GeoIgnite
OTTAWA 2025

Open Building Population Layer for Canada: A Game-Changer in High-Resolution Population Data

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About

- This is a personal project!
- Opinions shared are my own
- All project details available at www.maximfortin.com

flood + water resources engineer
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public servant
recent dad

A deep dive in building and population data…

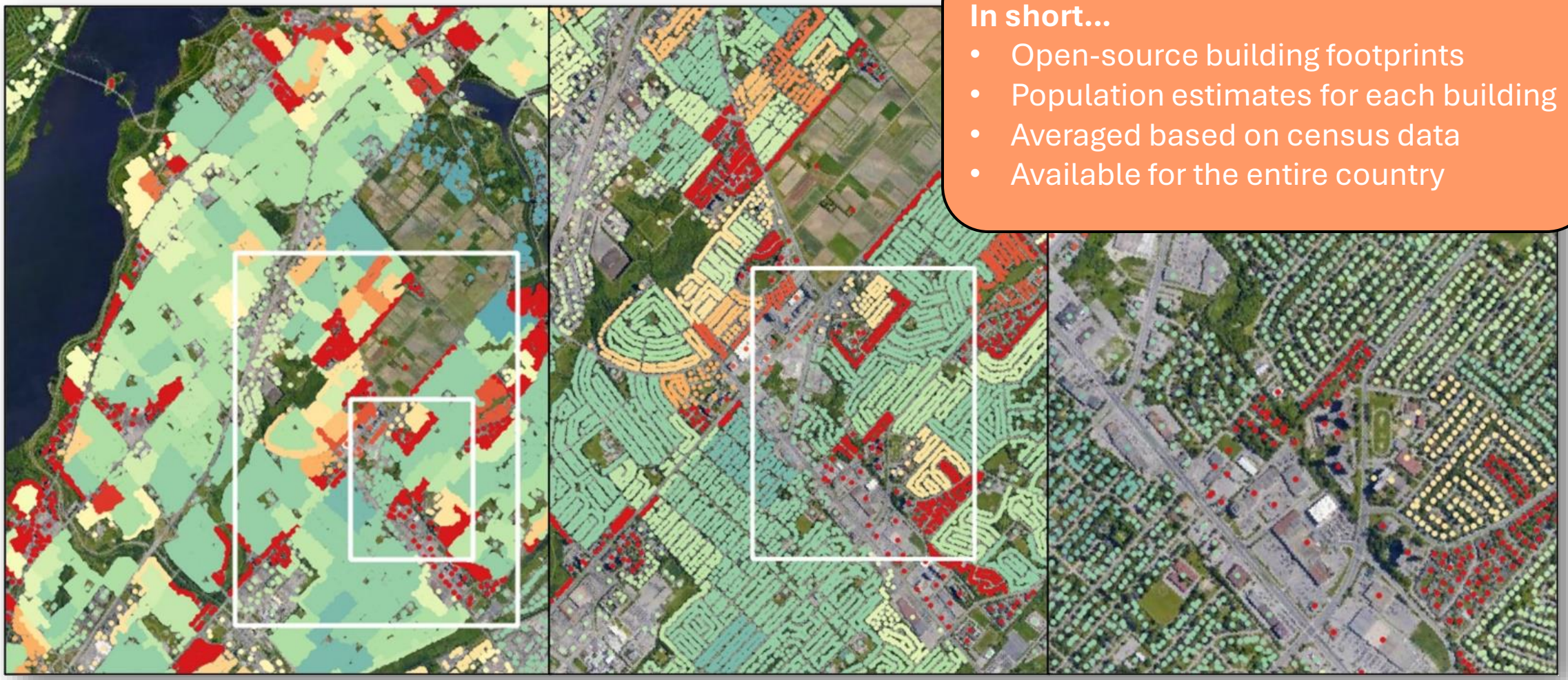
- What is “building population”?
- Why was this project created?
  - Potential use cases
  - Existing population data
  - Existing building footprint data
- How was the data layer developed?
  - Data sources
  - Methodology
  - QA/QC
  - Project timeline
  - Data availability
  - Limitations
- Initial reception, next steps and closing thoughts

Open Building Population Layer (Canada), 2025

What is building population?

