Spirit Lake Tribe

Priority Climate Action Plan (PCAP)

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EXECUTIVE SUMMARY

The Spirit Lake Tribe received a Climate Pollution Reduction Grant (CPRG) to develop a Priority Climate Action Plan (PCAP) and ultimately a Comprehensive Climate Action Plan (CCAP). To be eligible for federal implementation grants through the EPA Climate Pollution Reduction Grants program, the Tribe's near-term, high priority, implementation-ready measures to reduce greenhouse gas emissions (GHG) from emission sources located on and due to activities that occur within the boundaries of the Spirit Lake Reservation. This plan will enable Tribal programs to apply for projects with measures referenced in the PCAP. It will result in quantifiable reductions in GHG emissions that will contribute to state, national and global efforts to reduce GHG emissions and mitigate the negative consequences of climate change.

The effort to prepare the PCAP was led by the Spirit Lake Tribe Environmental Protection Agency (SLT EPA). SLT EPA has worked with a number of tribal and federal agencies, has initiated coordination with State of North Dakota agencies, and has followed closely North Dakota and Minnesota's' PCAP development efforts. These outreach and coordination efforts have built momentum to identify and initiate work on GHG emissions reduction strategy and have been instrumental in developing the priority GHG reduction measures that are identified in Section 3.2 of the PCAP.

An essential element of the PCAP is the GHG emissions inventory (EI) (Section 3.1 of the PCAP). The EI was developed as an update with enhancements of the Tribe's initial emissions inventory prepared in 2004. The EI includes GHG emissions estimates for seven GHG source sectors and four GHG pollutants. The EI informs the evaluation, selection, and prioritization of GHG reduction measures that the Tribe, in coordination with other federal, state, and local entities, will implement in order to contribute to the national efforts to cut 2005 levels of GHG emissions in half by 2030 and achieve a net-zero emissions economy by 2050. The Spirit Lake Tribe's priority GHG emissions reductions include:

1. <u>Energy Efficient Housing</u> – Reduce greenhouse gas (GHG) emissions from residential buildings (single and multi-family) by promoting energy efficiency, renewable energy, electrification, lower-carbon design, materials, and fuels in new construction as well as retrofitting existing housing.
2. <u>Clean Transportation</u> – Accelerate the transition to low- and no-carbon fuels in vehicles, off-highway equipment, and EV-plug in infrastructure and increase the availability and use of clean travel options (e.g., rideshare & public transit expansion using low- and no-carbon fuel vehicles, vans and buses).
3. <u>Solid Waste Reduction</u> – Reduce GHG emissions by adopting waste-prevention and recycling (including hazardous wastes) practices for households, commercial, and tribal offices and introduce organics capture and control programs to reduce landfill GHG emissions.
4. <u>Clean Energy & Efficient Buildings</u> – Reduce GHG emissions from public, commercial, and manufacturing facilities by supporting development, re-opening, or transition of public buildings and facilities to renewable energy sources, implementation of energy

efficiency measures, and/or shifting to lower GHG emitting production methods or products.

5. Tree Planting Initiative – Work with the State of North Dakota on tree and shrub planting to improve soil health and energy efficiency upgrades for tree seedling storage coolers.
6. Carbon Freer Agricultural Practices – Updating farm and ranch leases to include terms for lower GHG emitting practices.

The priority GHG reduction measures are also expected to result in economical, air quality, public health, quality of life, cultural, and public awareness benefits to the Tribe and tribal members living on the Reservation.

The PCAP marks the beginning of the Spirit Lake Tribe's multiyear effort to reduce GHG emissions on the Reservation. The next critical step to take place over the next 2 to 3 years is the development of the Comprehensive Climate Action Plan (CCAP). The CCAP will be a more refined assessment of Reservation's significant GHG emission sectors and sources, potential GHG pollutant, and the effectiveness of near-term and long-term GHG emission reduction projects. The CCAP will include the strategies and funding mechanisms for GHG emission reduction measures that will be implemented across GHG emissions sectors on the Reservation.

1.0 INTRODUCTION

The Spirit Lake Reservation is located in the east-central portion of North Dakota primarily in Benson County, a very small portion in Nelson County, and parts in Eddy and Ramsey Counties. The 2021 U.S. Census Report lists the Reservation population at 4096 with 3,318 being Native population. The City of Devil's Lake, with a population of 7,192, lies adjacent and east of the Reservation. The Reservation covers 389.6 square miles (245,135 acres) and the topography is generally consistent with the Northern Plains Region and exhibits flat terrain, rolling hills and wooded areas. The area experiences a humid continental climate with very cold winters with frequent light snowfall, and warm to very warm wetter summers with most rain from convective thunderstorms. The Reservation is bounded on the north and west by Devils Lake and on the south by the Sheyenne River. Devil's Lake, which comprises 90,000 acres and stretches over 200 miles, does not have a natural outlet and has risen about 27 feet over the last 30 years or so. The area experienced excessive flooding in the 1990 reclaiming farmland and residential areas. Additionally, the rivers and streams of the Reservation have substantial areas of associated wetlands and glacially associated prairie potholes with thickly forested rolling hills along the Sheyenne River. The terrain on the southern portion of the Reservation is relatively flat, much of which is prairie lands suitable for grazing and grain crops. The general land use around the Reservation is primarily crop, grazing and pasture lands.

1.1 CPRG Overview

The Spirit Lake Tribe received a Climate Pollution Reduction Grant (CPRG) to develop a Priority Climate Action Plan (PCAP) and ultimately a Comprehensive Climate Action Plan (CCAP). To be eligible for federal implementation grants through the EPA Climate Pollution Reduction Grants program, the Tribe's PCAP describes near-term, high priority, implementation-ready measures to reduce climate pollution on the Reservation. This plan will enable Tribal programs to apply for projects with measures referenced in the PCAP.

The Tribe's Priority Climate Action Plan (PCAP) is developed in eight (8) tasks:

1. Conducting a GHG emission inventory for the Reservation.
2. Identifying and prioritizing the Sectors which have been impacted.
3. Gathering information on available strategies for GHG control and abatement measures pertinent to the Reservation environment and resources available.
4. Assessing the applicability of GHG control and abatement measures to existing sources of GHG emissions on the Reservation.
5. Quantifying the range of GHG emission reductions that could be achieved by implementing applicable GHG control and abatement measures.
6. Developing foundational information for the SLT-EPA to share information about the GHG emissions reduction planning process with the Tribe's selected group of stakeholders.
7. Documenting the findings of this project in pertinent sections of the PCAP and disseminating information to Spirit Lake Tribal Council.
8. Designating proper authority and Tribal programs that can implement the greenhouse gas emissions reduction measures described in the PCAP, as well as the implementation steps and cost associated with requested GHG emissions reduction projects.

1.2 PCAP Overview and Definitions

Overview

The Spirit Lake Tribe's (SLT)Priority Climate Action Plan (PCAP) describes near-term, high-priority, implementation-ready measures to reduce greenhouse gases (GHG) from emission sources and activities that occur on our Reservation. Participation in the Climate Pollution Reduction Grant program will allow the Tribe to contribute to efforts to address climate change and to access funds earmarked for GHG reduction initiatives. Funds are available through Federal Agencies, including, but not necessarily limited to, USEPA, US DOE, USDA, US DOT, and US DOI.

The Spirit Lake Tribe's efforts to reduce GHG emissions are focused on the development of two key deliverables over the next three years. Key Deliverable 1 will be to develop a Priority Climate Action Plan (PCAP) due by April 2024. Key Deliverable 2 will be to develop a Comprehensive Climate Action Plan (CCAP) that will be completed before the end of the Cooperative Agreement period, estimated to be August 2026. The CCAP will provide a road map for actual mitigative measures, implementation plans, and identify the Tribal agencies, in coordination with adjoining counties (and perhaps other entities) that will implement the GHG reduction measures. We will work with our stakeholders and partners to identify, prioritize and address various GHG reduction areas.

Definitions

- **Comprehensive Climate Action Plan (CCAP):** a narrative report that provides an overview of the Tribe's significant GHG sources/sinks and sectors, establishes near-term and long-term GHG emission reduction goals, and provides strategies and identifies measures that address the highest priority sectors to help the Tribe meet those goals.
- **Greenhouse gas (GHG) Inventory:** a list of emission sources and sinks and the associated emissions quantified using standard methods. The PCAP must include a "simplified" inventory (see Section 3). The CCAP must include a comprehensive inventory of emissions and sinks for the following sectors: industry, electricity generation/use, transportation, commercial and residential buildings, agriculture, natural and working lands, and waste and materials management.
- **Priority Climate Action Plan (PCAP):** a narrative report that includes a focused list of near-term, high-priority, and implementation-ready measures to reduce GHG pollution and an analysis of GHG emissions reductions.

1.3 Approach to Developing the PCAP

The Spirit Lake Tribal EPA is our lead agency for developing the Climate Action Plans (PCAP and CCAP). It has developed a Strategic Energy Plan (March 2011) with the assistance of IECIS Group, LLC, which will continue to guide all existing and new residential and commercial buildings relative to remodeling, renovations, demolition and/or any construction activities as the Tribe evolves/transitions towards green and healthy homes, green environment, energy efficient, business development on reservation lands for Tribal members, and integrated and optimized budget management, and preservation of natural resources on the Spirit Lake Nation.

Tribal EPA has developed, under its U.S. EPA programs, an approved Community Relations Plan that can easily be adapted for any outreach project including Climate Action Plan activities. Our Community Relations Plan records meetings, identifies potential stakeholders and partners, lists outreach procedures that inform and educate, gathers input, and provides responses to the public comments and questions. We will pursue MOUs with some stakeholders (especially counties) to achieve common interest GHG reduction measures. Further, the Spirit Lake Tribe has established relationships with professional consulting firms with pertinent experience and expertise to support the Tribe's work on our climate change initiatives. Below is an initial list of potential stakeholders in this work.

Stakeholders, Partners, and Implementing Agencies

Lead Organization

Spirit Lake Tribal Environmental Protection Administration (Tribal EPA)
Joshua Tweeton, Environmental Director
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Technical Assistance

IECIS Group, LLC
Air Science, Inc. (GHG Inventory)

Other Partners (contributing, future, and potential)

- Spirit Lake Tribal Council
- Spirit Lake Tribe Environmental Programs of GAP, Air, Water and Brownfields
- Tribal Planning
- Tribal Transportation Services
- BIA and Tribal Realty
- Refuse Control Services
- Tribal Roads
- Spirit Lake Housing Corporation
- Spirit Lake Emergency Management
- Spirit Lake Fish & Wildlife
- Tribal Enterprises: Casino, College, industries, businesses
- Tribal Utility Authority (under organization)
- Tribal Tax/TERO Department
- Tribal Legal Support
- North Dakota Department of Environmental Quality
- Federal Agencies – EPA, IHS, BIA, Fish & Wildlife, USDA
- Counties that overlap the Reservation: Benson County, Eddy, Nelson, Ramsey County

1.4 SCOPE OF THE PCAP

Spirit Lake Tribe's dedicated multiyear effort to reduce pollutants that contribute to climate change is focused on the development and submittal to EPA of two Key Deliverables. Key Deliverable 1 is this Priority Climate Action Plan (PCAP). The PCAP documents the essential information and decision-making steps used by the SLT to identify the priority GHG emission reduction measures that the Tribe plans to implement. Key Deliverable 2 is the Climate Change Action Plan (CCAP). The CCAP (expected to be submitted in summer-fall of 2025), will provide additional detail regarding the Tribe's significant GHG sources/sinks and sectors, will establish near-term and long-term GHG emission reduction goals, and provide the specific strategies to implement the GHG reduction measures for sources in the highest priority sectors to help the Tribe meet those goals.

The PCAP is centered on the recently developed GHG emissions inventory for the Reservation. By identifying the sources within seven GHG sectors and reviewing the annual quantities of GHG emissions that are emitted by the sources, Spirit Lake Tribe has identified, reviewed, and prioritized the measures available to reduce GHG emissions from sources on the Reservation.

Below are the PCAP developmental steps

- GHG Inventory
- Quantified GHG Reduction Measures
- Benefits Analysis
- Review of Authority to Implement
- Intersection with Other Funding Availability, and (Under the SLT 103 Air Program, the air quality emissions inventory will not include the Greenhouse Gas Emissions, which will be the focus of this CPR grant.)
- Workforce Planning Analysis (project responsibilities will be provided by Tribal EPA Staff with support from outside Technical Consultants and Legal support.

The PCAP includes several selected high-priority GHG pollutant reduction measures that are specific to the Spirit Lake Reservation area and have been evaluated by the Tribe to have the highest likelihood for immediate success when specific data are collected and pollutant reduction measures are implemented. The PCAP provides actual implementation-ready mitigative measures by Tribal agencies in coordination with adjoining Counties.

Listed below are the GHG reduction measures that the Spirit Lake Tribe is proposing to address in two Steps

Step I: Identify and Preliminarily Investigate Pertinent GHG Reduction Measures

- Carbon free transportation: increasing access to electric vehicles (EVs), beginning the process of decarbonizing heavy transport and freight and helping more people to walk, cycle and take public transport.
- Carbon free buildings: supporting tribal businesses to improve energy efficiency and move away from fossil fuels, such as coal, by continuing to roll out Federal funding for decarbonization.
- Carbon free buildings: banning new low- and medium-temperature coal boilers and phasing out existing ones.
- Carbon-freer agriculture: introducing an emissions pricing mechanism for on-reservation agriculture and adjoining counties; work with surrounding counties and state through MOU for seamless planning.
- Carbon free agriculture: accelerating the delivery of agricultural emissions reduction tools and technologies for farmers and farming businesses through the establishment of a new tribal/local government/state/federal groups for climate action on agricultural

emissions requiring refrigerants to be captured and destroyed when heating and cooling systems reach the end of their life and more.

- Reducing the amount of waste (including food waste) going to landfills, investing in waste infrastructure and expanding landfill gas capture.
- Establishing native forests, wetlands and water bodies at scale to develop long-term carbon sinks and improve biodiversity.
- Accelerating the supply of woody biomass to replace coal and other carbon intensive fuels and materials.
- Driving mission-led innovation in some of the most challenging parts of the local economy through climate innovation platforms and existing wider research, science and innovation system.
- Increasing applications of wind-solar-hydrogen energy technologies. The key answer is found with energy storage technologies. These technologies which would allow energy to be dispatched during calm wind conditions, cloudy periods and after sunsets. The Tribe has access to an abundance of renewable energy resources. These resources include a rich wind resource, harvestable solar and an abundance of water. Utilizing simple scientific principles (electrolysis of water) for the production of hydrogen and oxygen, a hybridized renewable energy system for Wind-Solar-Hydrogen production/combustion can readily be created for producing, storing and dispatching energy on an as-needed basis. The storage mechanism relies on the conversion of energy between its various forms (electrical, mechanical, and chemical) that are consistent with the local environment (solar, wind, and water availability). This combination of renewable energy resources and storage systems could be sized to enable all of the energy requirements of the tribal community to be met cleanly, safely, cost effectively, and reliably at all times.

Step 2: Acquire Data to Help Formulate a Priority Climate Action Plan for Pollution Reduction

- Develop a Quality Assurance Plan for the Spirit Lake Reservation GHG emission inventory.
- Develop the GHG emission inventory (EI). The EI will improve understanding of current GHG emission sources and quantities so that the Spirit Lake Tribe can prioritize actions that reduce GHG and co-pollutants known to contribute to serious human health effects (criteria air pollutants and toxic air pollutants) where citizens live, work, play, and go to school, particularly.
- Quantify the amount of GHG that will be reduced when the prioritized GHG reduction measures are implemented.
- Assess other benefits that may occur when the priority GHG reduction measures are implemented.
- Conduct a Review of Authority to implement reduction measures and to determine Memorandum of Agreements with local County government agencies that may be needed to facilitate implementation of reduction measures.

- Identify the intersections with other sources of available funding such as solid waste and water quality programs *(under the SLT 103 Air Program, the air quality emissions inventory will not include the Greenhouse Gas Emissions, which will be the focus of this CPR grant)*.
- Prepare a Workforce Planning Analysis, including identifying tribal and local agencies' staff availability and project responsibilities (to be provided by Tribal EPA Staff with support from outside technical consultants and legal support, as necessary). Project organization and responsibilities will be identified in the QAPP for the EI.

2.0 TRIBAL CONSIDERATIONS

Because the Spirit Lake Reservation is located in a rural area of a rural state, funding and resources are limited from Tribal and non-Tribal sources to address many issues including environmental and greenhouse gas concerns. Lack of nearby recycling locations present challenges for the Tribe to identify funding and resources and transport recyclable products long distances to larger cities. Results from the 2020 Census showed the Poverty Rate on the Reservation (38.9%) was more than four times higher than the State of North Dakota and the Nation. Additionally, the Median Household Income of the Reservation ($43,824) was more than one-third less than the State of North Dakota and the Nation. The effects of low incomes and lack of jobs are apparent in many ways as tribal families struggle to get by, provide healthy food for their families and find affordable housing (over 300 families are on the waitlist for housing). Low-income families that cannot afford to pay for solid waste disposal services resort to dropping waste into unmanaged open dumps and burning garbage in open pile burns or burn barrels. These occurrences indicate that high unemployment and underemployment are typical of the Reservation and are representative of Environmental Justice issues that are also impacted by Climate Change. An EPA analysis report (2021), on Climate and Social Vulnerability in the United States, showed that changes in climate most severely and disproportionately harm underserved or Environmental Justice communities, who also are less equipped to have resources to recover from the impacts of increased flooding, droughts, poor air quality and other hazards. The Reservation has received many Federal Disaster Declarations for flooding, drought, freeze, frost, lightening, hail, wind and insect conditions, and other hazards. Sources of GHGs and other air pollutants add to this situation by releasing pollutants to the air, contaminating soil and water resources, affecting food supplies and contributing to overall human health and safety.

3.0 PCAP ELEMENTS

3.1 Greenhouse Gas (GHG) Inventory

The Spirit Lake Tribe (SLT) GHG emission inventory was developed in 2023/2034 as part of the SLT EPA's project to enhance the Reservation-wide emission inventory developed in 2003-2004. Activity data and the resulting emission estimates of GHG (presented in this summary as annual tons of carbon dioxide equivalent (CO2e)) are intended to be representative of calendar year 2022[1] Reservation-specific data were used where available and were supplemented with non-local but still determined to be representative data, as necessary.

Scope

The GHG emission inventory was developed in adherence to the steps in the Quality Assurance Project Plan (QAPP). The QAPP was submitted to and approved by the U.S. EPA Region 8. The scope of the SLT GHG emission inventory project is to quantify GHG emissions that are generated within the exterior boundary of the Spirit Lake Reservation (e.g., residential heating using propane and natural gas) and GHG emissions that are directly caused by activities of the population of the Spirit Lake Reservation (e.g., residential and commercial electricity consumption).

Table ***1*** presents the GHG Sectors that are represented in the SLT GHG inventory and lists the GHGs quantified in the inventory.

Table 1 – GHG Sectors and Greenhouse Gasses

GHG Sectors	***Greenhouse Gases (across all sectors)***
1. Mobile Source Combustion 2. Residential Heating 3. Electricity Consumption 4. Solid Waste Management 5. Agriculture/Land Management & Forestry 6. Wastewater Treatment 7. Fires (structure)	carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), and CO2 equivalent (CO_2e)

The deliverables for the SLT GHG emission inventory project include:

- A Quality Assurance Project Plan – Spirit Lake Reservation Emissions Inventory of Criteria Pollutants & Greenhouse Gases (QAPP) (approved by USEPA Region 8 in December 2023).
- A Microsoft Excel workbook containing multiple worksheets including data for the Reservation, activity rates of emission sources, emission factors, emission calculations, summary tables and graphics, and references.
- The Spirit Lake Reservation-Wide Emission Inventory – 2023 Update and Enhancements Final Report (March 2024). The report is included as Attachment A to the PCAP document.

Data Collection

[1] In some cases, pre-2022 activity data are used to calculated CO_2e because pre-2022 data were the best available data of sufficient quality.

Data collection relied on SLT's 2004 emissions inventory as the starting point for the 2023 GHG emission inventory project. Potential source categories included in the emissions inventory were quality assured via reality check by the SLT EPA PM who has basic knowledge of the Reservation's environs and Air Sciences Project Quality Assurance Officer (QAO) who is specifically familiar with the Spirit Lake Reservation due to Air Sciences involvement working with SLT EPA staff in the field to gather information and source data for the 2004 emissions inventory (criteria pollutants only) effort.

For sources in the current SLT inventory, activity data were updated through literature sources, online information sources, phone calls, and field research by SLT EPA technical staff. Data resources included census data, traffic data (departments of transportation), industry records, governmental geographic information system layers, and local and professional judgment.

The list of data resources used to update activity rates was reviewed by reality check and peer review. Tracking of the data sources was quality controlled by preparing the data gathering sheets. Matching the list of sources back to the AP-42 categories and the Tribal Greenhouse Gas Inventory Tool (TGIT) reality checked the completeness of the data resources list for data that needed to be gathered for the reservation. Peer review by SLT EPA Tribal staff further ensured completeness and ensured that sources that could potentially go undetected without additional field research were captured. All data have been logged into an Activity Data Notebook complete with local contact information. Contents of the Activity Data Notebook are summarized in Table 2.

Table 2 – Activity Data Notebook

Data Type	Source of Data	Description	GHG EI Use
Traffic Count	North Dakota Department of Transportation (NDDOT)	Average daily traffic counts by station for the latest year of data downloaded into excel workbook (2022).	Mobile combustion
Energy Consumption	Energy Information Administration (EIA)	Annual energy usage by state by fuel type (2020).	Heating
Boundaries (Townships, Counties, Reservation)	North Dakota GIS Hub Data Portal (NDGIS Hub), U.S. Census Bureau TIGER/Line Shapefiles	Reservation (2020), township, and county boundary (2021) shapefiles input into QGIS.	Ag/land management, forestry
Roads	North Dakota GIS Hub Data Portal (NDGIS Hub)	County roads (2022) in North Dakota shapefile, input into QGIS.	Mobile combustion

Data Type	Source of Data	Description	GHG EI Use
Population/ Townships	U.S. Census Bureau	2022 population and township data.	Heating, solid waste, wastewater
Motor Fuel Usage, Registered Vehicles	U.S. Department of Transportation (USDOT)	Monthly motor fuel reported in North Dakota (2023). Number of registered vehicles by vehicle type (2019).	Mobile combustion
Waste Generation	Center for Sustainable Systems (CSS), University of Michigan	Average municipal waste generation by person in the U.S. (2018).	Solid waste
Waste Stations	J. Tweeton (SLT), Spirit Lake Tribe Integrated Waste Management Plan (SLT-IWMP)	Type of landfills/open dumps, years started, Residential vs. Commercial/Industrial waste.	Solid waste
Flow rates of wastewater going to lagoons	Spirit Lake Casino and Resort Statement of Basis for USEPA's issuance of the NPDES permit (2019) for the Spirit Lake Casino.	Average wastewater flow per day from Spirit Lake Casino to lagoons (2019).	Estimates of GHG emissions from lagoons.
Lagoons	U.S. Environmental Protection Agency (EPA)	Lagoon locations and design flow from Lagoon Inventory Dataset (2022).	Wastewater
Electricity Usage	SLT DOE Annual Program Review	Spirit Lake Tribe 1.5 MW Community Wind Energy Project, electricity usage on the reservation.	Electricity
Fertilizer Usage	U.S. Department of Agriculture (USDA)	Fertilizer type and amount (acre) per county in North Dakota for 2017.	Ag/land management
Forested Land	Spirit Lake Tribe Integrated Waste Management Plan (SLT-IWMP)	Land use and acreage (2012).	Forestry
Structure Fires	Spirit Lake Fire Department (SLT)	# Structure fires per year.	Structure fires

Data Type	Source of Data	Description	GHG EI Use
Sioux Manu-facturing	U.S. Environmental Protection Agency (EPA)	Sioux Manufacturing annual emissions inventory submitted 06/12/2023.	Sioux Mnf.

GHG Accounting Method

Table 3 presents the essential details of the accounting method for each GHG sector. More complete details of the accounting methods are in Section 3 of the emission inventory report (Attachment A).

