August 5, 2022

2018 Greenhouse Gas Inventory Memo

Oakland County

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Greenhouse Gas Inventory

The County conducted a greenhouse gas (GHG) inventory to understand the sources of County operational GHG emissions and to identify priority actions that can advance its net zero carbon goal. The GHG inventory results presented in this memo highlight the sectors in which the County will need to focus GHG reduction efforts to achieve the net zero target. The inventory accounts for emissions across all sites, facilities, and operations to represent the full spectrum of County operational emissions.

This government operations GHG inventory follows the guidance outlined in the Local Government Operations Protocol (LGOP), developed by ICLEI – Local Governments for Sustainability, the California Air Resources Board, and the California Climate Action Registry. As an ICLEI member, the County selected ICLEI's ClearPath tool as the primary GHG inventory tracking tool. ClearPath is an online application for the calculation, tracking, and management of GHG emissions inventories at the government operations and community scales. ClearPath allows users to create government operations inventories that are in line with the LGOP. The tool accounts for the GHGs recognized under the Kyoto Protocol, including carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). These GHGs have varying levels of climate impact and are represented as carbon dioxide equivalents (CO_2e) in the GHG inventory to allow for comparison. Each GHG has a global warming potential (GWP) that represents its heat-trapping ability relative to that of CO_2. Quantities of different GHGs are converted to CO_2e using their 100-year GWP values from the Intergovernmental Panel on Climate Change's (IPCC) Fifth Assessment Report.[1]

Table 1 – IPCC Fifth Assessment Report GWP Values

GHG*	GWP
CO_2	1
CH_4	28
N2O	265

** Due Oakland County's inventory boundary and reporting protocol requirements, only CO_2, CH_4, and N_2O emissions were relevant to the County's operations and are included in this table.*

The LGOP recommends GHG inventories be developed based on calendar year data. The County's base year inventory represents calendar year 2018 as it is the most recent year that reflects normal, pre-COVID-19 operating conditions. The inventory is organized into five sectors: Buildings and Facilities, Vehicle Fleet, Solid Waste Facilities, Wastewater Facilities, and Fugitive Emissions. Generally, the inventory includes emissions from sources over which the County has operational control, except for solid waste disposal. The County has operational control in instances where there is full authority to introduce and implement operating policies at the operation. If services are contracted to other organizations who maintain operational control, any emissions resulting from the service are considered "outside" of the County's control and can be optionally reported. Even though solid waste disposal operations would be considered an optional emissions source, these emissions have been included in the 2018 inventory to better represent total GHG emissions due to County operations.

GHG Inventory Summary

In calendar year 2018, government operations generated 56,411 metric tonnes (MT) CO_2e. Approximately 75% of these emissions are from building and facility electricity and natural gas use. The remaining emissions are primarily from on-road fleet vehicles followed by wastewater treatment processes, solid waste disposal, and off-road vehicles and equipment. The following sections detail municipal emissions in each of the five sectors (see Figure 1 and Table 2).

[1] https://www.ipcc.ch/assessment-report/ar5/

Figure 1 – 2018 GHG Inventory

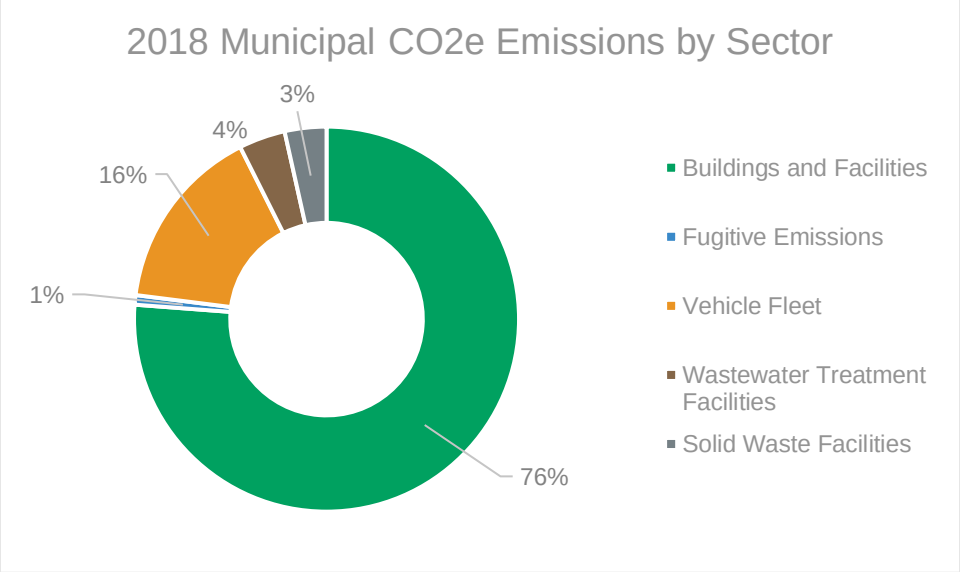


Table 2 – 2018 Municipal Activity Data and Emissions

ClearPath Category	CY2018	Activity Data	Unit	ClearPath Emissions (MTCO2e)	% Total
Buildings and Facilities	Natural Gas	2,460,769	therms	13,088	23%
	Generator Fuel Oil	1,587	gallons	16	<1%
	Electricity	49,829,981	kWh	29,857	53%
Vehicle Fleet	On-road Vehicles - Diesel	39,163	gallons	400	<1%
	On-road Vehicles - Gasoline	891,677	gallons	7,864	14%
	Off-road Vehicles - Diesel	31,144	gallons	321	<1%
	Off-road Vehicles - Biodiesel	451	gallons	4	<1%
	Off-road Vehicles - Gasoline	28,292	gallons	250	<1%
Solid Waste Facilities	Campus Solid Waste	5,014	short tons	1,627	3%
	Park Waste - Landfill	1,129	short tons	366	<1%
	Park Waste - Compost	49	short tons	3	<1%
	Conventional WWTP Process Emissions	221,112	people	513	<1%

Wastewater Treatment Facilities	Conventional Aerobic WWTP Effluent Discharge	96,112	people	589	1%
	Conventional Anaerobic WWTP Effluent Discharge	125,000	people	910	2%
	Conventional Anaerobic WWTP Digester Gas Combustion	125,000	people	8	<1%
	Septic Systems	1,379	people	168	<1%
Process and Fugitive Emissions	Fugitive Emissions from Natural Gas Distribution	2,460,769	therms	427	<1%
TOTAL				56,411	MTCO2e

Buildings and Facilities

Buildings and facilities generate GHG emissions from on-site energy use. Electricity consumption is the single largest contributor to County GHG emissions, generating roughly 53% of total local government operations emissions. The County uses a third-party choice purchaser, Executive Energy, to purchase electricity, but does not currently participate in any green power purchasing, which could serve to reduce the County's electricity emissions in the future. Natural gas consumption generates approximately 23% of total GHG emissions, while fuel oil used in generators contributes less than one percent.

The Central Steam Plant uses natural gas to generate steam. The steam is distributed to the main campus buildings to provide space heating/cooling and water heating. Though the Central Steam Plant occasionally uses fuel oil, none was consumed in calendar year 2018. Additionally, three campus buildings do not use central steam and are served directly by utility-provided natural gas. The County also operates three airports and multiple wastewater treatment facilities, septic systems, and retention treatment basins that use natural gas and electricity. Streetlight electricity consumption was excluded from this inventory as direct electricity consumption data was not available and GHG emissions are likely negligible based on the small number of streetlights within County control.

The County operates 35 emergency generators that use #2 dyed ultra-low sulfur diesel. The County's wastewater treatment facilities also use separate generators, but the fuel consumption information for these systems is not currently tracked and has not been included in the 2018 inventory.

Fugitive Emissions

Fugitive emissions include the intentional or unintentional releases of GHGs commonly arising from the production, processing, transmission, storage, and use of fuels and other substances. This includes refrigerant leakage from air conditioners or natural gas leakage from distribution pipelines.

Municipal operations fugitive emissions include those from natural gas distribution and represent less than 1% of the County's total GHG emissions. Calculating refrigerant leakage emissions depends on knowing the timing and quantity of refrigerant recharge. The County hires contractors to re-charge refrigerants in chiller systems but the amount of added refrigerant is not tracked. The County is currently working to create a refrigerant tracking system for large chillers, which could help inform future GHG inventories.

Vehicle Fleet

The County's vehicle fleet includes on-road and off-road vehicles and equipment. The on-road vehicle fleet generates nearly 15% of total GHG emissions while off-road vehicles and equipment contribute approximately 1%.

On-road and off-road vehicles and equipment both use gasoline and diesel fuels while some off-road equipment also uses biodiesel. While on-road vehicle fleet fuel use could not be disaggregated by County department, off-road emissions included in the inventory were from Parks and Recreation and Airport Administration equipment, such as lawnmowers all-terrain vehicles, snowblowers, plows, runway brooms, fire trucks, and tractors. The Water Resources Commissioner's (WRC) Office also uses gasoline, diesel, and liquified petroleum gas (LPG) powered off-road vehicles and equipment, such as forklifts, pumps, rough terrain vehicles (RTV), telehandlers, snow blowers, and pressure washers. However, WRC does not specifically track off-road fuel consumption, so emissions from their off-road vehicles and equipment were excluded from the 2018 inventory.

The Sheriff's Office helicopters are the only source of aviation fuel consumption in County municipal operations. During inventory development, County staff considered this fuel use to be negligible and this activity was excluded from the inventory.

Wastewater Treatment Facilities

Wastewater generates GHG emissions during its treatment and discharge. The County operates multiple wastewater treatment facilities, septic systems, and retention treatment basins. These systems serve residents, businesses, parks, and golf courses. Wastewater treatment and discharge from these systems generates nearly 4% of total County emissions.

This category represents process emissions that occur from wastewater treatment and discharge. Any electricity and natural gas use from County-operated wastewater facilities is reflected in the Buildings and Facilities sector. Wastewater produced by municipal operations, such as in bathrooms, is primarily sent to wastewater facilities outside of the County's operational control (e.g., Clinton River Water Resource Recovery Facility). Therefore, these emissions are considered optional sources for reporting purposes and are not included in the 2018 inventory.

Solid Waste Facilities

Solid waste disposal generates GHG emissions based on its treatment process, such as through the decomposition of organic matter. This typically occurs in landfills where fugitive methane emissions are released. Composting organic waste can drastically reduce these emissions, while recycling waste typically produces no GHG emissions that are reflected in the GHG inventory. Using estimated waste quantities, landfilled waste from the campus and parks generates almost 4% of total government operations emissions. Composting green waste from County Parks generates less than 1%. Around 13% of total waste is estimated to be diverted to recycling or compost.

The County does not own or operate any landfills and therefore does not report any direct landfill fugitive GHG emissions. The County does generate solid waste though and contracts waste disposal services. Even though contracted solid waste disposal operations are considered optional emissions sources, they are included in the 2018 inventory to better represent total GHG emissions from municipal operations.

Empirical data on solid waste disposal in 2018 was not available. However, a campus operations diversion rate analysis was conducted as part of the sustainability planning process with 2020 data that showed estimated campus and park waste quantities and destinations. These estimates were developed based on information gathered from department interviews, dumpster sizes, and pick-up schedules. The 2020 estimated waste quantities were used as a proxy for calendar year 2018. Notably, these waste

values reflect pandemic-related operational impacts while the rest of the 2018 GHG inventory data does not. Additionally, the specific receiving landfills and composting sites for the campus and park waste are unknown, so default assumptions were made to support the GHG emissions calculations.

To improve future solid waste tracking and emissions reporting, the County should require waste quantity and disposal destination reporting from its waste contractors (see the strategy *H5: Review and Renegotiate Waste Hauling Contracts* in the Sustainability Plan for more detail).

Target Setting Considerations

The County set a target to achieve net zero emissions for County government operations by 2050 with an interim target of 50% emissions reduction by 2035. During the Sustainability Plan development process, the County selected 2018 as the inventory baseline year. As there are different pathways for meeting a net zero target, the definition of net zero in the context of Oakland County's operations and Sustainability Plan is as follows:

Net Zero: The net GHG emissions associated with County government operations are zero. This is achieved through ambitious local climate action that reduces GHG emissions to the extent feasible combined with implementation of local and regional carbon dioxide removal (CDR) opportunities to remove any remaining emissions estimated to occur in the target years. CDR opportunities can include natural strategies, such as forest restoration and agricultural soil management, or high-tech strategies, such as direct air capture.

In order to reach net zero, sector-specific strategies and targets can be identified to ensure sector reductions are progressing in line with the net zero goal. However, there may be technological or political barriers to meeting these sector targets or reducing remaining emissions. The following sections discuss draft sector-specific targets, potential barriers to achieving emissions reductions, and sources of remaining or residual emissions.

Sector Targets

The following section describes draft sector-level GHG reduction targets.

Transportation

Draft Targets:

1. Transition to 100% ZEV purchases as soon as possible for passenger/light-duty vehicles and no later than 2035 for all other vehicle types
2. 100% ZEV fleet by 2050

Fleet emissions can be reduced by converting fleet vehicles to zero-emission vehicles (ZEVs). ZEVs include battery electric or fuel cell electric vehicles. If the County aspires to transition 100% of the fleet to ZEVs by 2050, fleet vehicles should begin to be replaced with ZEVs at the end of the vehicle's lifetime starting no later 2030 (this year can vary depending on vehicle lifetime).

Maximizing GHG emission reductions in this sector is likely also dependent on decarbonizing the electric grid. To fully reduce transportation emissions, the fleet should be 100% ZEV and the grid should be powered by 100% zero-carbon energy.

Building and Facility Electrification

Draft Targets:

1. Begin transition to 100% all-electric (or other decarbonized option) replacements for fossil fuel equipment no later than 2035
2. Fully decommission Central Heating Plant by 2050
3. 100% building and facility electrification by 2050

Building and facility emissions can be reduced through electrification which is transitioning from fossil fuel equipment to electric options. If the County is to transition 100% of buildings and facilities to all-electric by

2050, fossil fuel equipment should begin to be replaced with only electric options at the end of the equipment's lifetime starting around 2035 (this year can vary depending on the equipment lifetime).

