ECCC LANDFILL METHANE MODELLING TOOL – USER GUIDE

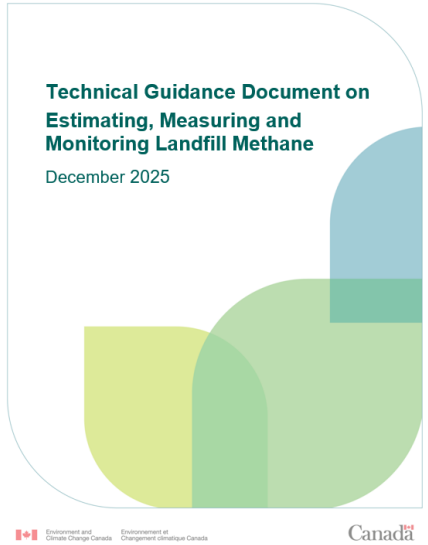
December 2025

Environment and Climate Change Canada

Environment and Climate Change Canada
Environnement et Changement climatique Canada

Canada

Modelling Tool Resources



Technical Guidance Document

This document was developed to provide a Canadian technical reference on estimating, measuring and monitoring landfill methane generation and emissions. The technical guidance document also provides instructions for the ECCC Landfill Methane Modelling Tool.

Landfill Methane Modelling Tool

The Landfill Methane Modelling Tool is an excel spreadsheet that calculates methane generation at Canadian landfills using a first order decay model.

Technical Guidance Document and Model are available on LMR Google Drive or upon request

How the Modelling Tool Works

INPUT → **WASTE COMPOSITION (optional)** → **DIVERSION (optional)** → **RESULTS**

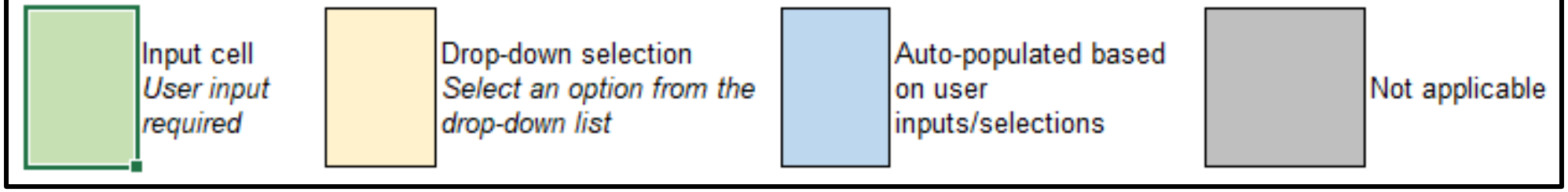
The user must first complete all sections: Landfill Information (opening/closing year, location), Model Parameters, and Annual Waste Disposed.

The user can input site specific waste composition data, if available, for bulk MSW disposed at the site. These values would replace the default provincial and territorial-specific waste composition values included in the tool.

The user can input annual quantities of biodegradable waste that could be diverted from the landfill for future years, either by mass (tonnes) or as a percentage (%). Diverted biodegradable waste is entered by waste category (e.g. Food, Soiled Paper, Yard and Garden, Paper and Wood).

Displays on a graph and table the estimated annual methane generation (tonnes/year) for scenarios with and without biodegradable waste diversion.

Cell colours for the 'INPUT', 'WASTE COMPOSITION' and 'DIVERSION' worksheets are defined as follows:



