VOC
Passenger cars, gasoline	2.8656	0.1205	0.0055	0.0336	0.019	0.1701
Passenger trucks, gasoline	5.0191	0.3129	0.0073	0.0531	0.0319	0.2833
Heavy trucks, diesel single-unit short haul	1.0359	1.0189	0.0077	0.1069	0.0543	0.0788

Vehicle Type	Vehicle-miles	Emissions (tons/year)					
		CO	NOx	SO2	PM10	PM2.5	VOC
Passenger cars, gasoline	511100	1.6273	0.0684	0.0031	0.0191	0.0108	0.0966
Passenger trucks, gasoline	511100	2.8503	0.1777	0.0041	0.0302	0.0181	0.1609
Heavy trucks, diesel single-unit short haul	1733089	1.9948	1.9620	0.0148	0.2058	0.1046	0.1517
Pollutant Totals, All Vehicles		6.7461	2.7089	0.0229	0.2936	0.1709	0.4092

C.1.2.4 Construction Dust

AP-42 EF for Total	
Suspended Particles	1.2 tons/acre/month
Total area	10 acres
Total TSP	11.6 tons
PM10	6.496
PM2.5	3.48
PM10 Total	6.7896
PM2.5 Total	3.6509

Calculating fugitive dust emissions by estimating multiplying AP-42 Total Suspended Particulates (TSP) EF with anticipated area to be graded. Please note the entire acreage is assumed to be graded to provide a conservative analysis.

C.1.2.5 Air Quality Emissions Totals

Alt 3	CO	NO2	PM10	PM2.5	SO2	VOC
Construction Equipment	0.27	0.50	0.04	0.04	0.00	0.05
Worker vehicles	4.48	0.25	0.05	0.03	0.01	0.26
Delivery and waste trucks	1.99	1.96	0.21	0.10	0.01	0.15
Fugitive dust			6.79	3.65		
Total	6.75	2.71	7.08	3.82	0.02	0.46

C.2 Lynden LPOE Construction Greenhouse Gas Emissions

C.2.1 Alternative 2

Equipment List and Vehicle Hours for 15 ac site

Fuel	Equipment	Hours	Horsepower	Load Factor	Gallons of Fuel
Gasoline	Air compressors	60	78	0.48	112.32
Diesel	Cement and Mortar Mixers	0	9	0.56	0
Diesel	Concrete/industrial saws	160	81	0.738	478.224
Diesel	Cranes	1540	231	0.29	5158.23
Diesel	Excavators	576	158	0.38	1729.152
Diesel	Forklifts	5280	89	0.2	4699.2
Diesel	Generator sets	1760	84	0.74	5470.08
Diesel	Graders	48	187	0.41	184.008
Diesel	Pavers	160	130	0.42	436.8
Diesel	Paving equipment	160	132	0.36	380.16
Diesel	Rollers	160	80	0.38	243.2
Diesel	Rubber tired dozers	440	247	0.4	2173.6
Diesel	Scrapers	96	367	0.48	845.568
Diesel	Tractors/loaders/backhoes	4812	97	0.37	8635.134
Diesel	Welders	1760	46	0.45	1821.6

Assumptions:

HP and load factor taken from Capitol Annex DEIR

Assuming 0.05 gallons of fuel consumption per horsepower-hour

Emissions Factors

Fuel		CO2	CH4	N2O
		kg/gal	g/gal	g/gal
Gasoline	112.32	8.78	0.5	0.22
Diesel	32254.956	10.21	0.57	0.26

Emissions (MT)

Fuel	CO2	CH4	N2O	CO2-eq
Gasoline	1.0	0.0001	0.0000	1.0
Diesel	329.3	0.0184	0.0084	332.3

Note: CO2-eq is calculated by multiplying CO2, CH4, N2O by their respective global warming potential (GWP) and summing. This analysis uses GWP values from 40 CFR 98, Subpart A, Table A-1 (CO2 = 1, CH4 = 25, N2O = 298).