In short...

- Open-source building footprints
- Population estimates for each building
- Averaged based on census data
- Available for the entire country



Open Building Population Layer (Canada), 2025

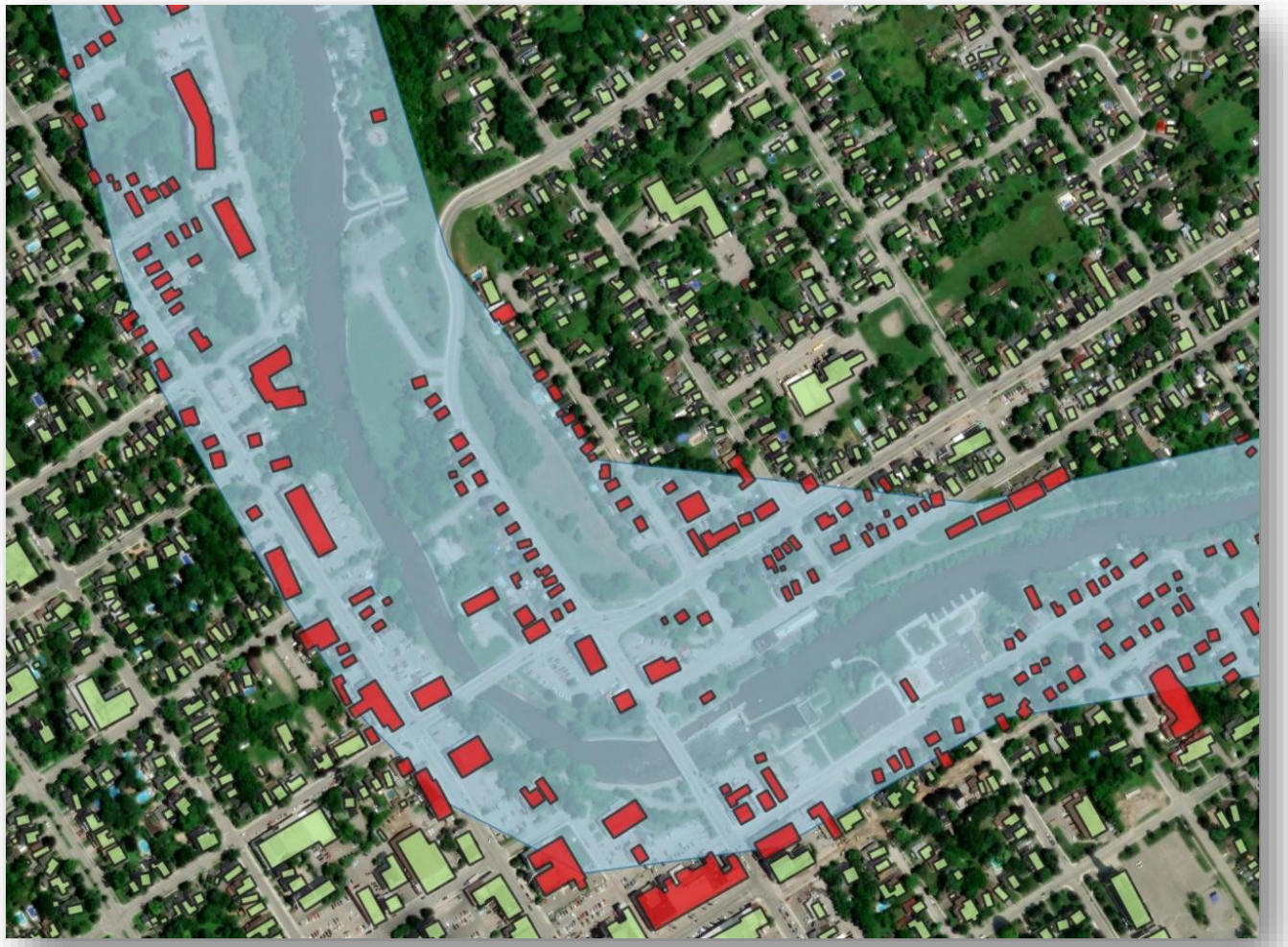
Why was this project created?