Input Worksheet – Landfill Information

Enter Landfill Information

- Name
- Province (select from dropdown)
- Opening Year
- Closing Year

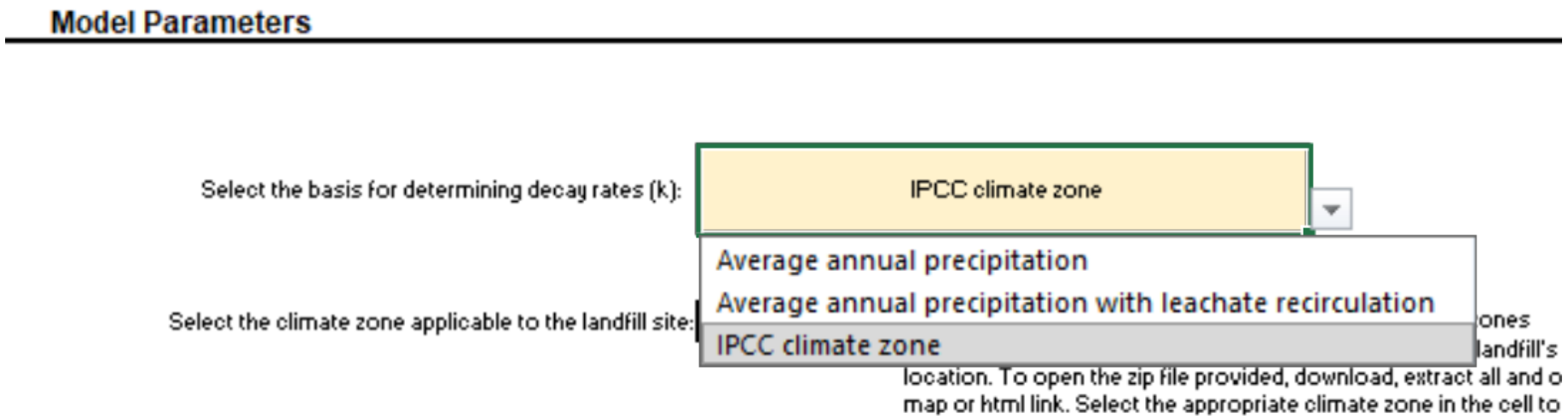
Landfill Information

Landfill name:			GHGRP ID:	(if applicable)
Province:	AB	*The landfill location determines which provincial or territorial time-series waste composition will be used in the model*		
Landfill opening year:	2020	*The first year the landfill began receiving waste (the earliest possible year in the model is 1941)*		
Landfill closing year:	2040	*The last year in which the landfill received waste (either a known year for closed landfills, or estimated for active landfills)*		

Input Worksheet – Model Parameters (Decay Rate)

Select basis for decay rate (k) category

- IPCC Climate Zone
- Average Annual Precipitation
- Average Annual Precipitation with leachate recirculation



Input Worksheet – IPCC Climate Zone

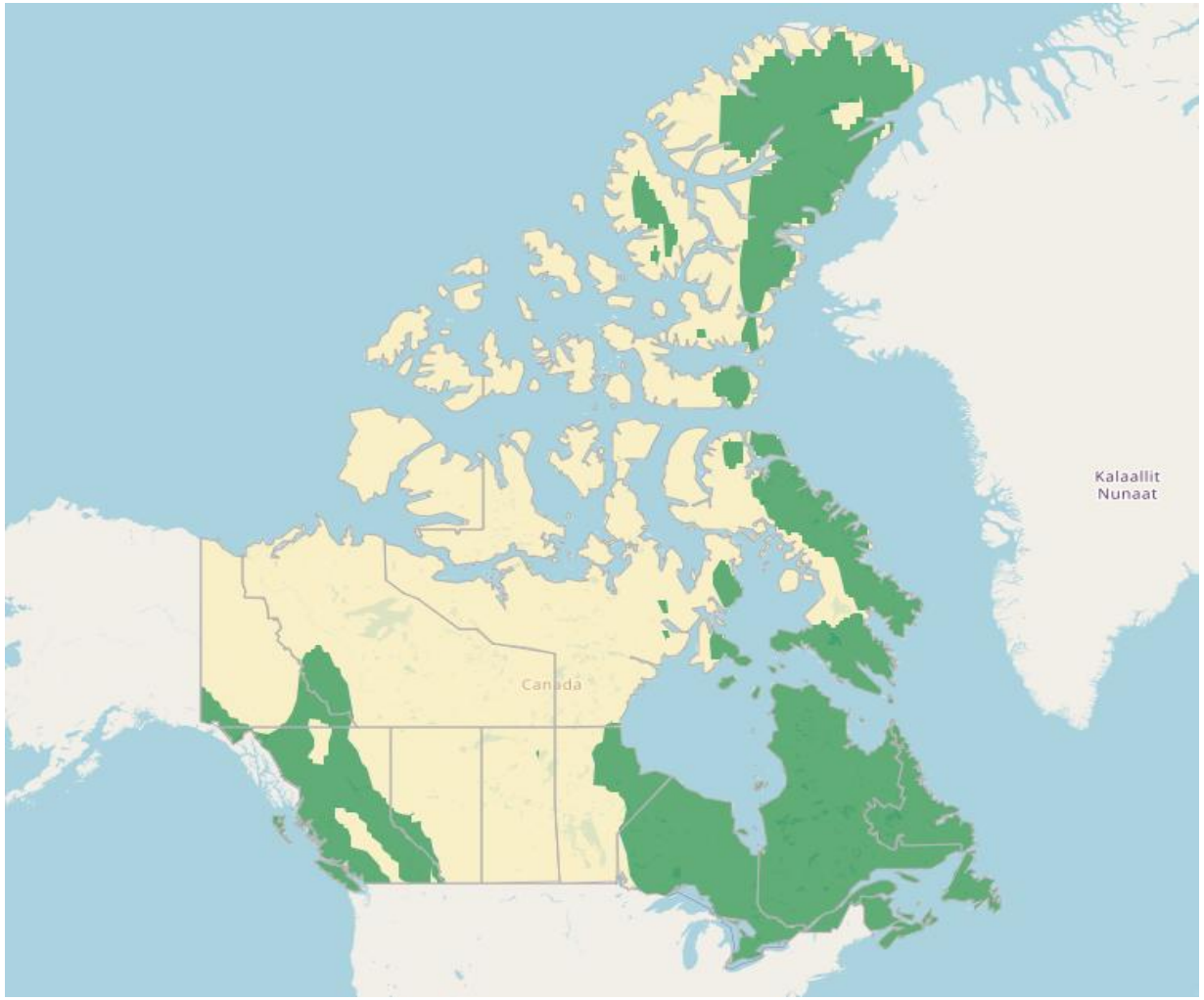
IPCC “Boreal and Temperate” Climate Zone categories are applicable in Canada (mean annual temperature < 20°C):

- "IPCC Dry" - MAP/PET<1
- "IPCC Wet" - MAP/PET>1

MAP = Mean annual precipitation
PET = Potential evapotranspiration

If “IPCC Climate Zone” is selected, the user must select the climate zone applicable to the landfill.

