Table 1-1. Summary of Construction GHG Emissions

Emission Source	CO_2 (metric tons)	CH_4 (metric tons)	N_2O (metric tons)	CO_2e (metric tons)	
Combustion	--	--	--	448.42	
Fence	1.25	1.94E-03	1.26E-03	1.31	
Land Use Change	--	--	--		14.30
Off-Site Waste	--	--	--		249.00
TOTAL	**1.25**	**1.94E-03**	**1.26E-03**	**713.04**	

Table 1-2. Summary of Operational GHG Emissions

Emission Source	CO_2 (metric tons/yr)	CH_4 (metric tons/yr)	N_2O (metric tons/yr)	CO_2e (metric tons/yr)
Combustion	--	--	--	0.48
Land Use Change	--	--	--	0.81
TOTAL	-	-	-	1.29

Table 2-1. Conversions

Unit	Amount	Unit
1 US ton	2000.00	lbs
1 US ton	0.91	metric tons
1 US ton	907.19	kg
1 US ton	907185.00	grams
1 lb	453.59	grams
1 MWh	1000.00	kWh
1 hectare	2.47	acres
1 MJ	0.37	hp-h
1 US gallon of diesel	144.95	MJ
1 US gallon of diesel	53.99	hp-h
1 US gallon of gasoline	126.83	MJ
1 US gallon of gasoline	47.25	hp-h

Table 2-2. Global Warming Potentials

Greenhouse Gas Name	CAS Number	Chemical Formula	Global Warming Potential (100-yr.) [1]
Carbon dioxide	124–38–9	CO_2	1
Methane	74–82–8	CH_4	28
Nitrous oxide	10024–97–2	N_2O	265

