US Army Corps of Engineers ®
Wilmington District

General Re-evaluation Report and Environmental Assessment Surf City, Onslow and Pender Counties, North Carolina Coastal Storm Risk Management Project

Appendix O:

Greenhouse Gas Emissions

Draft

August 2024

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1.0 Overview

The U.S. Council on Environmental Quality's, on January 9, 2023, issued interim guidance (policy CEQ-2022-0005) on Greenhouse Gases (GHG) emissions and how Federal agencies can determine GHG emissions predicted to occur with each construction alternative.

The total GHG emissions for the project were calculated using the type, quantity, horsepower, total hours, and other associated emission factors of the equipment (e.g., tugboats, pilot boats and heavy equipment needed to position the pipeline and regrade the newly placed sand) for the entire project life (i.e., 50 years).

Initial baseline calculations were determined using a tool developed by the State of California's Sacramento Metro Air Quality Management District (SMAQMD). This spreadsheet calculates GHG emissions associated with harbor-related activities. The initial data was input to the spreadsheet to develop baseline emissions related to vessel/equipment type, size and predicted runtime. This baseline data was then input into formulas provided by U.S. Council on Environmental Quality.

This appendix contains calculation tables for GHG emissions that consider the project duration and the number of construction seasons, by alternative.

2.0 Action Alternative Descriptions

The scope of the action alternatives for this project are discussed in Section 3.5 of the main report. Generally, all include the construction of sand berm and dune system measuring approximately 33,300 feet long, or approximately six miles of shoreline, with the dune peak constructed to an elevation of 14 feet North Atlantic Vertical Datum 1988 (NAVD 88) and fronted by a 6-foot (NAVD 88) by 50-foot-wide beach berm. All construction alternatives include a 1,000-foot transition berm in northern end of the project that would go into the town limits of North Topsail Beach. Other features of the alternative would include dune vegetation and 500 walkover structures.

After initial construction, the sand berm and dune system would be renourished (i.e., nourishment event) seven times over the 50-year project life, at fixed six-year intervals. Sand for placement would be taken from several borrow sites that are located between one and six miles off the coast of Topsail Island. Each construction alternative would require at least eight mobilization and demobilization efforts for initial construction and renourishment events.

In addition, construction activities for the action alternatives are distinguished in this analysis by the use or removal of construction/environmental windows. These periods provide a specific date range for in-water dredging and placement activities to occur as to minimize potential impacts to threatened and endangered species and their habitats. Alternative 2a and 2b are proposed with such windows.

Alternative 2a would include a construction/environmental window between December 1 and March 31 (120 days) for initial construction and renourishment events. The initial construction activities would span approximately four dredging seasons and require four disturbance events from all equipment in the water and on the beach.

Alternative 2b would include expanded environmental window between November 16-April 30 (165 days) for initial construction and renourishment events. The initial construction activities would span approximately three dredging seasons and require three disturbance events from all equipment in the water and on the beach.

Alternative 2c would include no environmental window for initial construction and an expanded environmental window between November 16-April 30 (165 days) for renourishment events. Only one disturbance event, both in -water and on-beach, would be required lasting approximately 16 months.

Given this, the following factors were used to estimate total greenhouse gases by project life and construction alternative:

<u>Alternative 2a</u>

- Initial construction would occur over a four-season period.
    - 8 hours x 120 days x 4 seasons = 3,840 hours total construction time.
- Four mobilization and demobilization events (Six days per mobilization and six days per demobilization per season).
    - 8 hours x 12 days x 4 seasons = 384 hours mobilization/demobilization time.

<u>Alternative 2b</u>

- Initial construction would occur over a three-season period.
    - 8h x 165d x 3 seasons = 3,960 total hours construction time.
- Three mobilization and demobilization events. (Six days per mobilization and six days per demobilization per season).
- 8h x 12d x 3 seasons = 288 hours mobilization/demobilization time.

<u>Alternative 2c</u>

- Initial construction would occur over one 16-month continuous period.
    - 8h x 480d x 1 season = 3,840 total hours construction time.
- One mobilization and demobilization event (Six days per mobilization and six days per demobilization per season).
    - 8h x 12d x 1 season = 96 hours mobilization/demobilization time.

3.0 Assumptions

The following assumptions were also considered for this analysis:

<u>All Alternatives</u>

- Seven nourishment events during the 50-year project life.

- Each nourishment event would be conducted in 165-days (November 16 – April 30.
- Two dredgers would be used simultaneously for the initial construction and all seven nourishment events.
- Two pilot boats
- Three tugboats would be needed.
- In the standardized GHG emissions calculation spreadsheet (SMAQMD_HC file name) horsepower (hp) values for bulldozers are not available. Emissions calculations were determined for bulldozers by using the surrogate standard emissions for tow boats/push boat generators (79 hp) and other generators (29 hp) from the Auxiliary Engine Type worksheet to calculate bulldozer emission. The total of 108 hp captures hp for all 15,000 lb. dozers and many 20,000 lb. models.
- Seven nourishment events result in 6,720 hours of engine runtime per piece of equipment. (8 hours x 120 days x 7 events apply to all Alternatives = total individual engine runtime).

