



Hatchie/Loosahatchie, Mississippi River Mile 775-736, TN and AR Final Integrated Feasibility Report and Environmental Assessment



Appendix 2e – Greenhouse Gas

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Section 1

Introduction

1.1 INTRODUCTION

This appendix describes the calculations and associated assumptions used in the consideration of effects of greenhouse gas (GHG) emissions for the study using the recommendations of the Council on Environmental Quality (CEQ) guidance in January 2023 (88 FR 1196). These analyses quantify the proposed action's projected GHG emissions from the burning of fossil fuels by construction equipment and associated reductions from carbon sequestration of reforestation efforts compared to the no action or future without project scenario. Additional context is provided for GHG emissions through using the best available social cost of GHG (SC-GHG) estimates (see Table 2e-5) to translate climate impacts into the more accessible metric of dollars.

$$SC - GHG = CO * SC - CO_2 + CO_2 * SC - CO_2 + CH_4 * SC - CH_4 + N_2O * SC - N_2O$$

Where:

SC - GHG = the social cost of greenhouse gas emissions in dollars
CO = total carbon monoxide emissions in metric tons
CO₂ = total carbon dioxide emissions in metric tons
CH₄ = total methane emissions in metric tons
N₂O = total nitrous oxide emissions in metric tons
SC - CO₂ = social cost of carbon dioxide (also used for carbon monoxide)
SC - CH₄ = social cost methane
SC - N₂O = social cost of nitrous oxide

1.2 NO ACTION

For the no action/future without project scenario, the U.S. Department of Agriculture (USDA) COMET-Farm tool, version 4.1, was used to quantify GHG emissions on those agricultural lands proposed for reforestation (i.e., land use changes) to establish a baseline to compare it to the action alternatives (<https://comet-farm.com/>). The COMET-Farm tool is a whole farm GHG accounting system that can be used with a mapping-platform to estimate site-specific emissions on agricultural lands. It estimates biomass and soil carbon stocks changes, direct and indirect soil nitrous oxide (N₂O) emissions, methane (CH₄) uptake in soils, carbon dioxide (CO₂) emissions from liming, non-CO₂ emissions from biomass burning, and CO₂ emissions from urea fertilizer application. Those agricultural practices common to the study area (i.e., farmland in the batture) were entered into the tool for a hypothetical farm in the batture, near measure I40_3. The following assumptions were used in the COMET-Farm tool:

- Crop type = Soybeans;
- Pre-1980 Management = Lowland Non-Irrigated;
- Not enrolled in CRP before 2000;
- 1980-2000 Management: Non-Irrigated- Annual crops in rotation;
- 1980-2000 tillage = Reduced tillage;
- Planting date = June 22 (USDA-National Agricultural Statistics Service (NASS) 2010)
- Harvest date = Nov. 13 (USDA-NASS 2010);
- Yield = Used the 2022 average of 52 bushels/acre of soybeans in AR from USDA NASS (<https://www.nass.usda.gov/ar>);
- Reduced Tillage on June 1;
- No manure;
- No fertilizer;
- No Lime;
- No burning of crop residue;

The tool calculates the average annual metric tons of CO₂ equivalents over a 10-year period assuming the last ten years of the baseline is continued into the ten years after the end of the baseline. Results are shown in Figure 2e-1.