C.2.1.1 On-road vehicles

Vehicle	Emissions Factors			
	CO2 kg/gal fuel	CH4 g/mile	N2O g/mile	Fuel economy mpg
Passenger cars, gasoline	8.78	0.071	0.0046	24
Passenger trucks, gasoline	8.78	0.0095	0.0035	17.4
Heavy trucks, diesel single-unit short haul	10.21	0.95	0.0431	7.4

Delivery trucks

Source for fuel economy data: DOE Alternative Fuels Data Center Average Fuel Economy By Major Vehicle Category (<https://afdc.energy.gov/data/10310>)

Source for emission factors: EPA 2024 Emissions Factors Table 2 Mobile Combustion CO2, Table 3 Mobile Combustion CH4 and N2O for On-Road Gasoline Vehicle (<https://www.epa.gov/system/files/documents/2024-02/ghg-emission-factors-hub-2024.pdf>)

Vehicle	VMTs	Gal fuel	Emissions (MT)			
			CO2	CH4	N2O	CO2-eq
Passenger cars, gasoline	511100	21296	187	0.0362881	0.00235106	188.6
Passenger trucks, gasoline	511100	29374	258	0.00485545	0.00178885	258.6
Heavy trucks, diesel single-unit short haul	1708139	230830	2357	1.622731809	0.07362078	2419.3

C.2.1.2 Greenhouse Gas Emissions Totals

	CO2	CH4	N2O	CO2-eq
Construction equipment	330.31	0.02	0.01	333.28
Worker vehicles	444.88	0.04	0.00	447.14
Delivery and waste trucks	2356.77	1.62	0.07	2419.28
Total (in MT)	3131.96	1.68	0.09	3199.69

C.2.2 Alternative 3

Equipment List and Vehicle Hours for 10 ac site

Fuel	Equipment	Hours	Horsepower	Load Factor	Gallons of Fuel
Gasoline	Air compressors	60	78	0.48	112
Diesel	Cement and Mortar Mixers	0	9	0.56	0
Diesel	Concrete/Industrial saws	160	81	0.738	478
Diesel	Cranes	1540	231	0.29	5158
Diesel	Excavators	528	158	0.38	1585
Diesel	Forklifts	3520	89	0.2	3133
Diesel	Generator sets	1760	84	0.74	5470
Diesel	Graders	48	187	0.41	184
Diesel	Pavers	160	130	0.42	437
Diesel	Paving equipment	160	132	0.36	380
Diesel	Rollers	160	80	0.38	243
Diesel	Rubber tired dozers	440	247	0.4	2174
Diesel	Scrapers	0	367	0.48	0
Diesel	Tractors/loaders/backhoes	1780	97	0.37	3194
Diesel	Welders	1760	46	0.45	1822

Assumptions:

HP and load factor taken from Capitol Annex DEIR

Assuming 0.05 gallons of fuel consumption per horsepower-hour

Emissions Factors

Fuel		Emissions Factors		
		CO2	CH4	N2O
		kg/gal	g/gal	g/gal
Gasoline	112.32	8.78	0.5	0.22
Diesel	24257.968	10.21	0.57	0.26

Emissions (MT)

Fuel	CO2	CH4	N2O	CO2-eq
Gasoline	1.0	0.0001	0.0000	1.0
Diesel	247.7	0.0138	0.0063	249.9

Note: CO2-eq is calculated by multiplying CO2, CH4, N2O by their respective global warming potential (GWP) and summing. This analysis uses GWP values from 40 CFR 98, Subpart A, Table A-1 (CO2 = 1, CH4 = 25, N2O = 298).

C.2.2.1 On-road vehicles

Vehicle	Emissions Factors			
	CO2 kg/gal fuel	CH4 g/mile	N2O g/mile	Fuel economy mpg
Passenger cars, gasoline	8.78	0.071	0.0046	24
Passenger trucks, gasoline	8.78	0.0095	0.0035	17.4
Heavy trucks, diesel single-unit short haul	10.21	0.95	0.0431	7.4

Source: AFDC

Source for fuel economy data: DOE Alternative Fuels Data Center Average Fuel Economy By Major Vehicle Category (<https://afdc.energy.gov/data/10310>)

Source for emission factors: EPA 2024 Emissions Factors Table 2 Mobile Combustion CO2, Table 3 Mobile Combustion CH4 and N2O for On-Road Gasoline Vehicle (<https://www.epa.gov/system/files/documents/2024-02/ghg-emission-factors-hub-2024.pdf>)

Vehicle	VMTs	Gal fuel	Emissions (MT)			
			CO2	CH4	N2O	CO2-eq
Passenger cars, gasoline	511100	21296	187	0.0362881	0.002351	188.6
Passenger trucks, gasoline	511100	29374	258	0.00485545	0.001789	258.6
Heavy trucks, diesel single-unit short haul	1733089	234201	2391	1.622731809	0.073621	2453.7