Maximizing GHG emission reductions in this sector is also dependent on decarbonizing the electric grid. To fully reduce emissions in this sector, electrified buildings and facilities should be powered by a 100% zero-carbon electric grid.

Electricity

Draft Targets:

1. Purchase 100% carbon-free electricity through County utility provider by 2035
2. Develop on-site solar resources to generate 25% of electricity demand by 2035

GHG emissions reductions in the building and transportation sectors rely on obtaining electricity from a 100% zero-carbon grid. This can be achieved through a combination of on-site or off-site renewable energy installations, green power purchasing agreements, and lobbying for aggressive grid decarbonization targets at the state level.

Remaining Emissions and Reduction Barriers

Achieving the net zero target means directly reducing GHG emissions to the maximum feasible extent by focusing on the largest emissions sources through policies, incentives, and partnerships. However, there are current technological, regulatory, and financial barriers that will inhibit the County from directly reducing all emissions to zero by 2050. These barriers, as well as potential solutions the County can pursue, are presented in Table 3.

Table 3 – 2050 GHG Reduction Barrier Analysis

Barrier	Barrier Description	Potential Solutions
Grid decarbonization	Michigan's Renewable Energy Standard required Michigan electric providers to achieve a retail supply portfolio of 15% renewable energy in 2021. Additionally, it established a 2025 goal of meeting not less than 35% of the state's electric needs through a combination of energy waste reduction and renewable energy by 2025.[2] DTE Energy, which is the County's electric utility distributor, has set a target of 25% renewable electricity generation by 2030.[3] DTE has also set a net zero goal by 2050, but they have not set a formal renewable energy target by 2030. The Biden administration set a target of 100% carbon-free electricity by 2035, but this goal could face substantial political roadblocks and is not guaranteed to occur.	The County will need to increase its renewable energy procurement through a combination of on-site or off-site renewable energy installations, green power purchasing agreements, and lobbying for aggressive grid decarbonization targets at the state level.
Building natural gas use	Unlike other emissions sources, there are currently no industry commitments to decarbonize natural gas use in existing	Continue to evaluate the County's utility provider options considering a range of factors, including their

[2] https://www.michigan.gov/-/media/Project/Websites/mpsc/regulatory/reports/pa295-ren/2020_Renewable_Energy_Standard_Report_with_Appendices.pdf?rev=abf6a8f90b934d178f6e08e73bf970ca
[3] https://www.detroitnews.com/story/news/michigan/2018/05/18/michigan-dte-consumers-renewable-goal/35058065/

	buildings from space and water heating or cooking. Technology already exists to decarbonize many natural gas applications that are used in County buildings, so the barrier to target achievement is potential pushback from the County facility management team who might be unfamiliar with electric equipment options, for example. There could also be cost barriers associated with electrifying buildings if panel upgrades or other upfront expenses are required.	commitment to supporting decarbonization in the building sector with financial incentives. Establish a long-term plan for County building decarbonization that includes a phasing schedule that can inform the capital budgeting process to ensure sufficient funds are allocated to complete the work.
Zero emission vehicle (ZEV) and zero-emission off-road equipment purchasing	ZEV options may not be available for all vehicle and equipment types.	Conduct a fleet transition study to understand the timing and technologies available to achieve a 100% ZEV fleet and 100% zero-emissions off-road equipment target, including phasing schedules to inform capital budget planning.
Wastewater treatment	Wastewater treatment processes generate 4% of total emissions in 2018. Further, fully reducing all process-related GHG emissions from wastewater treatment is technologically challenging and potentially cost prohibitive.	Continue to research high-efficiency wastewater treatment processes and utilize state-wide or federal programs aimed at helping local wastewater treatment facilities in their decarbonization efforts. Plan for a 2050 scenario in which wastewater treatment emissions remain and must be compensated with CDR opportunities.
Solid Waste	Actual solid waste disposal and diversion data is not available. Estimated campus and park waste data shows that 13% of total waste is diverted to recycling or compost. In order to reduce waste emissions, all organic solid waste types must be diverted to recycling or to be composted. This primarily includes paper/cardboard, food, green/yard waste, and lumber scraps.	More accurate waste data is needed to better establish reduction targets. However, 100% diversion of all recyclable and compostable content could act as an aspirational target (the actual diversion % will be lower than 100% as not all materials can be diverted). Plan for a 2050 scenario in which some amount of solid waste emissions remain and must be compensated with CDR opportunities.

Areas of Inventory Improvement

If desired, the County can improve or expand on its optional GHG emissions reporting in future inventories, which could include the following:

1. Improving solid waste emissions calculations
    - Collect accurate solid waste data on quantity of waste landfilled, recycled, and composted

2. Calculating emissions from wastewater produced by County operations
    - Collect information on the treatment facilities and staff population served by each facility
3. Calculate emissions from employee commute and business travel
    - Collect information on miles travels, gallons of fuel consumed, and vehicle types

Note that each of these options is likely to represent a very minor additional contribution of GHG emissions to the County's inventory, and the data collection efforts necessary to achieve accurate results may not justify the extra effort. Additionally, other minor emissions sources that were excluded from the 2018 GHG inventory could be calculated and included in future inventories, if desired. These sources include:

1. Street light electricity consumption
2. Refrigerant leakage
3. WRC off-road equipment fuel consumption
4. Sherriff helicopter fuel consumption

Methodology and Calculator Guidance: How to Use ClearPath in Future GHG Inventories

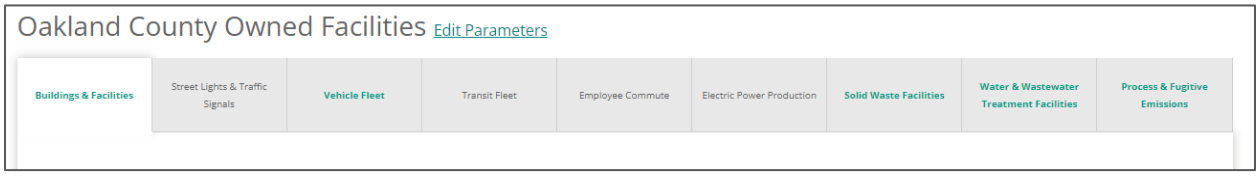
This methodology and guidance section documents use of the ClearPath GHG inventory calculator in developing the County's 2018 inventory. The information provided below, combined with the County's GHG inventory activity data files, should provide sufficient guidance for a future user to develop a subsequent GHG inventory that is consistent with the approach taken in the 2018 version.

ClearPath

The ClearPath GHG calculators applicable to Oakland County GHG emissions are located under the following ClearPath tabs (see green text-labeled tabs in Figure 1):

1. Buildings & Facilities
2. Vehicle Fleet
3. Solid Waste Facilities
4. Water & Wastewater Treatment Facilities
5. Process & Fugitive Emissions

Figure 2 – ClearPath Tabs Used in Oakland County Inventory



In these calculators, any "optional" inputs do not need to be completed. If the calculator used includes the question: "Is the facility owned/operated by your local government?", the answer should be marked as "Yes" for all calculators except for solid waste (landfill and compost).

Buildings & Facilities Calculations

Table 4 identifies the ClearPath calculators used on the Buildings & Facilities tab, including the activity data analyzed, the calculator name, the inputs needed, and the source of inputs collected for the 2018 GHG inventory. Details on calculating each activity type are provided in subsequent sections.

Table 4 – ClearPath Calculator Summary and Data Sources – Buildings & Facilities

Activity	ClearPath Calculator Name	ClearPath Inputs	Source of Inputs
Electricity	"Emissions from Grid Electricity"	• Electricity Use (kWh)	• **Municipal Buildings**: Joseph Murphy <murphyj@oakgov.com> • **Wastewater Treatment Facilities**: Gary Nigro <nigrog@oakgov.com> • **Airport**: Michelle Stover <stoverm@oakgov.com> • **Parks and Recreation:** Mike Donnellon <donnellonm@oakgov.com>
Natural Gas	"Emissions from Stationary Fuel Combustion"	• Fuel Type (Natural Gas) • Fuel Use (therms)	• **Central Heating Plant and Separate Municipal Accounts:** Joseph Murphy <murphyj@oakgov.com> • **Wastewater Treatment Facilities**: Gary Nigro <nigrog@oakgov.com> • **Airports**: Michelle Stover <stoverm@oakgov.com>
Generator Fuel Oil	"Emissions from Stationary Fuel Combustion"	• Fuel Type (Fuel Oil) • Fuel Use (gallons)	• Mike Chiasson <chiassonm@oakgov.com>

Electricity

Data Sources

Electricity data was provided separately for four different sources:

1. Municipal buildings
2. Wastewater treatment plants
3. Airports
4. Parks and Recreation operations

Total electricity consumption data for municipal buildings, wastewater treatment plants, and airports was provided as a separate kWh value for each source. Parks and Recreation electricity usage was represented by account and not summed. However, because kWh consumption was represented multiple times per account (see Figure 3), it was necessary to select one kWh reading per account in order to sum total Parks and Recreation kWh consumption rather than summing the entire "Usage" column.

Figure 3 – Sample of Oakland County Parks and Recreation Department Electricity Data File

Direct Energy Business — it Electricity : County of Oakland, for Oakland County Parks and Recreation - 1/1/2018 - 12/31/2018

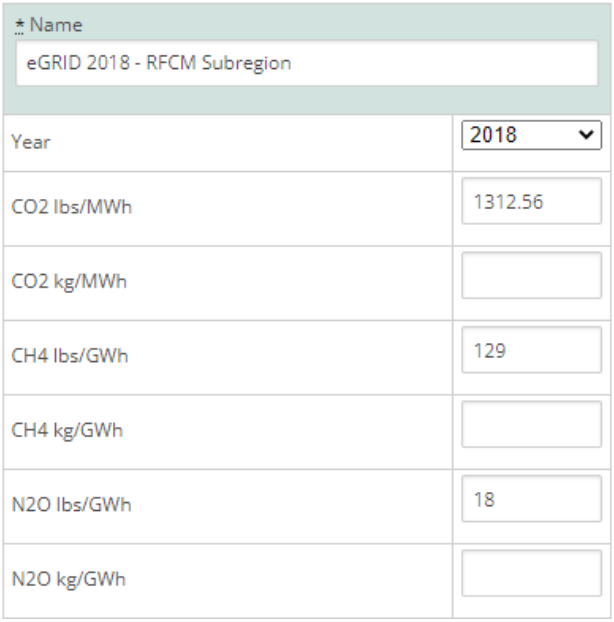
Invoice Date	Invoice #	Customer Name	Billing Ac	Utility Accoun	Service Location			Meter Read Sta	Meter Read End	Description	Billing Unit	Usage	Units	Amount
12/18/2018	183520036887451	Oakland County Parks and Recreation	1072270							Payment	$ '0.000'	0.00		$ (772.32)
12/18/2018	183520036887451	Oakland County Parks and Recreation	1072270	91000005187(	12451 ANDERSONVILLE	SPRINGFIELD	MI 48350	11/13/2018	12/13/2018	Fixed Price	$ 0.064	9600.00	kWh	$ 614.30
12/18/2018	183520036887451	Oakland County Parks and Recreation	1072270	91000005187(	12451 ANDERSONVILLE	SPRINGFIELD	MI 48350	11/13/2018	12/13/2018	MISO SECA Charge	$ '0.000'	9600.00	kWh	$ -
12/18/2018	183520036887451	Oakland County Parks and Recreation	1072270	91000005187(	12451 ANDERSONVILLE	SPRINGFIELD	MI 48350			State/Provincial Tax	0%	0.00		$ -
12/18/2018	183520036887451	Oakland County Parks and Recreation	1072270	91000005187(	12451 ANDERSONVILLE	SPRINGFIELD	MI 48350	11/13/2018	12/13/2018	Transmission Adjustment	$ 0.000	9600.00	kWh	$ 3.55
12/18/2018	183520036887450	Oakland County Parks and Recreation	1072269	91000005186(	12400 ANDERSONVILLE	SPRINGFIELD	MI 48350	11/13/2018	12/13/2018	Transmission Adjustment	$ 0.000	3600.00	kWh	$ 1.33
12/18/2018	183520036887450	Oakland County Parks and Recreation	1072269	91000005186(	12400 ANDERSONVILLE	SPRINGFIELD	MI 48350	11/13/2018	12/13/2018	MISO SECA Charge	$ '0.000'	3600.00	kWh	$ -
12/18/2018	183520036887450	Oakland County Parks and Recreation	1072269	91000005186(	12400 ANDERSONVILLE	SPRINGFIELD	MI 48350			Payment	$ '0.000'	0.00		$ (391.31)
12/18/2018	183520036887450	Oakland County Parks and Recreation	1072269	91000005186(	12400 ANDERSONVILLE	SPRINGFIELD	MI 48350	11/13/2018	12/13/2018	Fixed Price	$ 0.064	3600.00	kWh	$ 230.36
12/18/2018	183520036887450	Oakland County Parks and Recreation	1072269	91000005186(	12400 ANDERSONVILLE	SPRINGFIELD	MI 48350			State/Provincial Tax	0%	0.00		$ -
12/10/2018	183440036787410	Oakland County Parks and Recreation	1072279	91001278147(	2800 WATKINS LAKE	WATERFORD	MI 48328	11/2/2018	12/2/2018	Fixed Price	$ 0.064	7520.00	kWh	$ 481.20
12/10/2018	183440036787410	Oakland County Parks and Recreation	1072279	91001278147(	2800 WATKINS LAKE	WATERFORD	MI 48328			Payment	$ '0.000'	0.00		$ (514.88)
12/10/2018	183440036787410	Oakland County Parks and Recreation	1072279	91001278147(	2800 WATKINS LAKE	WATERFORD	MI 48328			State/Provincial Tax	0%	0.00		$ -
12/10/2018	183440036787410	Oakland County Parks and Recreation	1072279	91001278147(	2800 WATKINS LAKE	WATERFORD	MI 48328	11/2/2018	12/2/2018	MISO SECA Charge	$ '0.000'	7520.00	kWh	$ -
12/10/2018	183440036787410	Oakland County Parks and Recreation	1072279	91001278147(	2800 WATKINS LAKE	WATERFORD	MI 48328	11/2/2018	12/2/2018	Transmission Adjustment	$ 0.000	7520.00	kWh	$ 2.78
12/10/2018	183440036787409	Oakland County Parks and Recreation	1072272							Payment	$ '0.000'	0.00		$ (409.33)
12/10/2018	183440036787409	Oakland County Parks and Recreation	1072272	91004088301(	2804 WATKINS LAKE RD	WATERFORD	MI 48328	11/3/2018	12/4/2018	Transmission Adjustment	$ 0.000	7240.00	kWh	$ 2.68
12/10/2018	183440036787409	Oakland County Parks and Recreation	1072272	91004088301(	2804 WATKINS LAKE RD	WATERFORD	MI 48328	11/3/2018	12/4/2018	Fixed Price	$ 0.064	7240.00	kWh	$ 463.29
12/10/2018	183440036787409	Oakland County Parks and Recreation	1072272	91004088301(	2804 WATKINS LAKE RD	WATERFORD	MI 48328			State/Provincial Tax	0%	0.00		$ -
12/10/2018	183440036787409	Oakland County Parks and Recreation	1072272	91004088301(	2804 WATKINS LAKE RD	WATERFORD	MI 48328	11/3/2018	12/4/2018	MISO SECA Charge	$ '0.000'	7240.00	kWh	$ -
12/10/2018	183440036787408	Oakland County Parks and Recreation	1072268							Payment	$ '0.000'	0.00		$ (1,266.60)
12/10/2018	183440036787408	Oakland County Parks and Recreation	1072268	91000005165(	1480 W ROMEO RD	ADDISON	MI 48367	11/2/2018	12/3/2018	Fixed Price	$ 0.064	26400.00	kWh	$ 1,689.34