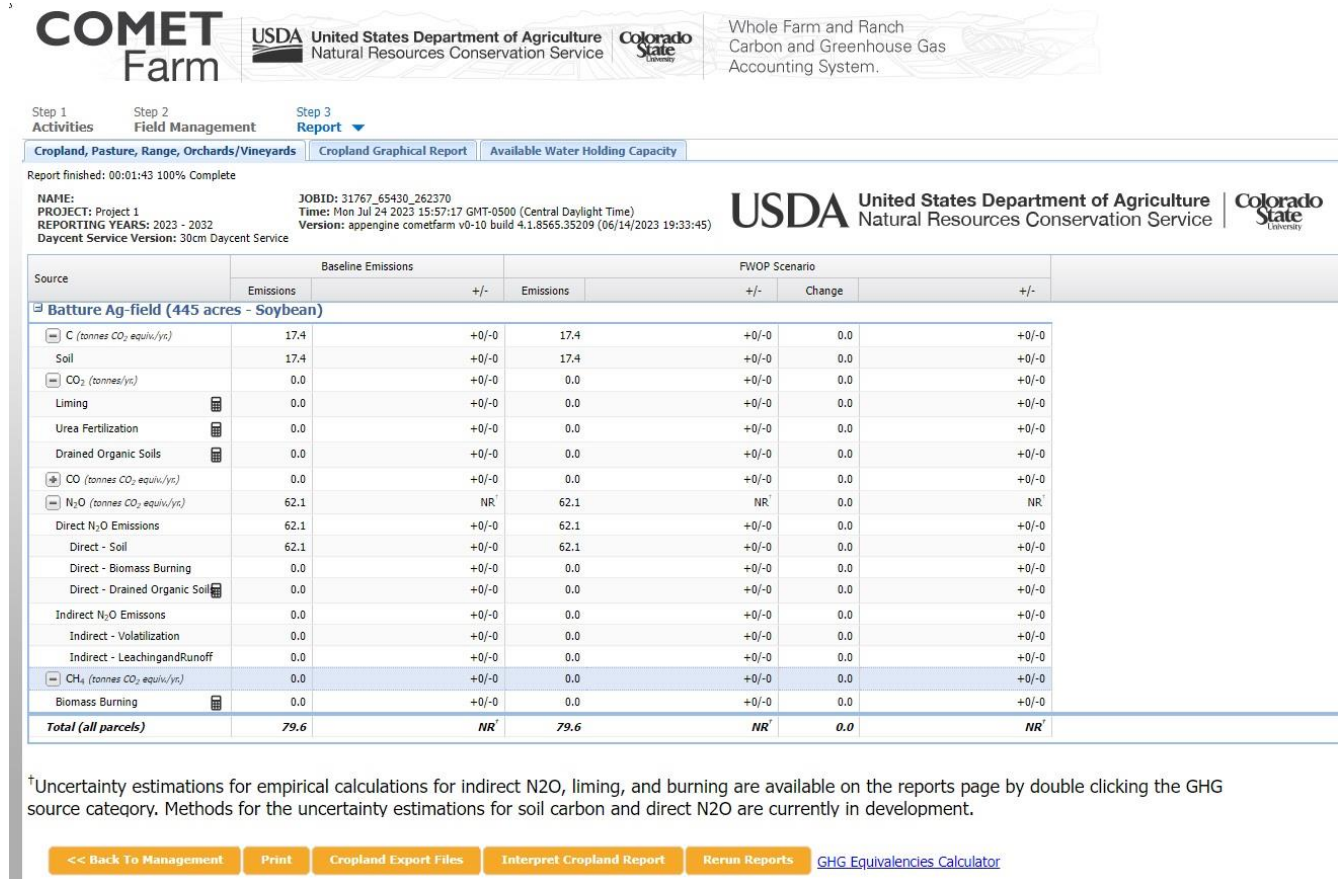


Figure 2e-1. Tabular Report showing metric tons of CO₂ equivalents from COMET-Farm Tool on agricultural lands in the Mississippi River batture study area.