Table 3 – GHG Accounting Method Summary

Sector/ Source	Emission Factor(s)	Activity Data	Calculation Method
Residential heating	Emission Factors: CO_2, CH_4, and N_2O emission factors for propane and natural gas, 40 CFR Part 98, Table C-1 and C-2 to Subpart C.	Per-household propane and natural gas use based on the Energy Information Administration's (EIA) annual household site fuel consumption in U.S. homes by state (EIA 2023). Number of households per township derived from U.S. Census 2022.	Use heat input for propane and natural gas from residential heating and apply emission factor for each GHG to then calculate total CO_2e emitted from one type of GHG (ton/yr) using GWP, do for CO_2, CH_4, and N_2O then sum for total CO_2e.
Calculation Formula Propane	Households x propane usage (gal propane/yr) x unit conversion (kgal/gal) x emission factor (lb pollutant/kgal propane) x unit conversion (ton/lbs) = pollutant emitted (ton/yr)		
Calculation Formula Natural Gas	Households x natural gas usage (MMscf natural gas/yr) x emission factor (lb pollutant/MMscf natural gas) x unit conversion (ton/lbs) = pollutant emitted (ton/yr)		

Sector/ Source	Emission Factor(s)	Activity Data	Calculation Method
Mobile Fossil Fuel Combustion	Emission Factors: CO_2, CH_4, and N_2O emission factors for diesel and gasoline, 40 CFR Part 98, Table C-1 and C-2 to Subpart C.	Activity Data: Total VMT/yr was taken from the Tailpipe calculations described in Section **Error! Reference source not found.** Average fuel economy by major vehicle category based on fuel type from TGIT (EPA 2023b). Gasoline vs. Diesel percentages from monthly motor fuel reported in North Dakota from U.S. Department of Transportation (US DOT 2023). Percent of each type of vehicle from Summary of National Transportation Statistics (US DOT 2021).	Calculation Method: Use total VMT/yr and mi/gal to calculate the output (gal/yr) for diesel and gasoline. Apply emission factor for each GHG to then calculate total CO_2e emitted from one type of GHG (ton/yr) using GWP, do for CO_2, CH_4, and N_2O then sum for total CO_2e.
Calculation Formula	Vehicle miles traveled (VMT/yr) x % of total for vehicle type x % of total fuel / Fuel economy (mi/gal) x unit conversion (Btu/gal) x unit conversion (MMBtu/Btu) x emission factor (kg/MMBtu) / unit conversion (kg/ton) x GWP = CO_2e emitted (ton/yr)		
Solid Waste Management – Open Burning	AP-42 2.5 Table 2.5-1, Emission Factors for Open Burning of Municipal Refuse, and ft3 CH_4/tonne CH_4 from the TGIT. Global Warming Potential (GWP): 40 CFR Part 98, Table A-1 to Subpart C.	Total municipal waste generation (lb/person/day) from the CSS at University of Michigan (CSS UM 2023). Waste stations on the reservation and the years started from J. Tweeton from SLT (SLT 2024c), (SLT 2024b). % Residential vs. Commercial/Industrial waste from SLT Integrated Waste Management Plan (SLT 2023b). Total SLT population and households from U.S. Census Bureau 2022.	Use the total municipal waste generated lb/day per person and convert to ton/yr per household using population and housing data then apply emission factor to get total CH_4 emissions (ton/yr) then GWP for CO_2e (ton/yr).

Sector/ Source	Emission Factor(s)	Activity Data	Calculation Method
Calculation Formula	Total municipal waste generated (lb/person/day) x (people/household / unit conversion (lb/ton) x unit conversion (365 day/yr) x emission factor (lb/ton) x % municipal solid waste burned x number of households = Total CH_4 emissions from burning open dumps (ton/yr) x GWP = CO_2e emitted (ton/yr)		
Solid Waste Management – Landfill	AP-42 2.5 Table 2.5-1, Emission Factors for Open Burning of Municipal Refuse, and ft3 CH_4/tonne CH_4 from the TGIT. Global Warming Potential (GWP): 40 CFR Part 98, Table A-1 to Subpart C.	Total municipal waste generation (lb/person/day) from the CSS at University of Michigan (CSS UM 2023). Waste stations on the reservation and the years started from J. Tweeton from SLT (SLT 2024c), (SLT 2024b). % Residential vs. Commercial/Industrial waste from SLT Integrated Waste Management Plan (SLT 2023b). Total SLT population and households from U.S. Census Bureau 2022.	Use the Landfill Air Emissions Estimate and default values from AP-42 2.4.-3 Eq. 1. Calculate total waste generated (ton/yr) for each transfer station and time the landfills have been open then plug into Landfill Estimation Model calculation along with default values to get methane generation rate (ft3/yr). Use generation rate to calculate CH_4 emissions and then GWP was applied to calculate CO_2e (ton/yr).
Calculation Formula	(Municipal solid waste/household) /unit conversion (lb/ton) x unit conversion (365 day/yr) x (people/household) x number of households x % of total waste = Total waste generated at transfer station (ton/yr) (R), t (yr) = 2023 – 2005. Calculate QCH_4 with default values and R and t, QCH_4=Lo*R(e-kc-e-kt). QCH_4 (ft3/yr) x unit conversion (ft3 CH_4/tonne CH_4) = Total CH_4 emissions from landfill (ton/yr) x GWP = CO_2e emitted (ton/yr)		

Sector/ Source	Emission Factor(s)	Activity Data	Calculation Method
Wastewater Treatment – Septic Systems	California Board of Resources, Local Government Operations Protocol (LGOP) For the Quantification and Reporting of Greenhouse Gas Emissions Inventories.	Average wastewater flow from Spirit Lake Casino Statement of Basis (EPA 2019). Average sewage flow per person from the North Dakota Administrative Code Chapter 62-03.1-03 (NDLB 2000). Total SLT population and households from U.S. Census Bureau 2022. Percentage of households using septic from the EPA, (EPA 2023d). Location and design capacity of lagoons within SLT (EPA 2022) and population data for each township. Flow for Spirit Lake Rural Water System Water Treatment from statement of basis (EPA 2017). Population served from lagoon in Four Winds Tate Topa School (PBS 2024).	Use LGOP Equation 10.6 default values and SLT population data to calculate CH_4 emissions (ton/yr) from septic systems then apply the GWP for CO_2e (ton/yr).
Calculation Formula	Population x BOD5 load (kg BOD5/day) x Bo (kg CH_4/kg BOD5) x MCFseptic x (356 day/yr) x unit conversion (ton/kg) = CH_4 emissions (ton/yr) x GWP = CO_2e emitted (ton/yr)		

Sector/ Source	Emission Factor(s)	Activity Data	Calculation Method
Wastewater Treatment – Lagoons	California Board of Resources, Local Government Operations Protocol (LGOP) For the Quantification and Reporting of Greenhouse Gas Emissions Inventories.	Average wastewater flow from Spirit Lake Casino Wastewater Treatment (Lagoons) Statement of Basis (EPA 2019). Average sewage flow per person from the North Dakota Administrative Code Chapter 62-03.1-03 (NDLB 2000). Total SLT population and households from U.S. Census Bureau 2022. Percentage of households using septic from the EPA, (EPA 2023d). Location and design capacity of lagoons within SLT (EPA 2022) and population data for each township. Flow for Spirit Lake Rural Water System Water Treatment from Statement of Basis (EPA 2017). Population served from lagoon in Four Winds Tate Topa School (PBS 2024).	Use LGOP Equation 10.10 default values and average wastewater flow to calculate N_2O emissions from effluent discharge (ton/yr) then apply the GWP for CO_2e (ton/yr).
Calculation Formula	Average flow (gal/day)/ average flow per person (gal/person/day) = P for Lagoons and WWTF, Ptotal = Plagoos + PWWTF, [Ptotal x Find-com x [Total N Load (kg N/person/day) - N uptake (kg N/kg BOD5) x BOD5 load (kg BOD5/day)] x emission factor effluent (kg N_2O-N/kg sewage) x 44/28 x [1 - F plant nit/denit] x (365 day/yr) x unit conversion (ton/kg) = N_2O emissions (ton/yr) x GWP = CO_2e emitted (ton/yr)		
Electricity Consumption	MROW eGrid Subregion from the TGIT. Global Warming Potential (GWP): 40 CFR Part 98, Table A-1 to Subpart C.	Total energy usage by utility company and percent residential vs. industrial energy use from SLT DOE Annual Program Review presentation (SLT 2023a).	Use total energy usage and apply the emission factors to get emissions for each GHG (ton/yr) then apply the GWP to get the CO_2e (ton/yr).
Calculation Formula	Total usage (kWh/yr) / unit conversion (kWh/MWh) x Grid emission rate (lb/MWh) / unit conversion (lb/ton) = GHG emissions (ton/yr) x GWP = CO_2e emitted (ton/yr)		

Sector/ Source	Emission Factor(s)	Activity Data	Calculation Method
Agriculture & Land Management	Land use factors from the TGIT. Global Warming Potential (GWP): 40 CFR Part 98, Table A-1 to Subpart C.	Fertilizer usage by type from U.S. Department of Agriculture (USDA 2017). Total acreage by county and within Spirit Lake from QGIS, from NDGIS hub portal shapefiles. Amount of commercial fertilizer purchased from the EPA, (EPA 2023a). Manure fertilizer usage (ton/acre) from University of Alaska, Fairbanks article (UAF 2021).	Ratio down fertilizer usage (acre) by county to percent of county within Spirit Lake. Calculate the fertilizer consumption (ton) based on fertilizer usage factors (ton/acre), apply the land use emission factors and formulas from TGIT for N_2O emissions (ton/yr). Then apply the GWP to obtain CO_2e emissions (ton/yr).
Calculation Formula	Fertilizer type by county (acre) x area ratio (%) x fertilizer usage (lb/acre) / unit conversion (lb/ton) = Fertilizer Consumption (ton/yr)		
Forestry	Carbon sequestration factor from the TGIT.	Total reservation area from QGIS, U.S. Census Bureau TIGER/Line shapefiles. Land use from Spirit Lake Tripe Integrated Waste Management plan (SLT 2023b).	Calculate % area with tree covered from forested land acres and total reservation land (from SLT-IWMP). Use updated total reservation area and apply tree cover and carbon sequestration factor.
Calculation Formula	Forested Land (acre) / IWMP Reservation Land Area (acre) = % Area with tree cover. QGIS Total Reservation Area (acre) / unit conversion (acre/km2) x % tree cover x carbon sequestration factor (tonne C/hectare/yr) = CO_2e Sequestered (ton/yr)		
Structure Fires	Wood GHG factors from 40 CFR Part 98, Table C-1 and C-2 to Subpart C. Global Warming Potential (GWP): 40 CFR Part 98, Table A-1 to Subpart C.	The number of structure fires annually came from Spirit Lake Fire Department from J. Tweeton (SLT 2024a). Average lumber use per single family household from USDA (USDA 1994). Weight of kiln dried lumber from The Engineering ToolBox (Eng. ToolBox 2013).	Calculate the weight of lumber used in an average structure, multiply this by the number of structure fires. Calculate the total combustion per year from the total wood burned in structure fires. Multiply by each emission factor then apply the GWP to obtain CO_2e emissions (ton/yr).

Sector/ Source	Emission Factor(s)	Activity Data	Calculation Method
Calculation Formula	Lumber use (board ft/structure) x Lumber Weight (lb/ft) x # Structure Fires (structures/yr) x unit conversion (Btu/lb – dry wood) / unit conversion (Btu/MMBtu) x emission factor (kg/MMBtu) = GHG emissions (ton/yr), GHG emissions (ton/yr) x GWP = CO_2e emitted (ton/yr)		

3.1.1 GHG Emissions Summary

Table 4 and Table 5 present the results from SLT Reservation GHG emission inventory.

Table 4 – Spirit Lake Reservation Total GHG Emissions (ton/yr) by GHG Sector

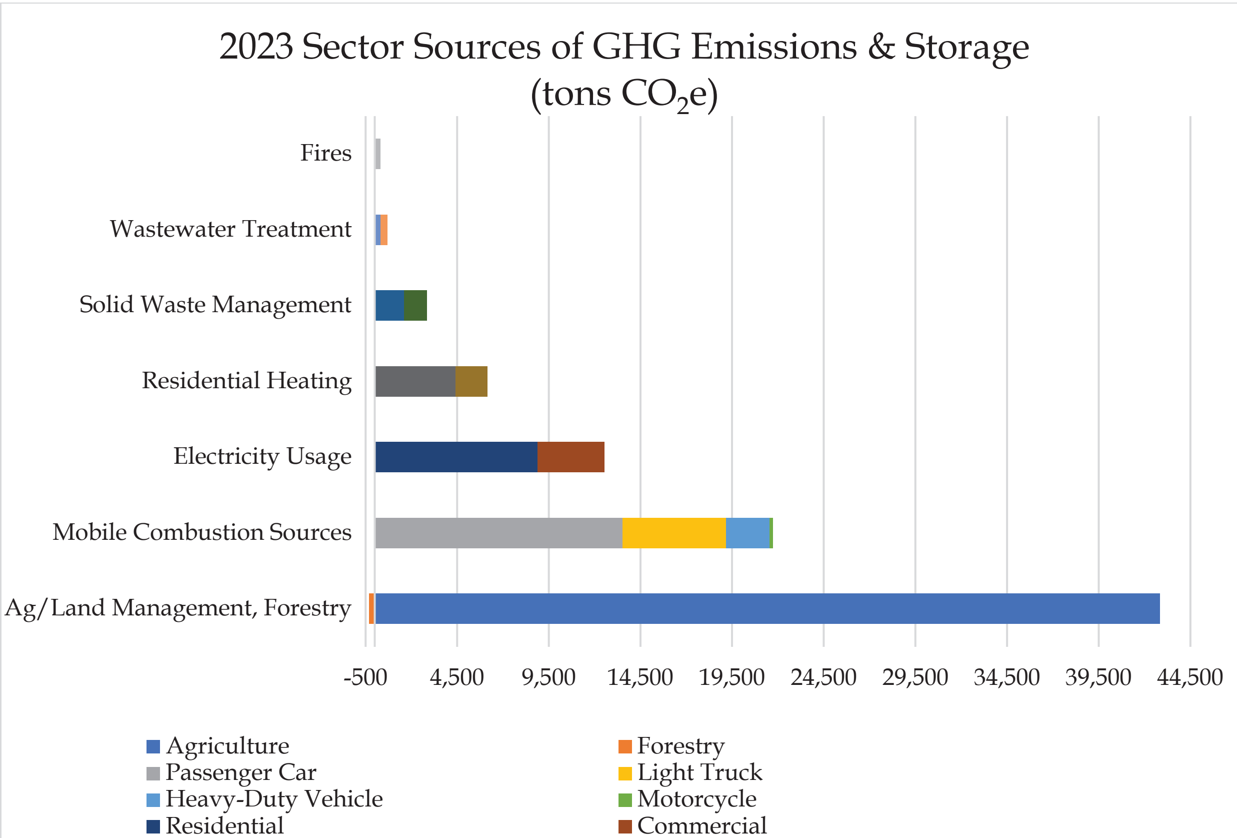
Source Category	CO_2	CH_4	N_2O	CO_2e
Stationary Fossil Fuel Combustion	6,133	0.24	0.05	6,153
Mobile Combustion Sources	21,658	0.91	0.18	21,735
Solid Waste Management	--	113.6	--	2,839
Wastewater Treatment	--	14.62	1.06	682.3
Electricity Usage	12,149	0.18	1.31	12,543
Agriculture and Land Management	--	--	143.8	42,855
Structure Fires	302.9	0.58	3.5	307.0
Forestry	--	--	--	(299.3)
Water use (offsite)	--	--	--	--
Total GHGs				**87,114**
Net GHGs				**86,814**

Table 5 – Spirit Lake Reservation Total CO_2e Emissions (tons/yr) by GHG Sector & Source Category

Sector	Source	CO_2e (ton/yr)
Ag/Land Management, Forestry	Agriculture	42,855
	Forestry	(299.3)
Mobile Combustion Sources	Passenger Car	13,528
	Light Truck	5,652
	Heavy-Duty Vehicle	2,377
	Motorcycle	177.6
Electricity Usage	Residential	8,905
	Commercial	3,637
Residential Heating	Propane	4,413
	Natural Gas	1,740
Solid Waste Management	Residential	1,590
	Commercial	1,249
Wastewater Treatment	WWTF/Lagoons	316.7
	Septic Systems	365.5
Fires	Structure Fires	307.0
Net GHGs		**86,814**

Figure 1 presents the results from the Spirit Lake Reservation GHG emission inventory. The horizontal bars show the annual CO2e emissions (tons) for each GHG sector. The colored sections of the horizontal bars show the contribution from the source categories within the GHG within the sector.

Figure 1 – Spirit Lake Reservation CO2e Emissions & Storage by GHG Sector



3.2 GHG Reduction Measures

The following GHG sector-specific GHG reduction measures were developed as a result of information in the GHG emission inventory recently completed for the Spirit Lake Reservation and in consultation with Tribal Stakeholders. The Spirit Lake Tribe acknowledges the U.S. goal of reducing U.S. GHG emissions by 50% from 2005 levels by the year 2030. The Spirit Lake Tribe and our stakeholders are taking a "consider all GHG reduction measures" approach to contribute to reducing GHG emissions from sources and activities on the Reservation in order to support the nation's aggressive GHG reduction goals nationally. ***The Spirit Lake Tribe's goal is to achieve 25% of the potential GHG emission reductions on the Reservation by 2030 (with initiating implementation-ready measure immediately) and fully implementing the GHG reduction strategies by 2040 to achieve 100% of the potential GHG emission reductions.***

Sector 1: Agriculture/Forestry

Estimate of the quantifiable GHG emissions reductions from 2025 to 2030: TBD. SLT believes that the Agriculture/Forestry GHG sector is the sector with the largest potential for significant GHG reductions on the Spirit Lake Reservation. However, because Tribal agricultural lands are mostly leased to non-tribal members, measures to reduce GHG in this sector will be included in the Tribal (BIA) leases and closely coordinated with the State of North Dakota and BIA as this involve non-tribal lessees on Tribal Trust lands.

In the meantime, SLT will gather existing farm/ranch equipment & machinery annual utilization rates (and or diesel/gasoline fuel consumption rates) for the Reservation, improve the estimates of annual GHG emission rates for use in the CCAP, and estimate the overall effectiveness of the Sector 1 priority reduction measures in order to quantify emission reductions.

Implementing agency or agencies: BIA and Tribal Realty, Tribal EPA, Fire Department (does routine vegetation and forestry management of fire control purposes on the Reservation, Planning, Tribal Forestry Department (to be created), NRCS Program.

The agriculture sector has a complicated set of objectives to consider alongside climate goals, including biodiversity, nutritional need, food security, and the livelihood of farmers and farming communities. Reducing agriculture emissions will require changes in how we farm, what we eat, how much we waste, and how we manage our forests and natural carbon sinks.

The first step in reducing emissions from agriculture is to produce food as efficiently as possible—that is, to change how we farm. A set of proven GHG-efficient farming technologies and practices—which are already being deployed—could achieve about 20 percent of the sector's required emissions reduction by 2050.

To understand exactly how the sector can reduce its emissions to achieve the 1.5°C pathway, we can follow a process adopted by Marginal Abatement Cost Curves (MACC). This process identified measures to reduce on-farm emissions and organized them into a marginal abatement cost curve (MACC). It details how much GHG abatement can be realized and at what costs in relation to specific measures that reduce emissions—either through reduced unit emission rate (for example, nitrous oxide emission per hectare) or improved productivity (for example, fewer dairy cows for the same level of milk production).

Priority GHG Reduction Measures

1. **Update the leases with farmers and ranchers to include Best Practices Requirements and GHG Reduction Measures *discussed below under "Additional GHG Measures Under Consideration*.**
   Continue coordination with the BIA on its updated lease initiative (Plan of Conservation Operation – Fort Totten Agency) that includes several Conservation Practices and a Grazing Plan. The Conservation Practices include: 1) Encouragement of no-till farming or minimum tillage faming, 2) Restrictions on row crop planning, 3) Protections against the growth and spread of diseases, insects, rodents, noxious weed and other weeds by chemical or mechanical means, 4) Maintaining natural waterways and/or drainage in their natural state, 5) Specific maintenance of hay land, its equipment and debris, 6) Maintaining grasslands and pastures, 7) Compliance with Tribal, Federal and State laws and regulations pertaining to livestock, 8) Following laws and regulations pertaining to burning, conservation developments and improvements, trespassing and fences, abandoning grasslands and bushlands, restrictions on grazing or cropping in the road rights-of-ways, assuring no base acreage is lost, and the placing of junk, trash, refuse and rocks.

2. **Manage forests, grasslands, and wetlands for increased carbon sequestration and storage**. **Steps include the following:**
   - Manage community forests, forestlands, and other plantings such as living snow fences for carbon sequestration through tree production and planting, maintenance of tree canopy, and protection of heritage trees. Focus on efforts to manage tree canopy in each Reservation district for benefits such as energy savings, risk reduction, air pollution, and mitigation of urban heat island effect.
   - Restore peatlands impacted by legacy drainage on private and public lands, to complement existing ND state funding aimed at acquiring, restoring, and enhancing peatlands.
   - Increase diverse grassland habitat by identifying and revegetating habitat corridors within solar sites, utility corridors, road rights-of way, waterways, and neighborhoods.

Additional GHG Measures Under Consideration for Agriculture/Forestry

In addition to the Conservation Practices that are being included in BIA's update lease initiative that is currently underway, there are many other agricultural practices that would reduce GHG emissions and that are being considered as potential new requirements in agriculture lease agreements. These include:

Adopt zero-emissions on-farm machinery and equipment. The largest amount of on-farm GHG emissions reduction potential can be achieved by shifting from traditional fossil-fuel equipment and machinery—such as tractors, harvesters, and dryers—to their zero-emission counterparts. This transition could also result in significant reductions in farming operating costs due to reduced maintenance and fuel costs.

Market penetration of zero-emissions farm equipment and machinery is far behind that of consumer vehicles today. Although market leaders have piloted proofs-of-concept and prototype equipment and machinery, no notable commercial launches have taken place. However, broader market dynamics suggest internal combustion engines and other fossil-fuel sources are ripe for mass displacement by 2050. With the right investment from machinery manufacturers, total-cost-of-ownership parity between, for example, tractors powered by internal combustion engines and those powered by zero-emissions sources (such as battery electric power) could be viable by about 2030. After that, incremental capital-expenditure cost reductions will likely come from rapid reduction in battery prices (historical and forecasted), which alone make up 30 to 50 percent of tractor component costs.

The most significant challenge to implementing these measures may be the slow turnover of farm equipment. For example, the typical lifetime of a tractor is more than 20 years. But policies, such as revised emissions regulations and targeted R&D investment by farm-equipment majors and new pure-play challengers, could accelerate adoption.

Reduce nitrogen overapplication.

Transition to Low or no tillage practices. Low- and no-tillage practices aim to reduce soil organic matter loss, limit erosion, and conserve water through alternatives to conventional tillage. When combined with deep placement of nitrogen, low- and no-tillage practices—such as shallow plowing, fewer tillage passes, chisel coulter drilling, and zone tillage—reduce fuel usage and denitrification, in turn reducing emissions. In aggregate, these practices have been shown to deliver an 18 percent reduction in yield-scaled nitrous oxide emissions in dry environments, in addition to an up to 75 percent reduction in on-farm fuel usage. While penetration of low- and no-tillage practices today is estimated at 11 percent of hectares globally, it has shown rapid growth in key markets, with approximately 40 percent of hectares in the United States now using low- and no-tillage practices.

Although potential yield losses may deter adopting low- and no-tillage practices, several studies contend that long-term cost savings outweigh lost revenue from production. In many cases, implementation has been shown to drive other economic benefits such as reduced field labor man-hours. However, low- and no-tillage practices are not universally effective; some studies have shown little (or even adverse) impact on nitrous oxide emissions in select moist, temperate environments. Given this shortcoming, technical advisors familiar with the local context (including soil, environment, and agriculture economics) will need to pair with local farmers willing to pilot the practice. Incentive programs would need to be developed to fund agricultural equipment technologies that use alternative fuels.

Improve equipment maintenance.

Improve animal health monitoring and illness prevention. By improving the health of farm animals, farmers could improve productivity and reduce animal mortality due to disease. The ability to meet the world's projected animal protein demand with fewer, healthier animals could reduce emissions from enteric fermentation, manure left on pasture, and manure management.

In North America, implementation of improved animal health management methods could improve overall cattle herd productivity by a weighted average of about 8 percent. In low- and middle-income regions that have less access to animal health products and clinical resources, the impact is likely to be significantly higher. However, achieving this potential requires overcoming significant hurdles. And since health challenges vary greatly by region and species, a silver bullet, or even several, are unlikely.

Several efforts could encourage implementation at greater scale: innovation from animal health-product manufacturers could increase the availability of vaccines for emerging diseases, such as African swine fever. Under resourced regions could particularly benefit from expanding distribution, advisory, and veterinary networks, as well as public health promotion strategies.

Improve livestock nutrient use efficiency.

Apply nitrification inhibitors on Spirit Lake buffalo pasture farms. Though the practice is nascent, direct application of nitrification inhibitors on pastureland has demonstrated significant reduction in nitrous oxide emissions from ruminant urine. Most widely used today are dicyandiamide and nitropyrene, and concurrent application of urease inhibitors has been shown to mitigate potential ammonia emissions.

Expand use of animal feed additives.
Some feed additives have been shown to inhibit methane production in the rumen. Propionate precursors—a class of free acids or salts, such as sodium acrylate or sodium fumarate—will likely have widespread applicability, as their use has been shown to directly

inhibit methane emissions from cattle without affecting animal growth. The combined impact of direct enteric-fermentation-rate reduction (approximately 13.0 percent) and productivity improvement (approximately 2.5 percent) generates potential for an approximately 15.0 percent reduction in CO_2e emissions per ruminant.