Street lighting electricity consumption is also billed and accounted for separately, but the actual kWh consumption is not available. Because of this lack of data, and the assumption that street light emissions are most likely legible (initial estimates from available data show they represent <0.001% of total electricity emissions), street light operation has been excluded from the 2018 inventory. For purposes of the 2018 GHG inventory, all kWh usage labeled as 'Fixed Price' in the "Description" column were summed to derive the total kWh activity data.

Emissions Factor

In ClearPath, the electricity emissions factor for the region can be entered under "Factor Sets" → "Grid Electricity." Because generation-specific emissions factors could not be obtained from the County's third-party choice purchaser Executive Energy, the 2018 EPA eGRID emissions factor for the RFCM Subregion was used (see Figure 4).[4]

Figure 4 – 2018 Electricity Emissions Factor



[4] https://www.epa.gov/egrid/download-data

Market- vs Location-based

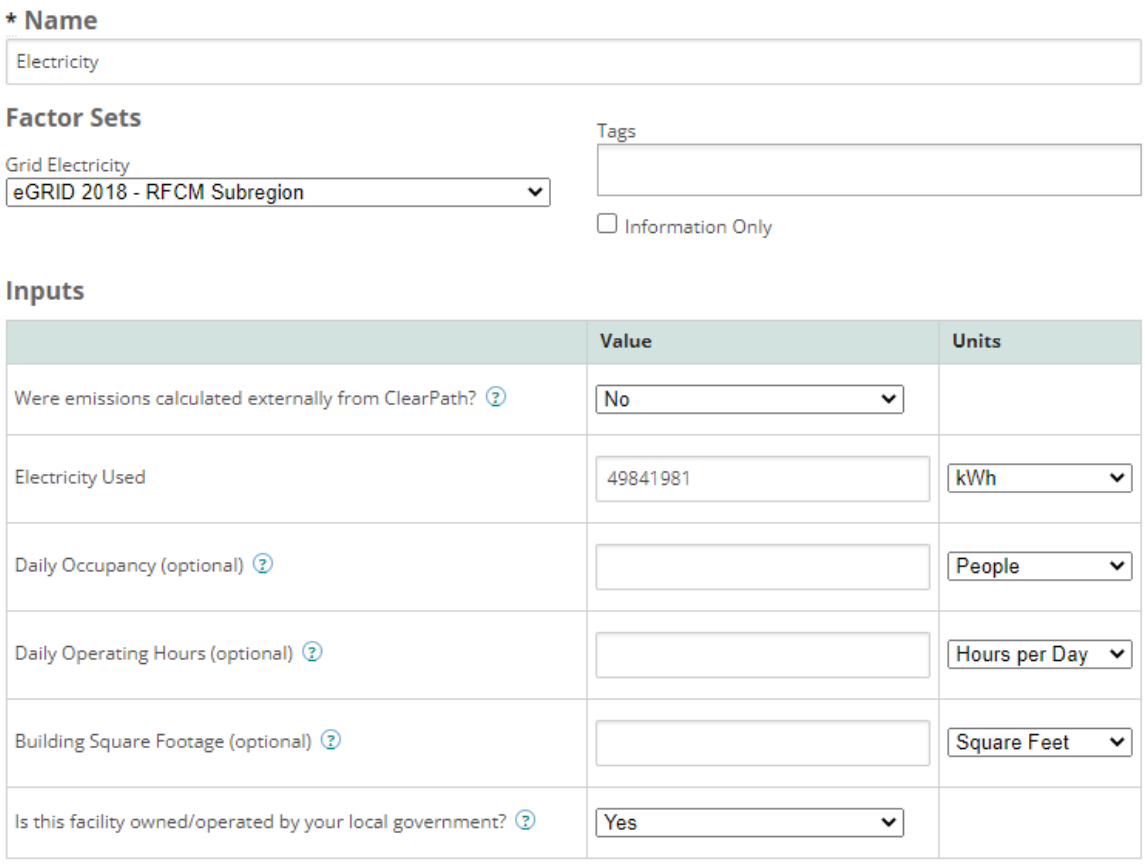
Agencies can assess emissions from electricity consumption using two methods: a location-based method or a market-based method. A location-based method is based on an average emission factor for the region's electrical grid, and location-based emissions factors are generally obtained from EPA eGRID. The market-based method allocates emissions from energy generators to consumers based on "contractual instruments" such as utility-specific emission factors, energy attribute certificates, or other contracts.

ClearPath recommends using an electricity emissions factor specific to the utility (market-based). If that's not available, ClearPath recommends using the regional factor from EPA eGRID (location-based). Because generation-specific emissions factors could not be obtained from the County's third-party choice purchaser Executive Energy, the location-based method was used instead. However, if generation- or utility-specific emissions factors are available in the future, these factors should be used to calculate market-based electricity emissions in ClearPath. Using this method will better reflect the emissions impact of the County's future green power purchasing. Both methods should be tracked annually, if possible.

ClearPath Calculator

Total kWh consumption from all facilities should be summed and entered in the ClearPath calculator "Emissions from Grid Electricity." Under Factors Sets input, the correct grid electricity emissions factor should be selected for that year (see Figure 5).

Figure 5 – ClearPath Electricity Calculator Data Inputs Screen



Natural Gas

Data Sources

Natural gas data was provided separately for four different sources:

1. Central Heating Plant
2. Three accounts that use utility natural gas from Consumer Energy
3. Airports
4. Wastewater treatment facilities

Total natural gas consumption data for municipal buildings, wastewater treatment plants, and airports was provided as a separate therm value for each source. Natural gas data for the three separate utility accounts was provided as scanned bills (see Figure 6). These bills were transcribed to sum the total therms consumed.

Figure 6 – Sample Natural Gas Data Bill

030
1200 N TELEGRAPH
PONTIAC, MI 48341

METER # 56021797
ACCT# 1000 4080 1795

FY2018 DATES	READINGS FROM	TO	MCF USED	CUMULATIVE CONSUMPTION	CONSUMERS CHARGES	CONSTELL CHARGES	MONTHLY TOTAL	YEAR-TO-DATE TOTAL
09/29-10/31	7551	17021	956.7	956.7	$1,001.10	$2,783.15	$3,784.25	$3,784.25
11/01-11/29	17021	27918	1100.9	2057.6	1,143.99	3,928.66	$5,072.65	8,856.90
11/30-12/28	27918	41560	1378.2	3435.9	1,487.31	5,253.54	$6,740.85	15,597.75
12/29-01/31	41560	58320	1693.2	5129.1	2,000.95	9,546.07	$11,547.02	27,144.77
02/01-02/28	58320	70545	1235.1	6364.2	1,489.66	4,241.90	$5,731.56	32,876.33
03/01-03/28	70545	82314	1189.0	7553.2	1,438.21	4,457.22	$5,895.43	38,771.76
03/29-04/30	82314	95145	1296.3	8849.4	1,557.97	6,076.25	$7,634.22	46,405.98
05/01-05/31	95145	4397	934.7	9784.1	1,154.40	3,978.76	$5,133.16	51,539.14
06/01-06/29	4397	12598	828.5	10612.7	989.85	3,675.63	$4,665.48	56,204.62
06/30-07/30	12598	20194	767.4	11380.1	924.62	2,431.22	$3,355.84	59,560.46
07/31-08/31adj	20194	28053	794.0	12174.1	953.01	3,760.82	$4,713.83	64,274.29
09/01-09/27	28053	34635	664.9	12839.0	807.38	1,702.96	$2,510.34	66,784.63
					14,948.45	51,836.18	$66,784.63	

It should be noted that while the County Central Heating Plant did not use any oil in 2018, if oil is consumed during future inventory years, oil consumption should be reported under a new calculator titled “Emissions from Stationary Fuel Combustion”.

Emissions Factor

ClearPath uses a default emissions factor for natural gas that cannot be edited.

ClearPath Calculator

Total therm consumption should be summed and entered in the ClearPath calculator “Emissions from Stationary Fuel Combustion” (see Figure 7).

Figure 7 – ClearPath Natural Gas Calculator Data Inputs Screen

*** Name**

Natural Gas

Tags

☐ Information Only

Inputs

	Value	Units
Were emissions calculated externally from ClearPath?	No	
Fuel Type	Natural Gas	
Fuel Use	2460769	Therms
Daily Occupancy (optional)		People
Daily Operating Hours (optional)		Hours
Building Square Footage (optional)		Square Feet
Is this facility owned/operated by your local government?	Yes	

Generator Fuel Oil

Data Source

The total gallons of generator fuel oil purchased was summed in an email from Michael Chiasson, Chief of Facilities Maintenance and Operations. He noted that all County generators use #2 Dyed Ultra Low Sulfur Diesel. In ClearPath, this fuel is entered as Distillate Fuel Oil #2.

Emissions Factor

ClearPath uses a default emissions factor for fuel oil that cannot be edited.

ClearPath Calculator

Total gallon consumption should be summed and entered in the ClearPath calculator “Emissions from Stationary Fuel Combustion” (see Figure 8).

Figure 8 – ClearPath Generator Fuel Oil Calculator Data Inputs Screen

*** Name**

Generator Fuel Oil

Tags

☐ Information Only

Inputs

	Value	Units
Were emissions calculated externally from ClearPath?	No	
Fuel Type	Distillate Fuel Oil No. 2	
Fuel Use	1587	Gallons
Daily Occupancy (optional)		People
Daily Operating Hours (optional)		Hours
Building Square Footage (optional)		Square Feet
Is this facility owned/operated by your local government?	Yes	

Vehicle Fleet Calculations

Table 5 identifies the ClearPath calculators used on the Vehicle Fleet tab, including the activity data analyzed, the calculator name, the inputs needed, and the source of inputs collected for the 2018 GHG inventory. Details on calculating each activity type are provided in subsequent sections.

Table 5 – ClearPath Calculator Summary and Data Sources – Vehicle Fleet

Activity	ClearPath Calculator Name	Inputs	Source
On-road Gasoline and Diesel	"Fleet Vehicle Emissions"	• Gallons of fuel consumed for each fuel • VMT per fuel • % VMT by vehicle type and fuel	• **Municipal Fleet**: Jon Tomkins <tomkinsj@oakgov.com> • **Airports**: Michelle Stover <stoverm@oakgov.com>
Off-Road Gasoline, Diesel and Biodiesel	"Emissions from Off Road Vehicles"	• Gallons of fuel consumed for each fuel	• **Airports**: Michelle Stover <stoverm@oakgov.com> • **Parks and Recreation:** Mike Donnellon <donnellonm@oakgov.com>

On-Road Vehicle Fleet

Data Source

On-road vehicle fleet data was obtained for two sources:

1. General municipal fleet
2. Airport fleet

General municipal fleet fuel data could not be disaggregated by department (see Figure 9). The municipal fleet data and airport fleet data provided may double-count the Airport 1 Dodge Minivan fuel consumption, but this only represents 0.01% of total gasoline gallons consumed and would not change the GHG inventory results in a meaningful way. The municipal fleet data may also include some off-road vehicle/equipment fuel consumption that could not be disaggregated, but fuel consumption is estimated to be minor and/or negligible.

Sheriff helicopter fuel data was not collected or reported as it is considered negligible by County staff. In the future, fuel data can be obtained by contacting helicopter pilot Phil Heckmann.

To calculate emissions, ClearPath requires both the gallons of fuel consumed and vehicle miles traveled (VMT) by vehicle type (passenger, light truck, or heavy truck). For the municipal fleet data, total miles traveled and gallons of fuel consumed were provided for each vehicle class.