[1] Global warming potentials from 40 CFR 98.2

Table 3-1. Construction Emissions from Temporary Mobile Combustion

WORK ITEM	EQUIPMENT FOR INSTALL[1]	PRODUCTIVITY	UNITS	PRODUCTIVITY	UNITS	FUEL USAGE RATE[1]	UNITS	ESTIMATED QUANTITY	UNITS	DURATION	UNITS	DIESEL FUEL CONSUMPTION (GAL)	EMISSION FACTOR (MT CO2e/GAL)[2][3]	GHG EMISSIONS (metric tons CO2e)
Remove Bituminous Pavement 5"	*crew productivity*	690	SY/Day	**47,000**	**LBS/HR**	**23.5**	**GAL/HR**	800	SY	28	HOURS	654	0.01024	6.7
	Trenching 1 backhoe 148 hp					4	GAL/HR							
	1 Road Reclaimer, 540 HP					15	GAL/HR							
	1 F.E. Loader, W.M., 4 C.Y.					4.5	GAL/HR							
Concrete Pavement Removal	*crew productivity*	255	SY/Day	16,000	LBS/HR	**12.5**	**GAL/HR**	100	SY	9	HOURS	118	0.01024	1.2
	Trenching 1 backhoe 148 hp					4	GAL/HR							
	1 hyd. Hammer (1200 lbs)					4	GAL/HR							
	1 F.E. Loader, W.M., 4 C.Y.					4.5	GAL/HR							
Remove Concrete Pipe or Structure	*crew productivity*	120	LF/Day	2,500	LBS/HR	**4**	GAL/HR	200	LF	40	HOURS	160	0.01024	1.6
	1 backhoe 48 hp					4	GAL/HR							
Earthwork (w/ Excavators and Trucks)	*crew productivity*	500	BCY/HR	2,300,000	LBS/HR	**143**	**GAL/HR**	23,300	BCY	47	HOURS	6,641	0.01024	68.0
	(1) hydraulic excavator, 6 CY, CAT Model 385					13	GAL/HR							
	(5) Tractor Crawler Dozer, 400HP, D-9R					80	GAL/HR							
	(4) off-highway truck, 29 CY, 40 ton, 400D					40	GAL/HR							
	1 F.E. Loader, W.M., 4 C.Y.					4.5	GAL/HR							
	1 Roller, Vibratory, 25 Ton					5	GAL/HR							
Export Material to Landfill (Heavy Duty Truck)	*crew productivity*				HR									
	0.9564426	kg CO2e/ton-mile						900	TON-MILES					0.9
Dewatering	*crew productivity*				HR	**20**	**GAL/HR**	1,080	HR	1080	HOURS	21,600	0.01024	221.3
	1 portable 6" pump 175 HP					20	GAL/HR							
Aggregate Base	*crew productivity*	1625	TON/Day	406,250	LBS/HR	**24.5**	**GAL/HR**	373	TON	6	HOURS	135	0.01024	1.4
	1 Grader, 30,000+ LBS					7.5	GAL/HR							
	1 Dozer, 300 HP					10	GAL/HR							
	1 Roller, Vibratory, 25 Ton					5	GAL/HR							
	1 Truck Tractor, 450 HP					1	GAL/HR							
	1 Water Tank Trailer, 5000 Gal					1	GAL/HR							
Bituminous Pavement	*crew productivity*	5000	SY/Day	**200,000**	**LBS/HR**	**18**	**GAL/HR**	800	SY	4	HOURS	69	0.01024	0.7
	1 Asphalt Paver 130 HP					8	GAL/HR							
	1 Tandem Roller 10 Ton					5	GAL/HR							
	1 Roller Pneum Whl 12 Ton					5	GAL/HR							
Bit. Tack Coat	*crew productivity*	10000	SY/Day	**532**	**LBS/HR**	**21.9**	**GAL/HR**	800	SY	2	HOURS	42	0.01024	0.4
	1 Dist. Tanker 3000 Gallon					1	GAL/HR							
	1 Truck Tractor, 6x4, 380 HP					20.9	GAL/HR							
Concrete Pavement (Fixed Form)	*crew productivity*	500	SY/Day	232,031	LBS/HR	**28.5**	GAL/HR	100	SY	5	HOURS	137	0.01024	1.4
	1 Grader, 30,000+ LBS					7.5	GAL/HR							
	1 Paving Machine					8	GAL/HR							
	1 Concrete Pump Truck w/ Boom					13	GAL/HR							
Precast Concrete Pipe (24")	*crew productivity*	100	LF/Day	3,375	LBS/HR	**14**	**GAL/HR**	100	LF	24	HOURS	336	0.01024	3.4
	Trenching 1 backhoe 148 hp					4	GAL/HR							
	Backfilling 1 Dozer, 300 HP					10	GAL/HR							
Ductile Iron Pipe (12")	*crew productivity*	105	LF/Day	709	LBS/HR	**22**	GAL/HR	200	LF	46	HOURS	1,006	0.01024	10.3
	1 SP Crane, 12 Ton					8	GAL/HR							
	Trenching 1 backhoe 148 hp					4	GAL/HR							
	Backfilling 1 Dozer, 300 HP					10	GAL/HR							
Precast Concrete Pipe (48")	*crew productivity*	200	LF/Day	6,936	LBS/HR	**29**	GAL/HR	3,500	LF	420	HOURS	12,180	0.01024	124.8
	1 hyd crane, 55 ton					15	GAL/HR							
	Trenching 1 backhoe 148 hp					4	GAL/HR							
	Backfilling 1 Dozer, 300 HP					10	GAL/HR							
Backfill Compaction (Earth Sheepsfoot, 6" lifts, 4 passes)	*crew productivity*	2,600	ECY/Day		LBS/HR	5	GAL/HR	13000	CY	120	HOURS	600	0.01024	6.1
	1 Sheepsfoot Roller, 240 HP													
Large Rock Aggregate (Riprap, placed, layered)		200	CY/HR	70,000	LBS/HR	**13**	**GAL/HR**	200	CY	1	HOURS	13	0.01024	0.1
	2 F.E. Loader, W.M., 4 C.Y.					9	GAL/HR							
	1 backhoe 148 hp					4	GAL/HR							
TOTAL														**448.4**

[1] Based on engineering estimates from Cat Performance Handbook, Edition 29 (2012). https://www.cat.com/en_US/products/new/equipment.html

[2] Diesel combustion emission factors from EPA Center for Corporate Climate Leadership, Emission Factors for Greenhouse Gas Inventories, 2024. https://www.epa.gov/system/files/documents/2024-02/ghg-emission-factors-hub-2024.pdf, 10.21 kgCO2/gallon, 0.41 gCH4/gallon, 0.08 gN2O/gallon

[3] CO2e calculated using Global warming potentials from 40 CFR 98.2, CO2=1, CH4=25, N2O=298.

