Township of McKellar

Corporate Milestone 1

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1. Methodology

1.1 Greenhouse Gas (GHG) Inventory

A greenhouse gas inventory brings together data on community and municipal sources of greenhouse gas emissions to estimate emissions for a given year. Two separate GHG inventories and forecasts have been created for the Township of McKellar: one for municipal corporate operations and one for community sources. As per the PCP protocol, the inventories consist of the following sources of GHG emissions.

Corporate	***Community***
-Buildings -Streetlights -Water and sewage treatment -Municipal fleet -Solid Waste	-Residential -Commercial and institutional -Industrial -Transportation -Solid Waste

1.2 Scope

This document will focus solely on ***corporate*** emissions.

1.3 Baseline Year

A baseline year of 2016 was selected because it is the year in which the most recent publicly available municipal greenhouse gas emissions data could be retrieved. 2016 also happens to be the most recent Statistics Canada Census year, providing the most recent data on population statistics. Additional data was gathered from other years as well, where relevant, and was referred to throughout the data analysis process. In the event that actual data could not be collected for the baseline year, assumptions were applied from prior, or successive years where relevant. Establishing a baseline is a useful tool to identify areas for improvement, inform the development of a GHG reduction action plan, estimate cost savings from reductions, and serve as a reference point to track improvements.

1.4 Data Collection

Energy and emissions quantities were collected for the Township of McKellar and compiled into an internal database for analysis and calculation.

1.5 Data Sources

Corporate energy usage and emissions were calculated for 2016 and reported by sector (buildings and facilities, fleet vehicles, streetlight, water and wastewater, and corporate solid waste) as well as by emissions source (electricity, natural gas, propane, fuel oil, gasoline, diesel, waste, and wastewater). In some cases, data sources varied depending on the type of expenditure required to calculate emissions. Corporate data was obtained from a variety of sources, such as municipal records that contained actual energy consumption data from billed consumption and the Township of McKellar's Energy Consumption Report[1]. Municipal records were provided by Township of McKellar staff and were used in the development of the Energy Consumption Report. For a detailed summary of corporate data sources, please refer to Table 1.

Table 1: Corporate Data Sources

Emission Sector	***Municipality***	***Source***	***Quality of Data***	***Notes***
Building/ Facilities	McKellar	Municipal Records & Energy Consumption Report	High	Actual energy consumption per source, per building for baseline year.
Streetlights	McKellar	Municipal Records & Hydro One	High	Actual electricity consumption in kWh for baseline year.
Fleet	McKellar	Municipal Records & Energy Consumption Report	High	Actual fuel consumption in litres for baseline year.
Water/ Wastewater	McKellar	DNE	DNE	McKellar Township does not provide water or wastewater services.
Solid Waste	McKellar	Municipal Records	Low	Calculation based primarily on assumptions.

Legend for data quality:

-High: Actual usage data covering the period of the inventory year, from a credible data collector/ provider
-Medium: Actual usage data provided, with some assumptions from within or around the geographic boundary, inventory year, or otherwise to fill in data gaps
-Low: Usage data provided, but mainly based on assumptions.

1.5.1 Buildings and Facilities

Actual energy consumption data by each emission source for each municipal building and facility was provided by municipal staff. Municipal staff provided the records of billed energy consumption and was cross-referenced against the Energy Consumption Report to ensure consistency. As a result, it can be said with a high degree of confidence that the reported energy consumption quantities are highly accurate given the access to actual energy consumption data.

[1] http://township.mckellar.on.ca/wp-content/uploads/2018/04/Energy-Consumption-Report-2018.pdf

1.5.2 Water and Wastewater

The Township of McKellar does not provide water or wastewater services. This is because the township's expansive geographic size in relation to it's small, spread out population makes it economically infeasible to provide these services.

1.5.3 Streetlights

Actual electricity consumption in kWh for all streetlights in the Township of McKellar was provided by municipal staff. Municipal staff provided the records of billed electricity consumption from Hydro One. It can be said with a high degree of confidence that the reported energy consumption quantities are highly accurate given the access to actual electricity consumption data.

1.5.4 Fleet Vehicles

Actual gasoline and diesel consumption in litres by vehicle, department, or bulk purchase was provided by municipal staff. The billed fuel records provided by municipal staff were then cross-referenced against the Energy Consumption Report to ensure consistency. As a result, it can be said with a high degree of confidence that the reported fuel consumption quantities are highly accurate given the access to actual fuel consumption data.