Accelerate soil health and nitrogen, livestock, and manure management practices that reduce greenhouse gas emissions and enhance carbon storage. Steps include the following:

- Implement nutrient management such as nitrification inhibitors, split nitrogen applications, and regional approaches.
- Implement livestock management practices such a grazing systems and feed management to reduce greenhouse gas emissions.
- Improve manure storage and handling optimize fertilizer application timing and reduce methane emissions. Practices include composting facilities, waste storage facilities, anaerobic digesters, roofs and covers, wastewater treatment facilities at agricultural sites including hog or dairy farms, and waste separation facilities.
- Provide planning, technical, and financial assistance, as necessary.

Develop cleaner fuel stocks and supporting infrastructure. Steps include the following:

- Generate renewable natural gas from anaerobic digestion and landfill gas capture, supporting facilities to transform organic waste into renewable energy, providing grants for methane digesters in feedlots, and creating programs to encourage anaerobic digestor development for renewable natural gas and fuels.
- Build a low-carbon aviation fuel supply chain and develop a regulatory framework for carbon sequestration pipelines and hydrogen consistently with the State of North Dakota practices.
- Produce green hydrogen, ammonia, and fertilizer by leveraging state funding for green hydrogen hubs, creating grant programs for manufacturing green fertilizers, and establishing production-based incentives for green ammonia.

Establish or expand economic development for local and regional economic development partners. Such partnerships would foster the establishment of food- and agriculture-based economic development strategies, such as community-based food co-ops.

Provide education and outreach, training, and technical assistance.

Sector 2: Transportation

Estimate of the quantifiable GHG emissions reductions from 2025 to 2030: TBD. SLT will gather additional information on the Reservation's vehicle fleet characteristics and the fleet replacement rate that would result from implementation of the Sector 2 – Transportation GHG reduction measures, the number of EV (incl. EV, plug-in hybrid, and hybrid vehicles) in the light-duty gasoline vehicle fleet on the Reservation, and the fleet replacement effectiveness of the Sector 2 – Transportation measures. Gasoline vehicle replacement with EV will result in approximately 50% reduction in CO2e emissions.

Implementing agency or agencies: Tribal Roads, Casino, Maintenance Department of Tribal Administration Building and Offices, Colleges and Local Schools

Priority GHG Reduction Measures

1. **Accelerate the transition to low- and no-carbon fuels in vehicles and equipment.**

2. **Electrify Public Transportation (School and District)**. Increasingly electrify light-duty public fleet vehicles and equipment, such as sedans, light-duty trucks, maintenance vehicles, and outdoor recreation-related vehicles. Increase the availability and access to public transportation in each district of the Reservation**.**

3. **Improve equitable access to electric vehicle charging infrastructure by installing charging stations.** Locations may include business and resorts (casino, malls, etc.), in each district of the Reservation, multifamily housing sites, providing public chargers, and assisting low- and moderate-income households to charge vehicles at home. Focus on charging infrastructure that would benefit low-income and disadvantaged communities (LIDACs).

4. **Transition fossil-fueled medium-duty, heavy-duty, and nonroad vehicles and engines to low- and no carbon-fueled alternatives.** Vehicles and equipment include, but are not limited to, transit and school buses, heavy-duty and medium-duty trucks, terminal tractors, construction equipment, agricultural equipment, landscaping and maintenance equipment, and diesel generators. Low- and no-carbon fuels including electricity and advanced biofuels. Focus efforts on vehicles that operate in LIDACs, especially where criteria and hazardous air pollutants are high.

5. Facilitate equitable access to transit and electric vehicle car-share programs in the Fort Totten, St. Michael, Tokio, Warwick, Cheyenne areas among others including micro transit, on-demand transit models, and strategic car-share locations to serve LIDACs such as multifamily housing sites. Establish electrified public, micro- and/or on-demand transit.

6. Commercial transportation efficiency to reduce vehicle miles traveled may be included, such as community waste hauler coordination.

Additional GHG Measures Under Consideration for Transportation

In addition to the implementation-ready transportation priority GHG reduction measures, there are many other transportation improvement measures that would reduce GHG emissions and that are being considered by the Tribe. These include:

Offer incentives for Electric Vehicles and Charging. Incentives will increase the share of electric vehicles (e.g., leasing and purchasing), and to expand electric vehicle charging infrastructure.

Provide planning, contracting, financial, and technical assistance to facilitate this transition. Focus efforts on vehicles and equipment used in LIDACs, especially where criteria and hazardous air pollutants are high.

Increase availability and adoption of clean travel options. Steps include the following:
- Increase safety and accessibility for walking, biking, and rolling in communities, for example by deploying community-designed quick-build projects such as curb extensions to reduce street crossing distance or paths physically separated from vehicle traffic.
- Increase adoption in LIDACs through strategic placement of bikeshare sites, such as at multifamily residences.
- Walking and Biking Paths - Additional walking and biking paths in your community.

Sector 3: Clean Energy and Efficient Buildings (usage)

Estimate of the quantifiable GHG emissions reductions from 2025 to 2030: A comprehensive program on the Spirit Lake Reservation to implement clean energy and efficient building practices for new housing and to retrofit existing housing would result in GHG emission reductions on the Reservation. The effectiveness of the GHG reduction measures will depend on the penetration of the program measures into the existing housing stock on the Reservation (approximately 1,350 homes), the adoption of Clean Energy and Efficient Buildings standards for new housing constructions, and the rate at which the 7 proposed measures are implemented. A comprehensive program (all of the proposed reduction measures) and that is implemented for 20% of existing houses and commercial entities per year (retrofitting all buildings by 2030) could result in up to 55% (2000 tons/year of CO_2e) reduction of CO_2e emissions due to decreases in consumption of natural gas, propane, and electricity across the reservation.

Implementing agency or agencies: Spirit Lake Housing Corporation, Tribal Housing

In the electricity sector, it is possible to replace coal and gas with wind, solar, and storage.

Priority GHG Reduction Measures

1. **Reduce greenhouse gas emissions in residential buildings** by promoting conservation, electrification, efficiency, and lower-carbon design, materials, and fuels.

2. **Decarbonize residential buildings by combining multiple technologies and approaches** including weatherization, energy efficiency, renewable energy (including development of Community-Scale Energy system – e.g. Solar Gardens, with micro-grid distribution),

refrigerant replacement, and electrification of cooking, heating, clothes drying, and hot water heating. For example, implement service panel upgrades and change out wood stoves, boilers, and furnaces for electric heat pumps or less carbon-intensive heating units. The Spirit Lake Tribe Strategic Energy Plan indicated the following savings:

Table 6: Annual Savings Opportunity Due To Efficiency Improvements In Four End-Uses Of Energy

Item	***Efficiency Improvement***	***Savings Per Year***
Space Heating	50% of technical potential	$100,000
Water Heating	50% of technical potential	$75,000
Refrigeration	25% of technical potential	$40,000
Lighting	50% of technical potential	$25,000
	Total	**$240,000**

Cost of Efficiency Improvements: The amount of money invested per home for energy efficiency improvements is a judgment call that requires discussion. There is a range in performance and price of technologies that provide improvements, and different homes require different variations in technology applications. Nevertheless, reasonable assumptions can provide a starting point for the necessary discussion, and toward that end, reasonable prices for selected technologies are provided below. More information about these technologies and prices is readily available on-line simply by asking an internet search engine a specific question about them, for example, Google: "cost of screw-in fluorescent lights;" or, "cost of water heater jackets;" or enter "AM Conservation Group, Inc.," just as examples.

Table 7: Examples of Cost Efficiency Improvement

Item	***Per House***
Programmable Thermostats ($40.00 each)	$40.00
Caulking	$30.00
Weather Stripping/Window Insulators ($15.00 per window, 6 windows per house)	$90.00
Attic Insulation – 1,300 sq. ft. per house ($0.50 - $2.25 per sq. ft.)	$900.00
Water Heater Jacket ($75.00 each)	$75.00
Water Pipe Insulation	$20.00
Low-Flow Showerhead ($15.00 each)	$15.00
Screw-In Fluorescent Lights ($5.00 per light, $12 lights per house)	$60.00
High-Efficiency Refrigerator (Cost above regular new refrigerator)	$250.00
Total Cost of Efficiency Improvement Technologies	**$1,480.00**
Labor Costs: 16 Hours per House @ $20.00/ Hr.	$320.00

Initial Energy Audit	$100.00
Total Costs Per House	**$1,900.00**

If these measures save an average of $200 per year in energy costs, they will have paid for themselves in cost savings in about ten (10) years, considering that light bulbs burn out, and some other routine expenditure are required. Again, costs and savings can vary significantly, depending on decisions made about what end-use efficiency measures to pursue, technologies selected to achieve efficiency improvements, and the performance of those technologies.

3. **Pair decarbonization with clean indoor air strategies;** for example, distribute single-burner induction cooktops to residents in Lower Income and Disadvantaged Communities (LIDACs) with higher-than-average rates of asthma. Include pre-weatherization to enable weatherization activities. Incorporate climate resiliency aspects to prepare homes and residents to withstand climate impacts, for example, heat pump cooling and rooftop solar and battery storage.

4. **Increase access to home decarbonization resources** through tiered financial incentives, rebates, pre-weatherization assistance, home energy audits and healthy home assessments, efficiency retrofitting, workforce training for weatherization and electrification, and expanded navigator programs, especially for low-income and disadvantaged residents in manufactured home parks, public housing, correctional facilities, rental units, reservations, and affordable multifamily and single-family homes. Conduct community-scale decarbonization block-by-block to reach the residents that will benefit most from energy savings and improvement of indoor air quality. Promote community involvement in planning for residential decarbonization. Install microgrid technology tailored to local community needs.

5. **Design new buildings using green building principles, energy sources, materials, and techniques.**

6. **Reduce greenhouse gas emissions in commercial, industrial, and public buildings by promoting conservation, efficiency, electrification, and lower-carbon design, materials, and fuels, and process improvements.**
   Decarbonize commercial and public buildings by combining multiple technologies and approaches including weatherization, energy efficiency, energy recovery, energy storage, renewable energy, refrigerant replacement, and electrification. Buildings include, but are not limited to schools, government buildings, commercial properties, small business districts, hospitals and health care facilities, university buildings, mixed use developments, resiliency hubs, community centers, correctional facilities, and ice arenas and other recreational buildings. Eligible activities include, but are not limited to energy audits, HVAC and electrical upgrades, solar panel installations, transitioning to low-temperature water heating systems, local geothermal networks, district heating and

cooling systems, and requirements for new buildings. Design new buildings using green building principles, energy sources, materials, and techniques.

<u>Additional GHG Measures Under Consideration for Clean Energy and Efficient Buildings (usage)</u>

To help the penetration of the priority GHG reduction measures for Clean Energy and Efficient Buildings, the Tribe is also exploring funding programs.

Identify Financing Programs - Establish a financing program (e.g., grants or low-interest loans) for energy efficiency and renewable energy installations in new and existing buildings.

<u>Sector 4: Residential Heating</u>

Estimate of the quantifiable GHG emissions reductions from 2025 to 2030: A comprehensive program on the Spirit Lake Reservation to implement the use of more efficient and alternative (cleaner) energy sources and more climate-friendly refrigerants for the existing housing stock would result in GHG emission reductions on the Reservation. The effectiveness of the GHG reduction measures will depend on the penetration of the program measures into the existing housing stock on the Reservation (approximately 1,350 homes), the rate of adoption of Clean Energy and Efficient Buildings standards for new housing constructions, and the rate at which the 6 proposed measures are implemented. A comprehensive program (all of the proposed reduction measures) and that is implemented for 20% of existing houses) per year (retrofitting all buildings by 2030) could result in more than 75% (more than 900 tons/year of CO_2e) reduction of CO_2e emissions due to decreases in consumption of natural gas, propane, and electricity by households across the reservation.

Estimate of the quantifiable GHG emissions reductions from 2025 to 2050: TBD

<u>Implementing agency or agencies:</u> Spirit Lake Housing Corporation, Tribal Housing

<u>Priority GHG Reduction Measures</u>

1. **Increase industrial efficiency and transition to cleaner energy sources and more climate friendly refrigerants.** Steps include the following:
   - Transition to clean industrial energy sources, materials, processes, products, and refrigerants. Replace wood and natural gas boilers with geothermal heat pumps starting with safe-house shelters.
   - Implement energy efficiency upgrades, refrigerant replacement, and solar. Evaluate industrial uses, work with businesses to reduce use of fossil fuels. Expand workforce training and development programs energy-efficiency and renewable energy services. Provide assistance for small business owners and municipalities to advance climate actions.

- Increase access and funding for solar panels on homes.
- Development of Community-Sale
- Identify funding for increasing energy efficiency in homes, including proper insulation, lighting, cooling and heating.
- Utilize sustainable building materials in home.
- Encourage electricity-based heating and cooling to influence residential consumption and demand for energy over time.

Sector 5: Solid Waste Management

Estimate of the quantifiable GHG emissions reductions from 2025 to 2030: A comprehensive program on the Spirit Lake Reservation to promote waste prevention and recycling programs, and to implement Best Practices measures at landfills would result in GHG emission reductions on the Reservation. The effectiveness of the GHG reduction measures will depend on the penetration of the program measures into existing households (approximately 1,350 households) and commercial entities on the Reservation, and the entire suites of the 3 proposed measures are implemented. A comprehensive recycling program that is implemented for 20% of existing households per year could result in a reduction of at least 45 tons of CO2e per year (3 percent of Solid Waste Management CO2e emissions due to residential waste). Implementation of waste prevention measures, also, would decrease CO2e emissions even more. Implementation of landfill Best Practices to limit methane generation and leaks would result in greater CO2e reductions due to Sector 6 reduction measures and can be quantified later when more specific information about landfill characteristics and effectiveness of the reduction measures are known.

Implementing agency or agencies: Tribal EPA, Refuse Control Services

Priority GHG Reduction Measures

1. **Promote waste prevention — often called source reduction.** Steps include the following:
   - Identify locations for surplus food donations.
   - Encourage switching from disposable to reusable products.
   - Encourage switching from single use plastics and plastics that cannot be recycled locally.
   - Encourage purchasing products and packaging that are as free of toxic substances as much as possible.
   - Work with businesses and industries to develop and implement plans for waste reduction, such as the tourism and hospitality industries.

2. **Increase recycling and composting.** Steps include the following:
   - Provide residential recycling and composting services.
   - Identify new/improved locations that accept recyclables.

- Increase access to recycling collections in Lower Income and Disadvantaged Communities (LIDACs), especially in multifamily dwellings.
- Coordinate with Tribal EPA Programs (GAP, Brownfields, Water, Air) and grants (BIL, Recycling, Climate Change, Wetlands, others) on recycling, reuse, and composting.

3. **Improve solid waste management.** Steps include the following:
   - Provide recyclable and composting bins to residential, commercial, and tribal offices at collection points throughout the Reservation.
   - Create a hazardous collection facility which encompasses a structure, equipment, and manpower to handle and manage the wastes (e.g., oil, combustible materials, batteries, medical, etc.)
   - Purchase/repair landfill collection and maintenance equipment.
   - Increase composting area at landfill.
   - Construct dedicated inert landfill.
   - Develop cooperative agreement with North Dakota State and counties of the Reservation with respect to composting, recycling, and hazardous wastes management.
   - Coordinate with Brownfields Program and related grants through cleanup of waste and contaminated materials; utilizing current funding to build dedicated inert landfill station for Brownfields sites, and waste management including inventory, separation, reuse potential, recycling, composting; and with a vision of using the land resource for clean energy community development.

Additional GHG Measures Under Consideration for Solid Waste Management

In addition to the implementation-ready waste reduction and solid waste management priority GHG reduction measures, there are other solid waste management practices and emission capture and control technologies that would reduce GHG emissions and that are being considered by the Tribe. These include:

Utilize the aerobic biological decomposition of organic matter, such as food scraps and plant matter, into humus, a soil-like material as natural fertilizer for landscaping and agricultural activities.

Install acid gas scrubbers and fabric filters in combustors to reduce emissions when burning debris at landfills.

Detect/fix and capture landfill methane leaks.

Sector 6: Wastewater Management

Estimate of the quantifiable GHG emissions reductions from 2025 to 2030: TBD. A comprehensive program on the Spirit Lake Reservation to promote technology changes for the wastewater treatment lagoons on the Reservation would result in reductions of GHG emissions on the Reservation. Replacing open lagoons with closed anaerobic digesters would reduce annual CO2e emissions from the lagoons by up to 98.9%. Implementation of other technologies could reduce CO2e emissions even more and can be quantified later when more specific information about technologies being considered and effectiveness of the reduction measures are known.

Implementing agency or agencies: Indian Health Services, Sioux Utilities, Tribal EPA

Priority GHG Reduction Measures

None at this time.

GHG Measures Under Consideration

Mitigation of wastewater treatment lagoons presents significant challenges for Spirit Lake Tribe if Federal Agencies (particularly the Indian Health Services) are not involved. Currently there are no wastewater treatment plants on Spirit Lake Reservation. Wastewater lagoons are the only methods of handling wastewater. The Indian Health Services provide initial turnkey support for the Tribe, with training and operation by the Tribe. The following GHG reduction measures are under consideration.

1. With the current lagoon system in place, the decomposition of organic matter in open wastewater lagoons produces biogas, including greenhouse gases like methane. When treated, these gases are released into the atmosphere. As part of Spirit Lake GHG reduction initiative, consideration to replace open lagoons with closed anaerobic digesters would be necessary to help reduce greenhouse gas emissions. Replacement of the lagoon technology with the cleaner aerobic technology reduces GHG emissions by up to 99.9%, (for example, a reduction from 317 tons CO2e/year to less than 5 tons CO2e /year from the 6 wastewater lagoons across the Reservation..

2. If wastewater treatment plants are determined to be another long-term option by the Indian Health Services for Spirit Lake Tribe, several steps may be considered when moving wastewater towards net-zero carbon conditions. The implementation of novel N (Nitrogen) removal processes such as PD/A (Partial Denitrification-Anammox or Anaerobic Ammonia Oxidation) and DAMO/A (Denitrifying Anaerobic Methane Oxidation-Anammox), could reduce GHG emissions and energy consumption while ensuring reliable N removal efficiencies. Other techniques such as source separation systems could potentially allow mitigation of N2O emissions by 60% while avoiding energy-intensive N fertilizer production. Nutrient recovery methods are another approach which offered negative value for the net CF (Carbon footprint). Permeable

membrane N recovery offered 1 kWh/kg N of energy savings and P (Phosphorus) recovery led to −3.76 kg CO_{2e}/kg $P_{recovered}$ CF savings. Upgrading biogas to biomethane could be a more sustainable scenario than on-site biogas consumption in CHP units, especially if the thermal energy is not capitalized. Recovering and utilizing N_2O for energy production is a promising method which leads to both direct and indirect CF reductions.

Collaborative steps include the following:

- Seek IHS (Division of Sanitation Facilities Construction and Office of Environmental Health and Engineering) technical and financial assistance in maintaining and improving lagoon operations.
- Seek EPA technical and financial assistance funding that will help lagoon communities access infrastructure investments and capacity-building assistance available to water treatment facilities in their communities.
- Seek funding from the Clean Water State Revolving Funds and grants such as the Bipartisan Infrastructure Law (BIL) to make lagoon improvement.
- Implement lagoon practices from EPA's newly released Lagoon Wastewater Treatment Action Plan.
- Review and implement appropriate practices from research currently being conducted by Michigan Technological University and West Virginia University to accelerate innovative and alternative wastewater treatment technology research in lagoon and pond systems serving small communities.

3.3 Benefits Analysis

The Spirit Lake Tribe has identified priority GHG reduction measures for 6 GHG sectors. In addition to the quantifiable GHG emission reductions associated with these reduction measures and the contribution that the GHG emission reductions will make toward tribal, regional, state and national efforts to slow down the negative consequences of climate change, implementation of the GHG reduction measures may result in many other benefits for the Spirit Lake Reservation. Table 6 includes a summary of the other benefits to the Reservation that may result from implementation of the GHG reduction measures.

Table 6 – Benefits to Spirit Lake Reservation due to GHG Reduction Measures

Sector	*Benefits*
Agriculture and Forestry	- Increase the amount of natural lands for scenic quality and recreation - Reduce amount and ambient concentrations of agricultural-related air pollutants (base level 2023 SLT Emission Inventory of criteria pollutants), including dust due to agricultural activities and wind erosion - Lower health risks throughout the community associated with exposure to elevated concentrations of dust and air pollutants from fossil fuel combustion

	- Reduced cost of food/produce from local markets due to more sustainable agricultural practices - Update and improve BIA leases with modern/sustainable terms - Improve BIA data on agricultural activities on the Reservation - Retain historical/traditional agricultural activities - Increased use of agricultural Best Practices will improve the environment of communities and neighborhoods - Increase property values - Reduce surface water/fertilizer runoff to adjacent lands and water resources - Decrease nitrification of surface waters - Increase livestock health without negatively affecting growth - Create economic and environmental benefits for local community and region - Increase employment due to additional jobs in sustainable farming/ranching service markets - Raise public awareness of sustainable agricultural practices and associated benefits to the environment, health, wellness, and economy - Address an environmental/sustainability issue that is culturally important to the Spirit Lake Tribe and its members.
Transportation	- Reduce demand for fossil fuels; - Reduce amount and ambient concentrations of transportation-related air pollutants (base level 2023 SLT Emission Inventory of criteria pollutants) - Lower health risks throughout the community associated with exposure to elevated concentrations of dust and air pollutants from fossil fuel combustion - Reduce infrastructure and travel costs for the communities, residents, and local business & employers - Improve quality of life due to reduced travel/commute times, reduction of stress, and increased productivity, and more time dedicated to more enjoyable activities - Reduce fuel and automobile maintenance costs freeing up limited resources that can be dedicated to other, essential expenses (e.g., housing, groceries, utilities) - With increased use of alternative modes of transportation (e.g., biking, walking), improve fitness, reduce rates of obesity - Address an environmental/sustainability issue that is culturally important to the Spirit Lake Tribe and its members.
Clean Energy and Efficient Buildings (usage)	- Reduce demand for fossil fuels; - Reduce amount and ambient concentrations of transportation-related air pollutants (base level 2023 SLT Emission Inventory of criteria pollutants) that contribute to smog and acid rain - lower concentrations of indoor air pollutants - Lower health risks throughout the community due to lower levels of exposure to ambient concentrations of air pollutants from fossil fuel combustion and lower levels of exposure to indoor air pollution - Improve quality of life due to more comfortable temperatures in households - Reduce vulnerability to energy price fluctuations - Decrease energy costs freeing up limited resources that can be dedicated to other, essential expenses (e.g., housing, groceries, utilities) - Create economic and environmental benefits for local community and region

	- Increase employment due to additional jobs in energy efficiency service markets - Reduce demand for residential/energy financial assistance programs - Reduce household costs for maintenance and repairs of appliances - Raise public awareness of energy conservation and associated benefits to the environment, health, wellness, and economy - Increased property values - Improve building resiliency - Address an environmental/sustainability issue that is culturally important to the Spirit Lake Tribe and its members.
Residential Heating	- Reduce demand for fossil fuels; - Reduce amount and ambient concentrations of transportation-related air pollutants ((base level 2023 SLT Emission Inventory of criteria pollutants) that contribute to smog and acid rain - lower concentrations of indoor air pollutants - Lower health risks throughout the community due to lower levels of exposure to ambient concentrations of air pollutants from fossil fuel combustion and lower levels of exposure to indoor air pollution - Improve quality of life due to more comfortable temperatures in households - Reduce vulnerability to energy price fluctuations - Decrease energy costs freeing up limited resources that can be dedicated to other, essential expenses (e.g., housing, groceries, utilities) - Create economic and environmental benefits for local community and region - Increase employment due to additional jobs in alternative energy service markets - Reduce demand for residential/energy financial assistance programs - Reduce household costs for maintenance and repairs of heating/cooling units - Raise public awareness of alternative energy and associated benefits to the environment, health, wellness, and economy - Increased property values - Improve building resiliency - Address an environmental/sustainability issue that is culturally important to the Spirit Lake Tribe and its members.
Solid Waste Management	- Reduce pressure for households to resort to burn barrels to dispose of household waste - Reduce amount and ambient concentrations of solid waste management-related air pollutants (base level 2023 SLT Emission Inventory of criteria pollutants) that contribute to smog and acid rain - Lower health risks throughout the community due to lower levels of exposure to ambient concentrations of air pollutants from methane and solid waste burning - Reduce nuisance odors affecting households and the community - Reduce demand on land for larger solid waste management facilities - Increase sustainability and useful life of existing landfills - Decrease expenditures on consumer products freeing up limited resources that can be dedicated to other, essential expenses. - Additional nutrient levels in garden soils - Reduce household waste and effort to manage it

	- Raise public awareness of waste prevention and recycling and associated benefits to the environment, health, wellness, and economy - Increase the use of Best Practices for operating all landfills - Address an environmental/sustainability issue that is culturally important to the Spirit Lake Tribe and its members.
Wastewater Management	- Reduce nuisance odors affecting households and the community - Reduce demand on land for larger/additional wastewater lagoons - Increase sustainability and useful life of existing wastewater lagoons - Reduce likelihood of lagoon overflows breaches that could negatively impact surface- and ground-water resources and wildlife habitat. - Potentially increase access to municipal water treatment facilities and decrease reliance on household septic systems that require maintenance and may impact nearby ground- and surface-water - Address an environmental/sustainability issue that is culturally important to the Spirit Lake Tribe and its members.