- Highly detailed population density datasets are available as proprietary products
- Products available to the public lacked detail required for geospatial processing
- Why not produce something different?

Open Building Population Layer (Canada), 2025

Example use cases

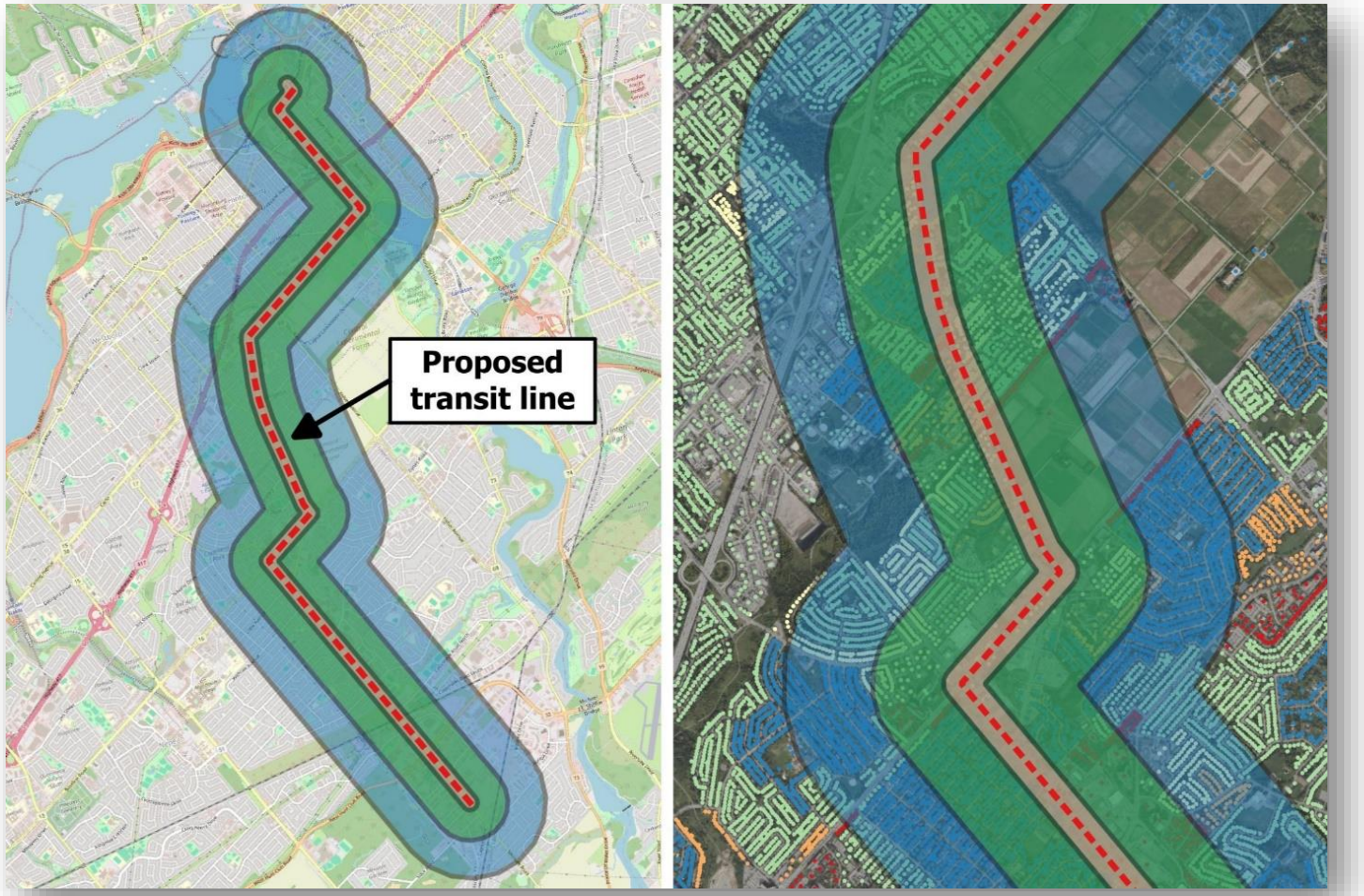
- Population exposure to flooding:
  - Often reported as buildings, but residential population estimates difficult to obtain
  - Useful for high-level estimates when intersecting with inundation extents or flood hazard maps
  - Prioritization studies, risk assessments, etc.