Equipment

- Three bulldozers: Using the standard emission rates of adding the standard emissions for the boat/push boat generators with "others" generator for the equivalency of one bulldozer. A total emissions rate that includes three of each of these categories added together to represent three bulldozers.
- Three frontend loaders
- One excavator
- Up to ten pieces of equipment (e.g., pumps, generators and pickup trucks).
- One barge
- One survey vessel
- Two tugboats
- Two dredgers
- Two pilot boats

4.0 Calculations

The estimated greenhouse gas admissions for the Action Alternatives are presented in **Tables 1 through 10**.

5.0 Conclusions

All alternatives produce the same amount of CO_2e emissions for the nourishment events because there is no difference between the alternatives in how vessels and equipment would be used, and for how long. Conversely, initial construction CO_2e emissions are different for each alternative. This is exclusively due to each alternative requiring different numbers of initial construction periods, which demonstrates a direct relationship between the number of initial construction periods with the total CO_2e emissions for each alternative.

Alternative 2a (56,320.69 metric tons CO_2e) would produce the most emissions, then 2b (56,246.62 metric tons CO_2e); with Alternative 2c (53,357.91 metric tons CO_2e) producing the least amount of carbon dioxide equivalency emissions over the 50-year project life. In percentages, Alternative 2b produces 0.13 percent less emissions than Alternative 2a. Alternative 2c produces 5.26 percent less emissions (by weight) than 2a and 5.13 percent than Alternative 2b. Therefore, Alternative 2c would be preferred. However, from a percentage perspective, all three alternatives would produce similar CO_2e emission loads during the project life. The three alternatives are so close that a preferred alternative based on greenhouse gas emissions is negligible. Although Alternative 2c produces the least amount of emissions, choosing a different alternative would not substantial/y influence the selected preferred alternative.

Table 1. Greenhouse Gas Emissions Values for Nourishment Events by Action Alternative.[1]

Greenhouse Gas Compound	Emission Rate (grams per hour)	Engine Runtime per Nourishment Event (hours)	Nourishment Event	Total Engine Runtime Per Nourishment Event (hours)	Total Nourishment Events Emissions by Compound (grams)	Metric Tons of Emission[3]	$C0_2$ Equivalency (CO_2e) (Metric Tons)
N_2O	44.8	165.0	7.0	1,155.0	51,709.4	0.052	15.41
CH_4	223.9	165.0	7.0	1,155.0	258,569.9	0.259	6.46
CO_2	9,239,765.4	165.0	7.0	1,155.0	10,671,929,071.7	10,671.929	10671.93
TOTAL						**10,672.24**	**10,693.80**

[1] Each event not-to-exceed 165 days during a single construction window (November 16 to April 30)
[2] Seven events during 50-year project life per each alternative
[3] Emissions applicable to all three build alternatives

Table 2. Greenhouse Gas Emissions Values, Initial Construction, Alternative 2a.

Greenhouse Gas Compound	Emission Rate (grams per hour)	Total Hours Engine Runtime per Nourishment Event	Total Project Lifetime Construction Period/Season Windows	Total Engine Runtime for Project Life (hours)	Total Nourishment Events Emissions (grams)	Metric Tons of Emission	$C0_2$ Equivalency (CO_2e)(Metric Tons)
N_2O	44.8	968.0	4.0	3,872.0	173,349.4	0.173	51.658
CH_4	223.9	968.0	4.0	3,872.0	866,824.6	0.867	21.671
CO_2	9,239,765.4	968.0	4.0	3,872.0	35,776,371,745.0	3.578E+04	35,776.372
TOTAL						35,777.412	35,849.70

Table 3. Greenhouse Gas Emissions Values, Initial Construction, Alternative 2b.

Greenhouse Gas Compound	Emission Rate (grams per hour)	Total Hours Engine Runtime per Nourishment Event	Total Project Lifetime Construction Period/Season Windows	Total Engine Runtime for Project Life (hours)	Total Nourishment Events Emissions (grams)	Metric Tons of Emissions	$C0_2$ Equivalency (CO_2e) (Metric Tons)
N_2O	44.8	1,320.0	3.0	3,960.0	177,289.2	1.773E-01	52.832
CH_4	223.9	1,320.0	3.0	3,960.0	886,525.2	8.865E-01	22.163
CO_2	9,239,765.4	1,320.0	3.0	3,960.0	36,589,471,102.8	3.659E+04	36,589.471
TOTAL						**36,590.535**	**36,664.47**

Table 4. Greenhouse Gas Emissions Values, Initial Construction, Alternative 2c.

Greenhouse Gas Compound	Emission Rate (grams per hour)	Total Hours Engine Runtime per Nourishment Event	Total Project Lifetime Construction Period/Season Windows	Total Engine Runtime for Project Life (hours)	Total Nourishment Events Emissions (grams)	Metric Tons of Emissions	$C0_2$ Equivalency (CO_2e) (Metric Tons)
N_2O	44.8	3,840.0	1.0	3,840.0	171,916.8	0.172	51.231
CH_4	223.9	3,840.0	1.0	3,840.0	859,660.8	0.860	21.492
CO_2	9,239,765.4	3,840.0	1.0	3,840.0	35,480,699,251.2	3.548E+04	35,480.699
TOTAL						**35,481.731**	**35,553.422**

Table 5. Mobilization and Demobilization Efforts with Environmental Windows (December 1 to March 31), Initial Construction, Alternative 2a.

