

Mankato to Mississippi River Project  
GHG Calculations

Table 1. Summary of Construction GHG Emissions

Segment ID	Fuel Combustion CO <sub>2</sub> e <sup>[1]</sup> (metric tons)	Land Use Change CO <sub>2</sub> e <sup>[1]</sup> (metric tons)	Total CO <sub>2</sub> e <sup>[1]</sup> (metric tons)
Alignment Alternative 15	86.24	103.99	190.23
Alignment Alternative 15 Equivalent	96.16	118.52	214.68
Alignment Alternative 16	14.23	1.25	15.48
Alignment Alternative 16 Equivalent	14.10	0.17	14.27
Alignment Alternative 2	117.82	3.02	120.84
Alignment Alternative 2 Equivalent	118.15	3.89	122.04
Alignment Alternative 8	14.60	35.02	49.61
Alignment Alternative 8 Equivalent	14.85	35.68	50.53
North	5,903.53	1,033.15	6,936.68
Route Connector 4G	53.00	1.79	54.79
Route Connector 4Q	31.25	0.85	32.09
Route Segment 1	195.06	8.00	203.07
Route Segment 1 Equivalent	163.77	4.41	168.18
Route Segment 10	206.12	16.66	222.78
Route Segment 10 Equivalent	149.19	6.33	155.53
Route Segment 11	258.12	9.70	267.83
Route Segment 11 Equivalent	189.16	7.43	196.58
Route Segment 17 Hwy 14 Option	6,742.61	586.40	7,329.00
Route Segment 18	110.59	17.25	127.84
Route Segment 18 Equivalent	110.83	67.16	177.99
Route Segment 4C	87.25	3.05	90.31
Route Segment 4C Equivalent	86.01	3.43	89.45
Route Segment 4E	222.44	15.38	237.81
Route Segment 4E Equivalent	244.60	43.26	287.85
Route Segment 4M	70.76	1.52	72.28
Route Segment 4M Equivalent	71.33	7.31	78.63
Route Segment 4R	40.70	13.70	54.40
Route Segment 4R Equivalent	40.30	3.69	43.98
Route Segment 5	92.26	7.21	99.47
Route Segment 5 Equivalent	82.59	3.11	85.70
Route Segment 6	726.17	151.10	877.27
Route Segment 6 Equivalent	757.26	81.31	838.57
Route Segment 7	140.99	8.50	149.49
Route Segment 7 Equivalent	140.16	3.25	143.41
Route Segment 9	63.58	3.07	66.65
Route Segment 9 Equivalent	63.44	34.37	97.81
Segment 1 North	2,986.31	764.51	3,750.82
Segment 1 South	3,378.13	379.72	3,757.85
Segment 2 North	2,917.22	268.71	3,185.93
Segment 2 North-North Option	2,728.21	244.99	2,973.20
Segment 2 North-South Option	2,209.84	132.51	2,342.34
Segment 2 South	2,697.39	211.35	2,908.75
Segment 2 South-North Option	2,823.44	303.59	3,127.03
Segment 2 South-South Option	2,199.07	187.67	2,386.74
Segment 3	3,072.90	998.19	4,071.09
Segment 4 CapX Co-Locate Option	1,161.99	292.30	1,454.29
Segment 4 East	1,389.49	179.02	1,568.50
Segment 4 North-North Option	561.58	215.67	777.25
Segment 4 North-South Option	597.64	161.66	759.30
Segment 4 South-North Option	550.56	142.95	693.51
Segment 4 South-South Option	524.13	87.44	611.58
Segment 4 West	1,675.52	508.35	2,183.87
Segment 4 West Mod	1,611.02	419.82	2,030.85
South	5,766.25	590.97	6,357.22

[1] CO<sub>2</sub>e calculated by multiplying the Global Warming Potential (GWP) for each pollutant by the potential pollutant emissions. GWPs (100-Year Time Horizon) are from Table A-1 to Subpart A of Part 98, Title 40.

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Table 2. Summary of Operations GHG Emissions from Fuel Combustion

Segment ID	Off-Road Fuel Combustion CO <sub>2</sub> e <sup>[1]</sup> (metric tons/yr)	On-Road Fuel Combustion CO <sub>2</sub> e <sup>[1]</sup> (metric tons/yr)	Total CO <sub>2</sub> e <sup>[1]</sup> (metric tons/yr)
All	17.18	0.02	17.20

[1] CO<sub>2</sub>e calculated by multiplying the Global Warming Potential (GWP) for each pollutant by the potential pollutant emissions. GWPs (100-Year Time Horizon) are from Table A-1 to Subpart A of Part 98, Title 40.