Figure 9 – Municipal Fleet Fuel Data

	TOTAL GALLONS CONSUMED	VEHICLE MILES TRAVELED	VEH. CLASS (0)	VEH. CLASS (1)	VEH. CLASS (2) & (3)	VEH. CLASS (5)	VEH. CLASS (6)	VEH. CLASS (7)	VEH. CLASS (8)	VEH. CLASS (9)	
VEHICLE TOTAL (830)			92	90	129	12	98	178	144	87	
(%) FUEL USED BY CLASS			6.0%	20.6%	22.8%	1.1%	8.2%	16.2%	16.6%	8.3%	
(%) MILES DRIVEN BY CLASS			11.1%	15.6%	24.8%	1.6%	9.5%	21.0%	14.8%	1.6%	
MILES DRIVEN		9,068,841	1,002,550	1,417,217	2,246,794	149,600	858,056	1,907,025	1,340,722	146,877	Miles
GASOLINE	886,105		55,492	190,437	211,320	10,561	76,232	149,782	151,746	40,535	Gal
DIESEL	38,739		0	0	0	0	0	0	2,095	36,644	Gal
		FLEET AVG. MPG	CLASS MPG	CLASS MPG	CLASS MPG	CLASS MPG	CLASS MPG	CLASS MPG	CLASS MPG	CLASS MPG	
	924,845	9.8	18.07	7.44	10.63	14.17	11.26	12.73	8.71	1.90	

The County vehicle classes were matched to the ClearPath vehicle classes for use in the calculators (see Figure 10).

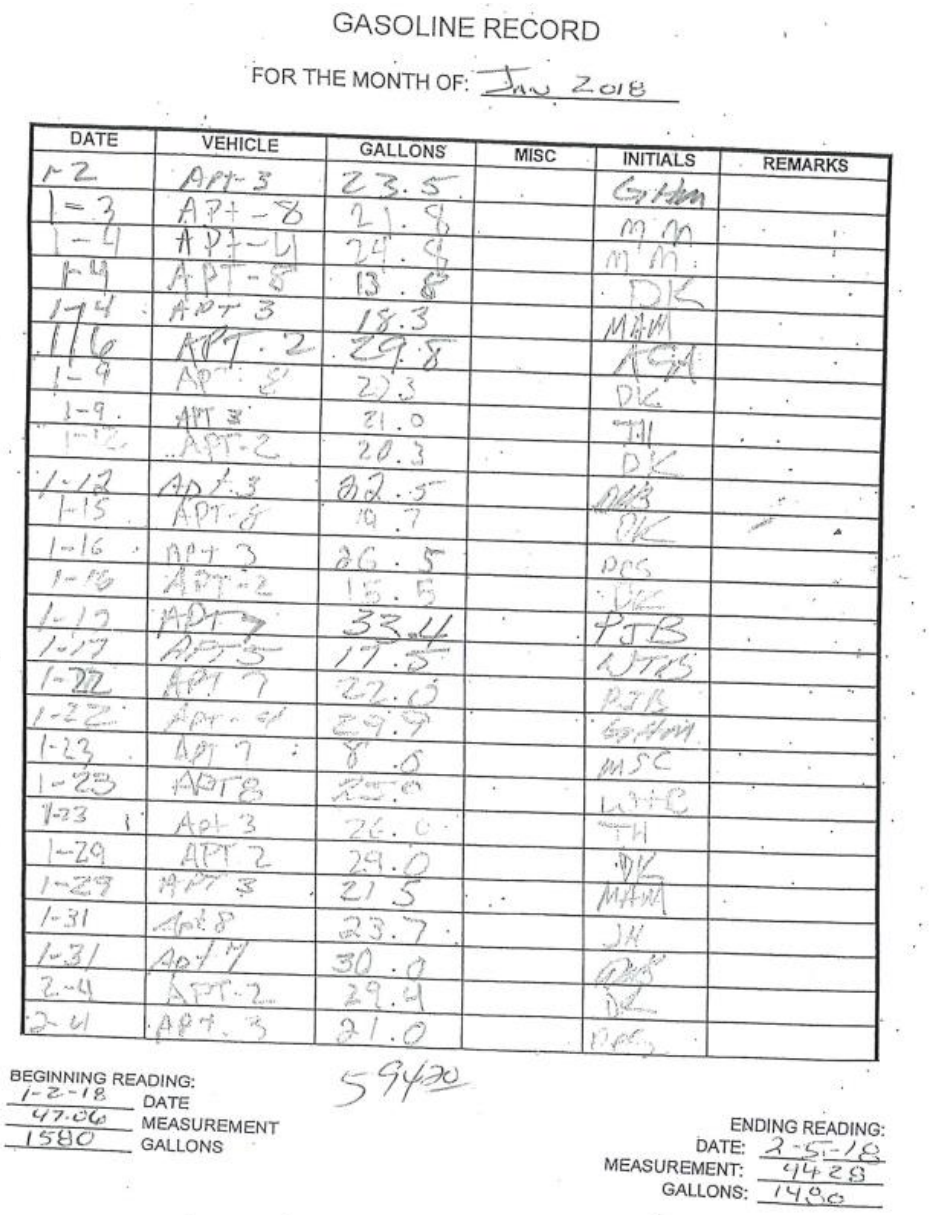
Figure 10 – Vehicle Class Categories

Oakland County Vehicle Class	ClearPath Vehicle Class (Passenger, Light Truck, Heavy Truck)
CLASS-0; CHEVY IMPALA/ MALIBU, FORD TAURUS, DODGE CHARGER,	Passenger
CLASS-1; CHEVY POLICE TAHOE	Passenger
CLASS-2 & 3; CHEVY POLICE IMPALA, DODGE POLICE CHARGER, FORD POLICE EXPLORER	Passenger
CLASS-5; CHEVY TAHOE, SUBURBAN, GMC YUKON	Passenger
CLASS-6; PICKUP TRUCK	Light truck
CLASS-7; SUV'S/ VAN'S; CHEVY EQUINOX, TRAVERSE, GMC TERRIAN, SAVANA VAN, DODGE CARAVAN, JEEP CHEROKEE	Light truck
CLASS-8; UTILITY TRUCK 2500/3500	Light truck
CLASS-9; DEPARTMENT OWNED VEHICLES, MEDUIM DUTY TRUCKS, MOTORCYCLES	Light truck

Gasoline vehicle classes (Class 0-9) were a mix of passenger and light trucks. All diesel vehicle classes (Class 8 and 9) were light trucks. For vehicle classes with both gas and diesel consumption (Class 8 and 9), total VMT for each fuel was calculated by multiplying the class MPG by the gallons of fuel (note that these MPGs represent a blended gas and diesel MPG).

For airport vehicle fleet fuel consumption data, scanned diesel and gasoline fuel logs were available. These logs included the gallons of fuel consumed per each vehicle identifier. These records contain a mix of on-road and off-road vehicles (see Figure 11).

Figure 11 – Airport Vehicle Fuel Log, Gasoline



GASOLINE RECORD

FOR THE MONTH OF: JAN 2018

DATE	VEHICLE	GALLONS	MISC	INITIALS	REMARKS
1-2	APT-3	23.5		GAM	
1-3	APT-8	21.8		MM	
1-4	APT-4	24.8		MM	
1-4	APT-8	13.8		DK	
1-4	APT 3	18.3		MAM	
1-6	APT. 2	29.8		AGA	
1-9	APT. 8	2.3		DK	
1-9	APT 3	21.0		MM	
1-12	APT-2	20.3		DK	
1-12	APT 3	02.5		DK	
1-15	APT-8	19.7		DK	
1-16	APT 3	26.5		DCS	
1-16	APT-2	15.5		DCS	
1-17	APT 7	33.4		PJB	
1-17	APT 3	17.5		MJTB	
1-22	APT 7	22.0		PJB	
1-22	APT. 4	29.9		GAM	
1-23	APT 7	8.0		MSC	
1-23	APT 8	24.6		MSC	
1-23	Apt 3	26.0		TH	
1-29	APT 2	29.0		DK	
1-29	APT 3	21.5		MAM	
1-31	Apt 8	23.7		JH	
1-31	Apt 7	30.0		DK	
2-4	APT-2	29.4		DK	
2-4	APT. 3	21.0		DCS	

BEGINNING READING:
1-2-18 DATE
47.06 MEASUREMENT
1580 GALLONS

5940

ENDING READING:
DATE: 2-5-18
MEASUREMENT: 4428
GALLONS: 1496

The vehicle identifier was used to determine the vehicle type and if the vehicle was on-road or off-road (see Figure 12). All the identified on-road gas and diesel vehicles (pickups, vans, utility trucks) are considered “light trucks” for the ClearPath calculator entry.

Figure 12 – Airport On-road Vehicle Fleet

OWNED BY AIRPORT	VEHCILE/EQUIPMENT (AS SHOWN ON LOG)	DESCRIPTION	UNLEADED	DIESEL	Onroad or Offroad	NOTES
	AIRPORT 1	MINI VAN	X			leased from Central Garage
X	AIRPORT 2	PICK-UP	X		Onroad	
X	AIRPORT 3	VAN	X		Onroad	
X	AIRPORT 4	PICK-UP	X		Onroad	
X	AIRPORT 5	PICK-UP	X		Onroad	
X	AIRPORT 6	UTILITY TRUCK		X	Onroad	
X	AIRPORT 7	UTILITY TRUCK	X		Onroad	
X	AIRPORT 8	PICK-UP	X		Onroad	

Fuel consumption for these vehicles was transcribed from the logs and summed to generate total gallons of on-road gas and diesel fuels consumed. To determine the total VMT, the Class 8 blended gas and diesel MPG from the municipal fleet data was applied to the total gallons.

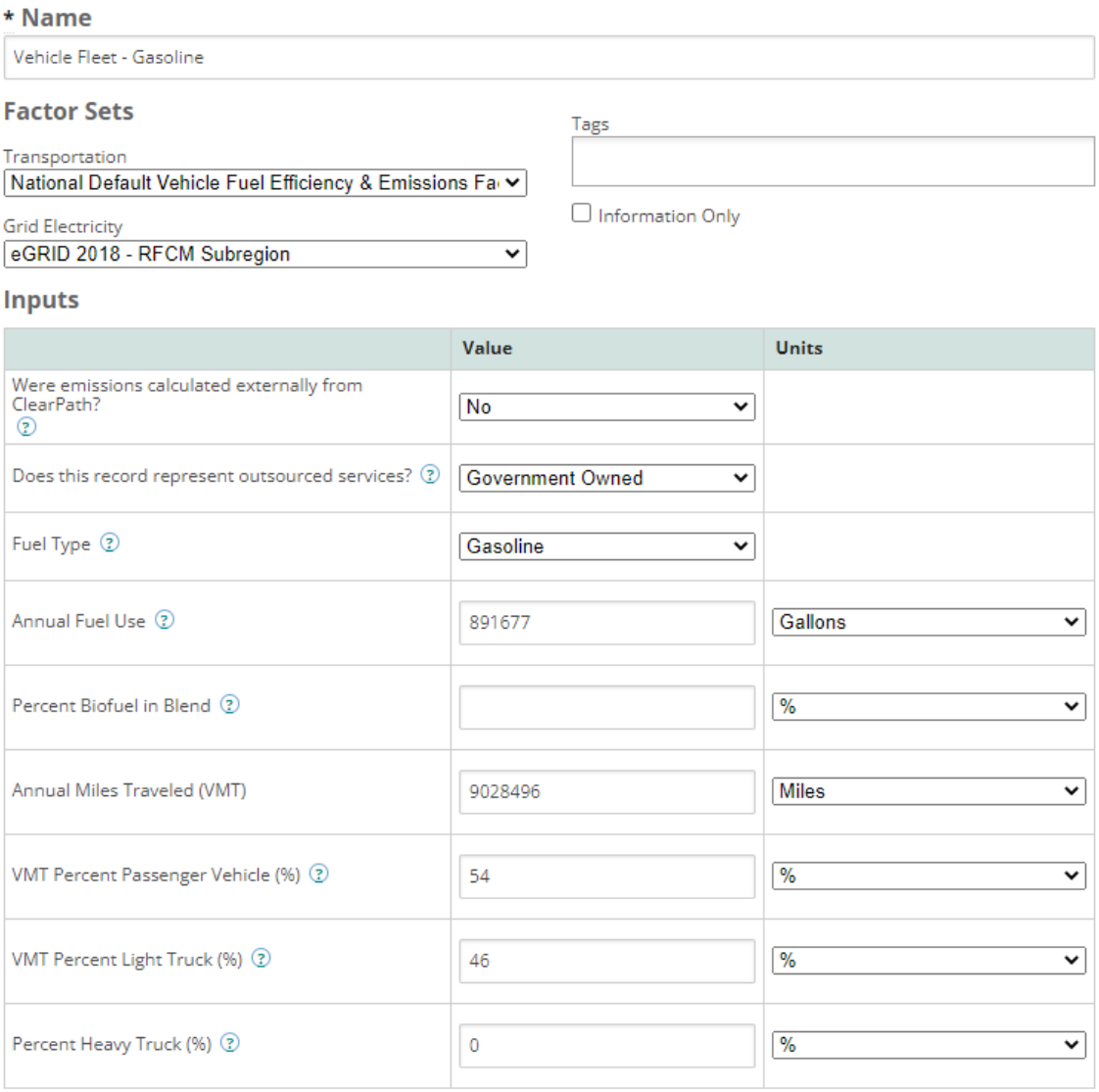
Emissions Factor

ClearPath provides annual vehicle fuel emission factor defaults under the “National Default Vehicle Fuel Efficiency & Emissions Factors” factor set. These defaults are obtained from the US Community Protocol, EIA, and EPA Emissions Factor Hub and are updated every year.