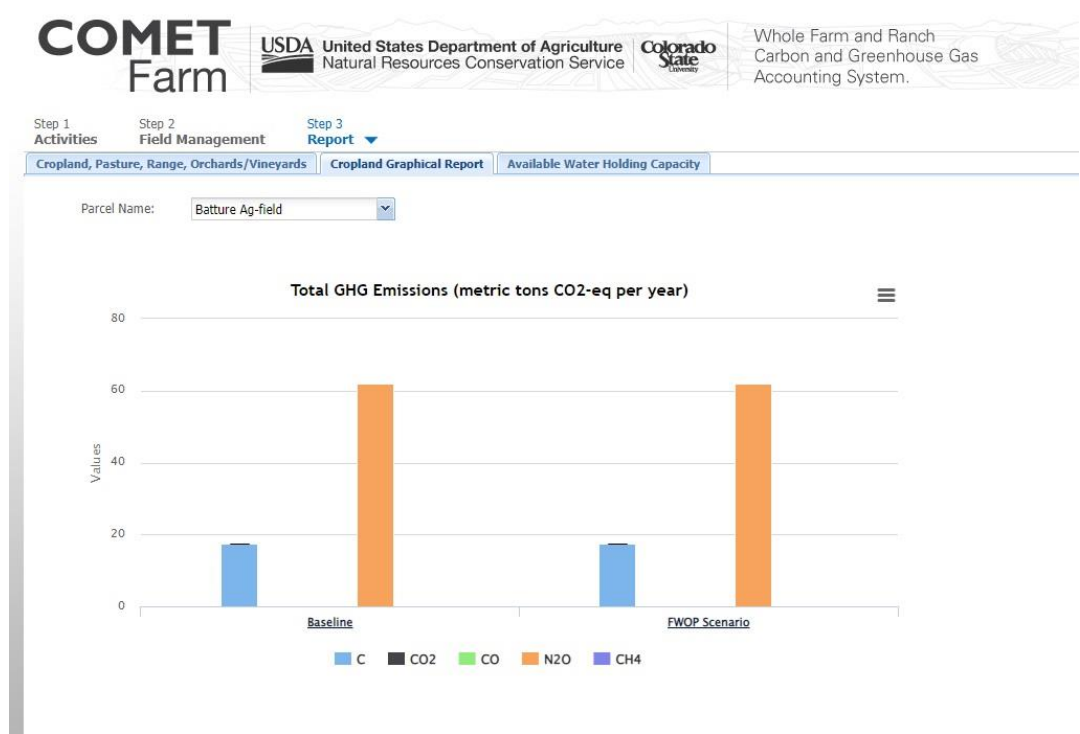


Figure 2e-2. Graphical Report showing metric tons of CO₂ equivalents from COMET-Farm Tool on agricultural lands in the Mississippi River batture study area.

In addition to the GHG emissions from agricultural activities, GHG emissions were calculated for the maintenance of existing culverts for those measures where culverts are proposed for replacement with the recommended plan, to compare the alternatives. Where existing culverts were present, these areas were assumed to undergo maintenance/replacement of culverts at the same frequency (typically one culvert replacement at year 30) and the associated emissions (same equipment, horsepower, and hours) as the operation and maintenance (O&M) for the proposed action scenarios.

The average annual GHG emissions for these farm and non-farm activities were then totaled for the project life for use in the alternative comparisons (Table 2e-1).

Table 2e-1. Total GHG Emissions for No Action/Future Without Project Scenario

Total GHG Emissions for farm activities and non-farm activities with No Action/Future without Project					
	Carbon Monoxide (CO)	Carbon Dioxide (CO ₂)	Methane (CH ₄)	Nitrous Oxide (N ₂ O)	CO ₂ Equivalent (CO ₂ e)
(Average Annual Metric tons)	0.0084	1.0350	2.4624	62.1213	148.5554

* CO₂eq = X*CO + X*CO₂ + Y*N₂O + Z*CH₄

Where X = 100 Year Global Warming Potential for Carbon Monoxide and Carbon Dioxide = 1

Where Y = 100 Year Global Warming Potential for Nitrous Oxide = 298

Where Z = 100 Year Global Warming Potential for Methane = 25

CFR Title 40 Chapter I Subchapter C Part 98: Table A-1 Global Warming Potentials

1.3 RECOMMENDED PLAN

For the recommended plan, average annual GHG emissions were calculated for the work comprising each of the 40 measures using the type, quantity, horsepower, total hours, and associated emission factors of the equipment used for construction (based on the 2010 emissions criteria from Emissions Factor (EMFAC) Tables) across the 50-year project life to compare to the no action/future without project scenario (Table 2e-2). Total hours included both construction and O&M activities for the recommended plan.