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Table 3. Conversions

Unit	Amount	Unit
ton	2000	lbs
ton	0.907185	metric tons
ton	907.185	kg
ton	907185	grams
lb	0.453592	kg
lb	453.592	grams
MWh	1000	kWh
hectare	2.47105	acres
1 MJ	0.372506136	hp-h
US gallon	3.785	L
US gallon (diesel) <sup>[1]</sup>	144.945	MJ
US gallon (diesel)	53.9929019	hp-h
US gallon (gasoline) <sup>[1]</sup>	126.833	MJ
US gallon (gasoline)	47.24606261	hp-h
US gallon (jet fuel) <sup>[1]</sup>	142.2	MJ
US gallon (jet fuel)	52.97036342	hp-h

[1] US Energy Information Administration, 2024.  
<https://www.eia.gov/energyexplained/units-and-calculators/energy-conversion-calculators.php>  
 [2] [https://www.convertunits.com/from/MJ/to/gallon+\[U.S.\]+of+kerosene+type+jet+fuel](https://www.convertunits.com/from/MJ/to/gallon+[U.S.]+of+kerosene+type+jet+fuel)

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Table 4. Global Warming Potentials

Greenhouse Gas Name	CAS Number	Chemical Formula	Global Warming Potential (100-yr. ) [1]
Carbon dioxide	124–38–9	CO <sub>2</sub>	1
Methane	74–82–8	CH <sub>4</sub>	28
Nitrous oxide	10024–97–2	N <sub>2</sub> O	265

[1] Global Warming Potentials, 100-Year Time Horizon, Table A-1 to Subpart A of Part 98, Title 40.

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Table 5. Construction Emissions from Fuel Combustion Sources

Segment ID	Route Length <sup>[1]</sup> (miles)	CO <sub>2</sub> e <sup>[2]</sup> (metric tons)
Alignment Alternative 15	1.22	86.24
Alignment Alternative 15 Equivalent	1.36	96.16
Alignment Alternative 16	0.20	14.23
Alignment Alternative 16 Equivalent	0.20	14.10
Alignment Alternative 2	1.66	117.82
Alignment Alternative 2 Equivalent	1.67	118.15
Alignment Alternative 8	0.21	14.60
Alignment Alternative 8 Equivalent	0.21	14.85
North	83.32	5,903.53
Route Connector 4G	0.75	53.00
Route Connector 4Q	0.44	31.25
Route Segment 1	2.75	195.06
Route Segment 1 Equivalent	2.31	163.77
Route Segment 10	2.91	206.12
Route Segment 10 Equivalent	2.11	149.19
Route Segment 11	3.64	258.12
Route Segment 11 Equivalent	2.67	189.16
Route Segment 17 Hwy 14 Option	95.16	6,742.61
Route Segment 18	1.56	110.59
Route Segment 18 Equivalent	1.56	110.83
Route Segment 4C	1.23	87.25
Route Segment 4C Equivalent	1.21	86.01
Route Segment 4E	3.14	222.44
Route Segment 4E Equivalent	3.45	244.60
Route Segment 4M	1.00	70.76
Route Segment 4M Equivalent	1.01	71.33
Route Segment 4R	0.57	40.70
Route Segment 4R Equivalent	0.57	40.30
Route Segment 5	1.30	92.26
Route Segment 5 Equivalent	1.17	82.59
Route Segment 6	10.25	726.17
Route Segment 6 Equivalent	10.69	757.26
Route Segment 7	1.99	140.99
Route Segment 7 Equivalent	1.98	140.16
Route Segment 9	0.90	63.58
Route Segment 9 Equivalent	0.90	63.44
Segment 1 North	42.15	2,986.31
Segment 1 South	47.68	3,378.13
Segment 2 North	41.17	2,917.22
Segment 2 North-North Option	38.50	2,728.21
Segment 2 North-South Option	31.19	2,209.84
Segment 2 South	38.07	2,697.39
Segment 2 South-North Option	39.85	2,823.44
Segment 2 South-South Option	31.04	2,199.07
Segment 3	43.37	3,072.90
Segment 4 CapX Co-Locate Option	16.40	1,161.99
Segment 4 East	19.61	1,389.49
Segment 4 North-North Option	7.93	561.58
Segment 4 North-South Option	8.43	597.64
Segment 4 South-North Option	7.77	550.56
Segment 4 South-South Option	7.40	524.13
Segment 4 West	23.65	1,675.52
Segment 4 West Mod	22.74	1,611.02
South	81.38	5,766.25

[1] Route length obtained from GIS data analysis.

[2] CO<sub>2</sub> and CO<sub>2</sub>e rate calculated for the applicants' proposed route, in tons/mile. Approximate route length was obtained from the Route Permit Application.

Proposed Route Fuel Combustion CO <sub>2</sub> e (metric tons)	Approximate Route Length (miles)	CO <sub>2</sub> e Rate (metric tons/mile)
9,920.03	140.00	70.86

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Table 6. Construction Emissions from Off-Road Fuel Combustion Sources - Proposed Route Calculations