Greenhouse Gas Compound	Emission Rate (grams per hour)	Total Hours Engine Runtime per Nourishment Event	Number of Construction Periods[1]	Total Emissions by Compound (grams)	Metric Tons of Emissions	C0₂ Equivalency (CO_2e) (Metric Tons)
N_2O	44.8	96.0	4.0	17,191.680	0.02	5.123
CH_4	223.9	96.0	4.0	85,966.080	0.09	2.149
CO_2	9,239,765.4	96.0	4.0	3,548,069,925.120	3,548.07	3,548.070
TOTAL					**3,548.173**	**3,555.342**

[1] Total determined by adding initial construction period(s) with the seven nourishment events emissions calculations.

Table 6. Mobilization and Demobilization Efforts with Expanded Environmental Windows (November 16 to April 30), Initial Construction, Alternative 2b.

Greenhouse Gas Compound	Emission Rate (grams per hour)	Total Hours Engine Runtime per Nourishment Event	Number of Construction Periods[1]	Total Emissions by Compound (grams)	Metric Tons of Emissions	C0₂ Equivalency (CO_2e) (Metric Tons)
N_2O	44.8	96.0	3.0	12,893.760	0.013	3.842
CH_4	223.9	96.0	3.0	64,474.560	0.064	1.612
CO_2	9,239,765.4	96.0	3.0	2,661,052,443.840	2661.052	2,661.052
TOTAL					**2,661.130**	**2,666.507**

[1] Total determined by adding initial construction period(s) with the seven nourishment events emissions calculations.

Table 7. Mobilization and Demobilization Efforts with No Environmental Window, Initial Construction, Alternative 2c.

Greenhouse Gas Compound	Emission Rate (grams per hour)	Total Hours Engine Runtime per Nourishment Event	Number of Construction Periods[1]	Total Emissions by Compound (grams)	Metric Tons of Emissions	C0$_2$ Equivalency (CO_2e) (Metric Tons)
N_2O	44.8	96.0	1.0	4,297.9	0.004	1.281
CH_4	223.9	96.0	1.0	21,491.5	0.021	0.537
CO_2	9,239,765.4	96.0	1.0	887,017,481.3	887.017	887.017
TOTAL					**887.043**	**888.836**

[1]Total determined by adding initial construction period(s) with the seven nourishment events emissions calculations.

Table 8. Mobilization and Demobilization Efforts with Environmental Windows (December 1 to March 31), Nourishment Events, Alternative 2a.

Greenhouse Gas Compound	Emission Rate (grams per hour)	Total Hours Engine Runtime per Nourishment Event	Number of Construction Periods[1]	Total Emissions by Compound (grams)	Metric Tons of Emissions	C0$_2$ Equivalency (CO_2e) (Metric Tons)
N_2O	44.8	96.0	7.0	30,085.440	0.03	8.965
CH_4	223.9	96.0	7.0	150,440.640	0.15	3.761
CO_2	9,239,765.4	96.0	7.0	6,209,122,368.960	6,209.12	6,209.122
TOTAL					**6,209.303**	**6,221.849**

[1] Total determined by adding initial construction period(s) with the seven nourishment events emissions calculations.

Table 9. Mobilization and Demobilization Efforts with Expanded Environmental Windows (November 16 to April 30), Nourishment Events, Alternative 2b.

Greenhouse Gas Compound	Emission Rate (grams per hour)	Total Hours Engine Runtime per Nourishment Event	Number of Construction Periods[1]	Total Emissions by Compound (grams)	Metric Tons of Emissions	C0₂ Equivalency (CO₂e) (Metric Tons)
N_2O	44.8	96.0	7.0	30,085.440	0.030	8.965
CH_4	223.9	96.0	7.0	150,440.640	0.150	3.761
CO_2	9,239,765.4	96.0	7.0	6,209,122,368.960	6209.122	6,209.122
TOTAL					**6,209.303**	**6,221.849**

[1]Total determined by adding initial construction period(s) with the seven nourishment events emissions calculations.

Table 10. Mobilization and Demobilization Efforts with No Environmental Window, Nourishment Events, Alternative 2c.

Greenhouse Gas Compound	Emission Rate (grams per hour)	Total Hours Engine Runtime per Nourishment Event	Number of Construction Periods[1]	Total Emissions by Compound (grams)	Metric Tons of Emissions	C0₂ Equivalency (CO₂e) (Metric Tons)
N_2O	44.8	96.0	7.0	30,085.4	0.030	8.965
CH_4	223.9	96.0	7.0	150,440.6	0.150	3.761
CO_2	9,239,765.4	96.0	7.0	6,209,122,369.0	6,209.122	6,209.122
TOTAL					**6,209.303**	**6,221.849**

[1]Total determined by adding initial construction period(s) with the seven nourishment events emissions calculations.