ClearPath Calculator

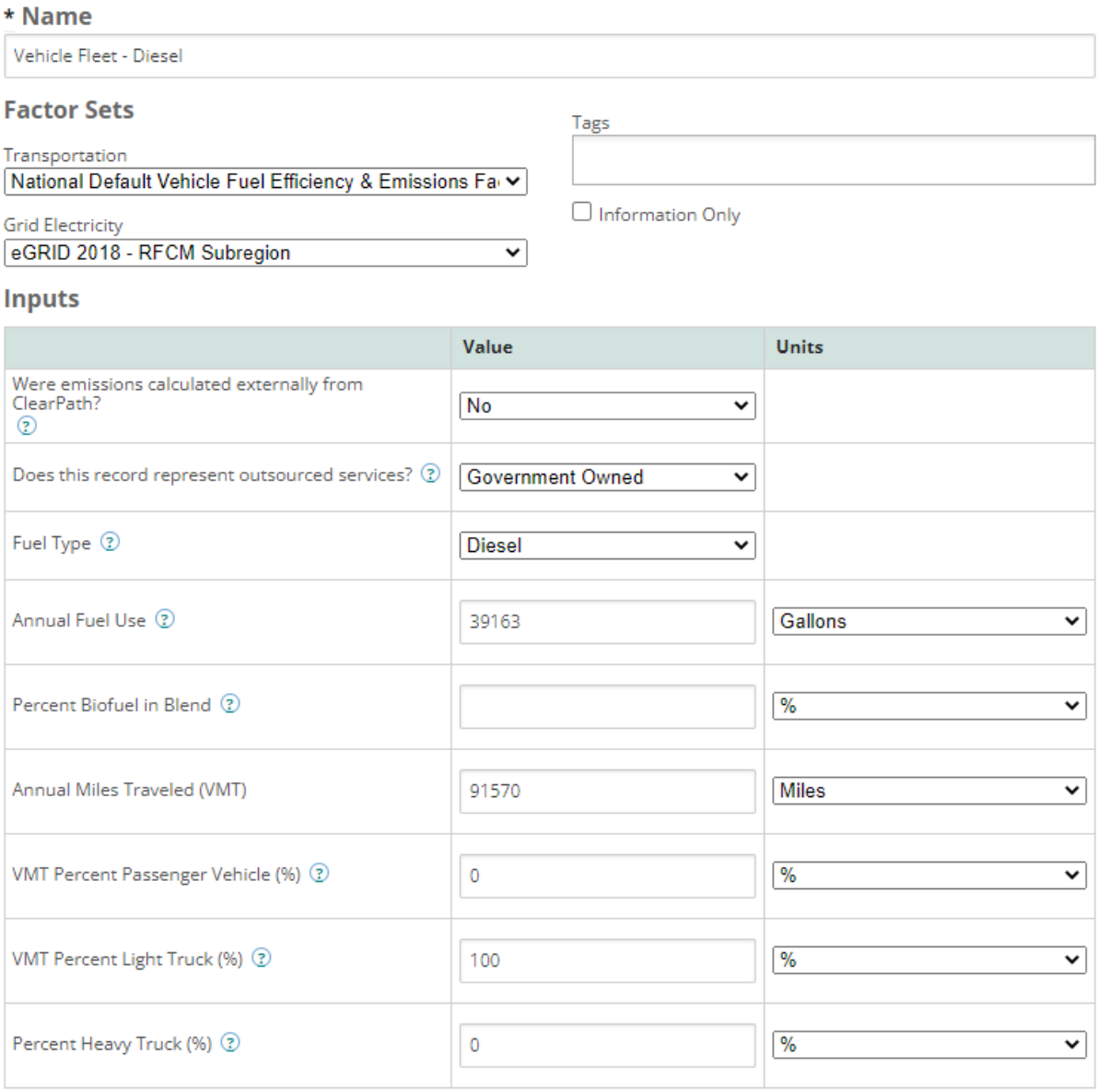
In ClearPath, a separate calculator needs to be created for each fuel type. Total gallons of gasoline and gasoline VMT were entered into the ClearPath calculator “Fleet Vehicle Emissions” (see Figure 13). VMT % vehicle types are determined by summing the VMT for each vehicle type for both the municipal fleet and aviation fleet data.

Figure 13 – ClearPath On-road Vehicle Fleet Calculator Data Inputs Screen - Gasoline



Total gallons of diesel and diesel VMT are entered into a separate “Fleet Vehicle Emissions” ClearPath calculator (see Figure 14). Because all diesel on-road vehicles were light duty trucks, 100% can be entered in the VMT % Light Truck entry for Diesel Fuels.

Figure 14 – ClearPath On-road Vehicle Fleet Calculator Data Inputs Screen - Diesel



*** Name**

Vehicle Fleet - Diesel

Factor Sets

Transportation: National Default Vehicle Fuel Efficiency & Emissions Fa

Grid Electricity: eGRID 2018 - RFCM Subregion

Tags

Information Only

Inputs

	Value	Units
Were emissions calculated externally from ClearPath?	No	
Does this record represent outsourced services?	Government Owned	
Fuel Type	Diesel	
Annual Fuel Use	39163	Gallons
Percent Biofuel in Blend		%
Annual Miles Traveled (VMT)	91570	Miles
VMT Percent Passenger Vehicle (%)	0	%
VMT Percent Light Truck (%)	100	%
Percent Heavy Truck (%)	0	%

Off-Road

Data Source

Off-road fuel consumption data is obtained from two sources:

1. Parks and Recreation
2. Airports

Fuel consumption data from wastewater treatment facility off-road equipment, such as forklifts, chainsaws, blowers, washers, pumps, and RTVs, is not recorded and therefore not included in the inventory.

To calculate emissions, ClearPath requires both the gallons of fuel consumed and the equipment type. Selection of Equipment Types for the ClearPath calculator is discussed in the "ClearPath Calculator" section below.

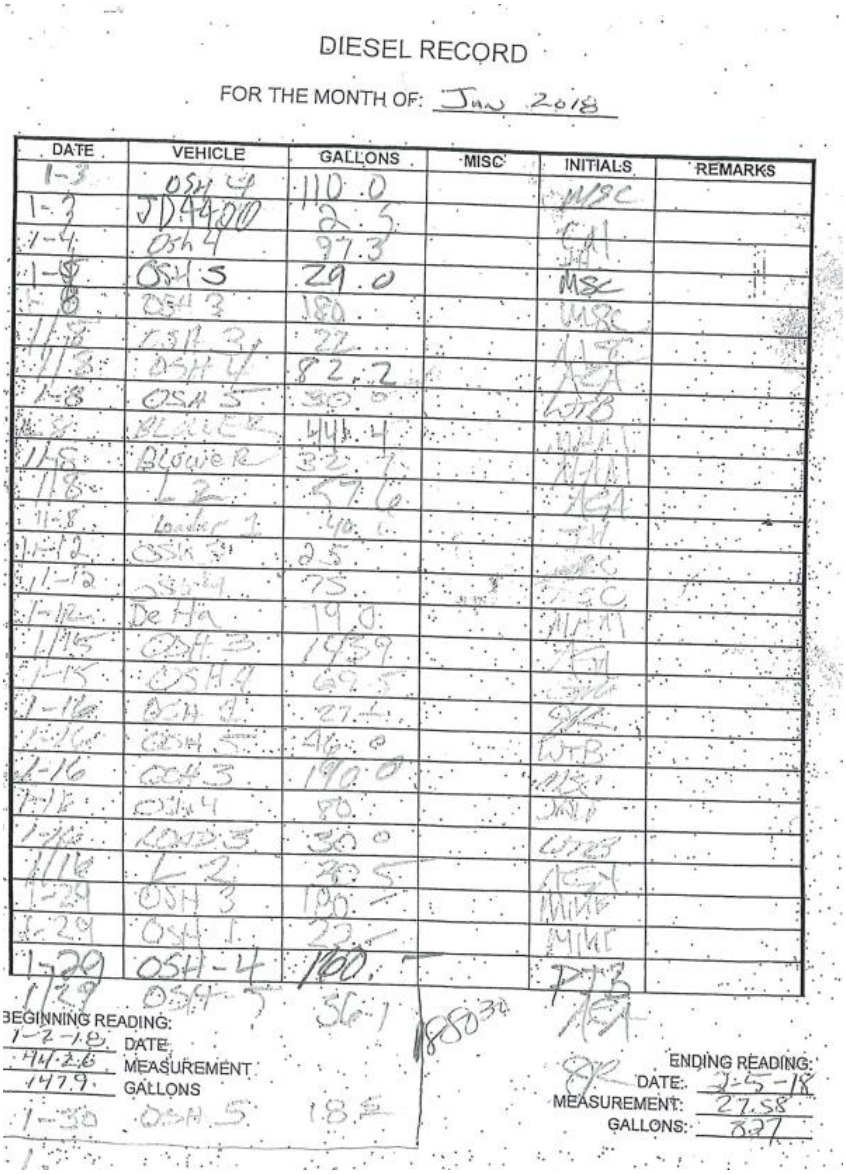
Parks and Recreation data includes quantity of each fuel type consumed. It is assumed that the fuel consumption is mainly for lawnmowers and ATVs. The fuel types were matched to the ClearPath fuel types (see Figure 15).

Figure 15 – Off-road Equipment Fuel Type Comparison

Parks and Rec Fuel Type	ClearPath Fuel Type
#2 Dyed Premium ULS Diesel	Diesel
#2 Ultra Low Sulfur Diesel	Diesel
#2 Dyed Ultra Low Sulfur Diese	Diesel
#2 ULS 5% Biodiesel	Bioiesel
87 Regular Gasoline E10	Gasoline

For airport vehicle fleet fuel consumption data, scanned diesel and gasoline fuel logs were available which included the gallons of fuel consumed per vehicle identifier. These records contain a mix of on-road and off-road vehicles.

Figure 16 – Airport Vehicle Fuel Log, Diesel



DIESEL RECORD

FOR THE MONTH OF: JAN 2018

DATE	VEHICLE	GALLONS	MISC	INITIALS	REMARKS
1-3	OSH 4	110.0		MSC	
1-3	JD 4400	2.3			
1-4	OSH 4	97.3		CAL	
1-8	OSH 5	29.0		MSC	
1-8	OSH 3	180.		MSC	
1-8	OSH 3	24.		MSC	
1-8	OSH 4	82.2		MSC	
1-8	OSH 5	30.5		MSC	
1-8	BLOWER	44.4		MSC	
1-8	BLOWER	32.7		MSC	
1-8	L-2	57.6		MSC	
1-8	Loader 2	40.		MSC	
1-12	OSH 3	25		MSC	
1-12	OSH 4	75		MSC	
1-12	DeHa	19.8		MSC	
1-15	OSH 3	193.9		MSC	
1-15	OSH 4	69.5		MSC	
1-16	OSH 4	27.4		MSC	
1-16	OSH 5	46.0		MSC	
1-16	OSH 3	190.0		MSC	
1-16	OSH 4	80.		MSC	
1-16	LOADER 3	30.0		MSC	
1-16	L-2	70.5		MSC	
1-29	OSH 3	180.		MSC	
1-29	OSH 1	23.		MSC	
1-29	OSH-4	100.		MSC	
1-29	OSH-5	56.1		MSC	
1-30	OSH 5	18.5			

BEGINNING READING:
1-2-18 DATE
144.2.6 MEASUREMENT
147.9 GALLONS

ENDING READING:
DATE: 1-15-18
MEASUREMENT: 27.58
GALLONS: 8.37

The vehicle identifier was used to determine the vehicle type and if the vehicle was on-road or off-road. Airport off-road vehicles/equipment include plow trucks, loaders, snowblowers, runway brooms, tractors, front-end loaders, and other equipment listed in Figure 17.

Figure 17 – Airport Off-road Vehicle Fleet

OWNED BY AIRPORT	VEHCILE/EQUIPMENT (AS SHOWN ON LOG)	DESCRIPTION	UNLEADED	DIESEL	Onroad or Offroad	NOTES
X	DELTA	PLOW/SAND TRUCK		X	Offroad	
X	ECHO	HEAVY-DUTY PLOW TRUCK		X	Offroad	
X	HI-LO	HI-LO		X	Offroad	
X	LOADER 1 & 2 (L-1, LDR)	FRONT END LOADER		X	Offroad	
X	ORANGE BLOWER	DRIVABLE SNOWBLOWER	X		Offroad	
X	SNOWBLOWER (BLOWER)	DRIVABLE SNOWBLOWER		X	Offroad	
X	OSH 1	HEAVY-DUTY PLOW TRUCK		X	Offroad	
X	OSH 2	HEAVY-DUTY PLOW TRUCK		X	Offroad	
X	OSH 3 (BROOM)	RUNWAY BROOM		X	Offroad	
X	OSH 4 (BROOM)	RUNWAY BROOM		X	Offroad	
X	OSH 5	HEAVY-DUTY PLOW TRUCK		X	Offroad	
X	R-1	AIRPORT FIRE TRUCK		X	Offroad	
X	R-2	AIRPORT FIRE TRUCK		X	Offroad	
X	EXMARK 1 & 2 (X'S or X-1, X-2)	ZERO-TURN MOWER		X	Offroad	
X	HUSTLER 1 & 2 (HUSTLER)	ZERO-TURN MOWER	X		Offroad	
X	ZERO TURNS (HUSTLER/EXMARK)	ZERO-TURN MOWER	X		Offroad	
X	FORD TRACTOR (FORD 260C)	HEAVY-DUTY TRACTOR (FOR MOWING)		X	Offroad	
X	JOHN DEERE (DEERE, JD4400, 6230)	HEAVY-DUTY TRACTOR (FOR MOWING)		X	Offroad	
X	NEW HOLLAND 5030	HEAVY-DUTY TRACTOR (FOR MOWING)		X	Offroad	
X	TRACTOR	HEAVY-DUTY TRACTOR (FOR MOWING)		X	Offroad	
X	YORK RAKE	TRACTOR		X	Offroad	
X	AIR COMPRESSOR	AIR COMPRESSOR		X	Offroad	
X	BANDIT	BRUSH HOG	X		Offroad	
X	CHIPPER	WOOD CHIPPER	X		Offroad	
X	PAINT MACHINE	RUNWAY PAINTING MACHINE	X		Offroad	
	STUMPER	STUMP GRINDER		X	Offroad	Rented
X	VERSA 4200	PRESSURE WASHER		X	Offroad	
X	GAS CAN (CAN, FUEL CAN, MIXED GAS)	CAN TO FUEL MOWERS & WEED	X	X	Offroad	
	LOANER	LOANER VEHICLE	X			loaner from Central Garage

Fuel consumption for these vehicles was transcribed from the logs and summed to generate total gallons of off-road gas and diesel fuels consumed.