Equipment Type <sup>[1]</sup>	Fuel Type <sup>[2]</sup>	Number of Units <sup>[1]</sup>	Operating Time <sup>[1]</sup> (hours/day/unit)	Days of Operation <sup>[1]</sup>	Operating Time <sup>[1]</sup> (total hours)	Horsepower <sup>[1]</sup>	CO <sub>2</sub> Emission Factor <sup>[3]</sup> (kg/gal)	CH <sub>4</sub> Emission Factor <sup>[4]</sup> (g/gal)	N <sub>2</sub> O Emission Factor <sup>[4]</sup> (g/gal)	CO <sub>2</sub> Emission Factor <sup>[5]</sup> (lb/hr)	CH <sub>4</sub> Emission Factor <sup>[5]</sup> (lb/hr)	N <sub>2</sub> O Emission Factor <sup>[5]</sup> (lb/hr)	CO <sub>2</sub> (metric tons)	CH <sub>4</sub> (metric tons)	N <sub>2</sub> O (metric tons)	CO <sub>2</sub> e <sup>[6]</sup> (metric tons)
ATV 4 TO 6 WHEEL, W/ DUMP	Gasoline (4 stroke) - Recreational	1	2	150	300	13.5	8.78	2.74	1.49	5.53	0.00173	0.00094	0.75	2.35E-04	1.28E-04	0.79
BACKHOE W/ LOADER 4X4	Diesel Equipment	2	2	216	864	94	10.21	1.01	0.94	39.19	0.00388	0.00361	15.36	1.52E-03	1.41E-03	15.78
BUCKET 105' WORK HEIGHT	Diesel Equipment	3	8	360	8,640	300	10.21	1.01	0.94	125.07	0.01237	0.01151	490.14	4.85E-02	4.51E-02	503.46
BUCKET 125' WORK HEIGHT 8X6	Diesel Equipment	1	8	360	2,880	350	10.21	1.01	0.94	145.91	0.01443	0.01343	190.61	1.89E-02	1.75E-02	195.79
BUCKET 77' WORK HEIGHT SWAMP TRK MTD	Diesel Equipment	2	8	150	2,400	300	10.21	1.01	0.94	125.07	0.01237	0.01151	136.15	1.35E-02	1.25E-02	139.85
TRUCK MTD 4 T ARTICULATING BOOM W/ FORKS & CLAM	Diesel Equipment	1	2	216	432	450	10.21	1.01	0.94	187.60	0.01856	0.01727	36.76	3.64E-03	3.38E-03	37.76
CRANE TRUCK 45 T HYDRAULIC 6 AXLE	Diesel Equipment	6	8	360	17,280	450	10.21	1.01	0.94	187.60	0.01856	0.01727	1,470.43	1.45E-01	1.35E-01	1,510.38
DIGGER DERRICK 15 T CAP	Diesel Equipment	4	8	360	11,520	330	10.21	1.01	0.94	137.57	0.01361	0.01267	718.88	7.11E-02	6.62E-02	738.41
DIGGER DERRICK 15 T CAP SWAMP TRACK	Diesel Equipment	2	8	150	2,400	300	10.21	1.01	0.94	125.07	0.01237	0.01151	136.15	1.35E-02	1.25E-02	139.85
DOZER 10 THRU 12 T, W/ WINCH	Diesel Equipment	1	4	216	864	80	10.21	1.01	0.94	33.35	0.00330	0.00307	13.07	1.29E-03	1.20E-03	13.43
DOZER 18 T W/ WINCH	Diesel Equipment	1	4	216	864	190	10.21	1.01	0.94	79.21	0.00784	0.00729	31.04	3.07E-03	2.86E-03	31.89
CRAWLER CARRIER W/ 360 DUMP BOX OR DOZER 18 T W/ WINCH	Diesel Equipment	1	6	150	900	80	10.21	1.01	0.94	33.35	0.00330	0.00307	13.62	1.35E-03	1.25E-03	13.99
EXCAVATOR 25 T	Diesel Equipment	1	4	150	600	172	10.21	1.01	0.94	71.71	0.00709	0.00660	19.52	1.93E-03	1.80E-03	20.05
FORKLIFT 11,000 THRU 12,000# TELESCOPIC BOOM	Diesel Equipment	3	4	360	4,320	142	10.21	1.01	0.94	59.20	0.00586	0.00545	116.00	1.15E-02	1.07E-02	119.15
FRONT END LOADER 68,000# 4X4	Diesel Equipment	4	4	360	5,760	386	10.21	1.01	0.94	160.92	0.01592	0.01482	420.44	4.16E-02	3.87E-02	431.86
GENERATOR 23KW THRU 60KW TRAILER MOUNTED TOW TYPE	Diesel Equipment	4	8	200	6,400	38	10.21	1.01	0.94	15.84	0.00157	0.00146	45.99	4.55E-03	4.23E-03	47.24
HYDRAULIC BULLWHEEL BUNDLE TENSIONER	Diesel Equipment	1	2	180	360	80	10.21	1.01	0.94	33.35	0.00330	0.00307	5.45	5.39E-04	5.01E-04	5.59
PULLER ROPE TRAILER 4,000# CAP W/ SPLIT REEL TOW TYPE TANDEM AXLE	Diesel Equipment	1	2	180	360	74	10.21	1.01	0.94	30.85	0.00305	0.00284	5.04	4.98E-04	4.64E-04	5.17
PULLER CABLE TRAILER 30,000# CAP TOW TYPE TANDEM AXLE	Diesel Equipment	1	2	180	360	400	10.21	1.01	0.94	166.76	0.01650	0.01535	27.23	2.69E-03	2.51E-03	27.97
PULLER ROPE TRAILER 4 DRUM 3,500# CAP TOW TYPE TANDEM AXLE	Diesel Equipment	1	2	180	360	115	10.21	1.01	0.94	47.94	0.00474	0.00441	7.83	7.74E-04	7.21E-04	8.04
300T AT Setting Crane	Diesel Equipment	1	6	300	1,800	577	10.21	1.01	0.94	240.55	0.02380	0.02215	196.40	1.94E-02	1.81E-02	201.73
60T RT Crane	Diesel Equipment	4	4	360	5,760	320	10.21	1.01	0.94	133.41	0.01320	0.01228	348.55	3.45E-02	3.21E-02	358.02
SKID STEER LOADER TRACK MTD 80 > 75 HP	Diesel Equipment	5	4	360	7,200	95	10.21	1.01	0.94	39.60	0.00392	0.00365	129.34	1.28E-02	1.19E-02	132.86
DUMP BOX TRUCK 2-1/2 T 6X6	Diesel Off-Road Trucks	1	2	360	720	505	10.21	0.92	0.56	210.53	0.01897	0.01155	68.76	6.20E-03	3.77E-03	69.93
DUMP BOX TRUCK 1-1/4 & 1-1/2 T	Diesel Off-Road Trucks	2	4	360	2,880	420	10.21	0.92	0.56	175.09	0.01578	0.00960	228.73	2.06E-02	1.25E-02	232.64
FLATBED (FRAMING) TRUCK 1-1/4 & 1-1/2 T	Diesel Off-Road Trucks	6	4	360	8,640	420	10.21	0.92	0.56	175.09	0.01578	0.00960	686.20	6.18E-02	3.76E-02	697.91
PICKUP TRUCK 3/4 T	Diesel Off-Road Trucks	14	8	360	40,320	420	10.21	0.92	0.56	175.09	0.01578	0.00960	3,202.28	2.89E-01	1.76E-01	3,256.90
TRUCK TRACTOR 2-1/2 T 6X4 & 5 T 6X6	Diesel Off-Road Trucks	6	4	216	5,184	450	10.21	0.92	0.56	187.60	0.01690	0.01029	441.13	3.97E-02	2.42E-02	448.66
TOTAL	--	--			--	--	--	--	--	--	--	--	9,201.85	0.87	0.68	9,405.08