3.4 Review of Authority to Implement

The Spirit Lake Tribe established authority beginning with the *Spirit Lake Nation Strategic Energy Plan* prepared by the Spirit Lake Tribal EPA with assistance from IECIS Group (2011); and followed by a Tribal Resolution A05-11-111 directing Tribal Programs to secure funding in support of the *Spirit Lake Tribal EPA Strategic Energy Plan*, March 21, 2011. Additional authority to implement various GHG reduction measures by the Spirit Lake Tribe are outlined in its Constitution and Bylaws and also under its Law and Order Code. A summary from each is documented below:

Spirit lake Tribe Constitution and Bylaws:
Submitted for ratification April 14, 1944. Approved by the Commissioner, Bureau of Indian Affairs February 14, 1946. Revisions - January 10, 1958; May 5, 1960; July 14, 1961; July 17, 1969; May 3, 1974; April 16, 1976; May 4, 1981; November 21, 1991; August 19, 1996.

PREAMBLE
"We, the members of the Spirit Lake Tribe, in order to promote justice, insure tranquility, encourage the general welfare, safeguard our interests and secure the blessings of freedom and liberty for ourselves and for our posterity, do hereby amend and revise our Tribal Constitution, reorganize our Tribal Council, and we do ordain and establish this Constitution and set of Bylaws as rules for its deliberation."

ARTICLE II – JURISDICTION
"The jurisdiction of this organization shall extend to all land on the Spirit Lake Reservation in the State of North Dakota and to such other lands as may be acquired by or on behalf of said tribe and added thereto under the laws of the United States."
"Section 3. The Tribal Council shall have authority to regulate its own procedures, to appoint a Vice-Chairman to act in the absence of the Chairman, to appoint subordinate committees, delegates, boards, tribal officials and employees not otherwise provided for

in this constitution and bylaws and to provide their tenure and duties; provided, that any delegation of authority described in this constitution and bylaws shall be granted only by written resolution or ordinance and shall be withdrawn in the same manner."

Spirit Lake Tribe Law and Order Code:
Spirit Lake Tribe has established Codes related to the Environment, Health and Sanitation under the *Spirit Lake Tribe Law and Order Code; Title 16: Environment, Health and Sanitation; Chapters 1 – 4.*; dated January 5, 2015. The Tribe's jurisdictional authority covers the following:

"(a) The Spirit Lake Reservation, including all lands, islands, waters, roads and bridges or any interests therein, whether trust or non-trust status and notwithstanding the issuance of any patent or right-of-way, within the boundaries of the Reservation as established in Article IV of the Treaty of February 19, 1867, and such lands, islands, waters or any interest therein hereafter added to the Reservation. Any future right-of-way issued by the SLT shall include a provision retaining regulatory authority for purposes of the application of this Title and its Chapters;" and

"(b) The Tribal Court of the Spirit Lake Tribe, and the entities listed under Chapter 2 of this Title, have civil jurisdiction under this Title over the conduct of Tribal members and all other persons on all lands within the Reservation and on Tribal lands outside of the Reservation boundaries to maintain the environment, natural resources, public health, safety, welfare, political integrity and economic well-being of the Tribe."

4.0 References

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APPENDICES

Appendix 1: *Spirit Lake Tribal Resolution A05-11-111* directing Tribal Programs to secure funding in support of the *Spirit Lake Tribal EPA Strategic Energy Plan*, March 21, 2011

SPIRIT LAKE TRIBE
RESOLUTION NO. A05-11-111

WHEREAS, the Spirit Lake Tribe of Indians is a federally recognized Indian tribe acting under a revised Constitution dated May 5, 1960, approved by the Acting Commissioner, Bureau of Indian Affairs, July 14, 1961, and as subsequently amended which amendments were approved by the Commissioner, Bureau of Indian Affairs; and August 19, 1996; and

WHEREAS, the Constitution of the Spirit Lake Tribe generally authorizes and empowers the Spirit Lake Tribal Council to engage in activities on behalf of and in the interest of the welfare and benefit of the Tribe and of the enrolled members thereof; and

WHEREAS, the Spirit Lake Tribal Council (hereinafter the Tribal Council) is the governing body of the Tribe and is empowered to administer the economic resources and financial affairs of the Tribe; and

WHEREAS, the Tribe has a fundamental responsibility to protect the health, safety and welfare of all tribal members and others on the Spirit Lake reservation, and an obligation to preserve the quality of the reservations environment and protect tribal natural resources for the future generations; and

WHEREAS, the Tribe, as a sovereign nation, has the inherent authority to regulate the activities of all persons on all land, including trust, allotted and fee land within its territorial boundaries, when those persons activities have an impact upon the economic security, political integrity, or health and welfare of the Tribe through adoption of Environmental Codes and Zoning Ordinances as sources of enforcement; and

WHEREAS, the Tribe, identifies the Tribal EPA Strategic Energy Plan as a guide for all existing and new residential and commercial buildings relative to remodeling, renovations, demolition and/or any construction activities as we evolve/transition towards green and healthy homes, green environment, energy efficient, business development on reservation lands for tribal members, and integrated and optimized budget management, and preservation of natural resources on the Spirit Lake Nation.

NOW THEREFORE BE IT RESOLVED, that the Tribal Council hereby directs tribal programs to secure funding sources for all new construction projects residential or commercial to insure; healthier, greener, and more affordable to maintain, green environment and preservation of tribal natural resources; all products and material be energy efficient and include proposed savings prior to any project start date.

CERTIFICATION

I, the undersigned as Secretary-Treasurer of the Tribal Council, do hereby certify that the Tribal Council is composed of six (6) members of whom six (6) were present, constituting a quorum for a Special Meeting duly called and convened on this 21st day of MARCH, 2011, and approved this resolution by an affirmative vote of four (4) in favor, none (0) opposed, none (0) abstaining, and none (0) absent. (the Secretary-Treasurer does not vote and the Chairman votes only in case of a tie.)

Justin Yankton
Secretary-Treasurer

Myra Pearson
Chairperson

Appendix 2: Spirit Lake Reservation-Wide Emission Inventory – 2023 Update and Enhancements - Final Report. Air Sciences Inc., March 2024

AIR SCIENCES INC.

DENVER • PORTLAND • LOS ANGELES

Spirit Lake Reservation-Wide Emission Inventory – 2023 Update and Enhancements - Final Report

PREPARED FOR:
SPIRIT LAKE TRIBE

PROJECT NO. 443-1
MARCH 2024

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1.0 INTRODUCTION

1.1 Project Objective and Overview

This version of the Spirit Lake Tribe (SLT) Emission Inventory updates and enhances the Reservation-wide emission inventory developed in 2003-2004. Updates/enhancements include: identifying new potential sources of emissions that have occurred since the 2003-2004 emission inventory work was completed; updating activity data for continuing sources; updating emission factors and emission calculation methods; and adding greenhouse gas emissions (GHG) to the emission inventory. GHG emissions were added to the emission inventory because the SLT EPA is receiving funding from the EPA's Climate Pollution Reduction (CPRG) program. The resulting emission inventory will be used to support the preparation of the SLT Priority Climate Action Plan (PCAP), a plan that will include near-term, implementation-ready, priority GHG reduction measures. In addition, the emission inventory will support the SLT EPA's Air Quality Program as it continues to identify Tribal air quality priorities, monitoring necessities, regulatory needs, and staffing decisions.

The emission inventory includes mobile and area sources and a tribally-owned industrial point source, Sioux Manufacturing Corporation. The activity data and emission calculations are representative of calendar year 2022 unless pre-2022 data are the best available data of sufficient quality. Reservation-specific data were used where available and were supplemented with non-local but still determined to be representative data as necessary. The following criteria pollutants were inventoried: Carbon monoxide (CO), oxides of nitrogen (NOx), ozone precursor pollutants (volatile organic compounds [VOC]), particulate matter (PM_{10} and $PM_{2.5}$), and sulfur dioxide (SO_2). GHGs in the inventory are: Methane (CH_4), Carbon Dioxide (CO_2), Nitrous Oxide (N_2O), and Carbon Dioxide Equivalent (CO_2e).

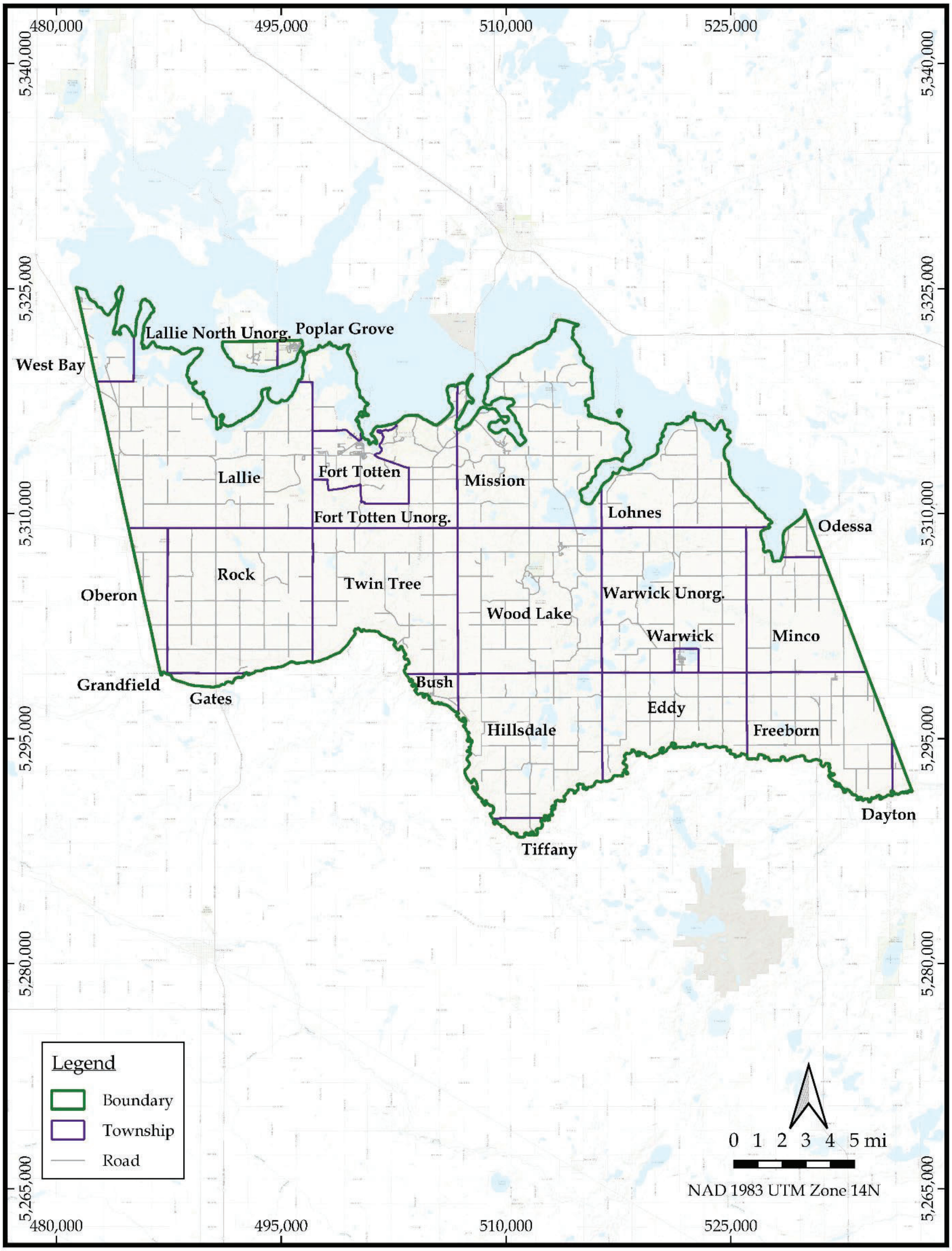
This technical report describes the data and methods used to construct the emission inventory and presents the emissions data. The emission inventory spreadsheets are attached in hardcopy as Appendix A.

1.2 Reservation Location

The Spirit Lake Reservation is located in east central North Dakota and covers approximately 405 square miles primarily in Benson County. The southern part is in Eddy County; Nelson County is on the east boundary; and Ramsey County is to the north. A map of the reservation is shown as Figure 1.

The topography of the Reservation is generally consistent with the Northern Plains region, with both flat terrain and rolling hills, and some wooded areas. The major surface water feature of the Reservation is Devils Lake, which comprises 90,000 acres.

Figure 1. Reservation Map



2.0 METHODS

2.1 Emission Inventory Organization and Database Design

The Spirit Lake Emission Inventory has been developed in a Microsoft Excel workbook. Emission calculations for criteria pollutants for each source category are on individual worksheets and all GHG calculations are contained in one worksheet. References for all emission factors for all sources, and other critical meta-data behind the emissions data and calculations are included in the worksheets. Township-specific activity data (e.g., acres of land susceptible to wind erosion) were compiled using QGIS version 3.28.13-Firenze and exported to Excel. These activity data, broken out by township, were then multiplied by usage and emission factors to calculate emissions for each source category. GHG emissions were calculated using activity data and emission factors for each source category in each sector. Emissions data for the Sioux Manufacturing Company were transferred from that company's most recent facility emission inventory report.

Reservation-wide criteria pollutant emissions are summarized by township and source category. GHG calculations are summarized by sector and source. These are all presented in table form and graphs in the workbook.

2.2 QAPP

This emission inventory adhered to the steps in the Quality Assurance Project Plan (QAPP). The QAPP was submitted to and approved by the U.S. EPA. The QAPP was followed in accordance with the steps below.

1. Potential source categories included in the emissions inventory were quality assured via reality check by the SLT EPA PM who has basic knowledge of the Reservation's environs and Air Sciences Project Quality Assurance Officer (QAO) who is specifically familiar with the Spirit Lake Reservation due to Air Sciences involvement working with SLT EPA staff in the field to gather information and source data for the 2004 emissions inventory (criteria pollutants only) effort. Quality assurance included completeness of the source category list compared to knowledge of on-Reservation activities and activities common to the region. Source sector emission totals were also compared to GHG emission estimates prepared for other jurisdictions.

2. The list of data resources used to update activity rates was reviewed by reality check and peer review. Tracking of the data sources was quality controlled by preparing the data gathering sheets. Matching the list of sources back to the AP-42 categories and the Tribal Greenhouse Gas Inventory Tool (TGIT) reality checked the completeness of the data resources list, for data that needed to be gathered for the reservation. Peer review

by SLT EPA Tribal staff further ensured completeness and ensured that sources that could potentially go undetected without additional field research were captured.

3. The quality of activity data was reviewed by reality check, peer review and sample calculations. All activity data was reality checked with respect to the general Reservation facts including location, surface area, population size and demographic data. Activity data were summarized and distributed for peer review. Compilation of activity data into the Reservation-wide activity dataset was quality controlled by minimizing the amount of transcription and utilizing a concise database schema. The final activity dataset received quality assurance through sample calculations. Staff checked 100% of the data transcription, data pulling and unit conversion steps. Each activity source present in the Reservation-wide dataset had records traced from beginning to end. The Air Sciences QAO performed similar beginning-to-end checks on records. Summaries of the final activity dataset and explanation of the compilation procedures were distributed for peer review.

4. The quality of emission factors was assessed by reality check, peer review and sample calculations. Emission factors gathered from AP-42 were quality controlled by using the latest online version of the document. Emissions factors consistent with those used in the most current version of the TGIT were used for the GHG emission inventory. The final emission factor table was quality assured through beginning-to-end sample calculations for transcription and unit conversion errors by staff for 100% of the entries. The Air Sciences QAO reviewed a sampling of the conversion calculations, and for each source category traced the calculations for the use of at least one emission factor appropriate for the source category.

5. Emission calculations were investigated using reality check, peer review, and sample calculations. Use of a simple spreadsheet format procedurally controlled calculation quality. The final emission inventory was reality checked for each pollutant with respect to the general Reservation facts including location, surface area, population size, and demographic information. Sample calculations were utilized to quality assure the emission compilation steps. Calculations for each source were checked beginning-to-end by the staff. The QAO reviewed the final emission inventory through spot checks within each source category. A summary of the final inventory was compared back to the summary of activity data for consistency, compared to the prior version of the SLT emissions inventory, compared to pertinent county and facility data in US EPA's NEI (2020), compared to similarly organized GHG emission inventories prepared for other jurisdictions (e.g., MN) and distributed to the SLT EPA Director & Project Manager (PM), the IECIS Group Team Leader (TL) and to SLT EPA staff for peer review.

6. The final report was evaluated for accuracy and completeness through reality check and peer review. The report was reality checked for completeness by comparison to the QAPP and the project scope of work. Procedural QC of report maps, tables and figures was facilitated by references in the report document to the external sources. The report was generated with the objective of minimizing transcription from the analytical tools. The final report and deliverable data were thoroughly reviewed by the QAO and distributed for peer review by the PM, TL, and Tribal EPA staff.

To ensure all pertinent data were collected to develop the emission inventory a data gathering notebook was created, shown below as Table 1. This notebook was also used as a QA tool to ensure all activity data needed was collected and each source is a valid reference. The data activity notebook contains the type of data collected, the source it was collected from, a description of the data, and its use within the emissions inventory workbook.

Table 1. Activity Data Notebook

Title	Source	Description	EI Use
Traffic Count	North Dakota Department of Transportation (NDDOT)	Average daily traffic counts by station for the latest year of data downloaded into excel workbook (2022).	mobile, road dust
Energy Consumption	Energy Information Administration (EIA)	Annual energy usage by state by fuel type (2020).	heating
Boundaries (Townships, Counties, Reservation)	North Dakota GIS Hub Data Portal (NDGIS Hub), U.S. Census Bureau TIGER/Line Shapefiles	Reservation (2020), township, and county boundary (2021) shapefiles input into QGIS.	wind erosion, ag/land management, forestry
Roads	North Dakota GIS Hub Data Portal (NDGIS Hub)	County roads (2023) in North Dakota shapefile, input into QGIS.	tailpipe, road dust
Population/ Townships	U.S. Census Bureau	2022 population and township data.	heating, solid waste, wastewater
Motor Fuel Usage, Registered Vehicles	U.S. Department of Transportation (USDOT)	Monthly motor fuel reported in North Dakota (2023). Number of registered vehicles by vehicle type (2019).	mobile
Waste Generation	Center for Sustainable Systems (CSS), University of Michigan	Average municipal waste generation by person in the U.S. (2018).	solid waste
Waste Stations	J. Tweeton (SLT), Spirit Lake Tribe Integrated Waste Management Plan (SLT-IWMP)	Type of landfills/open dumps, years started, Residential vs. Commercial/Industrial waste.	solid waste
Wastewater Flow	Spirit Lake Casino and Resort Statement of Basis	Average wastewater flow per day from SLT Casino to wastewater treatment lagoons (2019).	wastewater
Lagoons	U.S. Environmental Protection Agency (EPA)	Lagoon locations and design flow from Lagoon Inventory Dataset (2022).	wastewater
Electricity Usage	SLT DOE Annual Program Review	Spirit Lake Tribe 1.5 MW Community Wind Energy Project, electricity usage on the reservation.	electricity
Fertilizer Usage	U.S. Department of Agriculture (USDA)	Fertilizer type and amount (acre) per county in North Dakota for 2017.	ag/land management
Forested Land	Spirit Lake Tribe Integrated Waste Management Plan (SLT-IWMP)	Land use and acreage (2012).	forestry
Structure Fires	Spirit Lake Fire Department (SLT)	# Structure fires per year.	structure fires
Sioux Manuf.	U.S. Environmental Protection Agency (EPA)	Sioux Manufacturing annual emissions inventory submitted 06/12/2023.	Sioux Mnf.

3.0 EMISSIONS INVENTORY

3.1 Criteria Pollutant Emission Calculations & Data Summary

This section specifies the emission factor, activity data, and emission calculation technique for each source category as implemented in the emission inventory workbook for criteria pollutants. Section 3.1.6 includes summary tables and charts that display annual emissions of criteria pollutants.

3.1.1 Residential Heating

- Emission Factors: AP-42 1.4 Natural Gas, AP-42 1.5 Propane.

- Activity Data: Per-household propane and natural gas use based on the Energy Information Administration's (EIA) annual household site fuel consumption in U.S. homes by state (EIA 2023). Number of households per township derived from U.S. Census 2022.

- Calculation Method: Apply emission factors to fuel usage for number of households for each township.

- Propane Calculation Formula: households x propane usage (gal propane/yr) x unit conversion (kgal/gal) x emission factor (lb pollutant/kgal propane) x unit conversion (ton/lbs) = pollutant emitted (ton/yr)

  Natural Gas Calculation Formula: households x natural gas usage (MMscf natural gas/yr) x emission factor (lb pollutant/MMscf natural gas) x unit conversion (ton/lbs) = pollutant emitted (ton/yr)

Notes: Because a clearly identifiable source of accurate Reservation-wide fuel usage was not available for Spirit Lake, heating demand per household (MMBtu/yr) was assumed to be the same as the per household statewide data for North Dakota. Per household propane and natural gas usage for North Dakota was calculated in gallons per year based on MMBtu/household from the EIA. The number of households per township was obtained from U.S. Census 2022 data. Because no delineation of where the different fuels were used was available, it was assumed that houses in organized townships used natural gas, and rural households consumed propane. Emission factors for natural gas and propane were applied accordingly.

3.1.2 Windblown Fugitive Dust Emissions

- Emission Factors: AP-42 13.2.5 Industrial Wind Erosion Eq. 4 based on National Weather Service (NWS) Devils Lake monitoring station meteorological data for 2021-2023.

Fastest-mile wind speed conversion factor from EPA's Modeling Fugitive Dust Impacts (EPA 1994).

- Activity Data: U.S. Census 2020 Reservation Boundary shapefile and North Dakota GIS (NDGIS) Hub Data portal 2021 township and county boundary shapefiles input into QGIS.

- Calculation Method: Summarize acres by susceptible land cover types (Dryland Cropland and Pasture, Cropland/Grassland Mosaic, and Grassland) by township. Apply soil loss emission factor to acreages.

- Calculation Formula: susceptible land (acre) x soil loss (ton/acre-yr) = pollutant emitted (ton/yr)

Notes: Meteorological data from NWS for the Devils Lake monitoring station was downloaded and used to calculate the soil loss emission factor based on AP-42 13.2.5. For threshold velocity the average of scoria and uncrusted coal pile factors (AP-42 Table 13.2.5-2) was used to account for roads and dust on the reservation.

3.1.3 Roads - Tailpipe Emissions

- Emission Factors: Exhaust Emission Factors from MOVES4 for rural restricted and unrestricted roads in Benson County, North Dakota.

- Activity Data: Average daily traffic counts (ADT) from North Dakota Department of Transportation (NDDOT) for roads of various service levels (NDDOT 2022). Road lengths by surface classification from NDGIS hub input into QGIS for roads within the Spirit Lake Reservation boundary.

- Calculation Method: Summarize road lengths by surface class for each township in QGIS. In spreadsheet apply Vehicle Miles Traveled (VMT) and tailpipe emission factors by surface class for emissions by township.

- Calculation Formula: average daily traffic (count/day) x 365 (day/year) x road length (mile) x emission factor (g/VMT) x unit conversion (lb/g) x unit conversion (ton/lb) = pollutant emitted (ton/yr)

Notes: ADTs were downloaded from NDDOT for all monitoring stations within Benson, Eddy, Nelson, and Ramsey County for 2022. These stations were uploaded into QGIS and the stations within Spirit Lake were extracted and the road type for each station was classified using the county road data from the NDGIS hub in QGIS. The average ADT for each road type was then utilized and scaled to average yearly traffic (AYT).

The map of townships was overlaid on the NDGIS hub road layer in QGIS. By this technique, road lengths for each surface class were summarized by township. Vehicle miles traveled (VMT) were calculated by applying traffic counts to the summed road sections for each type of road (dirt, gravel, paved, and highway).

3.1.4 Roads – Fugitive Dust Emissions

- Emission Factors: AP-42 13.2.1 Paved Roads and 13.2.2 Unpaved Roads emission factor algorithms based on AP-42 defaults and fleet composition assumptions from the U.S. Department of Energy (US DOE) and U.S. Department of Transportation (US DOT).

- Activity Data: ADT and road lengths methodology the same as for the tailpipe emissions explained in Section 3.1.3.