Maps are provided in .pdf and .html format showing “Dry” and “Wet” regions in Canada:
Climate zones climatiques



Input Worksheet – Average Annual Precipitation

If “Average Annual Precipitation” is selected, the user must enter the annual average precipitation obtained from the nearest weather station.

Model Parameters

Select the basis for determining decay rates (k): Average annual precipitation

Enter annual precipitation: 966 mm

Annual Precipitation: In order to obtain the average annual precipitation, please use the link provided below to access the Canadian Climate Normals data. Under the tab "1991-2020", select the nearest weather station. On the next screen, select the "Normals Data" tab and scroll to the "Precipitation" table. The annual precipitation (in mm) is provided in the column titled "Year". Enter this number in the cell to the left.

Canadian Climate Normals

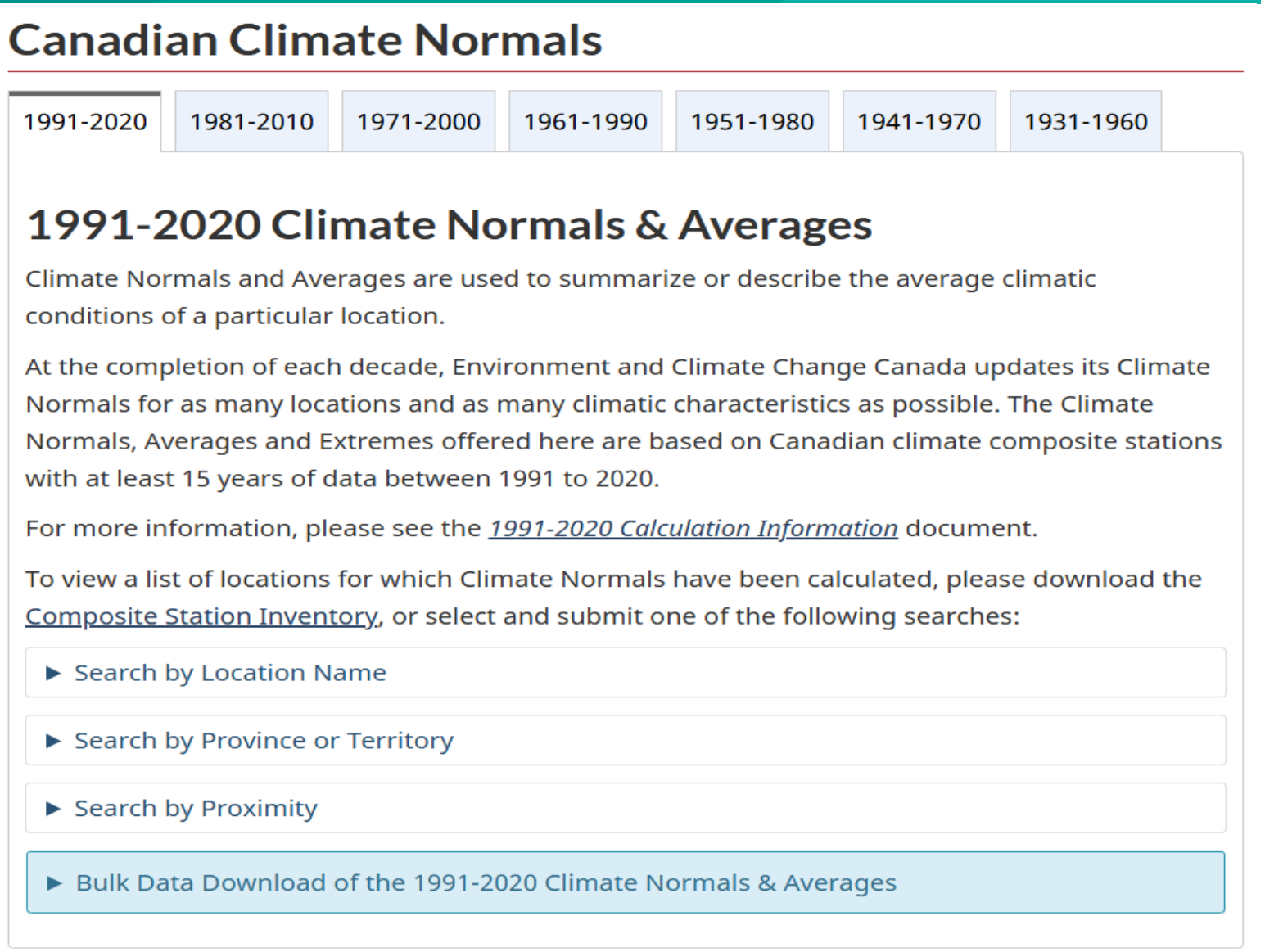
Decay rate precipitation category: >500 to 1000mm

Input Worksheet – Average Annual Precipitation

Average annual precipitation values can be obtained from the following webpage:

[Canadian Climate Normals - Climate - Environment and Climate Change Canada]

Search the nearest weather station by “Location Name”, “Province or Territory” or by “Proximity”.