[1] Equipment and usage data obtained from Appendix T of Mankato to Mississippi River Project Route Permit Application.  
[2] Fuel type assumed based on equipment type.  
[3] CO<sub>2</sub> emissions calculated using the EPA CCCL emission factors for mobile combustion, Table 2: Mobile Combustion CO<sub>2</sub> 2025. <https://www.epa.gov/system/files/documents/2025-01/ghg-emission-factors-hub-2025.pdf>

Fuel Type	CO <sub>2</sub> Emission Factor (kg/gal)
Diesel Fuel	10.21
Motor Gasoline	8.78

[4] CH<sub>4</sub> and N<sub>2</sub>O emissions calculated using the EPA CCCL emission factors for construction/mining equipment, Table 5: Mobile Combustion CH<sub>4</sub> and N<sub>2</sub>O for Non-Road Vehicles, 2025. <https://www.epa.gov/system/files/documents/2025-01/ghg-emission-factors-hub-2025.pdf>

Vehicle Type	Fuel Type	CH <sub>4</sub> Emission Factor (g/gal)	N <sub>2</sub> O Emission Factor (g/gal)
Construction/Mining Equipment	Diesel Equipment	1.01	0.94
Construction/Mining Equipment	Diesel Off-Road Trucks	0.92	0.56
Recreational Equipment	Gasoline (4 stroke) - Recreation	2.74	1.49

[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<sub>2</sub>e calculated by multiplying the Global Warming Potential (GWP) for each pollutant by the potential pollutant emissions. GWPs (100-Year Time Horizon) are from Table A-1 to Subpart A of Part 98, Title 40.

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Table 7. Construction Emissions from On-Road Fuel Combustion Sources - Proposed Route Calculations

Vehicle Type <sup>[1]</sup>	Fuel Type <sup>[1]</sup>	Total Miles Traveled <sup>[1]</sup>	Fuel Efficiency <sup>[2]</sup> (miles/gal)	Fuel Used (gal)	CO <sub>2</sub> Emission Factor <sup>[3]</sup> (kg/gal)	CH <sub>4</sub> Emission Factor <sup>[4][5]</sup> (g/vehicle-mile)	N <sub>2</sub> O Emission Factor <sup>[4][5]</sup> (g/vehicle-mile)	CO <sub>2</sub> (metric tons)	CH <sub>4</sub> (metric tons)	N <sub>2</sub> O (metric tons)	CO <sub>2</sub> e <sup>[6]</sup> (metric tons)
Worker Commute (Gas Passenger Truck)	Gasoline	1,313,550	22.8	57,612	8.78	0.0079	0.0012	505.83	1.04E-02	1.58E-03	506.54
Material Hauling (Single Unit Truck)	Diesel	6,450	7.9	816	10.21	0.0095	0.0431	8.34	6.13E-05	2.78E-04	8.41
TOTAL	--	--		--	--	--	--	514.17	0.01	0.00	514.95

[1] Equipment, fuel type, and total miles traveled obtained from Appendix T of Mankato to Mississippi River Project Route Permit Application.