Table 3-2. Construction Emissions from Temporary Land Use Change

Temporary Land Use Change[1]	Area of Land Change[1] (acres)	2022 Net CO_2 Flux for Converted Land Type[2] (M metric tons CO_2e)	2022 Total US Land Use Change of Original Land Type[3] (thousands of hectares)	CO_2e Emission Factor (metric tons CO_2e/acre)	GHG Emissions CO_2e (metric tons/year)	Project Specific CO_2e Emissions[4] (metric tons)
Grassland to Settlement	1.58	7.5	1,648	1.84	2.91	0.65
Forest to Settlement	1.14	58.6	440	53.90	61.44	13.65
TOTAL	**2.72**	--	--	--	**64.35**	**14.30**

[1]

[2] Table 6-136. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 - 2022. https://www.epa.gov/system/files/documents/2024-02/us-ghg-inventory-2024-chapter-6-land-use-land-use-change-and-forestry.pdf

[3] Table 6-5: Land Use and Land-Use Change for the U.S. Managed Land Base for All 50 States, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 - 2022. https://www.epa.gov/system/files/documents/2024-02/us-ghg-inventory-2024-chapter-6-land-use-land-use-change-and-forestry.pdf

[4] Estimated project emissions are based off a 4 month construction time frame.

Table 3-3. Construction Emissions from Off-site Waste

Waste Type	Quantity Sent Off-site for Disposal (CY)[1]	Disposal Facility Type	CO_2e Emission Factor (metric tons CO_2e/tons of material)[2]	GHG Emissions CO_2e (metric tons)[3]
Contaminated Soil	8,300.00	Landfill	0.02	249.00
TOTAL				249.00

[1] [illegible]

[2] Waste emission factors from EPA Center for Corporate Climate Leadership, Emission Factors for Greenhouse Gas Inventories, 2024. https://www.epa.gov/system/files/documents/2024-02/ghg-emission-factors-hub-2024.pdf, Concrete material: 0.02 metric tons CO2e/ton of material.

[3] 1 cubic yard of aggregate, sand, or durt is equivalent to 1.5 tons. https://www.soildirect.com/calculator/cubic-yard-calculator/

Table 3-4. Construction Emissions from Fence Installation

Source	Estimated Hours of Operation [1]	Estimated Hp	Estimated hp-hr	Fuel Type	CO_2 Emissions (metric tons) [3],[5]	CH_4 Emissions (metric tons) [4],[5]	N_2O Emissions (metric tons) [4],[5]	GHG Emissions CO_2e (metric tons) [3]
Chainsaw	50	4	200	Gasoline	0.04	3.39E-04	5.08E-06	0.05
Mower	50	19	950	Gasoline	0.18	5.75E-04	2.98E-04	0.19
Skid Loader with Mounted Post Driver	50		5500	Diesel	1.04	1.03E-03	9.58E-04	1.07
TOTAL					**1.25**	**1.94E-03**	**1.26E-03**	**1.31**

[1] Total fence installation, including vegetation removal, will take 1 week per information from 3M. Assume 10hr work days for a 5 day week.