C.2.2.2 Greenhouse Gas Emissions Totals

	CO2	CH4	N2O	CO2-eq
Construction equipment	248.66	0.01	0.01	250.89
Worker vehicles	444.88	0.04	0.00	447.14
Delivery and waste trucks	2391.19	1.62	0.07	2453.70
Total (in MT)	3084.73	1.68	0.08	3151.73

Employees

36 Current
 56 Total, after expansion
 20 miles, one way commuting distance
 365 working days per year

Alternatives 2 and 3

Employee Commuting - Criteria Pollutants

817600 vehicle miles per year

Vehicle Type	Vehicle-miles per year	Emission Factors (g/mile)						Emissions (tons/year)					
		CO	Nox	PM10	PM2.5	SO2	VOC	CO	Nox	PM10	PM2.5	SO2	VOC
Passenger cars, gasoline	408800	2.87	0.12	0.03	0.02	0.01	0.17	1.30	0.05	0.02	0.01	0.00	0.08
Passenger trucks, gasoline	408800	5.02	0.31	0.05	0.03	0.01	0.28	2.28	0.14	0.02	0.01	0.00	0.13
Total								3.58	0.20	0.04	0.02	0.01	0.21

Employee Commuting - GHGs

Vehicle	Emissions Factors			Fuel economy (mpg)	Vehicle-miles per year	Gal fuel consumed	Emissions (MT/year)			
	CO2 (kg/gal)	CH4 (g/mile)	N2O (g/mile)				CO2	CH4	N2O	CO2-eq
Passenger cars, gasoline	8.78	0.071	0.0046	24	408800	17033	150	0.029025	0.00188	150.8
Passenger trucks, gasoline	8.78	0.0095	0.0035	17.4	408800	23494	206	0.003884	0.001431	206.8
Total							355.83	0.03	0.00	357.64

Source for fuel economy data: DOE Alternative Fuels Data Center Average Fuel Economy By Major Vehicle Category (<https://afdc.energy.gov/data/10310>)

Source for emission factors: EPA 2024 Emissions Factors Table 2 Mobile Combustion CO2, Table 3 Mobile Combustion CH4 and N2O for On-Road Gasoline Vehicle (<https://www.epa.gov/system/files/documents/2024-02/ghg-emission-factors-hub-2024.pdf>)

Emergency Generators - Criteria Pollutants

Generators		Horsepower		Operating Hours	
2		335		72	
Emissions Factors (lbs/hp-hr)					
CO	Nox	PM10	PM2.5	SO2	VOC
0.00768	0.0115	0.00251	0.00251	0.00235	0.00279

Source: USEPA 1996 AP 42, Fifth Edition, Volume I Chapter 3.3. Gasoline and Diesel Industrial Engines, Table 3.3-1

Generator Emissions (tons)						
	CO	Nox	PM10	PM2.5	SO2	VOC
Total	0.1852416	0.27738	0.0605412	0.060541	0.056682	0.0672948

Emergency Generators - Greenhouse Gases

Emissions Factors (lbs/hp-hr)			
CH4	N2O	CO2	CO2e
4.63E-05	9.26E-06	1.15	1.33

Source: 40 CFR 98 Subpart C Table C-1 and C-2

Generator Emissions (tons)				
	CH4	N2O	CO2	CO2e
Total	0.0011167	0.000223	27.738	32.0796

Combined Operational Emissions - Criteria Pollutants

Source	Criteria Pollutant Emissions (tons)					
	CO	NO ₂	PM ₁₀	PM _{2.5}	SO ₂	VOC
Employee POVs (increase)	3.58	0.20	0.04	0.02	0.01	0.21
Generator Usage	0.19	0.28	0.06	0.06	0.06	0.07
Total	3.77	0.47	0.10	0.08	0.06	0.27

Combined Operational Emissions - Greenhouse Gases

Source	GHG Emissions (metric tons per year)			
	CO2	CH4	N2O	CO2-eq
Employee POVs (increase)	355.832	0.033	0.003	357.642
Generator Usage	27.738	0.001	0.000	32.080
Total	384	0.03	0.00	390

No Action Alternative

Baseline Employee Commuting - Criteria Pollutants

525600 vehicle miles per year

Vehicle Type	Vehicle-miles per year	Emission Factors (g/mile)						Emissions (tons/year)					
		CO	Nox	PM10	PM2.5	SO2	VOC	CO	Nox	PM10	PM2.5	SO2	VOC
Passenger cars, gasoline	262800	2.87	0.12	0.03	0.02	0.01	0.17	0.84	0.04	0.01	0.01	0.00	0.05
Passenger trucks, gasoline	262800	5.02	0.31	0.05	0.03	0.01	0.28	1.47	0.09	0.02	0.01	0.00	0.08
Total								2.30	0.13	0.03	0.01	0.00	0.13