[2] Fuel efficiency from 2022 values from U.S. Department of Transportation, Federal Highway Administration, Highway Statistics (Washington, DC: Annual Issues), Table VM-1. <https://www.fhwa.dot.gov/policyinformation/statistics/2022/vm1.cfm>

	Average Fuel Consumption (miles/gal)
Vehicle Type	
All Light Duty Vehicles	22.8
Single-Unit Trucks	7.9

[3] CO<sub>2</sub> emissions calculated using the EPA CCCL emission factors for mobile combustion,

Table 2: Mobile Combustion CO<sub>2</sub>, 2025. <https://www.epa.gov/system/files/documents/2025-01/ghg-emission-factors-hub-2025.pdf>

	CO <sub>2</sub> Emission Factor (kg/gal)
Fuel Type	
Diesel Fuel	10.21
Motor Gasoline	8.78

[4] CH<sub>4</sub> and N<sub>2</sub>O emissions calculated using the EPA CCCL emission factors for on-road gasoline vehicles,

Table 3: Mobile Combustion CH<sub>4</sub> and N<sub>2</sub>O for On-Road Gasoline Vehicles, 2025. <https://www.epa.gov/system/files/documents/2025-01/ghg-emission-factors-hub-2025.pdf>

		CH <sub>4</sub> Emission Factor (g/gal)	N <sub>2</sub> O Emission Factor (g/gal)
Vehicle Type	Model Year		
Gasoline Light-Duty Trucks	2022	0.0079	0.0012

[5] CH<sub>4</sub> and N<sub>2</sub>O emissions calculated using the EPA CCCL emission factors for on-road diesel vehicles,

Table 4: Mobile Combustion CH<sub>4</sub> and N<sub>2</sub>O for On-Road Diesel and Alternative Fuel Vehicles, 2025. <https://www.epa.gov/system/files/documents/2025-01/ghg-emission-factors-hub-2025.pdf>

		CH <sub>4</sub> Emission Factor (g/gal)	N <sub>2</sub> O Emission Factor (g/gal)
Vehicle Type	Model Year		
Medium- and Heavy-Duty Trucks	2007-2022	0.0095	0.0431

[6] CO<sub>2</sub>e calculated by multiplying the Global Warming Potential (GWP) for each pollutant by the potential pollutant emissions. GWPs (100-Year Time Horizon) are from Table A-1 to Subpart A of Part 98, Title 40.

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Table 8. Land Use Change Emission Factor Calculations

Temporary Land Use Change	2022 Net CO <sub>2</sub> Flux for Converted Land Type <sup>[1]</sup> (M metric tons CO <sub>2</sub> e)	2022 Total US Land Use Change from Forest Land <sup>[2]</sup> (thousands of hectares)	CO <sub>2</sub> e Emission Factor (metric tons CO <sub>2</sub> e/acre)
Forest Land to Grassland	46.8	3,894	4.86
Cropland to Grassland	(12.5)	11,444	(0.44)
Settlement to Grassland	(0.8)	93	(3.48)
Forest Land to Settlement	58.6	440	53.90
Cropland to Settlement	2.9	1,228	0.96
Grassland to Settlement	7.5	1,648	1.84

[1] Net CO<sub>2</sub> flux tables for converted land types. Inventory of U.S. Greenhouse Gas Emissions and Sinks: 1990 - 2022.

<https://www.epa.gov/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2022>

[2] 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/ghgemissions/inventory-us-greenhouse-gas-emissions-and-sinks-1990-2022>



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Table 9. Construction Emissions from Land Use Change