Open Building Population Layer (Canada), 2025

Example use cases

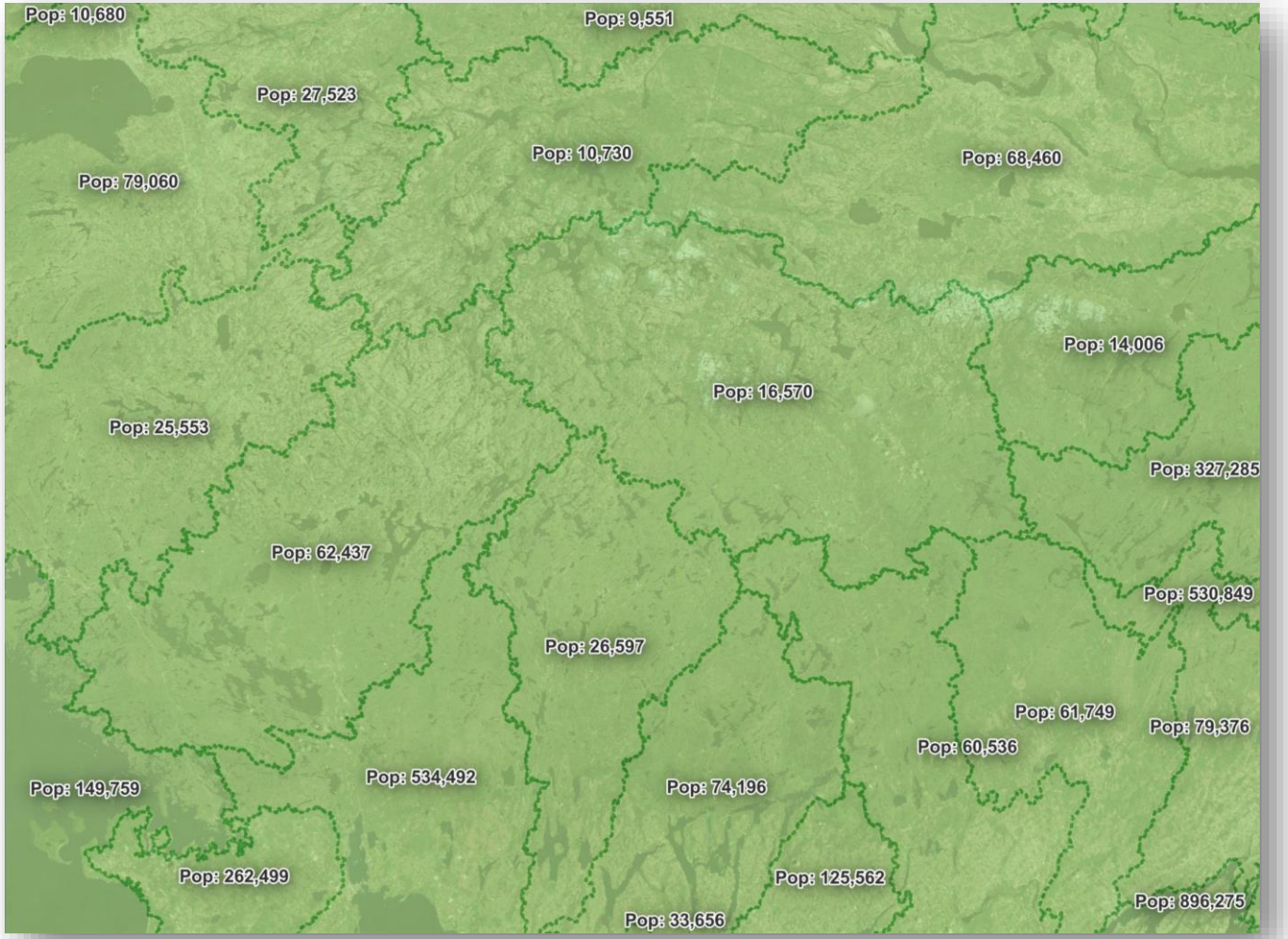
- Transportation:
  - Population living within a given radius of a proposed new transit line
  - Buffers of 100m, 500m and 1000m created on transit line, with population sum for each buffer area



Open Building Population Layer (Canada), 2025

Example use cases

- Any population estimate in irregular but detailed areas:
  - Watershed boundaries
  - Cell network / telecoms
  - Retail site selection
  - Service area analysis
  - Public health & epidemiology
  - Etc.