Table 2e-2. Total GHG Emissions from the equipment used in Construction and Operations and Maintenance activities of recommended plan, Alternative C3

Total GHG Emissions from equipment used in Construction and O&M activities with recommended plans (NOTE: values do NOT include sequestration from reforestation)					
	CO	CO2	CH4	N2O	*CO2e
(Average Annual Metric tons)	0.1892	40.0806	6.7173	0.4306	336.5288

* CO2eq = X*CO + X*CO2 + Y*N2O + Z*CH4

Where X = 100 Year Global Warming Potential for Carbon Monoxide and Carbon Dioxide = 1

Where Y = 100 Year Global Warming Potential for Nitrous Oxide = 298

Where Z = 100 Year Global Warming Potential for Methane = 25

CFR Title 40 Chapter I Subchapter C Part 98: Table A-1 Global Warming Potentials

In addition to the GHG emissions from the recommended plan, the amount of carbon sequestered from the proposed 445 acres of reforestation efforts was calculated using the March 2022 Environmental Protection Agency's (EPA) estimate of 0.84 metric tons of CO2/acre/year from an average U.S. forest (<https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator-revision-history>) allowing for the net benefits of the recommended plan from carbon sequestration. Additional carbon sequestration from the forest stand improvements and non-forested wetland restoration efforts proposed across the additional approximately 2,000 acres was not estimated and is not included in the results.

1.4 ALTERNATIVE COMPARISON

Comparisons of the no action/future without project scenario and the recommended plan (Alternative C3) are shown in Tables 2e-1, Table 2e-2, and Figure 2e-1. The recommended

plan is broken out to show the GHG emissions and total social costs from the construction and O&M, the carbon sequestered from the proposed reforestation efforts, and the net values. Overall, the recommended plan would result in beneficial long-term effects through the sequestration of approximately 185.83 average annual metric tons of CO₂ equivalents and a total social cost of -\$1,286,074.47 in 2020 dollars.

Table 2e-3. Total GHG Emissions by Project Alternative (average annual metric tons)

Total GHG Emissions by Project Alternative (average annual metric tons)					
Alternative	CO	CO₂	CH₄	N₂O	CO₂e
No-Action Alternative	0.01	1.03	2.46	62.12	148.56
GHG Emissions from Const. & O&M of Recommended Plan – Alt. C3	0.19	40.08	6.72	0.43	336.53
Carbon Sequestered from Reforestation of Recommended Plan – Alt. C3	-	-	-	-	-373.80
Net GHG Emissions of Recommended Plan – Alt. C3	0.18	39.05	4.25	-61.69	-185.83