- Calculation Method: Apply particulate emission factor by surface class to road segments using QGIS. Summarize by township and Reservation-wide.

- Calculation Formula: average daily traffic (count/day) x 365 (day/year) x road length (mile) x emission factor (g/VMT) x unit conversion (lb/g) x unit conversion (ton/lb) = pollutant emitted (ton/yr)

Notes: The same method to calculate vehicle miles traveled for Tailpipe activity (Section 3.1.3 was used for Fugitive Dust Emissions from Roads. Annual VMT for each type of road (dirt, gravel, paved, and highway) and each township were summed and multiplied by the PM2.5 and PM_{10} emission factors. The emission factors are based on the AP-42 13.2.1 and 13.2.2 algorithms, AP-42 defaults, and fleet composition assumptions were used to arrive at the total tons per year of fugitive dust emitted.

3.1.5 Sioux Manufacturing Corporation (Industrial Point Source)

Emission totals for this stationary point source were obtained from Sioux Manufacturing Corporation's (SMC) Part 71 annual emission inventory report fee calculation worksheet (EPA 2023e). SMC is a manufacturer of composite molded components and metal structures with a textile coating operation that qualifies as a major source of volatile organic compounds (VOC) under the federal Prevention of Significant Deterioration permitting program (40 CFR 52.21). The majority of the air emissions from SMC are generated by the surface coating line and paint booth, with small amounts of natural gas combustion emissions generated by the heaters, boilers, and ovens involved in the manufacturing of Kevlar and other coated fabric.

3.1.6 Criteria Pollutants Emissions Summary

Table 2 and Table 4 summarize total annual emissions by township and source category, respectively.

Table 2. Reservation Total Criteria Pollutant Emissions by Township

Township	$PM_{2.5}$	PM_{10}	CO	NO_x	VOC	SO_2
Bush	3.54	32.01	3.56	0.62	0.19	0.01
Dayton	1.75	16.10	0.91	0.24	0.04	0.01
Eddy	40.77	377.80	26.23	4.05	1.08	0.01
Fort Totten	15.10	136.44	20.74	3.13	0.93	0.01
Fort Totten Unorg.	34.14	304.33	36.33	6.56	1.62	0.15
Freeborn	59.03	553.70	41.20	6.55	1.51	0.03
Gates	3.61	34.05	2.69	0.50	0.10	0.01
Grandfield	0.00	0.02	0.01	0.02	0.001	0.002
Hillsdale	70.12	659.94	15.90	2.38	0.84	0.01
Lallie	88.75	812.56	71.99	11.79	2.72	0.11
Lallie North Unorg.	3.36	29.90	3.63	0.55	0.19	0.003
Lohnes	38.80	360.53	11.32	1.95	0.61	0.04
Minco	44.32	416.73	5.63	0.86	0.30	0.01
Mission	62.56	564.41	64.71	9.94	2.55	0.02
Oberon	14.95	141.63	3.63	0.63	0.19	0.01
Odessa	6.87	66.03	1.02	0.28	0.06	0.02
Poplar Grove	1.89	16.76	5.84	1.16	0.32	0.04
Rock	93.83	888.02	38.51	5.99	1.56	0.02
Tiffany	2.41	22.67	0.32	0.07	0.02	0.004
Twin Tree	58.66	544.17	15.30	2.33	0.81	0.02
Warwick	5.68	55.46	1.18	0.17	0.06	0.000
Warwick Unorg.	78.85	737.65	42.59	6.67	1.62	0.03
West Bay	5.17	43.66	4.84	0.81	0.26	0.01
Wood Lake	87.67	827.15	27.33	4.79	1.31	0.10
Totals	**821.8**	**7,642**	**445.4**	**72.0**	**18.9**	**0.69**

Table 3. Reservation Total Criteria Pollutant Emissions by Source Category

Source Category	$PM_{2.5}$	PM_{10}	CO	NO_x	VOC	SO_2
Residential Heating	0.24	0.24	2.61	4.53	0.28	0.55
Roads Tailpipe	2.37	4.78	442.79	67.50	18.62	0.14
Roads Fugitive Dust	661.13	6582.90	--	--	--	--
Wind Erosion	158.07	1053.79	--	--	--	--
Sioux Manufacturing Corp.	--	--	--	0.05	0.64	0.00
Totals	**821.8**	**7,642**	**445.4**	**72.1**	**19.5**	**0.69**

Figure 2 and Figure 3 display annual PM emissions totals by township and by source category, respectively.

Figure 2. PM Emissions by Township

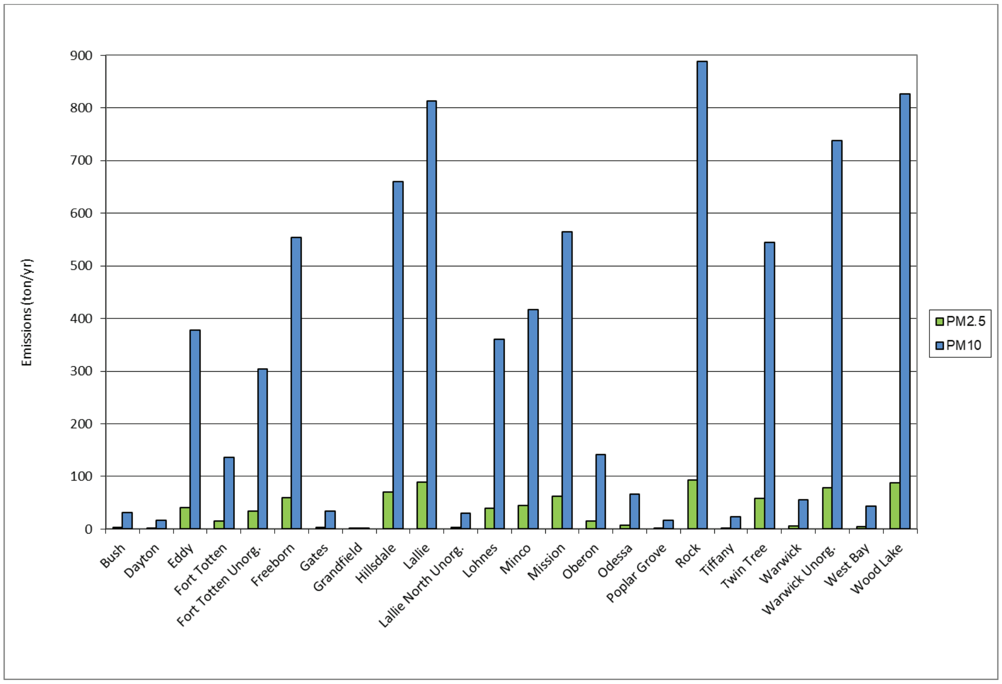


Figure 3. PM Emissions by Source Category

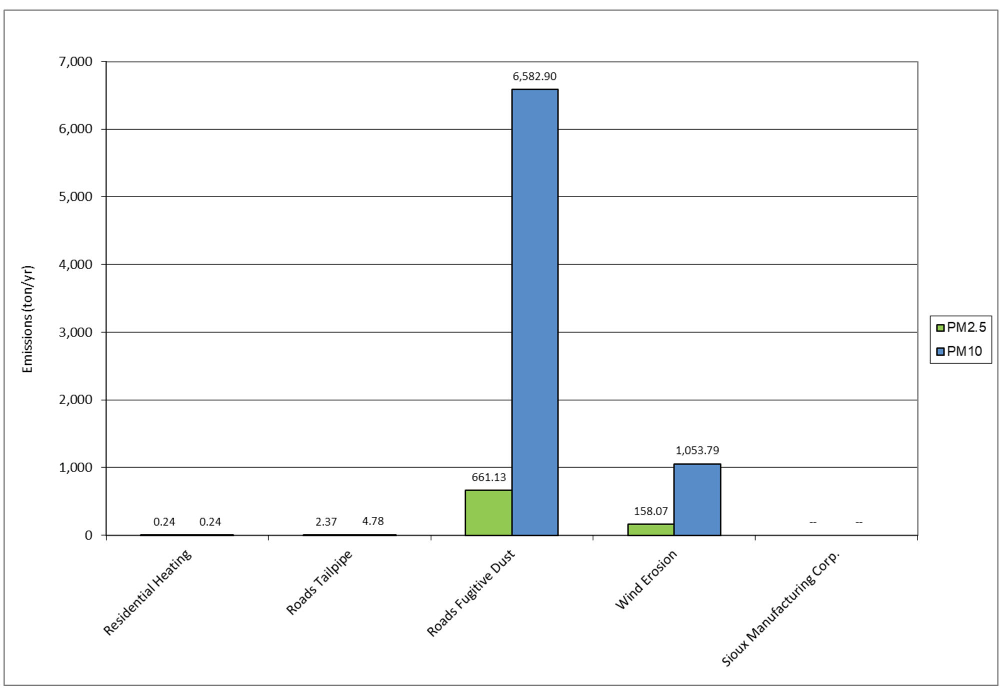


Figure 4 displays gaseous emissions totals by township and Figure 5 shows annual gaseous emissions by source category.

Figure 4. CO, NOx, and VOC Emissions by Township

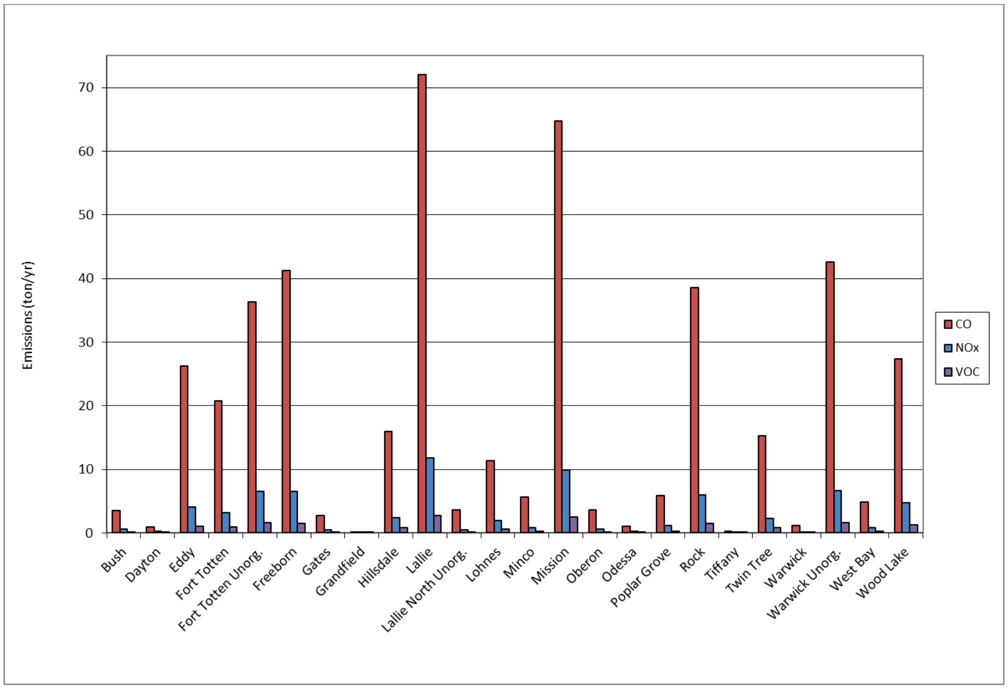
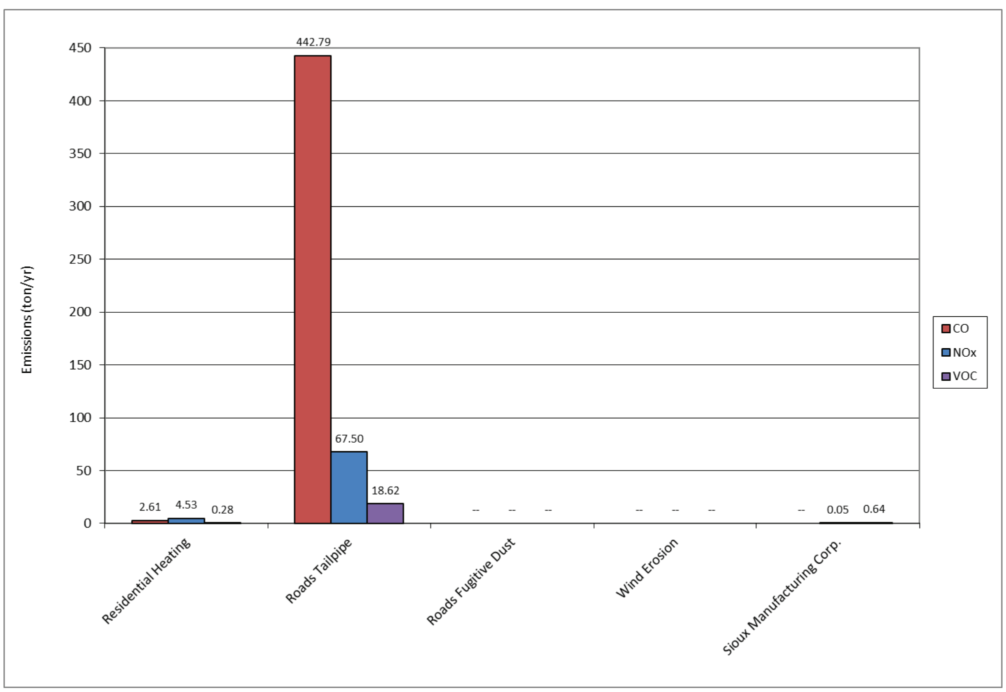


Figure 5. CO, NOx, and VOC Emissions by Source Category



3.2 Greenhouse Gas Emission Calculations & Data Summary

This section specifies the emission factor, activity data, and emission calculation technique for each source category for GHG calculations as implemented in the emission inventory workbook. Section 3.2.10 includes summary tables and charts that display annual emissions of GHGs.

3.2.1 Stationary Fossil Fuel Combustion

- Emission Factors: CO_2, CH_4, and N_2O emission factors for propane and natural gas, 40 CFR Part 98, Table C-1 and C-2 to Subpart C.

- Global Warming Potential (GWP): 40 CFR Part 98, Table A-1 to Subpart C.

- Activity Data: Per-household propane and natural gas use based on the EIA annual household site fuel consumption in U.S. homes by state (EIA 2023). Number of households per township derived from U.S. Census 2022.

- Calculation Method: Use heat input for propane and natural gas from residential heating (Section 3.1.1) and apply emission factor for each GHG to then calculate total CO_2e emitted from one type of GHG (ton/yr) using GWP, do for CO_2, CH_4, and N_2O then sum for total CO_2e.

- Propane Calculation Formula: propane usage (total gal propane/yr) x unit conversion (btu/gal) x unit conversion (MMBtu/Btu) x emission factor (kg/MMBtu) / unit conversion (kg/ton) x GWP = CO_2e emitted (ton/yr)

- Natural Gas Calculation Formula: natural gas usage (total MMscf natural gas/yr) x unit conversion (btu/scf) x emission factor (kg/MMBtu) / unit conversion (kg/ton) x GWP = CO_2e emitted (ton/yr)

Notes: The heat input for all households for propane and natural gas were taken from the residential heating calculation described in Section 3.1.1. Both values were then converted to MMBtu/yr and CO_2, CH_4, and N_2O emissions (ton/yr) were calculated for natural gas and propane. The GWP was then used to generate CO_2e (ton/yr) the CO_2e for natural gas and propane were then summed.

3.2.2 Mobile Fossil Fuel Combustion

- Emission Factors: CO_2, CH_4, and N_2O emission factors for diesel and gasoline, 40 CFR Part 98, Table C-1 and C-2 to Subpart C.

- Global Warming Potential (GWP): 40 CFR Part 98, Table A-1 to Subpart C.

- Activity Data: Total VMT/yr was taken from the Tailpipe calculations described in Section 3.1.3. Average fuel economy by major vehicle category based on fuel type from TGIT (EPA 2023b). Gasoline vs. Diesel percentages from monthly motor fuel reported in North Dakota from U.S. Department of Transportation (US DOT 2023). Percent of each type of vehicle from Summary of National Transportation Statistics (US DOT 2021).

- Calculation Method: Use total VMT/yr and mi/gal to calculate the output (gal/yr) for diesel and gasoline. Apply emission factor for each GHG to then calculate total CO_2e emitted from one type of GHG (ton/yr) using GWP, do for CO_2, CH_4, and N_2O then sum for total CO_2e.

- Calculation Formula: Vehicle miles traveled (VMT/yr) x % of total for vehicle type x % of total fuel / Fuel economy (mi/gal) x unit conversion (Btu/gal) x unit conversion (MMBtu/Btu) x emission factor (kg/MMBtu) / unit conversion (kg/ton) x GWP = CO_2e emitted (ton/yr)

Notes: The total vehicle miles traveled per year was taken from the calculation described in Section 3.1.3. The total VMT/yr was converted to fuel output (gal/yr) for each vehicle category for both fuel types. Emission factors for CO_2, CH_4, and N_2O were then applied along with the GWP to generate CO_2e emissions (ton/yr). The CO_2e emissions for both diesel and gasoline were then added together.

3.2.3 Solid Waste Management

- Emission Factors: AP-42 2.5 Table 2.5-1, Emission Factors for Open Burning of Municipal Refuse, and ft3 CH_4/tonne CH_4 from the TGIT.

- Global Warming Potential (GWP): 40 CFR Part 98, Table A-1 to Subpart C.

- Activity Data: Total municipal waste generation (lb/person/day) from the CSS at University of Michigan (CSS UM 2023). Waste stations on the reservation and the years started from J. Tweeton from SLT (SLT 2024c), (SLT 2024b). % Residential vs. Commercial/Industrial waste from SLT Integrated Waste Management Plan (SLT 2023b). Total SLT population and households from U.S. Census Bureau 2022.

- Calculation Method Open Buring: Use the total municipal waste generated lb/day per person and convert to ton/yr per household using population and housing data then apply emission factor to get total CH_4 emissions (ton/yr) then GWP for CO_2e (ton/yr).

- Calculation Formula Open Burning: Total municipal waste generated (lb/person/day) x (people/household / unit conversion (lb/ton) x unit conversion (365 day/yr) x emission factor (lb/ton) x % municipal solid waste burned x number of households =

Total CH_4 emissions from burning open dumps (ton/yr) x GWP = CO_2e emitted (ton/yr)

- Calculation Method Landfill: Use the Landfill Air Emissions Estimate and default values from AP-42 2.4.-3 Eq. 1. Calculate total waste generated (ton/yr) for each transfer station and time the landfills have been open then plug into Landfill Estimation Model calculation along with default values to get methane generation rate (ft3/yr). Use generation rate to calculate CH_4 emissions and then GWP was applied to calculate CO_2e (ton/yr).

- Calculation Formula Landfill: (municipal solid waste/household) /unit conversion (lb/ton) x unit conversion (365 day/yr) x (people/household) x number of households x % of total waste = Total waste generated at transfer station (ton/yr) (R), t (yr) = 2023 – 2005. Calculate QCH_4 with default values and R and t, QCH_4=Lo*R(e-kc-e-kt). QCH_4 (ft3/yr) x unit conversion (ft3 CH_4/tonne CH_4) = Total CH_4 emissions from landfill (ton/yr) x GWP = CO_2e emitted (ton/yr)

Notes: To calculate the amount of waste generated for each transfer station and open dump assumptions were made based on the SLT Waste Implementation Plan (33% waste from reservation study commercial and 67% residential) and discussions with J. Tweeton from SLT (Mini Transfer Station takes no residential waste). It was assumed that the open dumps were all residential waste and that the Main Transfer Station takes 67% residential waste and 33% commercial waste, and that it takes 67% of total waste from the reservation. It was also assumed that the Mini Transfer Station and Open Dumps account for 17% each of total waste.

3.2.4 Wastewater Treatment

- Emission Factors: California Board of Resources, Local Government Operations Protocol (LGOP) For the Quantification and Reporting of Greenhouse Gas Emissions Inventories.

- Global Warming Potential (GWP): 40 CFR Part 98, Table A-1 to Subpart C.

- Activity Data: Average wastewater flow from Spirit Lake Casino Wastewater Treatment (Lagoons) Statement of Basis (EPA 2019). Average sewage flow per person from the North Dakota Administrative Code Chapter 62-03.1-03 (NDLB 2000). Total SLT population and households from U.S. Census Bureau 2022. Percentage of households using septic from the EPA, (EPA 2023d). Location and design capacity of lagoons within SLT (EPA 2022) and population data for each township. Flow for Spirit Lake Rural Water System Water Treatment from statement of basis (EPA 2017). Population served from lagoon in Four Winds Tate Topa School (PBS 2024).

- Calculation Method Septic Systems: Use LGOP Equation 10.6 default values and SLT population data to calculate CH_4 emissions (ton/yr) from septic systems then apply the GWP for CO_2e (ton/yr).

- Calculation Formula Septic Systems: Population x BOD5 load (kg BOD5/day) x Bo (kg CH_4/kg BOD5) x MCFseptic x (356 day/yr) x unit conversion (ton/kg) = CH_4 emissions (ton/yr) x GWP = CO_2e emitted (ton/yr)

- Calculation Method Wastewater Treatment Lagoons: Use LGOP Equation 10.10 default values and average wastewater flow to calculate N_2O emissions from effluent discharge (ton/yr) then apply the GWP for CO_2e (ton/yr).

- Calculation Formula ~~Wastewater Facility/~~Lagoons: average flow (gal/day)/ average flow per person (gal/person/day) = P for Lagoons, Ptotal = Plagoons, [Ptotal x Find-com x [Total N Load (kg N/person/day) - N uptake (kg N/kg BOD5) x BOD5 load (kg BOD5/day)] x emission factor effluent (kg N_2O-N/kg sewage) x 44/28 x [1 - F plant nit/denit] x (365 day/yr) x unit conversion (ton/kg) = N_2O emissions (ton/yr) x GWP = CO_2e emitted (ton/yr)

Notes: The average per person flow of wastewater was calculated by taking similar types of establishments to SLT wastewater treatment (lagoons) chosen from North Dakota Administrative Code for Private Sewage Disposal Systems and estimated weights chosen to get a weighted average of wastewater. Four Winds Tate Topa Tribal School Lagoon student population was found online and the student to teacher ratio was used to estimate total population within the school. The other lagoons flow rates were found from the EPA lagoon inventory and from Statement of Basis'. The population served for each lagoon was estimated based on flow and wastewater generated per person per day.

3.2.5 Electricity Combustion

- Emission Factors: MROW eGrid Subregion from the TGIT.

- Global Warming Potential (GWP): 40 CFR Part 98, Table A-1 to Subpart C.

- Activity Data: Total energy usage by utility company and percent residential vs. industrial energy use from SLT DOE Annual Program Review presentation (SLT 2023a).

- Calculation Method: Use total energy usage and apply the emission factors to get emissions for each GHG (ton/yr) then apply the GWP to get the CO_2e (ton/yr).

- Calculation Formula: total usage (kWh/yr) / unit conversion (kWh/MWh) x Grid emission rate (lb/MWh) / unit conversion (lb/ton) = GHG emissions (ton/yr) x GWP = CO_2e emitted (ton/yr)

Notes: Total usage for each utility company was taken from the DOE Annual Program review presentation as well as the percent energy usage for residential vs. commercial usage. The MROW eGrid Subregion emission rates for each GHG were chosen for 2021 from the TGIT. The GHG emissions were calculated and then the percentage residential and commercial were applied.

3.2.6 Agriculture & Land Management

- Emission Factors: Land use factors from the TGIT.
- Global Warming Potential (GWP): 40 CFR Part 98, Table A-1 to Subpart C.
- Activity Data: Fertilizer usage by type from U.S. Department of Agriculture (USDA 2017). Total acreage by county and within Spirit Lake from QGIS, from NDGIS hub portal shapefiles. Amount of commercial fertilizer purchased from the EPA, (EPA 2023a). Manure fertilizer usage (ton/acre) from University of Alaska, Fairbanks article (UAF 2021).
- Calculation Method: Ratio down fertilizer usage (acre) by county to percent of county within Spirit Lake. Calculate the fertilizer consumption (ton) based on fertilizer usage factors (ton/acre), apply the land use emission factors and formulas from TGIT for N_2O emissions (ton/yr). Then apply the GWP to obtain CO_2e emissions (ton/yr).
- Calculation Formula: fertilizer type by county (acre) x area ratio (%) x fertilizer usage (lb/acre) / unit conversion (lb/ton) = Fertilizer Consumption (ton/yr)

  [Fertilizer Consumption (ton/yr) x % N Content x [1-% N lost to Volatilization] x % from Applied N + Fertilizer Consumption (ton/yr) x % N Content x % N lost to Volatilization x % from Volatized N + Fertilizer Consumption (ton/yr) x % N content x [1-% N lost to Volatilization] x % N Leach and Runoff x % from Leached and Runoff] x $N_2O/N_2O\text{-}N$ = N_2O Fertilizer Emissions (ton/yr) x GWP = CO_2e emitted (ton/yr)

Notes: The fertilizer type by acreage from USDA was county data, to make it more representative of Spirit Lake Reservation the total acreage of each county was found and the acreage within Spirit Lake Reservation was calculated in QGIS. The percentage of the county within Spirit Lake Reservation was then calculated and those percentages were used to get the fertilizer type used by acres in the Spirit Lake Reservation.