Baseline Employee Commuting - GHGs

Vehicle	Emissions Factors			Fuel economy (mpg)	Vehicle-miles per year	Gal fuel consumed	Emissions (MT/year)			
	CO2 (kg/gal)	CH4 (g/mile)	N2O (g/mile)				CO2	CH4	N2O	CO2-eq
Passenger cars, gasoline	8.78	0.071	0.0046	24	262800	10950	96	0.018659	0.001209	97.0
Passenger trucks, gasoline	8.78	0.0095	0.0035	17.4	262800	15103	133	0.002497	0.00092	132.9
Total							228.75	0.02	0.00	229.91

Source for fuel economy data: DOE Alternative Fuels Data Center Average Fuel Economy By Major Vehicle Category (<https://afdc.energy.gov/data/10310>)

Source for emission factors: EPA 2024 Emissions Factors Table 2 Mobile Combustion CO2, Table 3 Mobile Combustion CH4 and N2O for On-Road Gasoline Vehicle (<https://www.epa.gov/system/files/documents/2024-02/ghg-emission-factors-hub-2024.pdf>)

Baseline Emergency Generators - Criteria Pollutants

Generators		Horsepower	Operating Hours			
1		335	72			
Emissions Factors (lbs/hp-hr)						
CO	Nox	PM10	PM2.5	SO2	VOC	
0.00768	0.0115	0.00251	0.00251	0.00235	0.00279	

Source: USEPA 1996 AP 42, Fifth Edition, Volume I Chapter 3.3. Gasoline and Diesel Industrial Engines, Table 3.3-1

Generator Emissions (tons)						
	CO	Nox	PM10	PM2.5	SO2	VOC
Total	0.0926208	0.13869	0.030271	0.030271	0.028341	0.033647

Baseline Emergency Generators - Greenhouse Gases

Emissions Factors (lbs/hp-hr)			
CH4	N2O	CO2	CO2e
0.000046297	9.26E-06	1.15	1.33

Source: 40 CFR 98 Subpart C Table C-1 and C-2

Generator Emissions (tons)				
	CH4	N2O	CO2	CO2e
Total	0.00058342	0.000112	13.869	16.0398

Baseline Combined Operational Emissions - Criteria Pollutants

Source	Criteria Pollutant Emissions (tons)					
	CO	NO ₂	PM ₁₀	PM _{2.5}	SO ₂	VOC
Employee POVs (current)	2.3	0.13	0.03	0.01	0	0.13
Generator Usage	0.093	0.139	0.030	0.030	0.028	0.034
Total	2.393	0.269	0.060	0.040	0.028	0.164

Baseline Combined Operational Emissions - Greenhouse Gases

Source	GHG Emissions (metric tons per year)			
	CO2	CH4	N2O	CO2-eq
Employee POVs (current)	288.750	0.020	0.000	229.910
Generator Usage	13.869	0.001	0.000	16.040
Total	302.619	0.021	0.000	245.950

Construction Social Cost of Greenhouse Gases

SC-GHG (\$/metric ton)

Year	CO2		
	2.50%	2%	1.50%
2026	133	215	365

Source: <https://www.epa.gov/environmental-economics/scghg>

Alternative 2

SC-GHG (\$) Alternative 2

Year	CO2		
	2.50%	2%	1.50%
2026	416,550	673,371	1,143,164

Alternative 3

SC-GHG (\$) Alternative 3

Year	CO2		
	2.50%	2%	1.50%
2026	410,269.27	663,217.24	1,125,926.95

Operations Social Cost of Greenhouse Gases

SC-GHG (\$/metric ton)

Year	CO2		
	2.50%	2%	1.50%
2030	144	230	384
2035	158	248	408
2040	173	267	431
2045	189	287	456
2050	205	308	482

Alternatives 2 and 3

Year	CO2		
	2.50%	2%	1.50%
2030	55,234.11	88,221.15	147,290.96
2035	60,604.09	95,125.41	156,496.64
2040	66,357.65	102,413.25	165,318.76
2045	72,494.77	110,084.65	174,908.01
2050	78,631.89	118,139.62	184,880.84

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