All off-road vehicles were assigned the equipment type “Large Utility” (see “ClearPath Calculator” section below for further explanation on equipment type).

Emissions Factor

ClearPath provides annual vehicle fuel emission factor defaults under the “National Default Vehicle Fuel Efficiency & Emissions Factors” factor set. These defaults are obtained from the US Community Protocol, EIA, and EPA Emissions Factor Hub and are updated every year.

ClearPath Calculator

In ClearPath, a separate calculator needs to be created for each fuel type.

Off-road diesel consumption was entered into the ClearPath calculator “Emissions from Off Road Vehicles” (see Figure 18). For Equipment Type, “Large Utility” should be selected, unless the equipment is definitively considered “Construction” or “Agricultural.” If “Small Utility” or “Snowmobiles and Recreational” is selected, the methane and nitrous oxide emissions factors will calculate as zero.

Figure 18 – ClearPath Off-road Vehicle Fleet Calculator Data Inputs Screen - Diesel

*** Name**

Off-road Vehicles - Diesel

Factor Sets

Transportation: National Default Vehicle Fuel Efficiency & Emissions Fa

Tags

☐ Information Only

Inputs

	Value	Units
Were emissions calculated externally from ClearPath?	No	
Does this record represent outsourced services?	Government Owned	
Equipment Type	Large Utility	
Fuel Type	Diesel	
Fuel Used	31144	Gallons

For Biodiesel, selecting the equipment type will not change emissions as the methane and nitrous oxide emissions factors are zero for each type. “Large Utility” was selected to mirror the diesel selection (see Figure 19).

Figure 19 – ClearPath Off-road Vehicle Fleet Calculator Data Inputs Screen – Biodiesel

*** Name**

Off-road Vehicles - Biodiesel

Factor Sets

Transportation: National Default Vehicle Fuel Efficiency & Emissions Fa

Tags

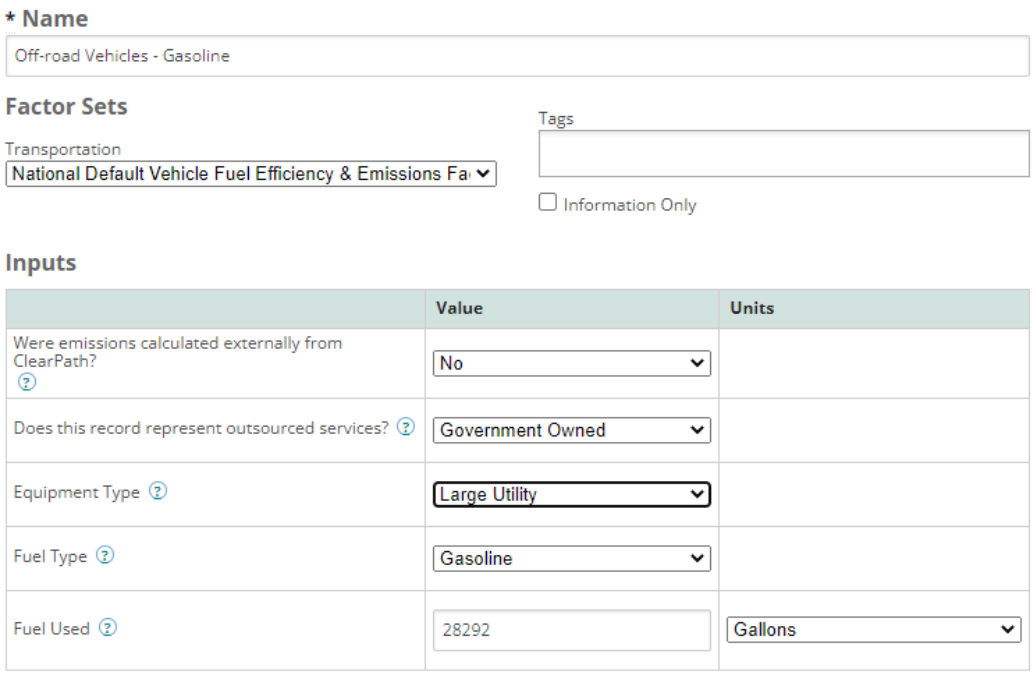
☐ Information Only

Inputs

	Value	Units
Were emissions calculated externally from ClearPath?	No	
Does this record represent outsourced services?	Government Owned	
Equipment Type	Large Utility	
Fuel Type	Biodiesel	
Fuel Used	451	Gallons
Percent Biofuel Blend	5	%

For gasoline, all the gasoline equipment types have the same emissions factors except for Agricultural, Locomotive, Ships and Boats, and Aircraft. "Large Utility" was selected to mirror the diesel selection (see Figure 20).

Figure 20 – ClearPath Off-road Vehicle Fleet Calculator Data Inputs Screen - Gasoline



Solid Waste Facilities Calculations

Table 6 identifies the ClearPath calculators used on the Solid Waste Facilities tab, including the activity data analyzed, the calculator name, the inputs needed, and the source of inputs collected for the 2018 GHG inventory. Details on calculating each activity type are provided in subsequent sections.

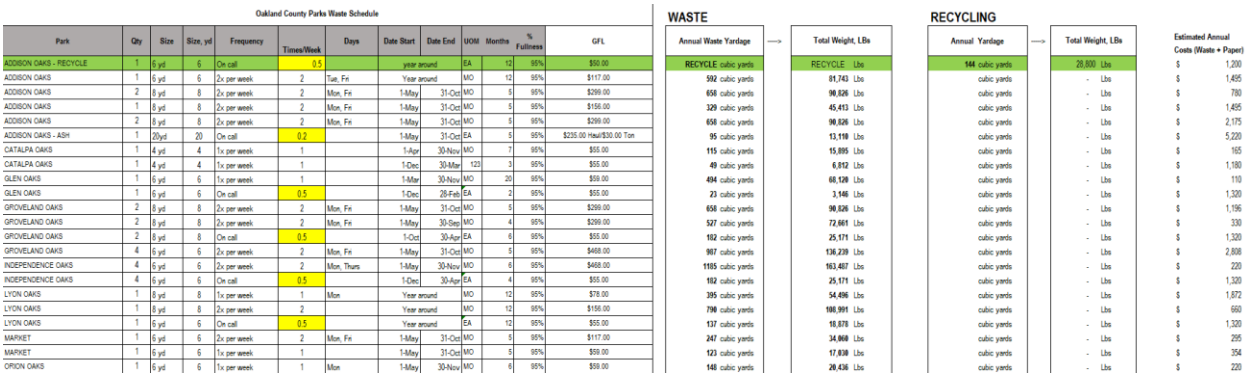
Table 6 – ClearPath Calculator Summary and Data Sources – Solid Waste Facilities

Activity	ClearPath Calculator Name	Inputs	Source
Landfilled Waste	"Waste Generation"	• Quantity of waste (short tons) • Landfill Methane Collection Scenario • Landfill Moisture Content	2020 campus operations diversion rate analysis
Composted Waste	"Composting Facilities"	• Quantity of waste (short tons) • Waste Type (green or biowaste)	

Data Source

Because of the lack of availability of 2018 solid waste data or more recent solid waste data, the 2020 campus operations diversion rate waste estimation was used as a proxy for 2018 waste. This analysis was conducted as part of the sustainability planning process that estimated 2020 campus and park waste quantities and destinations (see Figure 21). These estimates were developed based on information gathered from department interviews, dumpster sizes, and pick-up schedules. Notably, these waste values reflect pandemic-related operational impacts while the rest of the 2018 GHG inventory data does not. Additionally, the specific receiving landfills and composting sites for the campus and park waste are unknown, so default values were used in the GHG calculators.

Figure 21 – Sample of 2020 Park Waste Generation Analysis



Oakland County Parks Waste Schedule

Park	Qty	Size	Size, yd	Frequency	Times/Week	Days	Date Start	Date End	UOM	Months	% Fullness	GFL
ADDISON OAKS - RECYCLE	1	6 yd	6	On call	0.5		year around		EA	12	95%	$50.00
ADDISON OAKS	1	6 yd	6	2x per week	2	Tue, Fri	Year around		MO	12	95%	$117.00
ADDISON OAKS	2	8 yd	8	2x per week	2	Mon, Fri	1-May	31-Oct	MO	5	95%	$299.00
ADDISON OAKS	1	8 yd	8	2x per week	2	Mon, Fri	1-May	31-Oct	MO	5	95%	$156.00
ADDISON OAKS	2	8 yd	8	2x per week	2	Mon, Fri	1-May	31-Oct	MO	5	95%	$299.00
ADDISON OAKS - ASH	1	20yd	20	On call	0.2		1-May	31-Oct	EA	5	95%	$235.00 Haul/$30.00 Ton
CATALPA OAKS	1	4 yd	4	1x per week	1		1-Apr	30-Nov	MO	7	95%	$55.00
CATALPA OAKS	1	4 yd	4	1x per week	1		1-Dec	30-Mar	123	3	95%	$55.00
GLEN OAKS	1	6 yd	6	1x per week	1		1-Mar	30-Nov	MO	20	95%	$59.00
GLEN OAKS	1	6 yd	6	On call	0.5		1-Dec	28-Feb	EA	2	95%	$55.00
GROVELAND OAKS	2	8 yd	8	2x per week	2	Mon, Fri	1-May	31-Oct	MO	5	95%	$299.00
GROVELAND OAKS	2	8 yd	8	2x per week	2	Mon, Fri	1-May	30-Sep	MO	4	95%	$299.00
GROVELAND OAKS	2	8 yd	8	On call	0.5		1-Oct	30-Apr	EA	6	95%	$55.00
GROVELAND OAKS	4	6 yd	6	2x per week	2	Mon, Fri	1-May	31-Oct	MO	5	95%	$468.00
INDEPENDENCE OAKS	4	6 yd	6	2x per week	2	Mon, Thurs	1-May	30-Nov	MO	6	95%	$468.00
INDEPENDENCE OAKS	4	6 yd	6	On call	0.5		1-Dec	30-Apr	EA	4	95%	$55.00
LYON OAKS	1	8 yd	8	1x per week	1	Mon	Year around		MO	12	95%	$78.00
LYON OAKS	1	8 yd	8	2x per week	2		Year around		MO	12	95%	$156.00
LYON OAKS	1	6 yd	6	On call	0.5		Year around		EA	12	95%	$55.00
MARKET	1	6 yd	6	2x per week	2	Mon, Fri	1-May	31-Oct	MO	5	95%	$117.00
MARKET	1	6 yd	6	1x per week	1		1-May	31-Oct	MO	5	95%	$59.00
ORION OAKS	1	6 yd	6	1x per week	1	Mon	1-May	30-Nov	MO	6	95%	$59.00

WASTE		RECYCLING		
Annual Waste Yardage	Total Weight, LBs	Annual Yardage	Total Weight, LBs	Estimated Annual Costs (Waste + Paper)
RECYCLE cubic yards	RECYCLE Lbs	144 cubic yards	28,800 Lbs	$ 1,200
592 cubic yards	81,743 Lbs	cubic yards	- Lbs	$ 1,495
658 cubic yards	90,826 Lbs	cubic yards	- Lbs	$ 780
329 cubic yards	45,413 Lbs	cubic yards	- Lbs	$ 1,495
658 cubic yards	90,826 Lbs	cubic yards	- Lbs	$ 2,175
95 cubic yards	13,119 Lbs	cubic yards	- Lbs	$ 5,220
115 cubic yards	15,895 Lbs	cubic yards	- Lbs	$ 165
49 cubic yards	6,812 Lbs	cubic yards	- Lbs	$ 1,100
494 cubic yards	68,128 Lbs	cubic yards	- Lbs	$ 110
23 cubic yards	3,146 Lbs	cubic yards	- Lbs	$ 1,320
658 cubic yards	90,826 Lbs	cubic yards	- Lbs	$ 1,196
527 cubic yards	72,661 Lbs	cubic yards	- Lbs	$ 330
182 cubic yards	25,171 Lbs	cubic yards	- Lbs	$ 1,320
987 cubic yards	136,239 Lbs	cubic yards	- Lbs	$ 2,808
1185 cubic yards	163,487 Lbs	cubic yards	- Lbs	$ 220
182 cubic yards	25,171 Lbs	cubic yards	- Lbs	$ 1,320
395 cubic yards	54,496 Lbs	cubic yards	- Lbs	$ 1,872
790 cubic yards	108,991 Lbs	cubic yards	- Lbs	$ 660
137 cubic yards	18,878 Lbs	cubic yards	- Lbs	$ 1,320
247 cubic yards	34,068 Lbs	cubic yards	- Lbs	$ 295
123 cubic yards	17,030 Lbs	cubic yards	- Lbs	$ 354
148 cubic yards	20,436 Lbs	cubic yards	- Lbs	$ 220

Total landfilled waste from campus and parks and composted waste from parks was converted to short tons and summed to be entered in ClearPath calculators.

Emissions Factor

Solid waste emissions are determined by an area's waste characterization. The 2016 Michigan waste characterization from the "Economic Impact Potential and Characterization of Municipal Solid Waste in Michigan 2016" report Table 2-1[5] was used for the ClearPath "Waste Characterization" Factor Set (see Table 7 and Figure 22). The factor set percentages do not add up to 100% as the table excludes non-organic material like plastics. This factor set can be updated for future inventories as more accurate local data or more recent reports become available.