3.2.7 Forestry

- Emission Factor: Carbon sequestration factor from the TGIT.

- Activity data: Total reservation area from QGIS, U.S. Census Bureau TIGER/Line shapefiles. Land use from Spirit Lake Tripe Integrated Waste Management plan (SLT 2023b).

- Calculation Method: Calculate % area with tree covered from forested land acres and total reservation land (from SLT-IWMP). Use updated total reservation area and apply tree cover and carbon sequestration factor.

- Calculation Formula: Forested Land (acre) / IWMP Reservation Land Area (acre) = % Area with tree cover. QGIS Total Reservation Area (acre) / unit conversion (acre/km2) x % tree cover x carbon sequestration factor (tonne C/hectare/yr) = CO_2e Sequestered (ton/yr)

Note: The land use table from SLT-IWMP was used to find the estimate % tree cover for the reservation. The older reservation acreage from the table was used to calculate this percentage, however for the emissions calculation the total reservation area found in QGIS with the more updated reservation boundary was used with that same % tree cover for a more accurate result.

3.2.8 Fires

- Emission Factor: Wood GHG factors from 40 CFR Part 98, Table C-1 and C-2 to Subpart C.

- Global Warming Potential (GWP): 40 CFR Part 98, Table A-1 to Subpart C.

- Activity data: The number of structure fires annually came from Spirit Lake Fire Department from J. Tweeton (SLT 2024a). Average lumber use per single family household from USDA (USDA 1994). Weight of kiln dried lumber from The Engineering ToolBox (Eng. ToolBox 2013).

- Calculation Method: Calculate the weight of lumber used in an average structure, multiply this by the number of structure fires. Calculate the total combustion per year from the total wood burned in structure fires. Multiply by each emission factor then apply the GWP to obtain CO_2e emissions (ton/yr).

- Calculation Formula: Lumber use (board ft/structure) x Lumber Weight (lb/ft) x # Structure Fires (structures/yr) x unit conversion (Btu/lb – dry wood) / unit conversion (Btu/MMBtu) x emission factor (kg/MMBtu) = GHG emissions (ton/yr), GHG emissions (ton/yr) x GWP = CO_2e emitted (ton/yr).

Note: Lumber use in a structure was estimated using USDA 1992 single family households, assumed most structures that caught on fire were built in the 90’s and were the size of single family households. Additionally, it was assumed that the structures were made of 2x4 kiln dried lumber boards.

3.2.9 Waste Generation (offsite disposal)

No emissions for offsite disposal of waste. Waste is disposed of in facilities operated within the tribe's geopolitical boundaries, emissions were calculated in Section 3.2.3.

3.2.10 Water Use (offsite supply/treatment)

No emissions calculated for water offsite supply/treatment. Water is not imported, it comes from Spirit Lake Rural Water System Water Treatment lagoons, along with personal wells. Wastewater treatment calculations are explained in Section 3.2.4.

3.2.11 Greenhouse Gas Emissions Summary

Table 4 and Table 5 summarize the total annual GHG and CO_2e emissions (ton/yr) by sector and source category, respectively.

Table 4. Reservation Total GHG Emissions (ton/yr) by Sector

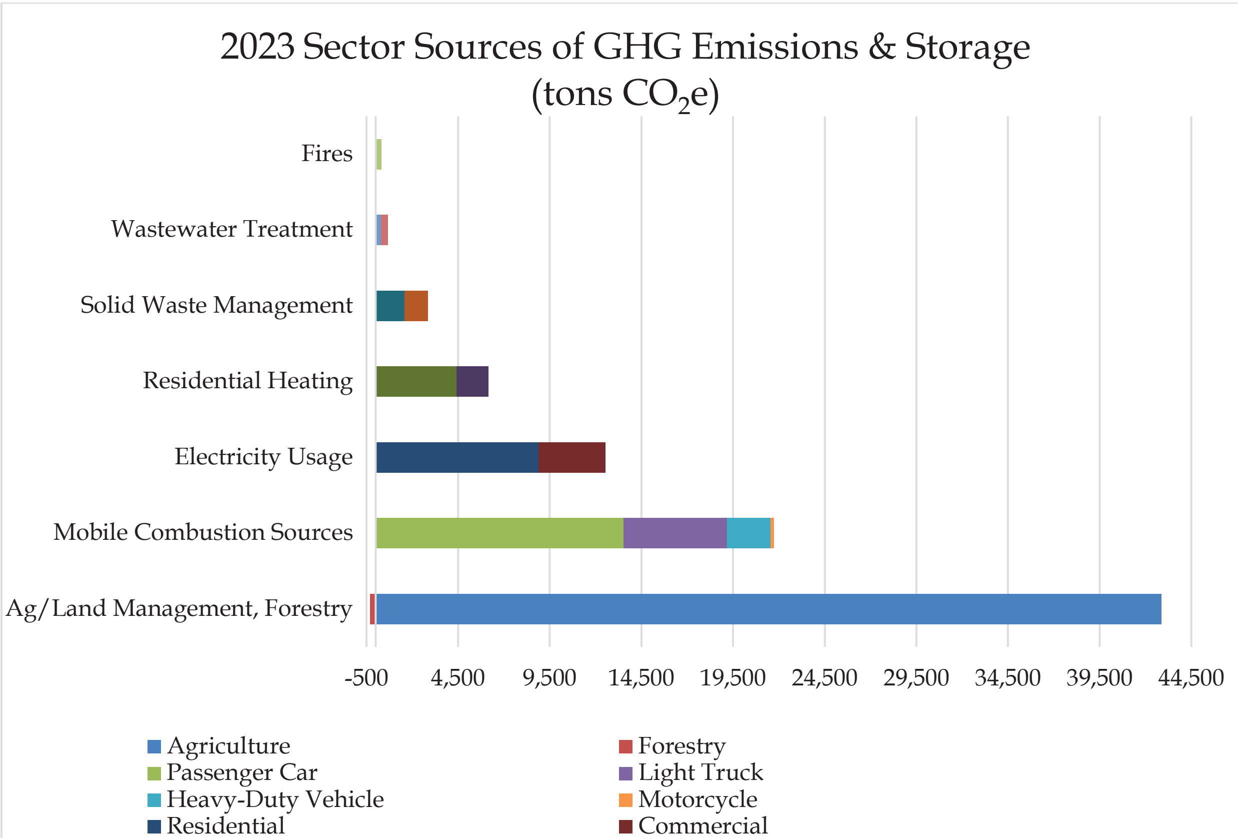
Source Category	CO_2	CH_4	N_2O	CO_2e
Stationary Fossil Fuel Combustion	6,133	0.24	0.05	6,153
Mobile Combustion Sources	21,658	0.91	0.18	21,735
Solid Waste Management	--	113.6	--	2,839
Wastewater Treatment	--	14.62	1.06	682.3
Electricity Usage	12,149	0.18	1.31	12,543
Agriculture and Land Management	--	--	143.8	42,855
Structure Fires	302.9	0.58	3.5	307.0
Forestry	--	--	--	(299.3)
Water use (offsite)	--	--	--	--
Total GHGs				**87,114**
Net GHGs				**86,814**

Table 5. Reservation Total CO_2e Emissions by Source Category

Sector	Source	CO_2e (ton/yr)
Ag/Land Management, Forestry	Agriculture	42,855
	Forestry	(299.3)
Mobile Combustion Sources	Passenger Car	13,528
	Light Truck	5,652
	Heavy-Duty Vehicle	2,377
	Motorcycle	177.6
Electricity Usage	Residential	8,905
	Commercial	3,637
Residential Heating	Propane	4,413
	Natural Gas	1,740
Solid Waste Management	Residential	1,590
	Commercial	1,249
Wastewater Treatment	Lagoons	316.7
	Septic Systems	365.5
Fires	Structure Fires	307.0
Net GHGs		**86,814**

Figure 6 presents the total annual CO_2e emission for each source category in each sector.

Figure 6. Sector Sources of GHG Emissions (CO2e) & Storage



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Appendix A – Emission Inventory Calculations

Air Sciences Inc.	PROJECT TITLE: Spirit Lake	BY: G. Lewis
	PROJECT NO: 443-1	PAGE: 1 OF: 3 SHEET: totals-EI
AIR EMISSION CALCULATIONS	SUBJECT: Emissions Summary	DATE: February 8, 2024

Reservation Total Emissions by Township

Emission inventory for criteria pollutants of particulate matter less than 10 microns, carbon monoxide, oxides of nitrogen, volatile organic compounds, and sulfur dioxide.

Township	$PM_{2.5}$ (tpy)	PM_{10} (tpy)	CO (tpy)	NO_x (tpy)	VOC (tpy)	SO_2 (tpy)
Bush	3.54	32.01	3.56	0.62	0.19	0.01
Dayton	1.75	16.10	0.91	0.24	0.04	0.01
Eddy	40.77	377.80	26.23	4.05	1.08	0.01
Fort Totten	15.10	136.44	20.74	3.13	0.93	0.006
Fort Totten Unorg.	34.14	304.33	36.33	6.56	1.62	0.15
Freeborn	59.03	553.70	41.20	6.55	1.51	0.03
Gates	3.61	34.05	2.69	0.50	0.10	0.01
Grandfield	0.004	0.02	0.01	0.02	0.001	0.002
Hillsdale	70.12	659.94	15.90	2.38	0.84	0.01
Lallie	88.75	812.56	71.99	11.79	2.72	0.11
Lallie North Unorg.	3.36	29.90	3.63	0.55	0.19	0.003
Lohnes	38.80	360.53	11.32	1.95	0.61	0.04
Minco	44.32	416.73	5.63	0.86	0.30	0.01
Mission	62.56	564.41	64.71	9.94	2.55	0.02
Oberon	14.95	141.63	3.63	0.63	0.19	0.01
Odessa	6.87	66.03	1.02	0.28	0.06	0.02
Poplar Grove	1.89	16.76	5.84	1.16	0.32	0.04
Rock	93.83	888.02	38.51	5.99	1.56	0.02
Tiffany	2.41	22.67	0.32	0.07	0.02	0.004
Twin Tree	58.66	544.17	15.30	2.33	0.81	0.02
Warwick	5.68	55.46	1.18	0.17	0.06	0.000
Warwick Unorg.	78.85	737.65	42.59	6.67	1.62	0.03
West Bay	5.17	43.66	4.84	0.81	0.26	0.01
Wood Lake	87.67	827.15	27.33	4.79	1.31	0.10
Totals	**821.8**	**7,641.7**	**445.4**	**72.0**	**18.9**	**0.7**

Reservation Total Emissions by Source Category

Source Category	$PM_{2.5}$ (tpy)	PM_{10} (tpy)	CO (tpy)	NO_x (tpy)	VOC (tpy)	SO_2 (tpy)
Residential Heating	0.24	0.24	2.61	4.53	0.28	0.55
Roads Tailpipe	2.37	4.78	442.79	67.50	18.62	0.14
Roads Fugitive Dust	661.13	6,582.90	--	--	--	--
Wind Erosion	158.07	1,053.79	--	--	--	--
Sioux Manufacturing Corp.	--	--	--	0.05	0.64	0.004
Totals	**821.8**	**7,641.7**	**445.4**	**72.1**	**19.5**	**0.7**

Air Sciences Inc.	PROJECT TITLE: Spirit Lake	BY: G. Lewis
	PROJECT NO: 443-1	PAGE: 2 OF: 3 SHEET: totals-EI
AIR EMISSION CALCULATIONS	SUBJECT: Emissions Summary	DATE: February 8, 2024

Relative Emission Strength by Township

Emissions are calculated as per acre. The top 75th percentile of emission density is highlighted.

Township	Area		$PM_{2.5}$		PM_{10}		CO		NO_x		VOC		SO_2	
	(m2)	(acres)	(tpy)	(ton/ac/yr)	(tpy)	(ton/ac/yr)	(tpy)	(ton/ac/yr)	(tpy)	(ton/ac/yr)	(tpy)	(ton/ac/yr)	(tpy)	(ton/ac/yr)
Bush	5,607,285	1,386	3.54	0.003	32.01	0.023	3.56	0.0026	0.62	0.00044	0.19	0.00014	0.01	9.5E-06
Dayton	2,436,690	602	1.75	0.003	16.10	0.027	0.91	0.002	0.24	0.0004	0.04	0.0001	0.01	2.3E-05
Eddy	52,658,461	13,012	40.77	0.003	377.80	0.029	26.23	0.002	4.05	0.0003	1.08	0.0001	0.01	1.0E-06
Fort Totten	22,889,791	5,656	15.10	0.003	136.44	0.024	20.74	0.004	3.13	0.0006	0.93	0.0002	0.01	1.1E-06
Fort Totten Unorg.	62,172,389	15,363	34.14	0.002	304.33	0.020	36.33	0.002	6.56	0.0004	1.62	0.0001	0.15	9.8E-06
Freeborn	62,049,383	15,333	59.03	0.004	553.70	0.036	41.20	0.003	6.55	0.0004	1.51	0.0001	0.03	2.2E-06
Gates	3,309,491	818	3.61	0.004	34.05	0.042	2.69	0.003	0.50	0.0006	0.10	0.0001	0.01	1.4E-05
Grandfield	18,844	5	0.004	0.001	0.02	0.004	0.01	0.002	0.02	0.004	0.001	0.0002	0.002	5.0E-04
Hillsdale	80,033,764	19,777	70.12	0.004	659.94	0.033	15.90	0.001	2.38	0.0001	0.84	0.0000	0.01	5.1E-07
Lallie	128,548,624	31,765	88.75	0.003	812.56	0.026	71.99	0.002	11.79	0.0004	2.72	0.0001	0.11	3.5E-06
Lallie North Unorg.	6,266,097	1,548	3.36	0.002	29.90	0.019	3.63	0.002	0.55	0.0004	0.19	0.00012	0.003	2.2E-06
Lohnes	52,294,852	12,922	38.80	0.003	360.53	0.028	11.32	0.001	1.95	0.0002	0.61	0.0000	0.04	3.1E-06
Minco	52,646,308	13,009	44.32	0.003	416.73	0.032	5.63	0.000	0.86	0.0001	0.30	0.0000	0.01	4.0E-07
Mission	103,008,937	25,454	62.56	0.002	564.41	0.022	64.71	0.003	9.94	0.0004	2.55	0.0001	0.02	7.9E-07
Oberon	15,134,021	3,740	14.95	0.004	141.63	0.038	3.63	0.001	0.63	0.0002	0.19	0.0001	0.01	3.5E-06
Odessa	5,182,690	1,281	6.87	0.005	66.03	0.052	1.02	0.001	0.28	0.0002	0.06	0.0000	0.02	1.3E-05
Poplar Grove	2,329,746	576	1.89	0.003	16.76	0.029	5.84	0.010	1.16	0.0020	0.32	0.0006	0.04	7.3E-05
Rock	91,881,392	22,704	93.83	0.004	888.02	0.039	38.51	0.002	5.99	0.0003	1.56	0.0001	0.02	1.0E-06
Tiffany	2,849,694	704	2.41	0.003	22.67	0.032	0.32	0.000	0.07	0.0001	0.02	0.0000	0.00	5.1E-06
Twin Tree	81,714,419	20,192	58.66	0.003	544.17	0.027	15.30	0.001	2.33	0.0001	0.81	0.0000	0.02	7.4E-07
Warwick	2,549,378	630	5.68	0.009	55.46	0.088	1.18	0.002	0.17	0.0003	0.06	0.0001	0.000	5.6E-07
Warwick Unorg.	90,772,323	22,430	78.85	0.004	737.65	0.033	42.59	0.002	6.67	0.0003	1.62	0.0001	0.03	1.2E-06
West Bay	14,330,815	3,541	5.17	0.001	43.66	0.012	4.84	0.001	0.81	0.0002	0.26	0.0001	0.01	4.2E-06
Wood Lake	93,198,899	23,030	87.67	0.004	827.15	0.036	27.33	0.001	4.79	0.0002	1.31	0.0001	0.10	4.3E-06
Total	**1,033,884,294**	**255,476**	**821.8**	**0.08**	**7,641.7**	**0.8**	**445.4**	**0.05**	**72.0**	**0.01**	**18.9**	**0.003**	**0.7**	**0.001**

Calculation assumptions: *75%* *percentile highlighted*

75th percentile (ton/ac/yr):

$PM_{2.5}$	0.004
PM_{10}	0.036
CO	0.002
NO_x	0.0004
VOC	0.0001
SO_2	9.6E-06

Reservation Total Percent Emissions by Source Category

Source Category	$PM_{2.5}$ (tpy)	PM_{10} (tpy)	CO (tpy)	NO_x (tpy)	VOC (tpy)	SO_2 (tpy)
Residential Heating	0.03%	0.003%	0.59%	6.29%	1.43%	79.74%
Roads Tailpipe	0.29%	0.06%	99.41%	93.65%	95.28%	19.69%
Roads Fugitive Dust	80.45%	86.14%	-	-	-	-
Wind Erosion	19.23%	13.79%	-	-	-	-
Sioux Manufacturing Corp.	-	-	-	0.07%	3.29%	0.58%
Totals	**100%**	**100%**	**100%**	**100%**	**100%**	**100%**

Calculation assumptions: *25% contribution or greater highlighted*

Conversions

4046.9 m2/acre

Air Sciences Inc.	PROJECT TITLE: Spirit Lake	BY: G. Lewis
	PROJECT NO: 443-1	PAGE: 3 OF: 3 SHEET: totals-EI
AIR EMISSION CALCULATIONS	SUBJECT: Emissions Summary	DATE: February 8, 2024

Sioux Manufacturing Corporation Emission Inventory Summary

Source ID	Source Description	NO_x (tpy)	VOC (tpy)	SO_2 (tpy)	PM (tpy)	CO (tpy)
DCL1	Heater for zone 1 of dip coater	--	--	--	--	--
DCL2	Heater for zone 2 of dip coater	--	--	--	--	--
DCL3	Heater for zone 3 of dip coater	--	--	--	--	--
DCL4	Heater for zone 4 of dip coater	--	--	--	--	--
SCL1	Surface coating line heater	0.024	0.001	2.0E-03	--	--
SCL2	Surface coating line heater	0.024	0.001	2.0E-03	--	--
PPB1	Press boiler	--	--	--	--	--
AI1	Hot water boiler	--	--	--	--	--
SJ1	Hot water heater	--	--	--	--	--
SJ2	Hot water heater	--	--	--	--	--
AM1	Heater for coating line air make-up unit	--	--	--	--	--
AM2	Heater for coating line air make-up unit	--	--	--	--	--
AM3	Heater for coating line air make-up unit	--	--	--	--	--
AM4	Heater for coating line air make-up unit	--	--	--	--	--
AM5	Heater for coating line air make-up unit	--	--	--	--	--
AM6	Heater for coating line air make-up unit	--	--	--	--	--
DO1	Draping oven	--	--	--	--	--
SCL3	Surface coating line	--	0.641	--	--	--
PB1	Paint booth	--	--	--	--	--
Facility Total		**0.05**	**0.64**	**0.004**	**--**	**--**

(EPA, 2023e)

Air Sciences Inc.	PROJECT TITLE: Spirit Lake	BY: G. Lewis
	PROJECT NO: 443-1	PAGE: 1 OF: 10 SHEET: GHG
AIR EMISSION CALCULATIONS	SUBJECT: Greenhouse Gas Emissions	DATE: February 20, 2024

GHG Emissions Summary

Source Category	CO_2 (ton/yr)	CH_4 (ton/yr)	N_2O (ton/yr)	CO_2e (ton/yr)
Stationary Fossil Fuel Combustion	6,133	0.24	0.045	6,153
Mobile Combustion Sources	21,658	0.91	0.18	21,735
Solid Waste Management	--	113.57	--	2,839
Wastewater Treatment	--	14.62	1.06	682.25
Electricity Usage	12,149	0.18	1.31	12,543
Agriculture and Land Management	--	--	144	42,855
Structure Fires	303	0.6	3.5	307
Forestry	--	--	--	(299)
Water use (offsite)	--	--	--	--
Total GHGs	**40,244**	**130.1**	**149.9**	**87,114**
Net GHGs	**40,244**	**130.1**	**149.9**	**86,814**

Sector Sources of GHG Emissions and Storage

Sector	Source	CO_2e (ton/yr)
Ag/Land Management, Forestry	Agriculture	42,855
	Forestry	(299)
Mobile Combustion Sources	Passenger Car	13,528.0
	Light Truck	5,651.8
	Heavy-Duty Vehicle	2,377.3
	Motorcycle	177.6
Electricity Usage	Residential	8,905
	Commercial	3,637
Residential Heating	Propane	4,412.9
	Natural Gas	1,740.1
Solid Waste Management	Residential	1,590.3
	Commercial	1,248.9
Wastewater Treatment	WWTF/Lagoons	316.7
	Septic Systems	365.5
Fires	Structure Fires	307
Total GHGs		**87,114**
Net GHGs		**86,814**

Air Sciences Inc.	**PROJECT TITLE:** Spirit Lake	**BY:** G. Lewis
	PROJECT NO: 443-1	**PAGE:** 2 **OF:** 10 **SHEET:** GHG
AIR EMISSION CALCULATIONS	**SUBJECT:** Greenhouse Gas Emissions	**DATE:** February 20, 2024

Stationary Fossil Fuel Combustion

Source Data

	Fuel	Unit	Heat Input Unit/yr	Heat Input MMBtu/yr	CO_2e ton/yr
Total Residential Heating	Propane	gal	696,918.7	63,419.6	4412.9
	NG	MMscf	28.66	29,720.8	2068.0
Total				**93,140**	**6,480.9**

Calculation assumptions: 1.00E-06 MMBtu/Btu 91,000 Btu/gal - Propane 1,037 Btu/scf

GHG Emissions

Fuel: Propane
Total Combustion: 63,420 MMBtu/yr

GHG	EF	Units	GWP	Emissions ton/yr	CO_2e ton/yr
CO_2	62.87	kg/MMBtu	1	4,395.13	4,395
CH_4	0.003	kg/MMBtu	25	0.2097	5.243
N_2O	0.0006	kg/MMBtu	298	4.2E-02	12.500
Total GHG					**4,412.9**

Fuel: NG
Total Combustion: 29,721 MMBtu/yr

GHG	EF	Units	GWP	Emissions ton/yr	CO_2e ton/yr
CO_2	53.06	kg/MMBtu	1	1,738.33	1,738
CH_4	0.001	kg/MMBtu	25	3.3E-02	0.819
N_2O	0.0001	kg/MMBtu	298	3.3E-03	0.976
Total GHG					**1,740.1**

Conversions
2,000 lb/ton
907.18 kg/ton

Air Sciences Inc.	PROJECT TITLE: Spirit Lake	BY: G. Lewis
	PROJECT NO: 443-1	PAGE: 3 OF: 10 SHEET: GHG
AIR EMISSION CALCULATIONS	SUBJECT: Greenhouse Gas Emissions	DATE: February 20, 2024

Mobile Combustion Sources

Source Data

Description	Fuel	% of Total Fuel	Output (gal/yr)	Fuel Consumption (MMBtu/yr)	CO_2e (ton/yr)
Mobile Combustion Sources	Diesel	40%	739,330	103,506.2	8,467.5
	Gasoline	60%	1,423,207	170,784.9	13,267.3
Total			**2,162,537**	**274,291**	**21,735**

Calculation assumptions: 1.00E-06 *MMBtu/Btu* 140,000 *Btu/gal - Diesel* 120,000 *Btu/gal - Gasoline*

Diesel	284,760,249 gal/yr	*(US DOT, 2023)*	50,906,336 VMT/yr
Gasoline	430,712,755 gal/yr	*(US DOT, 2023)*	

Typical Fuel Consumption - Vehicles

Vehicle Type	Gas/Other Fuels (mi/gal)	Diesel & Biodiesel (mi/gal)	% of Total, Gas	% of Total, Diesel	Gas (VMT/yr)	Diesel (VMT/yr)	Output, Gas (gal/yr)	Output, Diesel (gal/yr)
Passenger Car	24.1	32.4	70%	73%	21,541,054	14,698,583	893,820	453,660
Light Truck	18.5	22.1	22%	22%	6,590,967	4,497,360	356,269	203,500
Heavy-Duty Vehicle	10.1	13.0	5%	5%	1,560,661	1,064,920	154,063	82,170
Motorcycle	50.0	--	3%	--	952,790	--	19,056	--

Avg. Fuel Economy By Major Vehicle Category, TGIT (EPA, 2023b)

GHG Emissions by Vehicle Type

Vehicle Type	Fuel Consumption Gas (MMBtu/yr)	Fuel Consumption Diesel (MMBtu/yr)	CO_2e Gas, (ton/yr)	CO_2e Diesel, (ton/yr)
Passenger Car	107,258.4	63,512.4	8,332.3	5,195.7
Light Truck	42,752.2	28,490.1	3,321.2	2,330.7
Heavy-Duty Vehicle	18,487.6	11,503.8	1,436.2	941.1
Motorcycle	2,286.7	--	177.6	--