[2] Hr estimates are based on the following information:

Chainsaw: https://www.stihlusa.com/products/chain-saws/professional-saws/ms261/

Mower: https://www.deere.com/en/mowers/lawn-tractors/100-series/s110-lawn-tractor/

Skid Loader with Mounted Post Driver: https://www.cat.com/en_US/products/new/equipment/skid-steer-and-compact-track-loaders/skid-steer-loaders/30056688550099.htm

[3] CO_2 emissions calculated using the EPA CCCL emission factors for mobile combustion, Table 2: Mobile Combustion CO_2 2025. https://www.epa.gov/system/files/documents/2025-01/ghg-emission-factors-hub-2025.pdf

Fuel Type	CO2 Emission Factor (kg/gal)
Diesel Fuel	10.21
Motor Gasoline	8.78

[4] CH_4 and N_2O emissions calculated using the EPA CCCL emission factors for construction/mining equipment, Table 5: Mobile Combustion CH_4 and N_2O for Non-Road Vehicles, 2025. https://www.epa.gov/system/files/documents/2025-01/ghg-emiss

Vehicle Type	Fuel Type	CH4 Emission Factor (g/gal)	N2O Emission Factor (g/gal)
Construction/Mining Equipment	Gasoline (4 stroke)	2.86	1.48
Construction/Mining Equipment	Gasoline (2 stroke)	8.00	0.12
Construction/Mining Equipment	Diesel Equipment	1.01	0.94

[5] Emission factors converted to lb/hr using conversion rates of 53.993 hp-hr/gal for diesel and 47.246 hp-hr/gal for gasoline.

[6] CO_2e calculated by equation A-1 of 40 CFR 98.2, which states the total CO_2e is equal to the GWP for each pollutant multiplied by the potential pollutant emissions.

Table 3-1. Operational Emissions from Operational Maintenance Activities

WORK ITEM[1]	ESTIMATED QUANTITY	ESTIMATED QUANTITY UNITS	EMISSION FACTOR[2][3]	EMISSION FACTOR UNITS[2]	GHG EMISSIONS (metric tons CO2e/year)
Light-Duty Truck	500	vehicle-mile	0.962582	kg CO2e/vehicle-mile	0.48
TOTAL					0.48

[1] Based on engineering estimates from Cat Performance Handbook, Edition 29 (2012). https://www.cat.com/en_US/products/new/equipment.html

[2] Transportation combustion emission factors from EPA Center for Corporate Climate Leadership, Emission Factors for Greenhouse Gas Inventories, 2024. https://www.epa.gov/system/files/documents/2024-02/ghg-emission-factors-hub-2024.pdf, Light-Duty Truck: 0.955 kgCO2/vehicle-mile, 0.026 gCH4/vehicle-mile, 0.023 gN2O/vehicle-mile; Heavy-Duty Truck: 0.168 kgCO2/ton-mile, 0.0015 gCH4/ton-mile, 0.0047 gN2O/ton-mile

[3] CO2e calculated using Global warming potentials from 40 CFR 98.2, CO2=1, CH4=25, N2O=298.

Table 4-2. Operational Emissions from Land Use Change

Permanent Land Use Change[1]	Area of Land Change[1] (acres)	2022 Net CO_2 Flux for Converted Land Type[2] (M metric tons CO_2e)	2022 Total US Land Use Change of Original Land Type[3] (thousands of hectares)	CO_2e Emission Factor (metric tons CO_2e/acre)	GHG Emissions CO_2e (metric tons/year)	Project Specific CO_2e Emissions[4] (metric ton/year)
Grassland to Wetland	1.58	0.005	314	0.01	0.01	0.01
Forest to Wetland	1.07	0.040	76	0.21	0.23	0.23
Settlement to Wetland	0.23	0.005	2	1.01	0.23	0.23
Forest to Grassland	0.07	46.8	3,894	4.86	0.34	0.34
TOTAL	**2.95**	--	--	--	**0.81**	**0.81**

[1]

[2] Table 6-97. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 - 2022. https://www.epa.gov/system/files/documents/2024-02/us-ghg-inventory-2024-chapter-6-land-use-land-use-change-and-forestry.pdf

[3] Table 6-5: Land Use and Land-Use Change for the U.S. Managed Land Base for All 50 States, Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 - 2022. https://www.epa.gov/system/files/documents/2024-02/us-ghg-inventory-2024-chapter-6-land-use-land-use-change-and-forestry.pdf