Table 7 – Michigan State-wide Aggregate Composition (mean % by weight)

Waste Type	%	Include in ClearPath?	ClearPath %	ClearPath Waste Type
Mixed paper	12.1%	X	12.1%	Magazines/third class mail
Newsprint	1.2%	X	1.2%	Newspaper
Corrugated carboard	8.4%	X	8.4%	Corrugated carboard
Plastic	14.0%	-	-	-
Metals	3.8%	-	-	-
Glass	2.2%	-	-	-
Textiles/bulk/other inorganics	19.5%	-	-	-
Food	13.6%	X	13.6%	Food scraps
Yard	5.0%	X	5.0%	Grass, leaves
Soil	2.4%	X	2.4%	
Wood	5.2%	X	5.2%	Dimensional Lumber
Other Organics	9.1%	X	9.1%	Grass
MI Deposits	0.3%	-	-	-
Household Hazardous	0.9%	-	-	-
Electronics	2.5%	-	-	-
	100%		**57%**	

[5] https://www.michigan.gov/documents/deq/480236-14_WMSBF_waste_characterization_report_521920_7.PDF

Figure 22 – ClearPath Waste Characterization Factor Set Input

ClearPath Calculator

Total landfilled waste can be summed and entered in the “Waste Generation” calculator. Landfilled park waste and landfilled campus waste were reported in two separate calculators to better demonstrate the difference between their emissions, but can be summed in one calculator if desired (see Figure 23 and Figure 24). Total composted park waste was summed and included in the “Composting Facilities” calculator (see Figure 25). For all Solid Waste calculators, the answer for the question “Is the receiving landfill owned/operated by your local government?” should be marked as “No.”

Because the receiving landfills are unknown, the Landfill Methane Collection Scenario was marked as “Typical” in the ClearPath calculators. Landfill Moisture Content was marked as “Moderate” (20-40 inches/year) as this represents typical precipitation for Oakland County.[6] The Waste Type to Calculate Emissions For should be marked as “All.” Park composted waste type is entered as “Green Waste.”

[6] https://usafacts.org/issues/climate/state/michigan/county/oakland-county

Figure 23 – ClearPath Solid Waste Calculator Data Inputs Screen – Campus Waste to Landfill

*** Name**

Campus Solid Waste - Landfill

Factor Sets

Waste Characterization: 2016 Michigan Waste Characterization

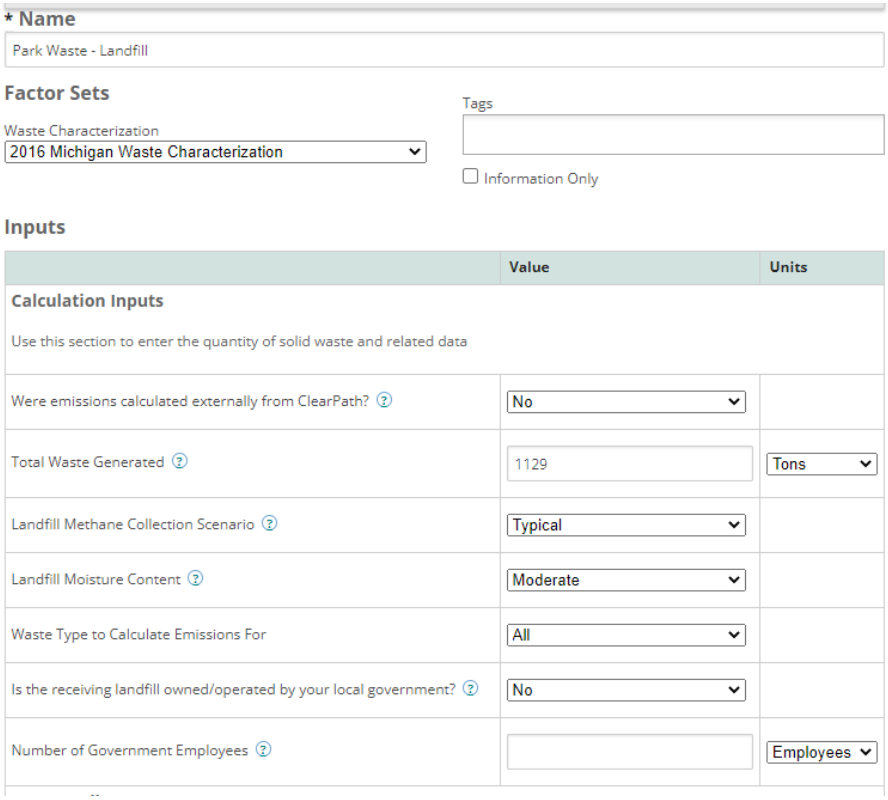
Tags

☐ Information Only

Inputs

	Value	Units
Calculation Inputs Use this section to enter the quantity of solid waste and related data		
Were emissions calculated externally from ClearPath?	No	
Total Waste Generated	5014	Tons
Landfill Methane Collection Scenario	Typical	
Landfill Moisture Content	Moderate	
Waste Type to Calculate Emissions For	All	
Is the receiving landfill owned/operated by your local government?	No	
Number of Government Employees		Employees

Figure 24 – ClearPath Solid Waste Calculator Data Inputs Screen – Park Waste to Landfill



* Name

Park Waste - Landfill

Factor Sets

Waste Characterization: 2016 Michigan Waste Characterization

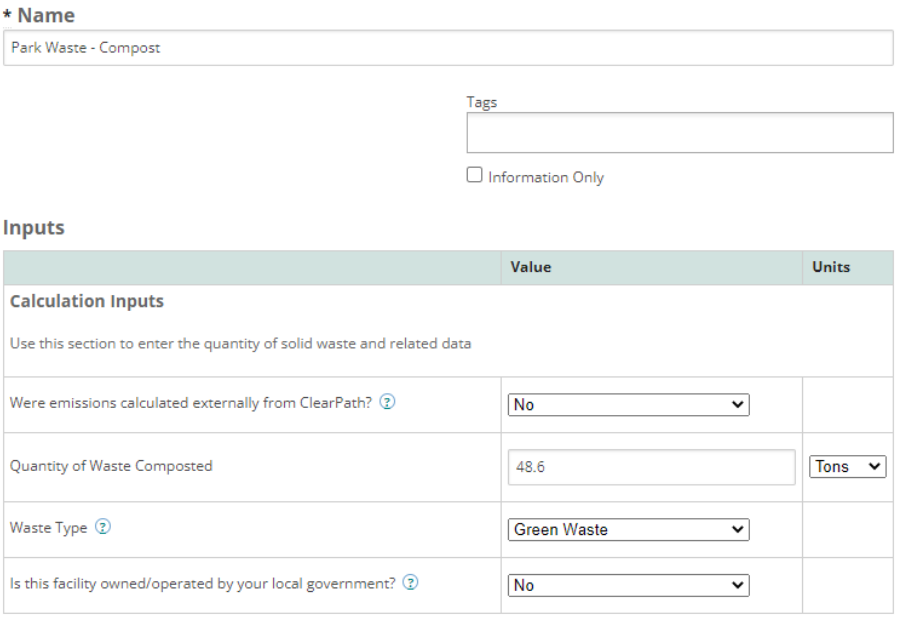
Tags

Information Only

Inputs

	Value	Units
Calculation Inputs Use this section to enter the quantity of solid waste and related data		
Were emissions calculated externally from ClearPath?	No	
Total Waste Generated	1129	Tons
Landfill Methane Collection Scenario	Typical	
Landfill Moisture Content	Moderate	
Waste Type to Calculate Emissions For	All	
Is the receiving landfill owned/operated by your local government?	No	
Number of Government Employees		Employees

Figure 25 – ClearPath Solid Waste Calculator Data Inputs Screen – Park Waste to Compost



* Name

Park Waste - Compost

Tags

Information Only

Inputs

	Value	Units
Calculation Inputs Use this section to enter the quantity of solid waste and related data		
Were emissions calculated externally from ClearPath?	No	
Quantity of Waste Composted	48.6	Tons
Waste Type	Green Waste	
Is this facility owned/operated by your local government?	No	

Wastewater Treatment Facilities Calculations

Table 8 identifies the ClearPath calculators used on the Wastewater Treatment Facilities tab, including the activity data analyzed, the calculator name, the inputs needed, and the source of inputs collected for the 2018 GHG inventory. Details on calculating each activity type are provided in subsequent sections.

Table 8 – ClearPath Calculator Summary and Data Sources –Wastewater Treatment Facilities

Activity	ClearPath Calculator Name	ClearPath Inputs	Source
Conventional Wastewater Treatment	• "Process N_2O Emissions from Wastewater Treatment" • "Emissions from Combustion of Digester Gas"	• Population • Nitrification/denitrification (Y/N) • Industrial/Commercial Discharge Multiplier (1 or 1.25)	Gary Nigro nigrog@oakgov.com, Water Resources Commissioner's Office
Conventional Wastewater Effluent	"Process N_2O from Effluent Discharge to Rivers and Estuaries"	• Population • Nitrification/denitrification (Y/N) • Industrial/Commercial Discharge Multiplier (1 or 1.25) • Aerobic or Anaerobic	
Septic Systems	"Fugitive Emissions from Septic Systems"	• Population	

Data Source

The information on each County-operated wastewater treatment facility was provided by Gary Nigro, Chief Engineer of the Water Resources Commissioner's office. Any energy consumed to operate the wastewater facilities is accounted for under the Buildings & Facilities sector. The process and effluent emissions accounted for in the inventory are from the facilities/systems listed in Table 9.

Table 9 – Facilities with Process/Effluent Emissions Included in the GHG Inventory

Conventional Wastewater Treatment Facilities	Septic Systems
1. **Lower Pettibone**	6. Lyon Oaks
2. **Walled Lake-Novi**	7. Woodbridge
3. **East Boulevard**	8. Belle Ann Falls
4. **Auburn**	9. Groveland Park
5. **Commerce Twp.**	10. Springfield Oaks Park

The Addison Oak Park Lagoon system process/effluent emissions were not entered into ClearPath as the ClearPath lagoon calculator is not meant for aerated or mixed lagoons. Additionally, the Addison Oak Park lagoon emissions would most likely be negligible (<1% total wastewater emissions) and were therefore excluded from the inventory.

The LGOP notes: "While IPCC, EPA and others have worked to estimate GHG emissions from wastewater on a gross basis, there are not widely-accepted, standardized guidelines to estimate

emissions from wastewater treatment at a facility level". Therefore, wastewater GHG emission calculations represent general estimations of emissions. ClearPath provides multiple wastewater emissions equations that account for various methods of wastewater treatment. Information on each County-operated wastewater treatment plant was gathered to determine which ClearPath equation to use and how to calculate emissions (see Table 10 and Table 11).

Table 10 – Conventional Wastewater Treatment Facility Information

	Lower Pettibone Lake WWTF	Walled Lake-Novi WWTF	East Boulevard WWTF	Auburn WWTF	Commerce Twp. WWTP
Treatment Type	Conventional	Conventional	Conventional	Conventional	Conventional
Population served*	112	19,000	61,000	125,000	16,000
Is there nitrification/denitrification?	Yes	Yes	Yes	Yes	Yes
Is the facility predominately an aerobic or anaerobic system?	Aerobic	Aerobic	Aerobic	Anaerobic	Aerobic
If digester gas is produced, is it combusted or flared?	N/A	N/A	N/A	Yes	N/A
Is there industrial or commercial wastewater that is received by the facility?	No	Yes	Yes	Yes	Yes

**Lower Pettibone's population was estimated using the given information of 28 homes (assumed 4 people/home)*

Table 11 – Septic System Facility Information

	Lyon Oaks Septic Field	Woodbridge Septic Field	Belle Ann Falls Community Septic*	Groveland Oaks Park Septic Sys.	Springfield Oaks Park Septic Sys.
Treatment Type	Septic	Septic	Septic	Septic	Septic
Population served**	200	68	24	343	744
Is there nitrification/ denitrification?	No	No	No	N/A	N/A
Is the daily biochemical oxygen demand (BOD5) load of the system in kg BOD5/day available?	No	No	No	No	No

** Belle Ann Falls was operated by the County until 2021, so it should not be included in County inventories past that date.*

***Septic System service populations were estimated using given information on number of homes served (assumed 4 people/home), contacting Parks and Rec Manager Melissa Prowse for Park visitor information, and contacting Lyon Oaks golf course for average # of customers/day*

If detailed wastewater treatment data cannot be obtained, ClearPath equations use service population as a proxy for wastewater activity data. Methods of summing service population and entering data into the calculators is discussed in the "ClearPath Calculators" section below. It should be noted that if wastewater treatment processes change in the future, the relevant ClearPath calculators may also change.

Emissions Factor

ClearPath uses a default emissions factor for wastewater that cannot be edited.

ClearPath Calculators

To decrease the amount of data entry needed, wastewater inputs and calculators were grouped by treatment type instead of wastewater facility. Table 12 maps the ClearPath calculators to wastewater facilities.