Canadian Climate Normals

1991-2020 | 1981-2010 | 1971-2000 | 1961-1990 | 1951-1980 | 1941-1970 | 1931-1960

1991-2020 Climate Normals & Averages

Climate Normals and Averages are used to summarize or describe the average climatic conditions of a particular location.

At the completion of each decade, Environment and Climate Change Canada updates its Climate Normals for as many locations and as many climatic characteristics as possible. The Climate Normals, Averages and Extremes offered here are based on Canadian climate composite stations with at least 15 years of data between 1991 to 2020.

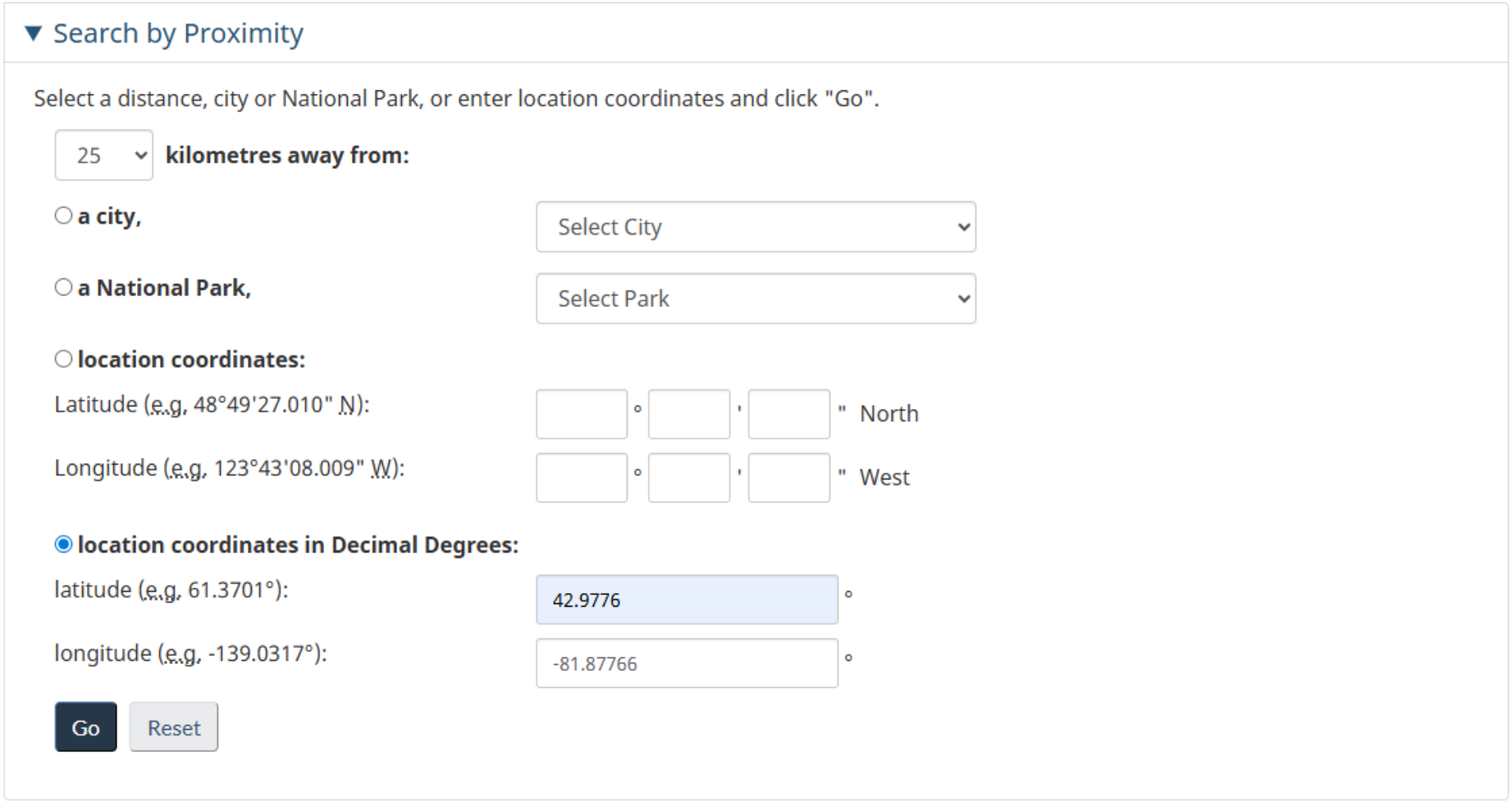
For more information, please see the *1991-2020 Calculation Information* document.

To view a list of locations for which Climate Normals have been calculated, please download the Composite Station Inventory, or select and submit one of the following searches:

- ► Search by Location Name
- ► Search by Province or Territory
- ► Search by Proximity
- ► Bulk Data Download of the 1991-2020 Climate Normals & Averages

Input Worksheet – Average Annual Precipitation

Click “Search by Proximity” and enter the latitude and longitude of the landfill.