Regional Segment or Refinement	Temporary Land Use Change from Forest Land to Settlement <sup>[1]</sup> (acres)	Temporary Land Use Change from Cropland to Settlement <sup>[1]</sup> (acres)	Temporary Land Use Change from Grassland to Settlement <sup>[1]</sup> (acres)	CO <sub>2</sub> e <sup>[2][3]</sup> (metric tons)
Alignment Alternative 15	11.57	7.84	0.73	103.99
Alignment Alternative 15 Equivalent	13.21	3.14	3.31	118.52
Alignment Alternative 16	0.08	0.01	1.64	1.25
Alignment Alternative 16 Equivalent	0.00	0.79	0.10	0.17
Alignment Alternative 2	-	16.92	1.20	3.02
Alignment Alternative 2 Equivalent	-	22.65	1.10	3.89
Alignment Alternative 8	3.95	-	-	35.02
Alignment Alternative 8 Equivalent	4.03	-	-	35.68
North	95.14	1,024.25	96.77	1,033.15
Route Connector 4G	-	11.04	0.19	1.79
Route Connector 4Q	-	2.38	1.57	0.85
Route Segment 1	0.32	20.23	6.54	8.00
Route Segment 1 Equivalent	-	22.99	2.64	4.41
Route Segment 10	0.94	45.08	4.25	16.66
Route Segment 10 Equivalent	0.38	17.53	0.69	6.33
Route Segment 11	-	53.41	4.33	9.70
Route Segment 11 Equivalent	0.39	24.11	0.69	7.43
Route Segment 17 Hwy 14 Option	42.34	1,207.93	71.05	586.40
Route Segment 18	1.49	25.57	0.15	17.25
Route Segment 18 Equivalent	7.22	20.48	-	67.16
Route Segment 4C	-	19.01	0.22	3.05
Route Segment 4C Equivalent	-	21.86	-	3.43
Route Segment 4E	1.04	26.20	6.88	15.38
Route Segment 4E Equivalent	3.99	34.70	8.15	43.26
Route Segment 4M	-	4.67	2.60	1.52
Route Segment 4M Equivalent	0.50	16.97	0.73	7.31
Route Segment 4R	1.38	8.50	0.34	13.70
Route Segment 4R Equivalent	0.25	9.50	-	3.69
Route Segment 5	0.44	21.24	-	7.21
Route Segment 5 Equivalent	0.11	13.33	0.22	3.11
Route Segment 6	16.16	48.89	0.86	151.10
Route Segment 6 Equivalent	8.47	40.16	-	81.31
Route Segment 7	0.32	35.85	-	8.50
Route Segment 7 Equivalent	0.03	19.13	-	3.25
Route Segment 9	0.07	15.87	-	3.07
Route Segment 9 Equivalent	3.66	12.59	-	34.37
Segment 1 North	74.80	534.94	58.64	764.51
Segment 1 South	33.10	458.03	48.06	379.72
Segment 2 North	20.34	489.72	38.13	268.71
Segment 2 North-North Option	18.50	447.56	35.63	244.99
Segment 2 North-South Option	5.80	479.20	19.26	132.51
Segment 2 South	13.68	499.52	38.61	211.35
Segment 2 South-North Option	24.53	446.89	52.91	303.59
Segment 2 South-South Option	11.84	457.31	36.21	187.67
Segment 3	100.35	560.35	69.67	998.19
Segment 4 CapX Co-Locate Option	28.10	238.32	19.59	292.30
Segment 4 East	16.16	151.12	39.84	179.02
Segment 4 North-North Option	22.68	71.63	11.39	215.67
Segment 4 North-South Option	16.59	50.01	22.47	161.66
Segment 4 South-North Option	14.57	63.78	12.58	142.95
Segment 4 South-South Option	8.48	37.40	21.18	87.44
Segment 4 West	51.04	305.14	27.12	508.35
Segment 4 West Mod	41.72	267.39	27.09	419.82
South	46.77	957.13	86.50	590.97

[1] Land use areas obtained from the National Land Cover Database for the ROW (75 feet).

[2] See land use change emission factors calculation table.

[3] Emissions are calculated for an assumed 60-day duration of temporary disturbance.

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Table 10. Operations Emissions from Off-Road Fuel Combustion Sources - Proposed Route Calculations

Equipment Type <sup>[1]</sup>	Fuel Type <sup>[2]</sup>	Number of Units <sup>[1]</sup>	Annual Operating Time <sup>[1]</sup> (hours)	Horsepower <sup>[1]</sup>	Fuel Usage <sup>[1]</sup> (kg)	Fuel Usage <sup>[3]</sup> (gal)	CO <sub>2</sub> Emission Factor <sup>[4]</sup> (kg/gal)	CH <sub>4</sub> Emission Factor <sup>[5]</sup> (g/gal)	N <sub>2</sub> O Emission Factor <sup>[5]</sup> (g/gal)	CO <sub>2</sub> Emission Factor <sup>[6]</sup> (lb/hr)	CH <sub>4</sub> Emission Factor <sup>[6]</sup> (lb/hr)	N <sub>2</sub> O Emission Factor <sup>[6]</sup> (lb/hr)	CO <sub>2</sub> (metric tons/yr)	CH <sub>4</sub> (metric tons/yr)	N <sub>2</sub> O (metric tons/yr)	CO <sub>2</sub> e <sup>[7]</sup> (metric tons/yr)
E4_OTL_EQP_PICKUP TRUCK-F350_CREW CAB_8001-11K_4X4	Diesel Off-Road Trucks	1	15	500	--	--	10.21	0.92	0.56	208.45	0.01878	0.01143	1.42	1.28E-04	7.78E-05	1.44
K8_OTL_EQP_HEAVY BUCKET TRUCK100 FT_RUBBER TIRE_6X6	Diesel Equipment	1	15	500	--	--	10.21	1.01	0.94	208.45	0.02062	0.01919	1.42	1.40E-04	1.31E-04	1.46
N4_OTL_EQP_TRUCK MOUNTEDCRANE_45T/50T_RUBBER TIRE	Diesel Equipment	1	15	500	--	--	10.21	1.01	0.94	208.45	0.02062	0.01919	1.42	1.40E-04	1.31E-04	1.46
S2_OTL_EQP_BACKHOE-LOADER RUBBER TIRE_4X4	Diesel Equipment	1	15	120	--	--	10.21	1.01	0.94	50.03	0.00495	0.00461	0.34	3.37E-05	3.13E-05	0.35
U1_OTL_EQP_SKID STEERLOADER_TRACKED	Diesel Equipment	1	15	120	--	--	10.21	1.01	0.94	50.03	0.00495	0.00461	0.34	3.37E-05	3.13E-05	0.35
W2_OTL_EQP_ATV/UTV POLARIS/CANAM/ARGO_RUBBER	Diesel Equipment	1	60	25	--	--	10.21	1.01	0.94	10.42	0.00103	0.00096	0.28	2.81E-05	2.61E-05	0.29
R1_OTL_EQP_TRAILERUTV/FRAMING/ENCLOS ED_<=12K_RU BBER TIRE_TAN	Diesel Equipment	1	60	120	--	--	10.21	1.01	0.94	50.03	0.00495	0.00461	1.36	1.35E-04	1.25E-04	1.40
D2_OTL_EQP_PICKUP TRUCK-F150_6001-8K_4X4	Diesel Equipment	1	60	500	--	--	10.21	1.01	0.94	208.45	0.02062	0.01919	5.67	5.61E-04	5.22E-04	5.83
R2_OTL_EQP_TRAILER MEDIUMQUIP_12001-20K_RUBBER TIRE_TANDEM	Diesel Equipment	1	15	120	--	--	10.21	1.01	0.94	50.03	0.00495	0.00461	0.34	3.37E-05	3.13E-05	0.35
R3_OTL_EQP_TRAILER LARGEQUIP_>20K_RUBBER TIRE_TANDEM	Diesel Equipment	1	15	120	--	--	10.21	1.01	0.94	50.03	0.00495	0.00461	0.34	3.37E-05	3.13E-05	0.35
Helicopter - Ground Idle Engine	Jet Fuel	1	1	55	52.79	17.35	9.75	0.00	0.30	--	--	--	0.17	0.00E+00	5.20E-06	0.17
Helicopter - Hover and Climb Engine Mode	Jet Fuel	1	1.25	365	147.17	48.36	9.75	0.00	0.30	--	--	--	0.47	0.00E+00	1.45E-05	0.48
Helicopter - Approach Engine Mode	Jet Fuel	1	1.25	193	112.43	36.95	9.75	0.00	0.30	--	--	--	0.36	0.00E+00	1.11E-05	0.36
Helicopter - Flight Engine Mode	Jet Fuel	1	8	336	898.21	295.16	9.75	0.00	0.30	--	--	--	2.88	0.00E+00	8.85E-05	2.90
TOTAL	--	--	--	--	--	--	--	--	--	--	--	--	16.81	0.00	0.00	17.18