Total GHG Emissions

Fuel: Diesel
Total Combustion: 103,506 MMBtu/yr

GHG	EF	Units	GWP	Emissions ton/yr	CO_2e ton/yr
CO_2	73.96	kg/MMBtu	1	8,439	8,439
CH_4	0.003	kg/MMBtu	25	0.34	8.6
N_2O	0.0006	kg/MMBtu	298	0.07	20.4
Total GHG					**8,468**

Fuel: Gasoline
Total Combustion: 170,785 MMBtu/yr

GHG	EF	Units	GWP	Emissions ton/yr	CO_2e ton/yr
CO_2	70.22	kg/MMBtu	1	13,219	13,219
CH_4	0.003	kg/MMBtu	25	0.56	14.1
N_2O	0.0006	kg/MMBtu	298	0.11	33.7
Total GHG					**13,267**

Conversions
907.18 kg/ton

Air Sciences Inc.	PROJECT TITLE: Spirit Lake	BY: G. Lewis
	PROJECT NO: 443-1	PAGE: 4 OF: 10 SHEET: GHG
AIR EMISSION CALCULATIONS	SUBJECT: Greenhouse Gas Emissions	DATE: February 20, 2024

Solid Waste Management

Total MSW Generati	4.9 lb/person/day	*(CSS UM, 2023)*	SLT Population	5,838
	0.89 ton/person/yr		SLT Households	1,346
Precipitation	15-16 in/yr	*(ND Gov, 2019)*	Avg. Household Size	5 people/household
			MSW/Household	4.47 ton/yr

Landfills/Open Dumps

	Year Opened	Residential (%)	Commercial (%)	Total Waste (%)	Residential (ton/yr)	Commercial (ton/yr)	Total Waste [4] (ton/yr)
Main Transfer Station [1]	2005	67%	33%	67%	2,674.8	1,337.4	4,012.2
Mini Transfer Station [2]	2005	0%	100%	17%	--	1,003.1	1,003.1
Open Dumps [3]	N/A	100%	0%	17%	1,003.1	--	1,003.1

(1) *Name: (SLT, 2024c), Yr: (SLT, 2024b), Res./Comm.: (SLT, 2023b), Tot. Waste: assumption*
(2) *Name: (SLT, 2024c), Yr & Res./Comm.: (SLT, 2024b), Tot. Waste: 33% all waste commercial (SLT, 2023b), assumed 1/2 goes to each station*
(3) *Res./Comm. & Tot. Waste: assumption*
(4) *Based off MSW/households and number of households*

Open Burn Emissions

Source	EF [1] (lb/ton) CH4	MSW/ household (ton/yr)	Fraction MSW Burned [2]	Emission/ Household (ton/yr)	Total Emissions (ton/yr)
Municipal Refuse	13	4.47	17%	0.005	6.5

(1) *AP-42 2.5 Table 2.5-1, Emission Factors for Open Burning of Municipal Refuse*
(2) *Assuming one burning at each open dump*

Landfill Air Emissions Estimate

$Q_{CH4}=Lo*R(e^{-kc}-e^{-kt})$

Description	Term	Main Transfe Value	Mini Transfer Value	Units	Comments
Methane generation rate at time t	Q_{CH4}	4,281,831.9	1,070,458.0	ft3/yr	
Methane generation potential	Lo	3,530	3,530	ft3 CH_4/ton refuse	*Ap-42 2.4-4 Default Value*
Average annual refuse acceptance rate during active life	R	4,012.2	1,003.1	ton/yr	*Total waste on reservation for each station*
Methane generation rate constant	k	0.02	0.02	yr-1	*Ap-42 2.4-4 Default Value for (<25 in precip.)*
Time since landfill closure	c	0	0	yr	*(c=0 for active landfills)*
Time since the initial refuse placement	t	18	18	yr	*Both landfills opened 2005, J. Tweeton, 2023 Emissions*

AP-42 2.4-3 Equation 1, Landfill Estimation Model Equation

GHG Emissions

		CH_4 GWP	CH_4 Emissions ton/yr	CO_2e ton/yr
Main Transfer Statio	Residential	25	57.09	1,427.3
	Commercial		28.55	713.6
	Total		85.64	2,140.9
Mini Transfer Statior	Residential		0.00	0.0
	Commercial		21.41	535.2
	Total		21.41	535.2
Open Dumps	Residential		6.52	163.0
	Commercial		0.00	0.0
	Total		6.52	163.0
Total Residential GHG			63.6	1,590.3
Total Commercial GHG			50.0	1,248.9
Total GHG			**113.6**	**2,839.1**

Conversions

907.18 kg/ton	52 wk/yr	0.00002 ft3 CH4/tonne CH4
2,000 lb/ton	365 day/yr	

Air Sciences Inc.	PROJECT TITLE: Spirit Lake	BY: G. Lewis
	PROJECT NO: 443-1	PAGE: 5 OF: 10 SHEET: GHG
AIR EMISSION CALCULATIONS	SUBJECT: Greenhouse Gas Emissions	DATE: February 20, 2024

Wastewater Treatment

Spirit Lake Casino Wastewater Treatment (Lagoons)				Spirit Lake Casino Wastewater Treatment Lagoons			
Average Flow	31,750	gal/day	*(EPA, 2019)*	Peak Flow Design (ga	45,000	gal/hr	*(EPA, 2022) design cap., actual N/A*
Average Sewage Flow	50.35	gal/person/day	*(NDLB, 2000)*	Population Served	630		
SLT Population	5,838						
SLT Households	1,346						
Avg. Household Size	5	people/household					
Population Served	630						

	Flow (gal/day)	(gal/person/da	Population Est.	
West Acres Wastewater Treatment Lagoons	15,000	75	200	*(EPA, 2022)*
St Michaels Wastewater Treatment Lagoon	73,300	75	977	*(EPA, 2022)*
Tokio Wastewater Treatment Lagoons	17,500	75	233	*(EPA, 2022)*
Spirit Lake Rural Water System Water Treatment Pla	564,700	75	7529	*(EPA, 2017)*
Four Winds Tate Topa Tribal School Lagoon	N/A	25	418	*(PBS, 2024), 366 students, 7:1 student:teacher ratio*

Emissions from Wastewater Treatment/Lagoons

Process N2O emissions from Effluent Discharge

Description	Term	Value	Units	Reference		
Population Served	P_{total}	12509				
Industrial Discharge Factor	$F_{ind\text{-}com}$	1.25		*(CARB, 2010)*		
Total Nitrogen Load	Total N Load	0.026	kg N/person/day	*(CARB, 2010)*		
Nitrogen uptake, aerobic system	N uptake	0.05	kg N/kg BOD5	*(CARB, 2010)*		
Default BOD_5 Load	BOD_5 Load	0.09	kg BOD5/day	*(CARB, 2010)*		
Emissions Factor, Effluent	EF effluent	0.005	kg N2O-N/kg sewage	*(CARB, 2010)*		
N2O/N2 MW Ratio	44/28	1.571		*(CARB, 2010)*		
No Nit/Denit default	F plant nit/denit	0		*(CARB, 2010)*		
	N_2O Emissions	**1.06**	**ton/yr**	**CO_2e Emissions**	**316.7**	**ton/yr**

Aerobic Treatment w/o Nitrification/Denitrification
*LGOP Equation 10.10 (Ptotal * Find-com) * (Total N Load - N uptake * BOD5 load) * EF effluent * 44/28 * (1 - F plant nit/denit) * day/yr * ton/kg*

Emissions from Septic Systems

Fugitive CH4 Emissions from Septic Systems

Description	Term	Value	Units	Reference		
Households using Septic		269		*1 in 5 households septic, (EPA, 2023d)*		
Population using Septic	P	1,346				
Default BOD5 Load	BOD_5 Load	0.09	kg BOD5/day	*(CARB, 2010)*		
Max. CH4 Production Cap.	Bo	0.6	kg CH4/kg BODs	(CARB, 2010)		
Septic CH4 Correction Factor	MCF_{septic}	0.5		(CARB, 2010)		
	CH_4 Emissions	**14.62**	**ton**	**CO_2e Emissions**	**365.5**	**ton/yr**

*LGOP Equation 10.6: (P * BOD_5 load * Bo * MCF_{septic} * day/yr * ton/kg)*

GHG Emissions

GHG	GWP	Emissions ton/yr	CO_2e ton/yr
CH_4	25	14.62	365.5
N_2O	298	1.06	316.7
Total GHG			**682**

Conversions

907.18	kg/ton
1,000	kWh/MWh
2,000	lb/ton
365	day/yr
907,185	g/ton

Air Sciences Inc.	PROJECT TITLE: Spirit Lake	BY: G. Lewis
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AIR EMISSION CALCULATIONS	SUBJECT: Greenhouse Gas Emissions	DATE: February 20, 2024

Electricity Usage

Grid CO_2 emission rate	995.79	pound CO_2/MWh	*MROW eGrid Subregion TGIT, 2021 (EPA, 2023b)*
Grid CH_4 emission rate	0.015	pound CH_4/MWh	*MROW eGrid Subregion TGIT, 2021 (EPA, 2023b)*
Grid N_2O emission rate	0.107	pound N_2O/MWh	*MROW eGrid Subregion TGIT, 2021 (EPA, 2023b)*

Residential Usage	71%	*(SLT, 2023a)*
Commercial Usage	29%	*(SLT, 2023a)*

Greenhouse Gas	GWP
CO2	1
CH4	25
N2O	298

Energy Analysis

Utility Company	Total Usage (kWh/yr)	(MWh/yr)	CO_2 ton/yr	CH_4 ton/yr	N_2O ton/yr	CO_2e ton/yr
Otter Tail Power Company	15,105,886	15,106	7,521	0.11	0.81	7,764.81
Northern Plains Electric Co-o	6,032,280	6,032	3,003	0.05	0.32	3,100.75
Nodak Electric Co-op	3,263,172	3,263	1,625	0.02	0.17	1,677.35
Total	**24,401,338**	**24,401**	**12,149**	**0.18**	**1.3**	**12,542.9**

(SLT, 2023a)

GHG Emissions

	CO_2 ton/yr	CH_4 ton/yr	N_2O ton/yr	CO_2e ton/yr
Residential Usage	8,626	0.13	0.93	8,905
Commercial Usage	3,523	0.05	0.38	3,637
Total GHG	**12,149**	**0.18**	**1.31**	**12,543**

Conversions

907.18 kg/ton
1,000 kWh/MWh
2,000 lb/ton

Air Sciences Inc.	PROJECT TITLE: Spirit Lake	BY: G. Lewis
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AIR EMISSION CALCULATIONS	SUBJECT: Greenhouse Gas Emissions	DATE: February 20, 2024

Agriculture and Land Management

County	Fertilizer Type (acre) [1] Synthetic	Organic	Manure	County Total Area (acre) [2]	Area in Spirit Lake (acre) [2]	Area Ratio (%)
Benson	375,232	0	3,199	911,777	198,394	21.8%
Eddy	167,309	0	4,063	412,199	51,034	12.4%
Nelson	295,319	10,480	3,664	645,693	602	0.1%
Ramsey	440,116	0	570	841,697	5,398	0.6%

(1) *(USDA, 2017) Chapter 2, Table 40 - Fertilizers and Chemicals Applied*
(2) *(QGIS)*

Land Use Emission Factors [1]

Fertilizer Type	% N Content	% N lost to Volatilization	% Leach & Runoff	% from Applied N	% from Volatized N	% from Leached & Runoff N
Synthetic	1	0.1	0.3	0.0125	0.01	0.025
Organic [2]	0.037	0.2	0.3	0.0125	0.01	0.025
Manure [3]	0.005	0.2	0.3	0.0125	0.01	0.025

(EPA, 2023b)
(1) *Unless otherwise noted, all fertilizer emission factors are IPCC default values from the Revised 1996 Guidelines for National GHG Inventories.*
(2) *Organic % N Content: from Commercial Fertilizers 2001 (AAPFCO/TFI 2002), Table 27, as used in the U.S. GHG Inventory: 1990-2001*
(3) *Manure % N Content: assume 0.5%, per AAPFCO, 2000, 1999-2000 Commercial Fertilizers Data, ASCII files (obtained from D. Terry, Secretary, AAPFCO), as is done in U.S. GHG Inventory: 1990-2001*

N2O/N2O-N 1.571428571

Commercial Fertilizer Purchased	729,401,000	kg of N	*(EPA, 2023a)*
	1,608,055,257	lb of N	
ND Fertilized Land (syn. and org.)	17,858,741	acres	*(USDA, 2017)*
Syn./Org. Fertilizer Usage	90.0	lb/acre	
Manure Fertilizer Usage	12	ton/acre	*(UAF, 2021)*

County	Fertilizer Type (acre in Spirit Lake) Synthetic	Organic	Manure	Fertilizer Consumption (ton) Synthetic	Organic	Manure
Benson	81,647	--	696	3675.9	--	8352.9
Eddy	20,714	--	503	932.6	--	6036.4
Nelson	275	10	3	12.4	0.4	41.0
Ramsey	2,822	--	4	127.1	--	43.9
Total				**4,748**	**0.4**	**14,474**

GHG Emissions

	N_2O ton/yr	CO_2e ton/yr
Synthetic	141.8	42,244
Organic	0.0005	0.14
Manure	2.0	610
Total GHG	**144**	**42,855**

Conversions
907.18 kg/ton
1,000 kWh/MWh
2,000 lb/ton

Air Sciences Inc.	PROJECT TITLE: Spirit Lake	BY: G. Lewis
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AIR EMISSION CALCULATIONS	SUBJECT: Greenhouse Gas Emissions	DATE: February 20, 2024

Forestry

Total Reservation Area	255,476	acre
	1,034	km2
Area with tree cover	3%	

Carbon Sequestration Factor 2.23 (tonne C/hectare/year) *(EPA, 2023b), EPA State Inventory Tools, Land-Use Land Use Change and Forestry module.*

Land Use	Acreage
Tribal Trust Land	26,426
Allotted Trust Land	39,179
Total Reservation Trust Land	65,605
Trust Pasture/Hay Land	26,883
Trust Crop Land	15,549
Total Agriculture Trust Land	42,432
Agricultural Leases (633)	34,000
Forested Land (12% of Trust Land - 1/3 of wooded areas are grazed by cat	7,873
Private Land	184,451
State and Government Lands	375
Total Reservation Land Area	**245,135**

(SLT, 2023b)

Carbon Sequestered

	CO_2e ton/yr
Forestry	299
Total	**299**

Conversions

247.10	acre/km2
4046.90	m2/acre
1.10	ton/tonne

Air Sciences Inc.	PROJECT TITLE: Spirit Lake	BY: G. Lewis
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AIR EMISSION CALCULATIONS	SUBJECT: Greenhouse Gas Emissions	DATE: February 20, 2024

Structure Fires

Structure Fires	19	fire/yr	*(SLT, 2024a)*
Lumber Use	16,946	board ft/structure	*(USDA, 1994), 1992 single family households*
Weight Lumber	1.3	lb/ft	*(Eng. ToolBox, 2013), 2x4 in kiln dried lumber boards*
Structure Total Lumber Weight	22,030	lb/structure	
Wood Burned in Structure Fires	418,566	lb/yr	

GHG Emissions

Fuel: Wood

Total Combustion: 2,930 MMBtu/yr

GHG	EF	Units	GWP	Emissions ton/yr	CO_2e ton/yr
CO_2	93.8	kg/MMBtu	1	302.9	302.9
CH_4	0.0072	kg/MMBtu	25	0.02	0.6
N_2O	0.0036	kg/MMBtu	298	0.01	3.5
Total GHG					**307.0**

Conversions

2000 lb/ton

907 kg/ton

7000 Btu/lb - dry wood

Water use (offsite)

Percent Water Importe(	0	%
Percent Water Local	100	%

Water comes from Spirit Lake Rural Water System Water Treatment Plant, along with personal wells. No water imported *(SLT, 2024c)*

No emissions, no water imported.

Air Sciences Inc.	PROJECT TITLE: Spirit Lake	BY: G. Lewis
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AIR EMISSION CALCULATIONS	SUBJECT: Residential Heating Emissions	DATE: February 8, 2024

Emission Factors

Fuel	$PM_{2.5}$	PM_{10}	CO	NO_x	VOC	SO_2	Units	Reference
Propane	0.7	0.7	7.5	13	0.8	1.59	lb/Kgal	*AP-42 1.5 Table 1.5-1, comm. boilers, SO_2: 185 ppmw (15.9 gr/100 ft3)*
Natural Gas	7.6	7.6	40	94	5.5	0.6	lb/MMscf	*AP-42 1.4 Tables 1.4-1 and 1.4-2, Residential furnaces - PM (Total)*

Activity Factors

Fuel	Unit Consumption	Reference
Propane	727.47 gal/household/yr	*(EIA, 2023), ND, Propane*
Natural Gas	0.07 MMscf/household/yr	*(EIA, 2023), ND, Natural Gas*

Activity Data

Township	Activity Fuel Used[(1)]	No. of Households per Township
		4
Bush	Propane	21
Dayton	Propane	23
Eddy	Propane	9
Fort Totten	Natural Gas	145
Fort Totten Unorg.	Propane	242
Freeborn	Propane	37
Gates	Propane	18
Grandfield	Propane	4
Hillsdale	Propane	9
Lallie	Propane	153
Lallie North Unorg.	Propane	4
Lohnes	Propane	64
Minco	Propane	6
Mission	Natural Gas	215
Oberon	Propane	21
Odessa	Propane	29
Poplar Grove	Propane	70
Rock	Propane	20
Tiffany	Propane	6
Twin Tree	Propane	18
Warwick	Natural Gas	28
Warwick Unorg.	Propane	23
West Bay	Propane	23
Wood Lake	Propane	158
Total:		**1,346**

(1) *No location specific fuel usage data available. Assuming Natural Gas utilized in "organized" townships and Propane used elsewhere.*

Conversions

2000	lb/ton	91,000	Btu/gal - Propane
0.001	Kgal/gal	1,037	Btu/scf
1.00E-06	MMBtu/Btu		

Air Sciences Inc.	PROJECT TITLE: Spirit Lake	BY: G. Lewis
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AIR EMISSION CALCULATIONS	SUBJECT: Residential Heating Emissions	DATE: February 8, 2024

Emissions Calculations

3	2	3	4	5	6	7	3	2	3	4	5	6	7
Propane Consump. (gal/yr)	**$PM_{2.5}$ (tpy)**	**PM_{10} (tpy)**	**CO (tpy)**	**NO_x (tpy)**	**VOC (tpy)**	**SO_2 (tpy)**	**Natural Gas Consump. (MMscf/yr)**	**$PM_{2.5}$ (tpy)**	**PM_{10} (tpy)**	**CO (tpy)**	**NO_x (tpy)**	**VOC (tpy)**	**SO_2 (tpy)**
15,277	0.01	0.01	0.06	0.10	0.01	0.01	--	--	--	--	--	--	--
16,732	0.01	0.01	0.06	0.11	0.01	0.01	--	--	--	--	--	--	--
6,547	0.002	0.002	0.02	0.04	0.003	0.01	--	--	--	--	--	--	--
--	--	--	--	--	--	--	10.71	4.07E-05	4.07E-05	0.000214	0.000503	2.95E-05	3.21E-06
176,048	0.06	0.06	0.66	1.14	0.07	0.14	--	--	--	--	--	--	--
26,916	0.01	0.01	0.10	0.17	0.01	0.02	--	--	--	--	--	--	--
13,095	0.005	0.005	0.05	0.09	0.01	0.01	--	--	--	--	--	--	--
2,910	0.001	0.001	0.01	0.02	0.001	0.002	--	--	--	--	--	--	--
6,547	0.002	0.002	0.02	0.04	0.003	0.01	--	--	--	--	--	--	--
111,303	0.04	0.04	0.42	0.72	0.04	0.09	--	--	--	--	--	--	--
2909.9	0.001	0.001	0.01	0.02	0.001	0.002	--	--	--	--	--	--	--
46558.2	0.02	0.02	0.17	0.30	0.02	0.04	--	--	--	--	--	--	--
4,365	0.002	0.002	0.02	0.03	0.002	0.003	--	--	--	--	--	--	--
--	--	--	--	--	--	--	15.88	6.0E-05	6.0E-05	0.000318	0.000746	4.37E-05	4.76E-06
15,277	0.01	0.01	0.06	0.10	0.01	0.01	--	--	--	--	--	--	--
21,097	0.01	0.01	0.08	0.14	0.01	0.02	--	--	--	--	--	--	--
50,923	0.02	0.02	0.19	0.33	0.02	0.04	--	--	--	--	--	--	--
14549.5	0.01	0.01	0.05	0.09	0.01	0.01	--	--	--	--	--	--	--
4,365	0.002	0.002	0.02	0.03	0.002	0.003	--	--	--	--	--	--	--
13,095	0.005	0.005	0.05	0.09	0.01	0.01	--	--	--	--	--	--	--
--	--	--	--	--	--	--	2.07	7.86E-06	7.86E-06	4.14E-05	9.72E-05	5.69E-06	6.2E-07
16,732	0.01	0.01	0.06	0.11	0.01	0.01	--	--	--	--	--	--	--
16,732	0.01	0.01	0.06	0.11	0.01	0.01	--	--	--	--	--	--	--
114,941	0.04	0.04	0.43	0.75	0.05	0.09	--	--	--	--	--	--	--
696,919	**0.2**	**0.2**	**2.6**	**4.5**	**0.3**	**0.6**	**28.7**	**0.0001**	**0.0001**	**0.0006**	**0.001**	**7.88E-05**	**8.6E-06**

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AIR EMISSION CALCULATIONS	SUBJECT: Residential Heating Emissions	DATE: February 8, 2024

Total Township Emission Calculations

	$PM_{2.5}$ (tpy)	PM_{10} (tpy)	CO (tpy)	NO_x (tpy)	VOC (tpy)	SO_2 (tpy)
Bush	0.005	0.005	0.057	0.099	0.006	0.012
Dayton	0.006	0.006	0.063	0.109	0.007	0.013
Eddy	0.002	0.002	0.025	0.043	0.003	0.005
Fort Totten	0.000	0.000	0.000	0.001	0.000	0.000
Fort Totten Unorg.	0.062	0.062	0.660	1.144	0.070	0.140
Freeborn	0.009	0.009	0.101	0.175	0.011	0.021
Gates	0.005	0.005	0.049	0.085	0.005	0.010
Grandfield	0.001	0.001	0.011	0.019	0.001	0.002
Hillsdale	0.002	0.002	0.025	0.043	0.003	0.005
Lallie	0.039	0.039	0.417	0.723	0.045	0.088
Lallie North Unorg	0.001	0.001	0.011	0.019	0.001	0.002
Lohnes	0.016	0.016	0.175	0.303	0.019	0.037
Minco	0.002	0.002	0.016	0.028	0.002	0.003
Mission	0.000	0.000	0.000	0.001	0.000	0.000
Oberon	0.005	0.005	0.057	0.099	0.006	0.012
Odessa	0.007	0.007	0.079	0.137	0.008	0.017
Poplar Grove	0.018	0.018	0.191	0.331	0.020	0.040
Rock	0.005	0.005	0.055	0.095	0.006	0.012
Tiffany	0.002	0.002	0.016	0.028	0.002	0.003
Twin Tree	0.005	0.005	0.049	0.085	0.005	0.010
Warwick	7.9E-06	7.9E-06	4.1E-05	9.7E-05	5.7E-06	6.2E-07
Warwick Unorg.	0.006	0.006	0.063	0.109	0.007	0.013
West Bay	0.006	0.006	0.063	0.109	0.007	0.013
Wood Lake	0.040	0.040	0.431	0.747	0.046	0.091
Total	**0.2**	**0.2**	**2.6**	**4.5**	**0.3**	**0.6**

Sample Calculations for Bush Township

Propane Consumption 15,277 gal/yr $= \frac{21 \text{ Household}}{\text{Township}} \times \frac{727 \text{ gal}}{\text{Household - year}}$

PM_{10} Emissions 0.005 ton/yr $= \frac{15276.92 \text{ gal}}{\text{yr}} \times \frac{0.7 \text{ lb - PM10}}{\text{Kgal - Propane}} \times \frac{1 \text{ Kgal}}{1000 \text{ gal}} \times \frac{1 \text{ ton}}{2000 \text{ lb}}$

Emission Factor

u10 = highest hourly average wind speed per day at 10 meters reference height, m/s
u10+ = fastest-mile wind speed, m/s
Highest hourly average to fastest-mile wind speed conversion factor 1.2 *(EPA, 1994)*

N = number of disturbances per year

Flat: u* = friction velocity, m/s = 0.053 × u10+ *AP-42, Sec. 13.2.5, Eq. 4, 11/06*

where, ut* = threshold friction velocity = 1.225 m/s avg. scoria and uncrusted coal pile *AP-42, Table 13.2.5-2, 11/06*

Solving for u*
Flat: 19.26 m/s

		Annual Emission Flux
		Flat
Pollutant	k	g/m^2
PM	1	1.85
PM_{10}	0.5	0.92
$PM_{2.5}$	0.075	0.14

AP-42, Page 13.2.5-3, 11/06

	$PM_{2.5}$	**PM_{10}**	**Units**
Soil loss	0.001	0.004	ton/acre

Conversions
907185 g/ton
4046.9 m2/acre

Air Sciences Inc.	PROJECT TITLE: Spirit Lake	BY: G. Lewis
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AIR EMISSION CALCULATIONS	SUBJECT: Windblown Fugitive Dust Emissions	DATE: February 8, 2024

Emission calculations

Township	Susceptible land (acre) [3]	$PM_{2.5}$ (tpy)	PM_{10} (tpy)
Bush	1,386	0.86	5.72
Dayton	602	0.37	2.48
Eddy	13,012	8.05	53.67
Fort Totten	5,656	3.50	23.33
Fort Totten Unorg.	15,363	9.51	63.37
Freeborn	15,333	9.49	63.24
Gates	818	0.51	3.37
Grandfield	4.66	0.003	0.02
Hillsdale	19,777	12.24	81.57
Lallie	31,765	19.65	131.02
Lallie North Unorg.	1,548	0.96	6.39
Lohnes	12,922	8.00	53.30
Minco	13,009	8.05	53.66
Mission	25,454	15.75	104.99
Oberon	3,740	2.31	15.43
Odessa	1,281	0.79	5.28
Poplar Grove	576	0.36	2.37
Rock	22,704	14.05	93.65
Tiffany	704	0.44	2.90
Twin Tree	20,192	12.49	83.29
Warwick	630	0.39	2.60
Warwick Unorg.	22,430	13.88	92.52
West Bay	3,541	2.19	14.61
Wood Lake	23,030	14.25	94.99
Total	**255,475.6**	**158.1**	**1,053.8**

CRP, tilled, and range land is susceptible to soil loss through wind erosion. A portion of this contributes to particulate air emissions. Area of township within Spirit Lake Reservation Boundaries used as a conservative estimate for susceptible land.