Input Worksheet – Average Annual Precipitation

01 Select the location closest to the landfill.

02 Click on the tab called “Normals Data”.

03 Scroll to the table called “Precipitation”.

04 Annual average precipitation value available in “Year” column.

▼ Precipitation

1991 to 2020 Canadian Climate Normals Data

Precipitation

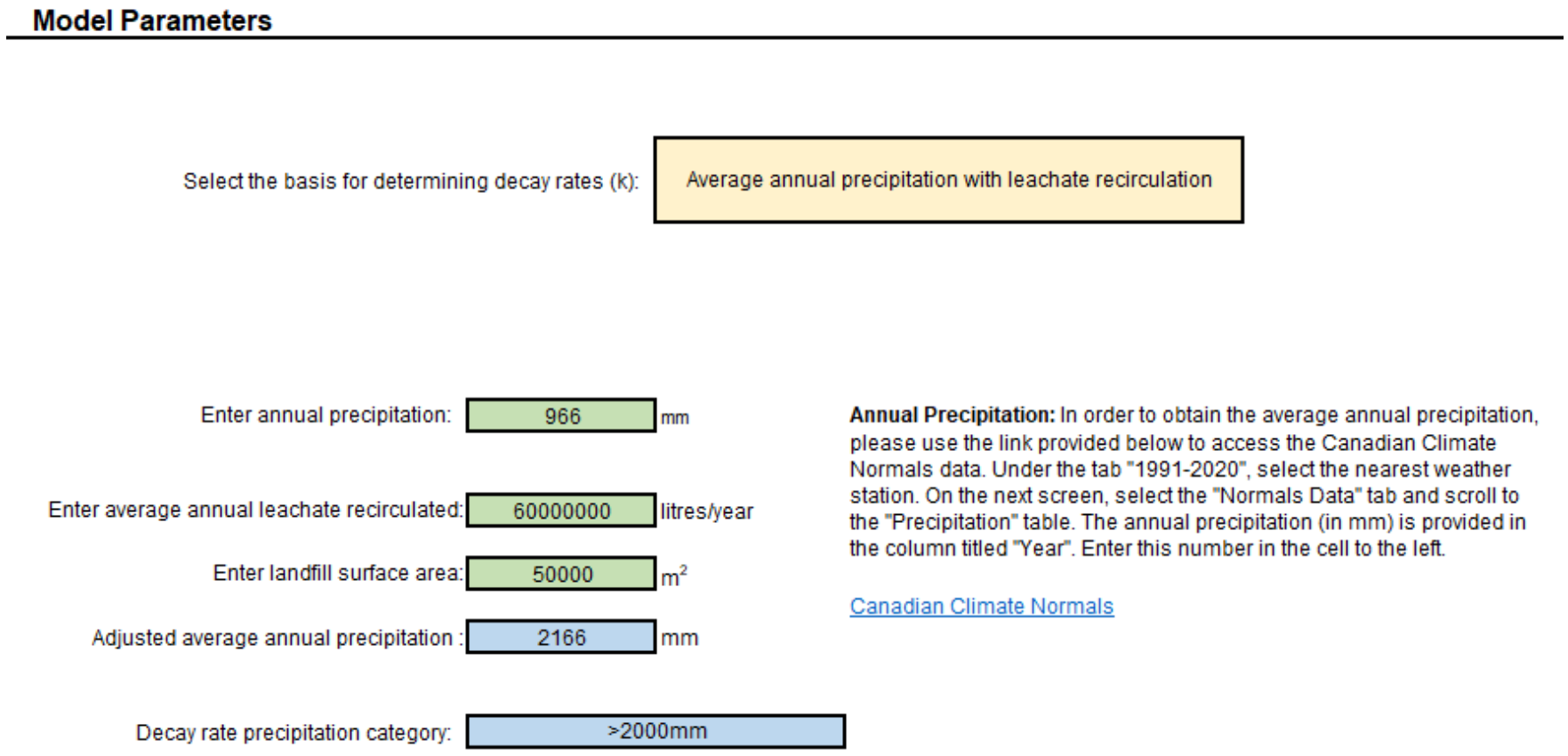
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year	Code
Rainfall (mm)	38.1	29.5	45.7	82.8	84.3	86.2	77.6	80.8	87.7	82.1	76.2	41.3	812.2	A
Snowfall (cm)	42.7	32.2	20.4	4.9	0.1	0.0	0.0	0.0	0.0	2.2	13.3	36.5	152.3	A
Precipitation (mm)	80.8	61.7	66.1	87.7	84.4	86.2	77.6	80.8	87.7	84.1	89.5	79.0	965.5	A
Average Snow Depth (cm)	11	12	4	0	0	0	0	0	0	0	1	5	3	A
Median Snow Depth (cm)	10	12	3	0	0	0	0	0	0	0	0	4	2	A
Snow Depth at Month-end (cm)	13	9	0	0	0	0	0	0	0	0	2	7	3	A

Input Worksheet – Average Annual Precipitation with Leachate Recirculation

01 If “Average annual precipitation with leachate recirculation” is selected, enter the annual precipitation following the steps on slide 9 through 11.