[1] Equipment and usage data obtained from Appendix T of Mankato to Mississippi River Project Route Permit Application.

[2] Fuel type assumed based on equipment type.

[3] Fuel usage converted using a density of 0.804 kg/L for jet fuel. <https://whycalculator.com/jet-fuel-weight-calculator/>

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

Fuel Type	CO <sub>2</sub> Emission Factor (kg/gal)
Diesel Fuel	10.21
Kerosene-Type Jet Fuel	9.75

[5] CH<sub>4</sub> and N<sub>2</sub>O emissions calculated using the EPA CCCL emission factors for construction/mining equipment, Table 5: Mobile Combustion CH<sub>4</sub> and N<sub>2</sub>O for Non-Road Vehicles, 2025. <https://www.epa.gov/system/files/documents/2025-01/ghg-emission-factors-hub-2025.pdf>

Vehicle Type	Fuel Type	CH <sub>4</sub> Emission Factor (g/gal)	N <sub>2</sub> O Emission Factor (g/gal)
Construction/Mining Equipment	Diesel Equipment	1.01	0.94
Construction/Mining Equipment	Diesel Off-Road Trucks	0.92	0.56
Aircraft	Jet Fuel	-	0.30

[6] Emission factors converted to lb/hr using conversion rates of 53.993 hp-hr/gal for diesel and jet fuel.

[7] CO<sub>2</sub>e calculated by multiplying the Global Warming Potential (GWP) for each pollutant by the potential pollutant emissions. GWPs (100-Year Time Horizon) are from Table A-1 to Subpart A of Part 98, Title 40.

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Table 11. Operations Emissions from On-Road Fuel Combustion Sources - Proposed Route Calculations

Vehicle Type <sup>[1]</sup>	Fuel Type <sup>[1]</sup>	Annual Miles Traveled <sup>[1]</sup>	Fuel Efficiency <sup>[2]</sup> (miles/gal)	Fuel Used (gal)	CO <sub>2</sub> Emission Factor <sup>[3]</sup> (kg/gal)	CH <sub>4</sub> Emission Factor <sup>[4]</sup> (g/vehicle-mile)	N <sub>2</sub> O Emission Factor <sup>[4]</sup> (g/vehicle-mile)	CO <sub>2</sub> (metric tons/yr)	CH <sub>4</sub> (metric tons/yr)	N <sub>2</sub> O (metric tons/yr)	CO <sub>2</sub> e <sup>[5]</sup> (metric tons/yr)
Worker Commute (Gas Passenger Truck)	Gasoline	40.5	22.8	2	8.78	0.0079	0.0012	0.02	3.20E-07	4.86E-08	0.02
TOTAL	--	--		--	--	--	--	0.02	0.00	0.00	0.02

[1] Equipment, fuel type, and total miles traveled obtained from Appendix T of Mankato to Mississippi River Project Route Permit Application.  
[2] Fuel efficiency from 2022 values from U.S. Department of Transportation, Federal Highway Administration, Highway Statistics (Washington, DC: Annual Issues), Table VM-1. <https://www.fhwa.dot.gov/policyinformation/statistics/2022/vm1.cfm>