Sample Calculations for Bush Township

PM_{10} Emissions 5.72 ton

$$\frac{1{,}386 \text{ acres - susceptible land}}{} \left| \frac{0.004 \text{ ton - soil loss}}{\text{acre}} \right.$$

Air Sciences Inc.	PROJECT TITLE: Spirit Lake	BY: G. Lewis
	PROJECT NO: 443-1	PAGE: 1 OF: 3 SHEET: tailpipe-EI
AIR EMISSION CALCULATIONS	SUBJECT: Roads - Tailpipe Emissions	DATE: February 8, 2024

Emission Factors

Road Type	$PM_{2.5}$ (g/VMT)	PM_{10} (g/VMT)	CO (g/VMT)	NO_x (g/VMT)	VOC (g/VMT)	SO_2 (g/VMT)	Reference
Dirt	0.06	0.14	8.76	1.29	0.46	0.0026	*MOVES4, average of all vehicles on rural restricted routes*
Gravel	0.06	0.14	8.76	1.29	0.46	0.0026	*MOVES4, average of all vehicles on rural restricted routes*
Paved	0.06	0.14	8.76	1.29	0.46	0.0026	*MOVES4, average of all vehicles on rural restricted routes*
Highway	0.03	0.04	7.26	1.14	0.24	0.0023	*MOVES4, average of all vehicles on rural unrestricted routes*

Traffic Counts

Road Type	ADT	AYT	Reference
Dirt	67.5	24,638	*Average ADT for gravel roads in SLT from NDDOT (NDDOT, 2022)*
Gravel	67.5	24,638	*Average ADT for gravel roads in SLT from NDDOT (NDDOT, 2022)*
Paved	327	119,407	*Average ADT for paved roads in SLT from NDDOT (NDDOT, 2022)*
Highway	1361	496,898	*Average ADT for major highways in SLT from NDDOT (NDDOT, 2022)*
Activity assumptions:		*365 day/yr*	

Activity Calculations

	7		3	8		3	9		3	6		3
	Dirt			Gravel			Paved			Highway		
Township	Road Lengths (m)	(mi)	Traffic (VMT/yr)	Road Lengths (m)	(mi)	Traffic (VMT/yr)	Road Lengths (m)	(mi)	Traffic (VMT/yr)	Road Lengths (m)	(mi)	Traffic (VMT/yr)
Bush	2723.15	1.69	41689.89	0	--	0	4329.59	2.69	321247.58	--	--	0
Dayton	33	0.02	507	1,385	0.86	21,210	360	0.22	26,719	155	0.10	47,883
Eddy	9,415	5.85	144,140	24,310	15.11	372,180	8,178	5.08	606,756	6213	3.86	1,918,302
Fort Totten	1,808	1.12	27,684	9,854	6.12	150,857	15,221	9.46	1,129,399	3,280	2.04	1,012,823
Fort Totten Unorg.	11,393	7.08	174,416	13,523	8.40	207,027	21,532	13.38	1,597,621	6,696	4.16	2,067,414
Freeborn	17,657	10.97	270,326	33,356	20.73	510,662	0	--	0	13570	8.43	4,190,036
Gates	1,748	1.09	26,763	1,442	0.90	22,073	0	--	0	879	0.55	271,393
Grandfield	--	--	--	--	--	--	--	--	--	--	--	0
Hillsdale	22884.01	14.22	350341.68	37,590	23.36	575,486	9,676	6.01	717,943	--	--	0
Lallie	26,733	16.61	409,262	44,016	27.35	673,868	8,539	5.31	633,601	22242	13.82	6,867,618
Lallie North Unorg.	776.20	0.48	11883.27	1,655	1.03	25,331	4,544	2.82	337,187	--	--	0
Lohnes	7161.46	4.45	109637.96	24,936	15.49	381,754	8,932	5.55	662,708	--	--	0
Minco	10070.72	6.26	154177.20	27,932	17.36	427,624	0	--	0	--	--	0
Mission	13,457	8.36	206,025	34,083	21.18	521,793	20,610	12.81	1,529,251	17,357	10.79	5,359,402
Oberon	6846.11	4.25	104810.25	6,348	3.94	97,184	2,264	1.41	167,972	--	--	0
Odessa	1414.02	0.88	21647.93	4,944	3.07	75,692	0	--	0	--	--	0
Poplar Grove	--	--	--	1453.86	0.90	22257.78	7,579	4.71	562,344	--	--	0
Rock	47,020	29.22	719,857	35,876	22.29	549,236	3,207	1.99	237,987	9666	6.01	2,984,569
Tiffany	766.95	0.48	11741.52	1,302	0.81	19,936	0	--	0	--	--	0
Twin Tree	16856.06	10.47	258057.08	31,310	19.46	479,338	11,347	7.05	841,920	--	--	0
Warwick	575.81	0.36	8815.27	4,954	3.08	75,842	499	0.31	37,049	--	--	0
Warwick Unorg.	41,505	25.79	635,419	25,709	15.97	393,583	1,806	1.12	134,004	12659	7.87	3,908,813
West Bay	1308.69	0.81	20035.31	1,692	1.05	25,906	6,055	3.76	449,249	--	--	0
Wood Lake	28,840	17.92	441,520	47,645	29.61	729,418	11,059	6.87	820,558	3101	1.93	957,553
Total	**270,993**	**168.4**	**4,148,756**	**415,316**	**258.1**	**6,358,259**	**145,738**	**90.6**	**10,813,515**	**95,819**	**59.5**	**29,585,806**
	TRUE			TRUE			TRUE			TRUE		

Conversions

1609.3 m/mi
453.6 g/lb
2000 lb/ton

Air Sciences Inc.	PROJECT TITLE: Spirit Lake	BY: G. Lewis
	PROJECT NO: 443-1	PAGE: 2 OF: 3 SHEET: tailpipe-EI
AIR EMISSION CALCULATIONS	SUBJECT: Roads - Tailpipe Emissions	DATE: February 8, 2024

Total Township Emission Calculations

		2	3	4	5	6	7
	Traffic (VMT/yr)	**$PM_{2.5}$ (tpy)**	**PM_{10} (tpy)**	**CO (tpy)**	**NO_x (tpy)**	**VOC (tpy)**	**SO_2 (tpy)**
Bush	362,937	0.023	0.06	3.50	0.52	0.19	0.0011
Dayton	96,320	0.00	0.01	0.85	0.13	0.04	0.0003
Eddy	3,041,377	0.14	0.27	26.21	4.01	1.08	0.01
Fort Totten	2,320,763	0.12	0.26	20.74	3.13	0.93	0.006
Fort Totten Unorg.	4,046,478	0.20	0.41	35.67	5.41	1.55	0.011
Freeborn	4,971,024	0.19	0.32	41.09	6.37	1.49	0.01
Gates	320,230	0.01	0.02	2.64	0.41	0.10	0.0008
Grandfield	0	0.0000	0.0000	0.00	0.000	0.000	0.00000
Hillsdale	1,643,771	0.11	0.26	15.87	2.34	0.84	0.00
Lallie	8,584,349	0.34	0.60	71.57	11.07	2.67	0.02
Lallie North Unorg.	374,402	0.02	0.06	3.62	0.53	0.19	0.0011
Lohnes	1,154,100	0.07	0.18	11.14	1.64	0.59	0.00
Minco	581,801	0.04	0.09	5.62	0.83	0.30	0.00
Mission	7,616,470	0.33	0.61	64.71	9.94	2.55	0.02
Oberon	369,966	0.02	0.06	3.57	0.53	0.19	0.001
Odessa	97,340	0.01	0.02	0.94	0.14	0.05	0.000
Poplar Grove	584,602	0.04	0.09	5.64	0.83	0.30	0.0017
Rock	4,491,649	0.20	0.38	38.45	5.89	1.55	0.01
Tiffany	31,677	0.00	0.01	0.31	0.05	0.02	0.0001
Twin Tree	1,579,315	0.10	0.25	15.25	2.25	0.81	0.00
Warwick	121,707	0.01	0.02	1.18	0.17	0.06	0.000
Warwick Unorg.	5,071,819	0.21	0.37	42.53	6.56	1.62	0.01
West Bay	495,190	0.03	0.08	4.78	0.71	0.25	0.0014
Wood Lake	2,949,049	0.16	0.36	26.90	4.04	1.27	0.01
Total	**50,906,336**	**2.4**	**4.8**	**442.8**	**67.5**	**18.6**	**0.1**

Air Sciences Inc.	PROJECT TITLE: Spirit Lake	BY: G. Lewis
	PROJECT NO: 443-1	PAGE: 3 OF: 3 SHEET: tailpipe-EI
AIR EMISSION CALCULATIONS	SUBJECT: Roads - Tailpipe Emissions	DATE: February 8, 2024

Sample Calculations for Eddy Township

VMT(Dirt Road)	144,140 VMT/yr	9,415 m - dirt rd		1 mi / 1609.3 m	24,638 Vehicle mi / dirt rd mi - yr	
VMT (Gravel Road)	372,180 VMT/yr	24,310 m - gravel rd		1 mi / 1609.3 m	24,638 Vehicle mi / gravel rd mi - yr	
VMT (Paved Road)	606,756 VMT/yr	8,178 m - paved rd		1 mi / 1609.3 m	119,407 Vehicle mi / paved rd mi - yr	
VMT (Highway)	1,918,302 VMT/yr	6,213 m - highway		1 mi / 1609.3 m	496,898 Vehicle mi / highway mi - yr	
NO_x Emission (Dirt Road)	0.21 tpy	144,140 VMT - dirt rd / yr	1.292085 g - NO_x / VMT - dirt rd	1 lb / 453.6 g	1 ton / 2000 lb	
NO_x Emission (Gravel Road)	0.53 tpy	372,180 VMT - gravel rd / yr	1.292085 g - NO_x / VMT - gravel rd	1 lb / 453.6 g	1 ton / 2000 lb	
NO_x Emission (Paved Road)	0.86 tpy	606,756 VMT - paved rd / yr	1.292085 g - NO_x / VMT - paved rd	1 lb / 453.6 g	1 ton / 2000 lb	
NO_x Emission (Highway)	2.41 tpy	1,918,302 VMT - highway / yr	1.138712 g - NO_x / VMT - highway	1 lb / 453.6 g	1 ton / 2000 lb	
NO_x Emission (Total)	**4.01 tpy**					

Air Sciences Inc.	PROJECT TITLE: Spirit Lake	BY: G. Lewis
	PROJECT NO: 443-1	PAGE: 1 OF: 3 SHEET: roaddust-EI
AIR EMISSION CALCULATIONS	SUBJECT: Roads - Fugitive Dust Emissions	DATE: February 8, 2024

Emission Factors

Road Type	$PM_{2.5}$	PM_{10}	Units	Reference
Dirt	0.12	1.25	lb/VMT	*AP-42 13.2.2 Public Unpaved Roads*
Gravel	0.12	1.25	lb/VMT	*AP-42 13.2.2 Public Unpaved Roads*
Paved	0.0003	0.001	lb/VMT	*AP-42 13.2.1 Paved Roads*
Highway	0.0003	0.001	lb/VMT	*AP-42 13.2.1 Paved Roads*

Unpaved roads

Emission factor equation (annual)	$E = [k(s/12)^a (S/30)^d/(M/0.5)^c - C] [(365-P)/365]$				*AP-42, Tab. 13.2.2-2, Eqs. 1b and 2, 11/06*
s = Surface material silt content	18.4 %				*AP-42 Tab. 13.2.2-3, 11/06*
S = Mean vehicle speed	32.5 mph				*AP-42 Tab. 13.2.2-3, 11/06*
M = Surface material moisture content	6.5 %				*AP-42 Tab. 13.2.2-3, 11/06*
P = Days/year with ≥0.01 in precip.	100 day/yr				*AP-42, Fig. 13.2.2-1, 11/06*
	PM	PM_{10}	$PM_{2.5}$		
k = Size-specific empirical constant	6	1.8	0.18		*AP-42, Tab. 13.2.2-2, Eqs. 1b, 11/06*
a = Size-specific empirical constant	1	1	1		*AP-42, Tab. 13.2.2-2, Eqs. 1b, 11/06*
c = Size-specific empirical constant	0.3	0.2	0.2		*AP-42, Tab. 13.2.2-2, Eqs. 1b, 11/06*
d = Size-specific empirical constant	0.3	0.5	0.5		*AP-42, Tab. 13.2.2-2, Eqs. 1b, 11/06*
C = Emission factor for exhaust, brake, and tire	0.00047	0.00047	0.00036		*AP-42, Tab. 13.2.2-4, Eqs. 1b, 11/06*
E = Size-specific emission factor					
Annual	3.17	1.25	0.12	lb/VMT	

Paved roads

Emission factor equation (annual)	$E = k(sL)^{0.91} (W)^{1.02} [(365-P)/365]$				*AP-42, Sec. 13.2.1, Eq. 1, 1/11 and AP-42, Tab. 13.2.2-2, Eqs. 2, 11/06*
sL = Road surface silt loading:					
Paved Road	0.2 g/m2				*AP-42, Tab 13.2.1-2, 1/11 (ADT 500-5,000)*
W = Mean vehicle weight	3.6 ton				
P = Days/year with ≥0.01 in precip.	100 day/yr				*AP-42 Fig. 13.2.1-2, 1/11*
	PM	PM_{10}	$PM_{2.5}$		
k = Size-specific empirical constant	0.011	0.0022	0.00054		*AP-42, Tab. 13.2.1-1, 1/11*
E = Size-specific emission factor					
Annual	0.01	0.001	0.0003	lb/VMT	

Traffic Counts

Road Type	ADT	AYT	Reference
Dirt	67.5	24,638	*Average ADT for gravel roads in SLT from NDDOT (NDDOT, 2022)*
Gravel	67.5	24,638	*Average ADT for gravel roads in SLT from NDDOT (NDDOT, 2022)*
Paved	327	119,407	*Average ADT for paved roads in SLT from NDDOT (NDDOT, 2022)*
Highway	1361	496,898	*Average ADT for major highways in SLT from NDDOT (NDDOT, 2022)*

Activity assumptions: 365 *day/yr*

Conversions

1609.3 m/mi
2000 lb/ton

Air Sciences Inc.	PROJECT TITLE: Spirit Lake	BY: G. Lewis
	PROJECT NO: 443-1	PAGE: 2 OF: 3 SHEET: roaddust-EI
AIR EMISSION CALCULATIONS	SUBJECT: Roads - Fugitive Dust Emissions	DATE: February 8, 2024

VMT and Emission Calculations

	7		3	2	3	8		3	2	3
	Dirt					Gravel				
Township	**Road Lengths**		**Traffic**	**$PM_{2.5}$**	**PM_{10}**	**Road Lengths**		**Traffic**	**$PM_{2.5}$**	**PM_{10}**
	(m)	**(mi)**	**(VMT/yr)**	**(tpy)**	**(tpy)**	**(m)**	**(mi)**	**(VMT/yr)**	**(tpy)**	**(tpy)**
Bush	2723.1	1.7	41689.9	2.6	26.0	0	--	0	--	--
Dayton	33	0.02	507	0.03	0.32	1,385	0.86	21,210	1.32	13.23
Eddy	9,415	5.85	144,140	8.98	89.93	24,310	15.11	372,180	23.18	232.20
Fort Totten	1,808	1.12	27,684	1.72	17.27	9,854	6.12	150,857	9.39	94.12
Fort Totten Unorg.	11,393	7.08	174,416	10.86	108.82	13,523	8.40	207,027	12.89	129.16
Freeborn	17,657	10.97	270,326	16.83	168.65	33,356	20.73	510,662	31.80	318.59
Gates	1,748	1.09	26,763	1.67	16.70	1,442	0.90	22,073	1.37	13.77
Grandfield	--	--	--	--	--	--	--	--	--	--
Hillsdale	22884.0	14.2	350341.7	21.8	218.6	37,590	23.36	575,486	35.84	359.04
Lallie	26,733	16.61	409,262	25.49	255.33	44,016	27.35	673,868	41.97	420.42
Lallie North Unorg.	776.2	0.5	11883.3	0.7	7.4	1,655	1.03	25,331	1.58	15.80
Lohnes	7161.5	4.5	109638.0	6.8	68.4	24,936	15.49	381,754	23.77	238.17
Minco	10070.7	6.3	154177.2	9.6	96.2	27,932	17.36	427,624	26.63	266.79
Mission	13,457	8.36	206,025	12.83	128.54	34,083	21.18	521,793	32.49	325.54
Oberon	6846.1	4.3	104810.2	6.5	65.4	6,348	3.94	97,184	6.05	60.63
Odessa	1414.0	0.9	21647.9	1.3	13.5	4,944	3.07	75,692	4.71	47.22
Poplar Grove	--	--	--	--	--	1453.9	0.9	22258	1.4	13.9
Rock	47,020	29.22	719,857	44.83	449.11	35,876	22.29	549,236	34.20	342.66
Tiffany	766.9	0.5	11741.5	0.7	7.3	1,302	0.81	19,936	1.24	12.44
Twin Tree	16856.1	10.5	258057.1	16.1	161.0	31,310	19.46	479,338	29.85	299.05
Warwick	575.8	0.4	8815.3	0.5	5.5	4,954	3.08	75,842	4.72	47.32
Warwick Unorg.	41,505	25.79	635,419	39.57	396.43	25,709	15.97	393,583	24.51	245.55
West Bay	1308.7	0.8	20035.3	1.2	12.5	1,692	1.05	25,906	1.61	16.16
Wood Lake	28,840	17.92	441,520	27.50	275.46	47,645	29.61	729,418	45.42	455.07
Totals:	**270,993**	**168.4**	**4,148,756**	**258.4**	**2588.4**	**415,316**	**258.1**	**6,358,259**	**396.0**	**3,967**
	TRUE									

	9		3	2	3	6		3	2	3
	Paved					Highway				
Township	**Road Lengths**		**Traffic**	**$PM_{2.5}$**	**PM_{10}**	**Road Lengths**		**Traffic**	**$PM_{2.5}$**	**PM_{10}**
	(m)	**(mi)**	**(VMT/yr)**	**(tpy)**	**(tpy)**	**(m)**	**(mi)**	**(VMT/yr)**	**(tpy)**	**(tpy)**
Bush	4330	2.7	321248	0.1	0.2	--	--	0.00	--	--
Dayton	360.10	0.22	26,718.92	0.00	0.02	155	0.10	47,883.49	0.008	0.03
Eddy	8,177.51	5.08	606,756.20	0.10	0.42	6213	3.86	#######	0.323	1.316
Fort Totten	15,221.38	9.46	1,129,399.03	0.19	0.77	3280	2.04	#######	0.17	0.69
Fort Totten Unorg.	21,531.81	13.38	1,597,621.27	0.27	1.10	6696	4.16	#######	0.35	1.42
Freeborn	0.00	--	0.00	--	--	13570	8.43	#######	0.706	2.87
Gates	0.00	--	0.00	--	--	879	0.55	271,393.29	0.046	0.186
Grandfield	--	--	--	--	--	--	--	0.00	--	--
Hillsdale	9,676.02	6.01	717,943.22	0.12	0.49	--	--	0.00	--	--
Lallie	8,539.30	5.31	633,600.73	0.11	0.43	22242	13.82	#######	1.16	4.71
Lallie North Unorg.	4,544.41	2.82	337,187.13	0.06	0.23	--	--	0.00	--	--
Lohnes	8,931.59	5.55	662,707.94	0.11	0.45	--	--	0.00	--	--
Minco	0.00	--	0.00	--	--	--	--	0.00	--	--
Mission	20,610.35	12.81	1,529,250.54	0.26	1.05	17357	10.79	#######	0.90	3.68
Oberon	2,263.82	1.41	167,971.64	0.03	0.12	--	--	0.00	--	--
Odessa	0.00	--	0.00	--	--	--	--	0.00	--	--
Poplar Grove	7,578.94	4.71	562,343.76	0.09	0.39	--	--	0.00	--	--
Rock	3,207.45	1.99	237,986.75	0.04	0.16	9666	6.01	#######	0.503	2.05
Tiffany	0.00	--	0.00	--	--	--	--	0.00	--	--
Twin Tree	11,346.91	7.05	841,919.93	0.14	0.58	--	--	0.00	--	--
Warwick	499.33	0.31	37,049.46	0.01	0.03	--	--	0.00	--	--
Warwick Unorg.	1,806.03	1.12	134,003.86	0.02	0.09	12659	7.87	#######	0.658	2.68
West Bay	6,054.71	3.76	449,248.58	0.08	0.31	--	--	0.00	--	--
Wood Lake	11,059.01	6.87	820,558.27	0.14	0.56	3101	1.93	957,553.07	0.16	0.66
Totals:	**145,738**	**90.6**	**10,813,515**	**1.8**	**7.4**	**95,819**	**59.5**	**#######**	**5.0**	**20.3**

Air Sciences Inc.	PROJECT TITLE: Spirit Lake	BY: G. Lewis
	PROJECT NO: 443-1	PAGE: 3 OF: 3 SHEET: roaddust-EI
AIR EMISSION CALCULATIONS	SUBJECT: Roads - Fugitive Dust Emissions	DATE: February 8, 2024

Total Township Emission Calculations

	$PM_{2.5}$ (tpy)	PM_{10} (tpy)
Bush	2.65	26.23
Dayton	1.37	13.60
Eddy	32.58	323.86
Fort Totten	11.48	112.86
Fort Totten Unorg.	24.37	240.49
Freeborn	49.34	490.12
Gates	3.09	30.65
Grandfield	0.00	0.00
Hillsdale	57.78	578.10
Lallie	68.72	680.90
Lallie North Unorg	2.37	23.45
Lohnes	30.71	307.03
Minco	36.23	362.98
Mission	46.49	458.80
Oberon	12.61	126.14
Odessa	6.06	60.73
Poplar Grove	1.48	14.27
Rock	79.58	793.98
Tiffany	1.97	19.76
Twin Tree	46.06	460.63
Warwick	5.28	52.84
Warwick Unorg.	64.76	644.75
West Bay	2.94	28.97
Wood Lake	73.22	731.75
Total	**661.1**	**6,583**

Sample Calculations for Eddy Township

VMT calculations shown on page 4, sheet 2

PM_{10} Emission (Dirt Road)	89.93 tpy	144,140 VMT - di / yr	1.25 lb - PM_{10} / VMT - di	1 ton / 2000 lb
PM_{10} Emission (Gravel Road)	232.20 tpy	372,180 VMT - gr / yr	1.25 lb - PM_{10} / VMT - gr	1 ton / 2000 lb
PM_{10} Emission (Paved Road)	0.42 tpy	606,756 VMT - pa / yr	0.001 lb - PM_{10} / VMT - pa	1 ton / 2000 lb
PM_{10} Emission (Highway)	1.32 tpy	1,918,302 VMT - hi / yr	0.001 lb - PM_{10} / VMT - hi	1 ton / 2000 lb

PM_{10} Emission (Total) **323.86 tpy**