1.5.5 Solid Waste

GHG emissions from solid waste are a unique emission source to be quantified by local governments. As a result, this presented difficult reporting and calculation challenges. These emissions reflect the impact of methane released through the decomposition of organic matter in landfills and can be calculated based on total waste deposited in a landfill. With waste generation data pertaining solely to corporate operations being unavailable, Georgian Bay Biosphere Reserve (GBBR) estimated the quantity of solid waste generated at corporate buildings and facilities based on approximations of the size of garbage bins used, their average fullness, and the frequency of their pickup per the PCP protocol. This was used in combination with actual tonnage of waste sent to the McDougall landfill from the Lee's Road transfer station to disaggregate corporately generated solid waste from community generated solid waste.

2. Calculation Process

2.1 Buildings and Facilities

There is only one formula for calculating building emissions from municipal operations. For reference, a simplified version of the formula for calculating building and facility emissions as per the PCP protocol is as follows.

2.1.1 Formula

$$\sum (FC * Cef) + (FC * CHef * CHwp) + (FC * Nef * Nwp)$$

Where:

FC = Amount of fuel by type consumed

Cef = Emission factor for Carbon Dioxide (CO_2)

CHef = Emission factor for Methane (CH_4)

Nef = Emission factor for Nitrous Oxide (N_2O)

CHwp = Global warming potential of Methane

Nwp = Global warming potential of Nitrous Oxide

2.1.2 Assumptions

No assumptions were made in calculating GHG emissions produced by corporate buildings and facilities because actual energy consumption data was available.

2.1.3 Outcome

The Township of McKellar's buildings and facilities produced **51** tonnes of CO_2e in 2016. These emissions were produced by consuming **1,367** GJ of energy.

2.2 Water and Wastewater

The Township of McKellar does not provide water or wastewater services to its residents because of geographic and economic limitations. As a result, no GHG emissions are generated through this category and no calculation is warranted. However, for reference, a simplified version of the formula for calculating water and wastewater emissions as per the PCP protocol is as follows.

2.2.1 Formula

$$\sum (FC * Cef) + (FC * CHef * CHwp) + (FC * Nef * Nwp)$$

Where:

FC = Amount of fuel by type consumed

Cef = Emission factor for Carbon Dioxide (CO_2)

CHef = Emission factor for Methane (CH_4)

Nef = Emission factor for Nitrous Oxide (N_2O)

CHwp = Global warming potential of Methane

Nwp = Global warming potential of Nitrous Oxide

2.2.2 Assumptions

No assumptions were made in calculating GHG emissions produced by municipal water and wastewater infrastructure because the associated infrastructure does not exist in the Township of McKellar.

2.3 Streetlights

There are multiple formulas that can be used to calculate the emissions produced by streetlights. Fortunately, since actual electricity consumption data was available through municipal records of Hydro One bills, the formula corresponding to actual electricity consumption data as per the PCP protocol was used. For reference, a simplified version of this formula is as follows.

2.3.1 Formula

$$\sum (FC * Cef) + (FC * CHef * CHwp) + (FC * Nef * Nwp)$$

Where:

FC = Amount of electricity consumed

Cef = Carbon Dioxide (CO_2) emission factor for electricity

CHef = Methane (CH_4) emission factor for electricity

Nef = Nitrous Oxide (N_2O) emission factor for electricity

CHwp = Global warming potential of Methane

Nwp = Global warming potential of Nitrous Oxide

2.3.2 Assumptions

No assumptions were made in calculating GHG emissions produced by streetlights because actual electricity consumption data from Hydro One was available.

2.3.3 Outcome

The Township of McKellar's streetlighting produced negligible quantities of CO_2e. By consuming **28** GJ of energy, the Township of McKellar's streetlights produced roughly **0** tonnes of CO_2e.

2.4 Fleet

Actual gasoline and diesel consumption data by vehicle or department was provided by McKellar staff. With the consumption of fuel known, a standard formula for calculating the GHG emissions produced by a corporate fleet can be applied. For reference, a simplified version of this formula, as per the PCP protocol is as follows.

2.4.1 Formula

$$\sum(FC * VTC) + (FC * VTCHef * CHwp) + (FC * VTNef * Nwp)$$

Where:

FC = Amount of fuel by type consumed

VTC = Emission factor by vehicle type for Carbon Dioxide (CO_2)

VTCHef = Emission factor by vehicle type for Methane (CH_4)

VTNef = Emission factor by vehicle type for Nitrous Oxide (N_2O)

CHwp = Global warming potential of Methane

Nwp = Global warming potential of Nitrous Oxide

2.4.2 Assumptions

In the case that fuel consumption was reported by department, it was assumed that fuel was consumed by vehicles most likely to be associated with completing tasks pertinent to that department. For example, it is logical to assume that bulk diesel used by the public works department was consumed by vehicles such as snowplows, backhoes, and other vehicles which can be classified as a heavy-duty vehicle. For Fire Stations #1 and #2 it is logical to assume that the diesel and gasoline consumed respectively was consumed by fire trucks and other heavy-duty emergency response vehicles. Lastly, for the Building and Recreation & Cemetery departments, it is logical to assume that gasoline was consumed by light-duty trucks for the purposes of transporting light-weight equipment such as lawnmowers and facilitating other related tasks.