Vehicle Type	Average Fuel Consumption (miles/gal)
All Light Duty Vehicles	22.8

[3] CO2 emissions calculated using the EPA CCCL emission factors for mobile combustion,  
Table 2: Mobile Combustion CO2, 2025. <https://www.epa.gov/system/files/documents/2025-01/ghg-emission-factors-hub-2025.pdf>

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

[4] CH<sub>4</sub> and N<sub>2</sub>O emissions calculated using the EPA CCCL emission factors for on-road gasoline vehicles,  
Table 3: Mobile Combustion CH4 and N2O for On-Road Gasoline Vehicles, 2025. <https://www.epa.gov/system/files/documents/2025-01/ghg-emission-factors-hub-2025.pdf>

Vehicle Type	Model Year	CH4 Emission Factor (g/gal)	N2O Emission Factor (g/gal)
Gasoline Light-Duty Trucks	2022	0.0079	0.0012

[5] CO<sub>2</sub>e calculated by multiplying the Global Warming Potential (GWP) for each pollutant by the potential pollutant emissions. GWPs (100-Year Time Horizon) are from Table A-1 to Subpart A of Part 98, Title 40.

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**Table 12. Operations Emissions from Land Use Change**

Segment ID	Land Use Change from Forest Land to Grassland <sup>[1]</sup> (acres)	Land Use Change from Cropland to Grassland <sup>[1]</sup> (acres)	Land Use Change from Settlement to Grassland <sup>[1]</sup> (acres)	CO <sub>2</sub> e <sup>[2][3]</sup> (metric tons/yr)
Alignment Alternative 15	12	8	1	49.33
Alignment Alternative 15 Equivalent	13	3	0	61.18
Alignment Alternative 16	0	0	2	(7.59)
Alignment Alternative 16 Equivalent	0	1	3	(11.19)
Alignment Alternative 2	-	17	11	(45.59)
Alignment Alternative 2 Equivalent	-	23	6	(32.24)
Alignment Alternative 8	4	-	0	18.53
Alignment Alternative 8 Equivalent	4	-	0	18.93
North	95	1,024	295	(1,017.16)
Route Connector 4G	-	11	3	(14.54)
Route Connector 4Q	-	2	4	(16.64)
Route Segment 1	0	20	23	(88.53)
Route Segment 1 Equivalent	-	23	16	(67.36)
Route Segment 10	1	45	3	(25.83)
Route Segment 10 Equivalent	0	18	20	(75.78)
Route Segment 11	-	53	9	(54.20)
Route Segment 11 Equivalent	0	24	24	(91.43)
Route Segment 17 Hwy 14 Option	42	1,208	357	(1,570.53)
Route Segment 18	1	26	2	(9.54)
Route Segment 18 Equivalent	7	20	1	22.61
Route Segment 4C	-	19	4	(20.71)
Route Segment 4C Equivalent	-	22	1	(11.72)
Route Segment 4E	1	26	23	(87.89)
Route Segment 4E Equivalent	4	35	16	(52.67)
Route Segment 4M	-	5	11	(41.29)
Route Segment 4M Equivalent	0	17	0	(6.76)
Route Segment 4R	1	8	1	0.90
Route Segment 4R Equivalent	0	10	1	(6.36)
Route Segment 5	0	21	2	(15.49)
Route Segment 5 Equivalent	0	13	8	(32.88)
Route Segment 6	16	49	1	52.43
Route Segment 6 Equivalent	8	40	27	(69.38)
Route Segment 7	0	36	0	(15.63)
Route Segment 7 Equivalent	0	19	17	(68.18)

**Mankato to Mississippi River Project**  
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**Table 12. Operations Emissions from Land Use Change**

Segment ID	Land Use Change from Forest Land to Grassland <sup>[1]</sup> (acres)	Land Use Change from Cropland to Grassland <sup>[1]</sup> (acres)	Land Use Change from Settlement to Grassland <sup>[1]</sup> (acres)	CO <sub>2</sub> e <sup>[2][3]</sup> (metric tons/yr)
Route Segment 9	0	16	1	(9.44)
Route Segment 9 Equivalent	4	13	0	10.69
Segment 1 North	75	535	96	(205.35)
Segment 1 South	33	458	326	(1,175.49)
Segment 2 North	20	490	199	(812.00)
Segment 2 North-North Option	18	448	198	(795.56)
Segment 2 North-South Option	6	479	62	(400.47)
Segment 2 South	14	500	61	(367.18)
Segment 2 South-North Option	25	447	200	(774.43)
Segment 2 South-South Option	12	457	59	(350.64)
Segment 3	100	560	52	59.66
Segment 4 CapX Co-Locate Option	28	238	10	(2.35)
Segment 4 East	16	151	149	(507.18)
Segment 4 North-North Option	23	72	38	(54.89)
Segment 4 North-South Option	17	50	64	(164.78)
Segment 4 South-North Option	15	64	51	(133.64)
Segment 4 South-South Option	8	37	68	(211.02)
Segment 4 West	51	305	46	(47.83)
Segment 4 West Mod	42	267	77	(183.06)
South	47	957	387	(1,542.97)

[1] Land use areas obtained from the National Land Cover Database for the ROW (75 feet).

[2] See land use change emission factors calculation table.