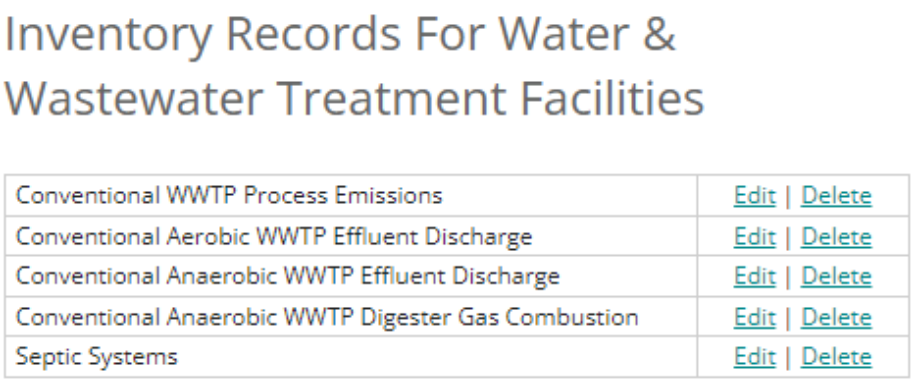
Table 12 – ClearPath Calculators and Wastewater Facility Mapping

	ClearPath Calculator			
Wastewater Facility	**Process N_2O Emissions from Wastewater Treatment**	**Process N_2O from Effluent Discharge to Rivers and Estuaries**	**Emissions from Combustion of Digester Gas**	**Fugitive Emissions from Septic Systems**
Lower Pettibone Lake WWTF	X	X		
Walled Lake-Novi WWTF	X	X		
East Boulevard WWTF	X	X		
Auburn WWTF	X	X*	X	
Commerce Twp. WWTP	X	X		
Lyon Oaks Septic Field				X
Woodbridge Septic Field				X
Belle Ann Falls Community Septic				X
Groveland Oaks Park Septic Sys.				X
Springfield Oaks Park Septic Sys.				X

**A separate "Process N_2O from Effluent Discharge to Rivers and Estuaries" calculator is needed to calculate Auburn's effluent emissions as it is an anaerobic system while the other conventional systems are aerobic*

The final list of ClearPath calculators appears as shown in Figure 26.

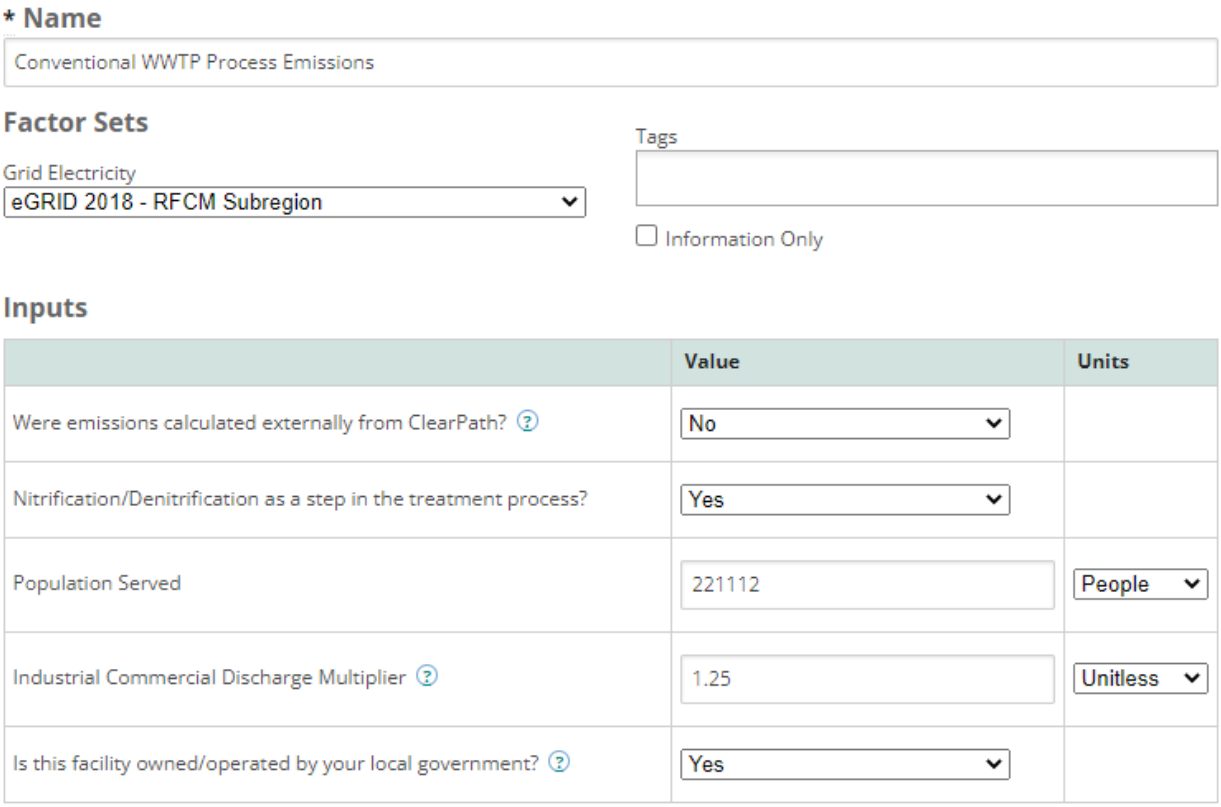
Figure 26 – ClearPath Wastewater Treatment Calculators Uses in 2018 GHG Inventory



For the "Process N_2O emissions from Wastewater Treatment Calculator" (named "Conventional WWTP Process Emissions" in Figure 26), total service populations for all conventional wastewater treatment plants were summed and entered. All conventional plants had nitrification/dentification and industrial

and/or commercial discharge (except for Lower Pettibone). Since there is industrial/commercial discharge, the “Industrial Commercial Discharge Multiplier” was entered as 1.25 (see Figure 27).

Figure 27 – ClearPath Wastewater Treatment Calculator Data Inputs Screen – Conventional WWTP Process Emissions



Two separate "Process N_2O from Effluent Discharge to Rivers and Estuaries" calculators must be created to account for the two different effluent treatment methods represented by the conventional treatment systems (the calculators were named "Conventional Aerobic WWTP Effluent Discharge" and "Conventional Anaerobic WWTP Effluent Discharge" in ClearPath). Lower Pettibone, Walled Lake-Novi, East Boulevard, and Commerce Township all use aerobic treatment (see Figure 28) while Auburn uses anaerobic. The service populations for Lower Pettibone, Walled Lake-Novi, East Boulevard, and Commerce Township were summed and entered in one calculator with the entry for "Is your facility predominately an Aerobic or Anaerobic system" set as "Aerobic." The industrial-commercial discharge multiplier should be entered as 1.25 and nitrification/denitrification should be marked as "Yes."

Figure 28 – ClearPath Wastewater Treatment Calculator Data Inputs Screen – Conventional Aerobic WWTP Effluent

*** Name**

Conventional Aerobic WWTP Effluent Discharge

Tags

☐ Information Only

Inputs

	Value	Units
Were emissions calculated externally from ClearPath?	No	
Do You have daily N load data from your effluent discharge?	No	
Population Served	96112	People
Industrial-Commercial Discharge Multiplier	1.25	Unitless
Is your facility predominantly an Aerobic or Anaerobic system?	Aerobic	
Does your facility employ Nitrification/Denitrification?	Yes	
Is this facility owned/operated by your local government?	Yes	

In a separate "Process N_2O from Effluent Discharge to Rivers and Estuaries" calculator (see Figure 29), the service population for Auburn was entered and the entry for "Is your facility predominately an Aerobic or Anaerobic system" set as "Anaerobic." The industrial-commercial discharge multiplier should be entered as 1.25 and nitrification/denitrification should be marked as "Yes."

Figure 29 – ClearPath Wastewater Treatment Calculator Data Inputs Screen – Conventional Anaerobic WWTP Effluent

*** Name**

Conventional Anaerobic WWTP Effluent Discharge

Tags

☐ Information Only

Inputs

	Value	Units
Were emissions calculated externally from ClearPath?	No	
Do You have daily N load data from your effluent discharge?	No	
Population Served	125000	People
Industrial-Commercial Discharge Multiplier	1.25	Unitless
Is your facility predominantly an Aerobic or Anaerobic system?	Anaerobic	
Does your facility employ Nitrification/Denitrification?	Yes	
Is this facility owned/operated by your local government?	Yes	

Because the Auburn facility also produces digester gas, the “Emissions from Combustion of Digester Gas” calculator must be used to calculate digester gas emissions (see Figure 30). The gas is used to run boilers and an engine and is also flared. Only population is needed to calculate these emissions.

Figure 30 – ClearPath Wastewater Treatment Calculator Data Inputs Screen – Digester Gas Combustion

*** Name**

Conventional Anaerobic WWTP Digester Gas Combustion

Tags

☐ Information Only

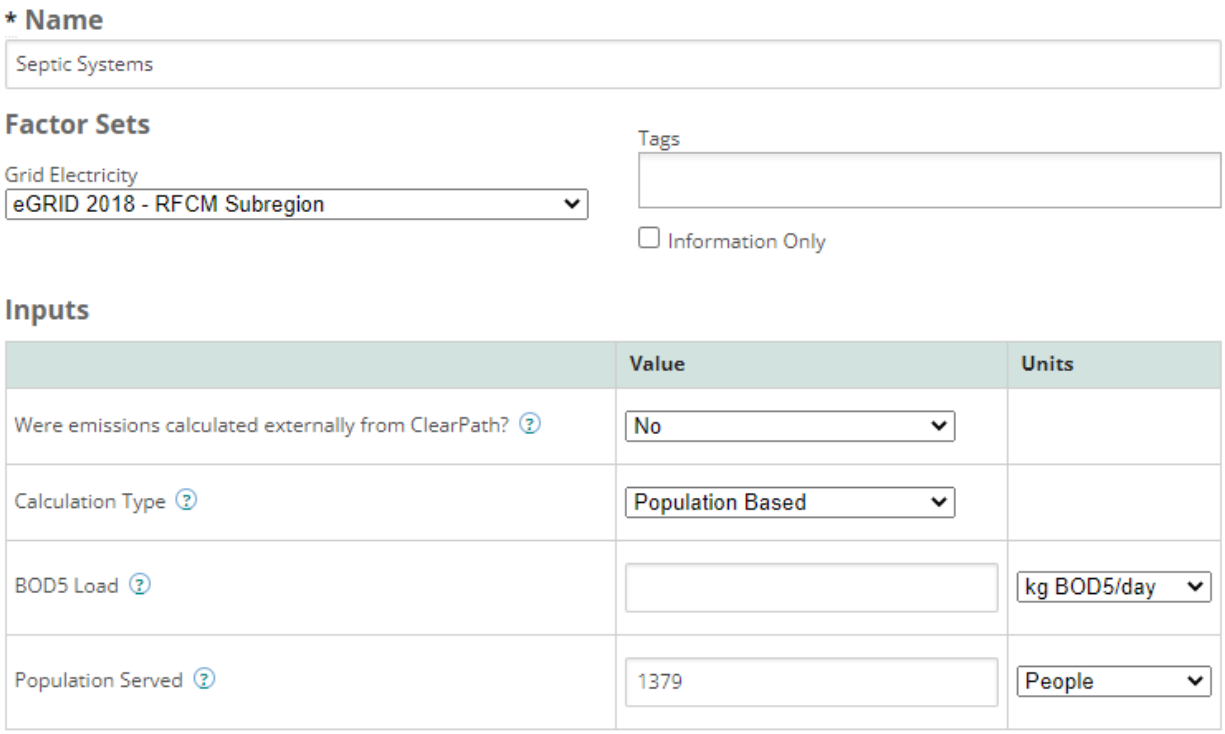
Inputs

	Value	Units
Calculation Type	Population Based	
Do you have data on Gas Composition or Heat Content?		
Gas Production		scf / day
Gas Composition		Percent CH4
Heat Content		Btu / scf
Population Served	125000	People
Is this facility owned/operated by your local government?	Yes	

NOTE: ClearPath notes that the “Emissions from Combustion of Digester Gas” calculator should be used and **not** the "Emissions from the Incomplete Combustion of Digester Gas" calculator or "Emissions from Flaring of Digester Gas" calculator. It also notes that although some facilities do not burn all the gas in a boiler, but flare some portion of it, there is currently no approved methods that distinguish between fuel burning devices.

For the “Fugitive Emissions from Septic Systems” calculator (see Figure 31), the septic system service populations should be summed and entered.

Figure 31 – ClearPath Wastewater Treatment Calculator Data Inputs Screen – Septic Systems



Process & Fugitive Emissions Calculations

Table 13 identifies the ClearPath calculators used on the Process & Fugitive Emissions tab, including the activity data analyzed, the calculator name, the inputs needed, and the source of inputs collected for the 2018 GHG inventory. Calculation details are provided in subsequent sections.

Table 13 – ClearPath Calculator Summary and Data Sources – Process & Fugitive Emissions

Activity	ClearPath Calculator Name	ClearPath Inputs	Source of Inputs
Natural Gas Fugitive Emissions	"Fugitive Emissions from Natural Gas Distribution"	• Fuel Type (Natural Gas) • Fuel Use (therms)	• **Central Heating Plant and Separate Municipal Accounts:** Joseph Murphy <murphyj@oakgov.com> • **Wastewater Treatment Facilities**: Gary Nigro <nigrog@oakgov.com> • **Airports**: Michelle Stover <stoverm@oakgov.com>

Data Source

Fugitive emissions calculations are derived from total natural gas consumption data as outlined in the "Buildings & Facilities - Natural Gas" section above.

Emissions Factor

ClearPath uses a default emissions factor for natural gas fugitive emissions that cannot be edited.

ClearPath Calculator

Total therm consumption should be summed and entered in the ClearPath calculator "Fugitive Emissions from Natural Gas Distribution" (see Figure 32). The ClearPath defaults for all other inputs should be used in the calculator. The ClearPath default natural gas leakage rate is from the Environmental Defense Fund (EDF) User Guide for Natural Gas Leakage Rate Modeling Tool.

Figure 32 – ClearPath Fugitive Emissions Calculator Data Inputs Screen

*** Name**

Fugitive Emissions from Natural Gas Distribution

Tags

☐ Information Only

Inputs

	Value	Units
Calculation Inputs Use the fields in this section to enter data on methane leakage from the local distribution system.		
Were emissions calculated externally from ClearPath?	No	
Quantity of Natural Gas Used	2460769	Therms
Leakage Rate	0.3	%
Nature Gas Energy Density	1028	btu/scf
Natural Gas Density	0.8	kg / m^3
Natural Gas % CH4	93.4	%
Natrual Gas % CO2	1	%