Although it is ideal to have fuel consumption disaggregated by vehicle, the similarity of fuel efficiency technologies associated with vehicles in a single department validates the allocation of fuel consumption to a department as a whole. When contrasting subsectors (i.e. truck to truck, equipment to equipment, etc.) there is a relative consistency between emissions technology and therefore the GHG coefficient associated with that technology. For example, looking to the public works department, a snowplow may have consumed more fuel than a backhoe, but given that they fall under the same classification (heavy-duty vehicle) and receive the same emission factors, a set amount of fuel consumed between those two vehicles would equate to the same amount of GHG emissions regardless of differing consumption scenarios. Therefore, despite the lack of knowledge on which vehicles consumed precise quantities of a department's fuel, it can confidently be assumed that a similar GHG outcome would result, based on the consistency of emission coefficients.

2.4.3 Outcome

The Township of McKellar's fleet produced an estimated **177** tonnes of CO_2e in 2016. These emissions were produced by consuming **2,508** GJ of energy.

2.5 Solid Waste

Since actual data on corporately generated waste is not available, local governments can estimate the quantity of solid waste generated at corporate buildings and facilities and the quantity of community produced waste that is diverted as part of municipal operations (i.e. parks and sidewalk garbage receptacles). This estimate is determined on the size of garbage bins used, their average fullness at pickup, and the frequency of pickup (PCP Protocol, Approach #2, p.22)[2].

The type of landfill is another determinant of the formula used for estimating emissions from corporate solid waste. For reference, a simplified version of this formula, as per the PCP protocol is as follows.

2.5.1 Formula

$$\sum 21 * (GBC * BF * PU * 2.136) * \left(\left(\frac{16}{12}\right) * MCF * DOC * DOCF * F\right)(1 - MR)(1 - OX)$$

Where:

GBC = garbage bin capacity (m^3)

BF = Approximately how full the bin is when it is emptied (%)

PU = Frequency of pickup (times per month)

MCF = Methane correction factor

DOC = Degradable organic content

DOCF = Fraction of DOC dissimilated

F = Fraction of methane in landfill gas

MR = Methane recovery at landfill (%)

OX = Oxidation Factor

2.5.2 Assumptions

Data on the actual tonnage of corporate solid waste generated by the Township of McKellar in 2016 does not exist. Gaining an understanding of solid waste practices and policies can help to determine some of the factors and coefficients of the formula that are determinant on landfill management and operations.

Municipal staff explained that when solid waste is generated, it is sent to the transfer station located on Lee's Road. Once the transfer station has reached capacity, solid waste is then

[2] https://data.fcm.ca/Documents/reports/PCP/PCP_Protocol_Canadian_Supplement_EN.pdf

diverted to the McDougall landfill. However, this waste is mixed with community generated waste as part of the solid waste service the transfer station provides to residents. As a result, the tonnage of solid waste from the transfer station reported by the McDougall landfill can only be used as a reference to determine the accuracy of the solid waste estimate. This is because once waste has been aggregated, it is impossible to discern waste produced by municipal operations and the broader community.

Staff from the McDougall landfill informed GBBR that no emission capture technology exists. This is because a feasibility study was undertaken, which determined that it was economically unfeasible to purchase the technology and embark on installation. While this technology does not exist, the landfill is still being actively managed. Garbage is compacted daily to reduce its volume and then buried to allow for additional landfill space, and to deter wildlife. The landfill is also classified as engineered. The landfill is lined to capture leachate, which is then removed and sent to an offsite treatment facility for processing. These factors helped to determine assumptions on several of the values required by the formula.

Next was the process of determining the quantity of solid waste produced. It was assumed that buildings with a relatively small number of daily occupants (classified as minor buildings) had a single bin for garbage, sized at $0.08m^3$, and was removed weekly to eliminate any odours. While this assumption may seem to be unrepresentative, $0.08m^3$ is equivalent to 2 large-sized garbage bags being produced per week and is appropriate given the occupancy of these facilities. Additionally, this represents an average across buildings with a smaller number of daily occupants. For example, the Public Works Garage may produce twice this amount in a given week, however, the Council Chambers and Youth Room may each produce half this amount. It should also be noted that for the purposes of estimating the tonnage of waste produced, it was assumed to be appropriate to treat each facility within the Community Centre as its own waste generating site. The underlying logic for this assumption was based in the recognition that the facilities within the Community Centre, such as the Library and Council Chambers, provide different functions and services that generate waste specific to those functions. In addition to the facilities located within the Community Centre, the Community Centre itself was allocated a $0.16m^3$ garbage bin under the assumption that hall rentals and events that attract larger quantities of occupants would generate larger quantities of waste more frequently.