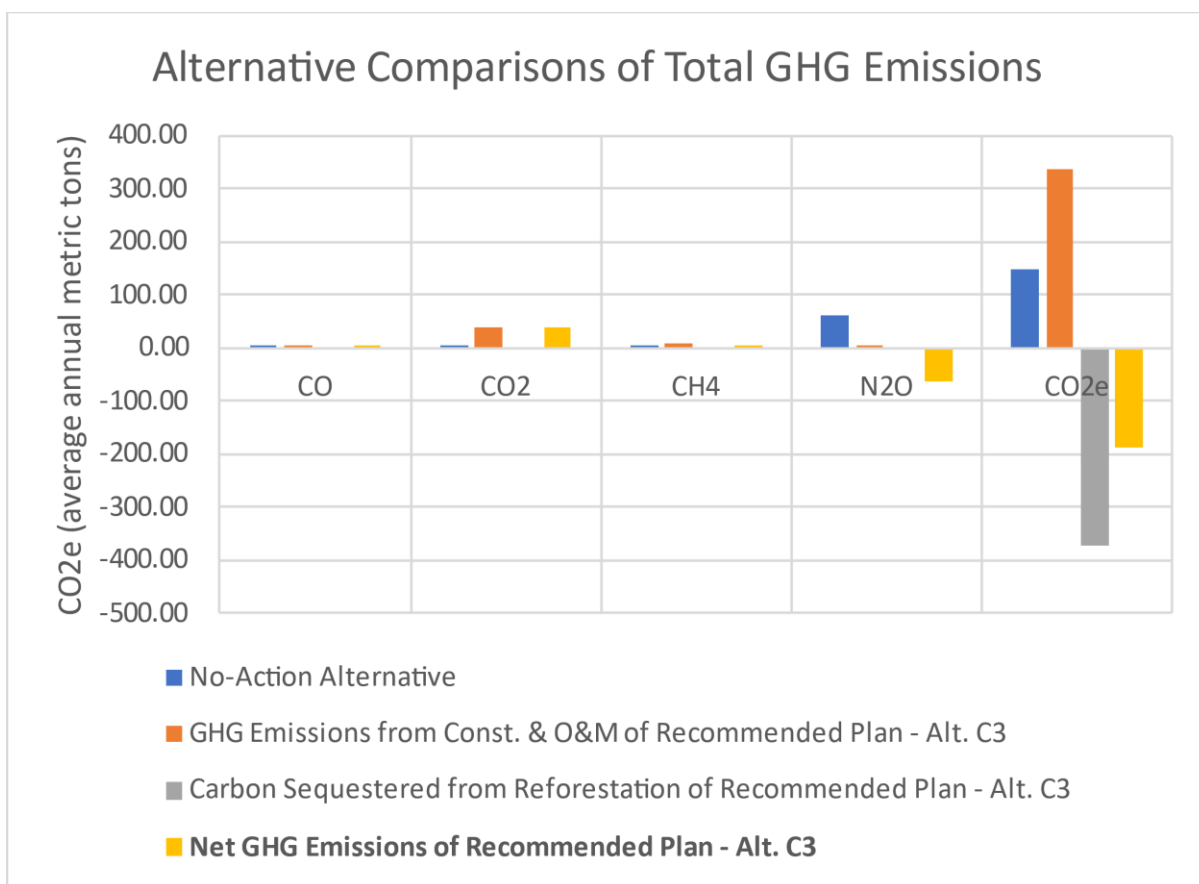


Figure 2e-3. Alternative Comparisons of Total GHG Emissions

Table 2e-4. Total Social Costs of Greenhouse Gases (2020 Dollars)

Total Social Costs of Greenhouse Gases (2020 Dollars)					
Alternative	CO	CO2	CH4	N2O	Total
No-Action Alternative	0.47	57.96	4,186.04	1,304,547.66	1,308,792.17
Social Cost of GHG from Const. & O&M of Recommended Plan – Alt. C3	10.60	2,244.51	11,419.33	9,043.22	22,717.66
Net Social Cost of GHG from Recommended Plan – Alt. C3	10.13	2,186.56	7,233.29	-1,295,504.45	-1,286,074.47

Table 2e-5. Cost table for calculating social cost of GHG (SC-GHG).

Social Costs From Guidance* (2020 Dollars)			
	SC-CO2	SC-CH4	SC-N2O
Year	3% Discount Rate	3% Discount Rate	3% Discount Rate
2020	51	1500	18000
2021	52	1500	19000
2022	53	1600	19000
2023	54	1600	20000
2024	55	1700	20000
2025	56	1700	21000
2026	57	1800	21000
2027	59	1800	21000

Social Costs From Guidance* (2020 Dollars)			
	SC-CO2	SC-CH4	SC-N2O
2028	60	1900	22000
2029	61	1900	22000
2030	62	2000	23000
2031	63	2000	23000
2032	64	2100	24000
2033	65	2100	24000
2034	66	2200	25000
2035	67	2200	25000
2036	69	2300	26000
2037	70	2300	26000
2038	71	2400	27000
2039	72	2500	27000
2040	73	2500	28000
2041	74	2600	28000
2042	75	2600	29000
2043	77	2700	29000
2044	78	2700	30000

Social Costs From Guidance* (2020 Dollars)			
	SC-CO2	SC-CH4	SC-N2O
2045	79	2800	30000
2046	80	2800	31000
2047	81	2900	31000
2048	82	3000	32000
2049	84	3000	32000
2050	85	3100	33000

*Taken From IWG (Interagency Working Group on Social Costs of Greenhouse Gases). 2021. Technical Support Document: Social Cost of Carbon, Methane, and Nitrous Oxide Interim Estimates under Executive Order 13990. Available online at: www.whitehouse.gov/wp-content/uploads/2021/02/TechnicalSupportDocument_SocialCostofCarbonMethaneNitrousOxide.pdf.

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List of Acronyms and Abbreviations

CEQ	Council on Environmental Quality
CH ₄	Methane
CO ²	Carbon Dioxide
CO ₂ e	CO ₂ equivalents
EPA	Environmental Protection Agency
GHG	Greenhouse Gas
NASS	National Agricultural Statistics Service
N ₂ O	Nitrous Oxide
O&M	Operations and Maintenance
SC-GHG	Social Cost of Greenhouse Gas
USDA	U.S. Department of Agriculture