02 Enter the average annual leachate recirculated (in litres/year).

03 Enter landfill surface area (in m^2).



Input Worksheet – Annual Waste Disposal – Options

01 Select whether waste quantities will be entered as “Bulk MSW” or “Sector of Origin”.

- ❖ “Sector of Origin” requires annual disposal data for each sector (Residential, ICI and C&D).
- ❖ “Bulk MSW” includes all Residential, ICI and C&D waste.

02 Specify if user-defined waste composition percentages will be entered.

03 Specify if waste diversion will be modelled and indicate the first year of diversion.

Annual Waste Disposal

Will annual waste disposed be entered as bulk MSW or by sector of origin (Residential, ICI, C&D)?	Bulk MSW	
Do you want to enter user-defined waste composition percentages?	Yes	Note: If you have selected "yes", please provide additional input in the "WASTE COMPOSITION" sheet
Do you want to model the impact of future diversion of biodegradable waste?	Yes	Note: If you have selected "yes", please provide additional input in the "DIVERSION" sheet.
First year of diversion.	2026	

	Annual Waste Disposed (Prior to Diversion)						
Year	Bulk Municipal Solid Waste	Residential Waste	ICI Waste	C&D Waste	Wastewater sludge or biosolids (wet weight)	Soil (Contaminated or other soils - does not include landfill cover)	Total Waste Disposed
	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes
1960	100,000				5,000	10,000	115,000
1961	100,000				5,000	10,000	115,000
1962	100,000				5,000	10,000	115,000
1963	100,000				5,000	10,000	115,000
1964	100,000				5,000	10,000	115,000
1965	100,000				5,000	10,000	115,000

Input Worksheet – Annual Waste Disposal – Bulk MSW

01 Enter annual quantity (in tonnes) of bulk MSW disposed for each year of landfill operation.

02 Enter annual quantity (in tonnes) of wastewater sludge and soil, which should not be included in the Bulk MSW totals.

- "Soil" includes contaminated or other soils but not landfill cover.

Annual Waste Disposal

Will annual waste disposed be entered as bulk MSW or by sector of origin (Residential, ICI, C&D)?	Bulk MSW	
Do you want to enter user-defined waste composition percentages?	Yes	Note: If you have selected "yes", please provide additional input in the "WASTE COMPOSITION" sheet
Do you want to model the impact of future diversion of biodegradable waste?	Yes	Note: If you have selected "yes", please provide additional input in the "DIVERSION" sheet.
First year of diversion.	2026	

	Annual Waste Disposed (Prior to Diversion)						
Year	Bulk Municipal Solid Waste	Residential Waste	ICI Waste	C&D Waste	Wastewater sludge or biosolids (wet weight)	Soil (Contaminated or other soils - does not include landfill cover)	Total Waste Disposed
	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes
1960	100,000				5,000	10,000	115,000
1961	100,000				5,000	10,000	115,000
1962	100,000				5,000	10,000	115,000
1963	100,000				5,000	10,000	115,000
1964	100,000				5,000	10,000	115,000
1965	100,000				5,000	10,000	115,000

Input Worksheet – Annual Waste Disposed – Sector of Origin

01 Enter annual quantity (tonnes) of Residential, ICI and C&D waste for each year of landfill operation.

02 Enter annual quantity of wastewater sludge and soil, which should not be included in the sector waste totals.

- "Soil" includes contaminated or other soils but not landfill cover.

Annual Waste Disposal

Will annual waste disposed be entered as bulk MSW or by sector of origin (Residential, ICI, C&D)?	Sector of Origin	
Do you want to enter user-defined waste composition percentages?	No	Note: If you have selected "yes", please provide additional input in the "WASTE COMPOSITION" sheet
Do you want to model the impact of future diversion of biodegradable waste?	No	Note: If you have selected "yes", please provide additional input in the "DIVERSION" sheet.
First year of diversion.	2026	

	Annual Waste Disposed						
Year	Bulk Municipal Solid Waste	Residential Waste	ICI Waste	C&D Waste	Wastewater sludge or biosolids (wet weight)	Soil (Contaminated or other soils - does not include landfill cover)	Total Waste Disposed
	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes	tonnes
1960		50,000	25,000	25,000	5,000	10,000	115,000
1961		50,000	25,000	25,000	5,000	10,000	115,000
1962		50,000	25,000	25,000	5,000	10,000	115,000
1963		50,000	25,000	25,000	5,000	10,000	115,000
1964		50,000	25,000	25,000	5,000	10,000	115,000
1965		50,000	25,000	25,000	5,000	10,000	115,000

- Note - If "Sector of Origin" waste disposal is selected, it is not possible to enter user-defined waste composition or model the impact of diversion. Ensure "No" is selected in grey-shaded cells.

Input Worksheet – Annual Waste Disposed Not Available

For years where detailed disposal data is not available (for example, prior to the installation of weigh scales at the landfill), quantities of annual waste disposed must be estimated. The following approaches may be used to populate missing disposal data:

- Multiply the estimated population served by the landfill in each year by an appropriate per capita waste disposal rate. The per capita disposal rate may be based on existing landfill-specific waste disposal and population data (for a year where this data is available). Provincial/territorial per capita waste disposal rates may also be used, if available.