Within the purview of municipal operations the Township of McKellar is also responsible for the maintenance of Minerva Park. Given the seasonal variability of visitation that Minerva Park experiences, a single $0.08m^3$ garbage bin was allocated to its premises to accommodate the waste generated there. Additionally, seasonality affects the frequency in which the receptacle needs to be emptied. As a result, it was assumed that the waste receptacle is continuously monitored and emptied when close to full, which would vary in frequency as a result of McKellar's seasonal population influx. Therefore, during July and August, receptacles are emptied weekly, and during May, June, September, and October they are emptied bi-weekly before being removed for the winter months. This assumption was then used to create a monthly average which could be applied across the entire year.

2.5.3 Outcome

The Township of McKellar's solid waste produced an estimated **15** tonnes of CO_2e in 2016.

2.6 Business as Usual

In calculating the business-as-usual (BAU) forecast, the year 2030 was chosen as the forecast year.

2.6.1 Assumptions

In their 2016 Population Census, Statistics Canada reported that the Township of McKellar experienced a 2.9% decline in population between the years 2011 and 2016. However, given that the BAU forecast is determined by annual population growth, it was determined that the reported decline in population would be unrepresentative of corporate operations and the projected BAU for the following reasons.

Geographically positioned near the Eastern shoreline of Georgian Bay and in the heart of cottage country, the Township of McKellar is a major tourist destination. As a result of this tourism, a massive increase in population occurs during the warmer months, raising the population from 1,111 permanent residents to include thousands of additional seasonal residents. Yet Statistics Canada only accounts for the 1,111 permanent residents in their 2016 Population Census. As a result, Statistics Canada's population decline is derived from permanent residents, failing to account for the major seasonal population influx. This is problematic and unrepresentative in producing a BAU forecast because the services and amenities provided by corporate operations are not restricted for permanent resident use only. For example, the Township of McKellar provides the numerous seasonal cottages and resorts with emergency services, and seasonal residents utilize roads and other local infrastructure, causing additional wear-and-tear that requires McKellar staff to maintain and repair. Therefore, as seasonal population grows, so too will corporate operations, and the associated GHG emissions. Essentially, using Statistics Canada's population decline would demonstrate that there would be a natural decrease in GHG emissions as population shrinks, a situation which can logically be assumed to be untrue, given that municipal operations are conducted on behalf of all residents residing in the jurisdiction, not just the permanent ones. As a result, the following methodology and assumptions were considered in producing a growth statistic that would factor seasonal population in producing a BAU forecast.

Data was first retrieved from the Municipal Property Assessment Corporation (MPAC). This data was referenced because it classifies each property in Ontario according to its functional purposes. For example, data entries categorized as a 300 series property are classified as a residential property, including both permanent residences and seasonal residences.

It can be difficult to assume the number of people that are staying at a seasonal residence at any given time. For example, it is common for numerous different families to rent a single seasonal residence throughout the summer. This produces a high degree of variability in the population of any single seasonal residence, as one week could have 3 residents occupying the premises and the following week could have 8. From a calculation perspective, the most appropriate response would be to use a provincial statistic, such as the average number of residents per household. However, using a statistical average such as the average number of residents per household results in a static number, and shifts the aspect of variability to the object it represents, which in this case is the household. Therefore, accounting for seasonal population in an annual population growth rate would require calculating the growth rate of the number of residential properties as determined by MPAC.

Based on the static nature of the number of residents per household, it was assumed that the growth rate of the number of residential properties would be the same as population, and that municipal operations would grow at a similar rate to match the added demand of municipal services. As a result, the annual growth rate of residential properties was used to determine the BAU forecast.

Given that the BAU forecast was determined by annual residential property growth, multiple years of data was used to eliminate the possibility of an outlier skewing the calculation result. With this consideration, the residential property growth rate was calculated for each year from 2010 to 2016, and then averaged. This resulted in an average annual residential property growth rate of 0.73%. Following the PCP protocol, this 0.73% growth rate was used to determine the forecasted emissions for the year 2030.

2.6.2 Outcome

Given a 0.73% population growth rate forecasted to the year 2030, the Township of McKellar is expected to produce 269 tonnes of CO_2e in 2030, representing an 11% increase from baseline levels, if business is to continue as usual.