- Use any available estimates of total waste disposed ("waste-in-place") for specific years in the landfill's history (for example, based on a topographic or aerial survey). The difference between any two waste-in-place values can be distributed across the intervening years evenly (or based on other assumptions). If the waste-in-place data is in volumetric units (e.g., cubic metres), an appropriate waste density value (based on the procedures employed at the landfill including compaction, cover material, cover frequency, etc.) should be used to estimate the waste mass in tonnes.

- Extrapolate the waste quantity for the first year for which waste quantities are available backwards in time to the landfill's opening year.

Waste Composition Worksheet (Optional)

Where option to provide user-defined waste composition data is selected (bulk waste only), this data is entered in the "WASTE COMPOSITION" worksheet.

- Values must be entered in the green-shaded "User-Defined" columns for all years and for all waste materials.
- For years where user-defined data is not available, default bulk waste composition values (provided in "Default" columns) must be entered in the "User-Defined" cells.

Year	P/T	Food		Paper		Soiled Paper		Wood		Yard and Garden		Diapers and Sanitary		Pet Waste	
		Default	User-Defined	Default	User-Defined	Default	User-Defined	Default	User-Defined	Default	User-Defined	Default	User-Defined	Default	User-Defined
1960	ON	12%	10%	43%	30%	0%	6%	2%	7%	11%	10%	0%	0%	0%	3%
1961	ON	12%	10%	43%	30%	0%	6%	2%	7%	11%	10%	0%	0%	0%	3%
1962	ON	12%	10%	43%	30%	0%	6%	2%	7%	11%	10%	0%	0%	0%	3%
1963	ON	12%	10%	43%	30%	0%	6%	2%	7%	11%	10%	0%	0%	0%	3%
1964	ON	12%	10%	43%	30%	0%	6%	2%	7%	11%	10%	0%	0%	0%	3%
1965	ON	12%	10%	43%	30%	0%	6%	2%	7%	11%	10%	0%	0%	0%	3%

Rubber and Leather		Textiles		Other - Unknown		Inert		Check	Reference/Source
Default	User-Defined	Default	User-Defined	Default	User-Defined	Default	User Defined		
0.3%	3%	1%	1%	0%	3%	27%	27%	100%	
0.3%	3%	1%	1%	0%	3%	27%	27%	100%	
0.3%	3%	1%	1%	0%	3%	27%	27%	100%	
0.3%	3%	1%	1%	0%	3%	27%	27%	100%	
0.3%	3%	1%	1%	0%	3%	27%	27%	100%	
0.3%	3%	1%	1%	0%	3%	27%	27%	100%	

User-defined values may be sourced from available waste audits completed for municipalities generating waste disposed at the landfill, or from waste audits completed at the landfill.

Ensure the totals add to 100% in the "Check" column.

Diversion Worksheet (Optional)

Where option to model impact of diversion is selected (bulk waste only), information is entered in the "DIVERSION" worksheet.

- Diversion targets (expressed as percentages or tonnages) for future years may be entered in the green-shaded "Diversion target" columns for any materials.
- Baseline disposal quantities are provided for reference where diversion target is expressed in tonnes or percentage.
- Diversion targets need only be entered for those materials and years of interest.

Year	Food			Soiled Paper			Yard and Garden			Paper			Wood		
	Baseline Disposal	Diversion target	Disposal with diversion	Baseline Disposal	Diversion target	Disposal with diversion	Baseline Disposal	Diversion target	Disposal with diversion	Baseline Disposal	Diversion target	Disposal with diversion	Baseline Disposal	Diversion target	Disposal with diversion
	tonnes	%	tonnes	tonnes	%	tonnes	tonnes	%	tonnes	tonnes	%	tonnes	tonnes	%	tonnes
2026	10,000	50%	5,000	6,000	60%	2,400	10,000	40%	6,000	30,000	25%	22,500	7,000	40%	4,200
2027	10,000	60%	4,000	6,000	65%	2,100	10,000	45%	5,500	30,000	25%	22,500	7,000	50%	3,500
2028	10,000	60%	4,000	6,000	65%	2,100	10,000	50%	5,000	30,000	45%	16,500	7,000	45%	3,850
2029	10,000	60%	4,000	6,000	70%	1,800	10,000	45%	5,500	30,000	45%	16,500	7,000	30%	4,900
2030	10,000	70%	3,000	6,000	70%	1,800	10,000	45%	5,500	30,000	45%	16,500	7,000	40%	4,200

Diapers and Sanitary			Pet Waste			Textiles			Total Waste Diverted
Baseline Disposal	Diversion target	Disposal with diversion	Baseline Disposal	Diversion target	Disposal with diversion	Baseline Disposal	Diversion target	Disposal with diversion	
tonnes	%	tonnes	tonnes	%	tonnes	tonnes	%	tonnes	tonnes
0	30%	0	3,000	50%	1,500	1,000	10%	900	24,500
0	30%	0	3,000	40%	1,800	1,000	25%	750	26,850
0	40%	0	3,000	55%	1,350	1,000	25%	750	33,450
0	40%	0	3,000	55%	1,350	1,000	30%	700	32,250
0	30%	0	3,000	55%	1,350	1,000	35%	650	34,000

Results Worksheet

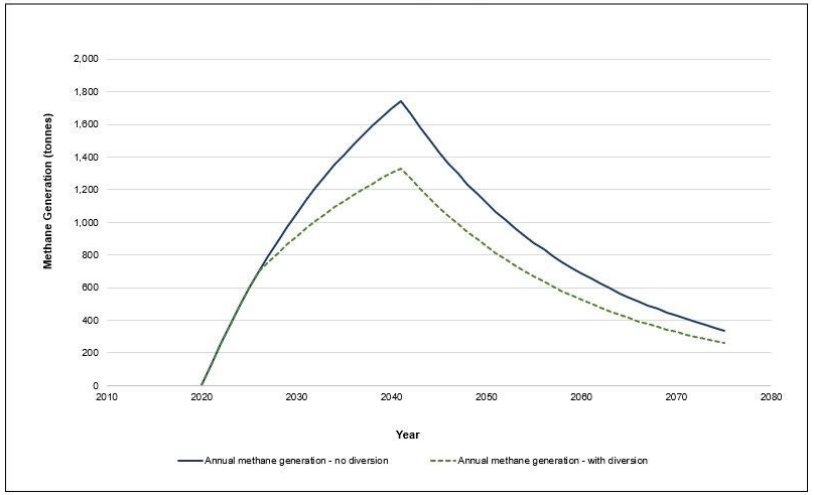
"RESULTS" worksheet provides:

- Graph of annual methane generation (showing impact of diversion, if modelled)
- Table with quantities of annual waste disposed, waste in place and methane generation (in tonnes, m^3 of methane and scfm LFG)
- Summary of model parameters used in calculation

Landfill Methane Modelling Tool: Results **Landfill Name: Landfill**

Year opened: 2020 **Province :** AB

Closure year: 2040



Year	Total Annual Waste Disposed	Total Waste in Place	Methane generation (no diversion)		
	tonnes/year	tonnes	tonnes/year	m^3 methane/year	scfm LFG (standard cubic feet per minute)
2020	50,000	50,000	0	0	0
2021	50,000	100,000	133	202,245	27
2022	50,000	150,000	257	392,112	53
2023	50,000	200,000	376	572,610	77
2024	50,000	250,000	488	744,216	100
2025	50,000	300,000	595	907,382	122
2026	50,000	350,000	697	1,062,536	143
2027	50,000	400,000	794	1,210,083	163
2028	50,000	450,000	886	1,350,408	182
2029	50,000	500,000	973	1,483,877	200
2030	50,000	550,000	1,057	1,610,835	217
2031	50,000	600,000	1,136	1,731,610	233
2032	50,000	650,000	1,211	1,846,514	248
2033	50,000	700,000	1,283	1,955,842	263
2034	50,000	750,000	1,351	2,059,873	277
2035	50,000	800,000	1,416	2,158,874	290
2036	50,000	850,000	1,478	2,253,095	303

Total Annual Waste Disposed (with diversion)	Methane generation (with diversion)			
tonnes/year	tonnes/year	m^3 methane/year	scfm LFG (standard cubic feet per minute)	% reduction
50,000	0	0	0	0%
50,000	133	202,245	27	0%
50,000	257	392,112	53	0%
50,000	376	572,610	77	0%
50,000	488	744,216	100	0%
50,000	595	907,382	122	0%
40,484	697	1,062,536	143	0%
40,484	755	1,151,558	155	5%
40,484	811	1,236,255	166	8%
40,484	864	1,316,844	177	11%
40,484	914	1,393,530	187	13%
40,484	962	1,466,509	197	15%
40,484	1,008	1,535,967	207	17%
40,484	1,051	1,602,079	215	18%
40,484	1,092	1,665,013	224	19%
40,484	1,132	1,724,927	232	20%
40,484	1,169	1,781,970	240	21%

User-selected and Default Model parameters

The following material parameters were used in the methane generation calculations, based on user selections and inputs:

Waste Type	Decay Rate (k) (User-selected)	DOC (Default)	DOC_f (Default)
	IPCC climate zone		
	IPCC Dry		
Food	0.06	0.15	0.7
Paper	0.04	0.4	0.5
Yard and Garden	0.05	0.2	0.7
Soiled Paper	0.05	0.4	0.5
Wood	0.02	0.43	0.1
Textiles	0.04	0.24	0.5
Pet Waste	0.06	0.24	0.5
Diapers and Sanitary	0.05	0.24	0.5
Rubber and Leather	0.02	0.39	0.1
Other - Residential	0.05	0.1	0.5
Other - ICI	0.05	0.05	0.5
Other - Unknown	0.05	0.05	0.5
Sludge	0.06	0.05	0.7
Soil	0.02	0.03	0.1

Other Parameters and Defaults		Constants	
Methane Correction Factor (MCF)	1	Molar ratio of CH_4:C	1.33
CH_4 content in LFG (%CH_4)	50%	CH_4 density (at 25 °C and 1 atm) (kg/m^3)	0.656

Questions?

Contact: rmle-lmr@ec.gc.ca