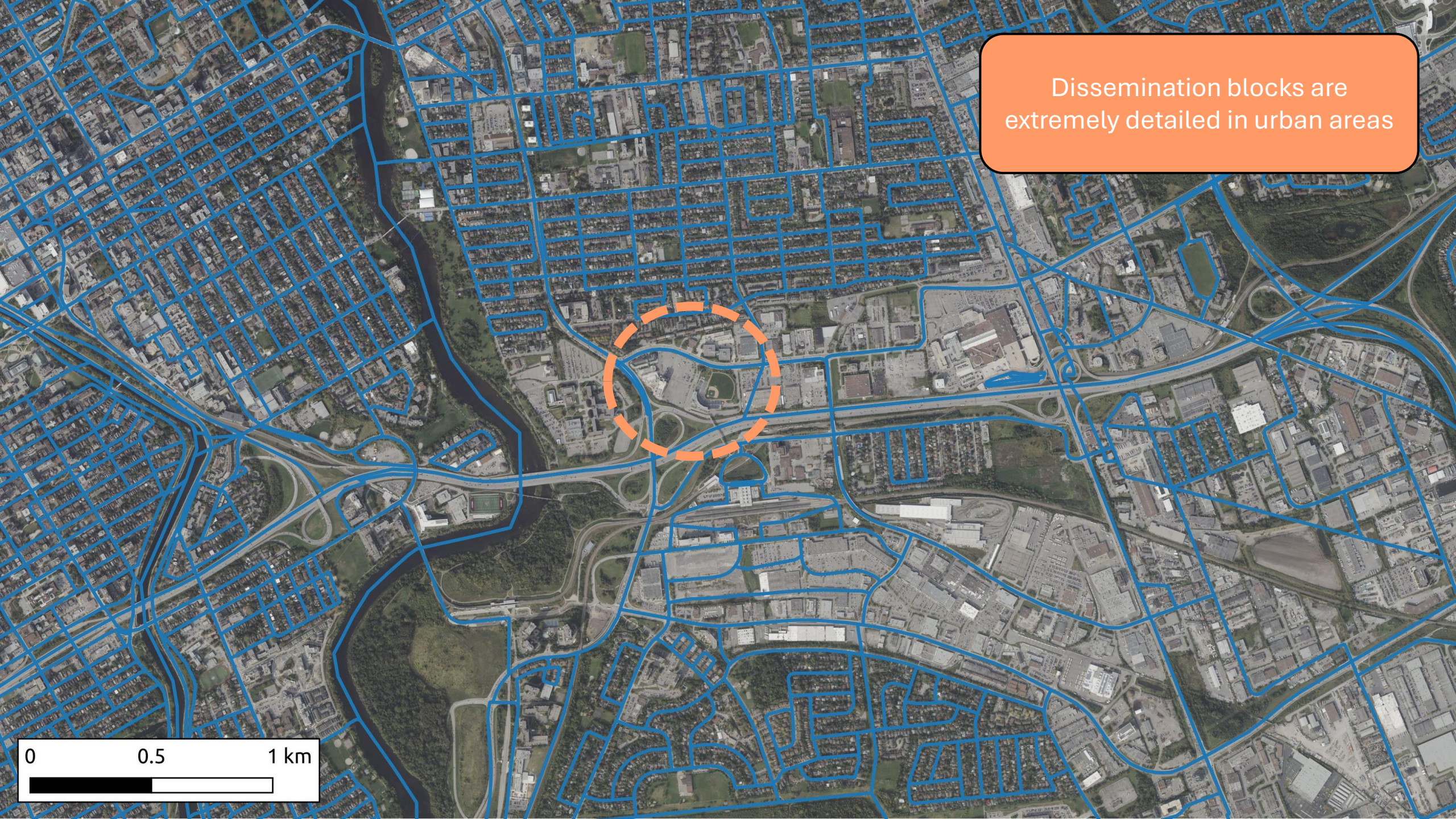


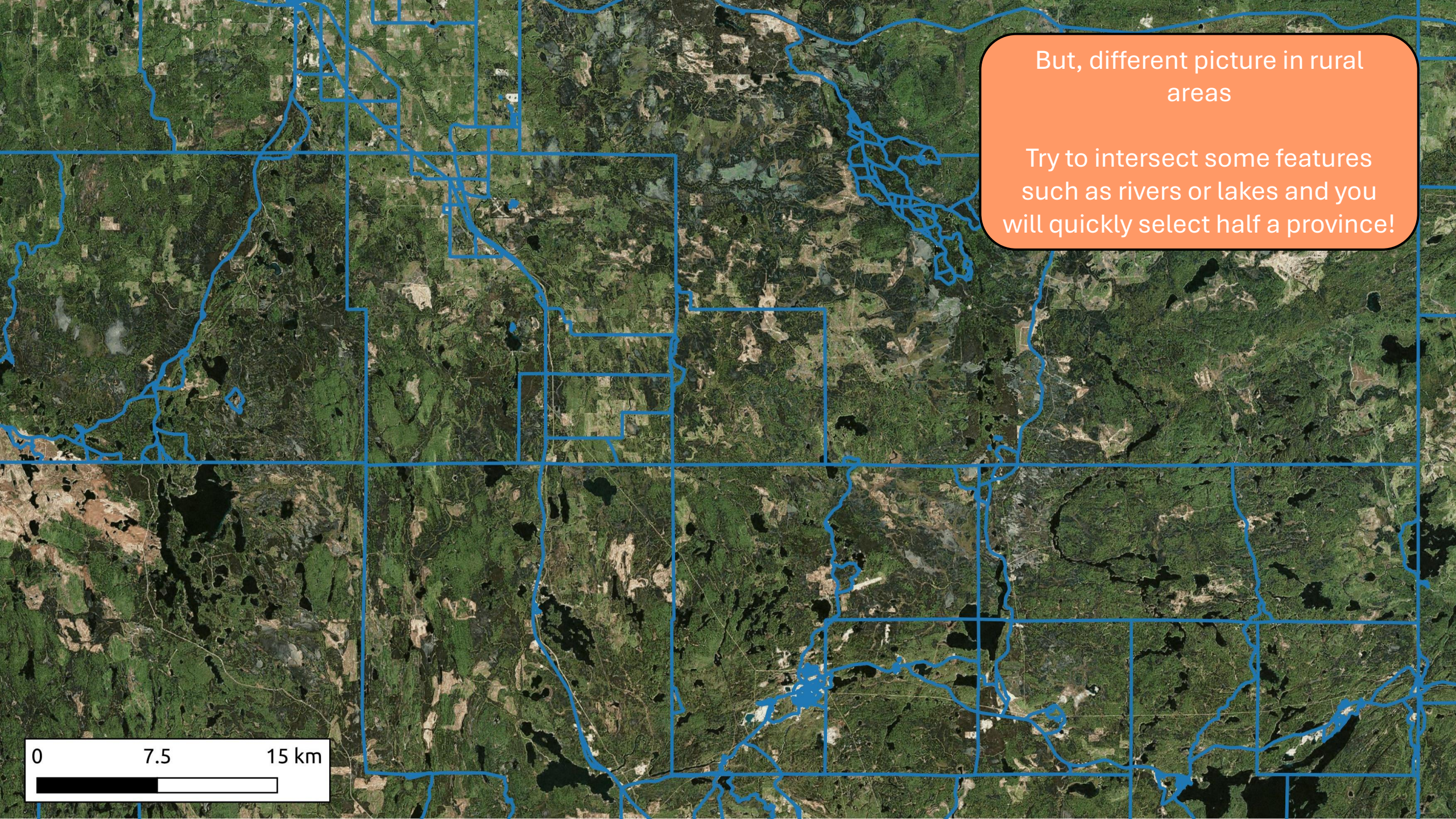
Open Building Population Layer (Canada), 2025

Existing population data

- 2021 Canada Census:

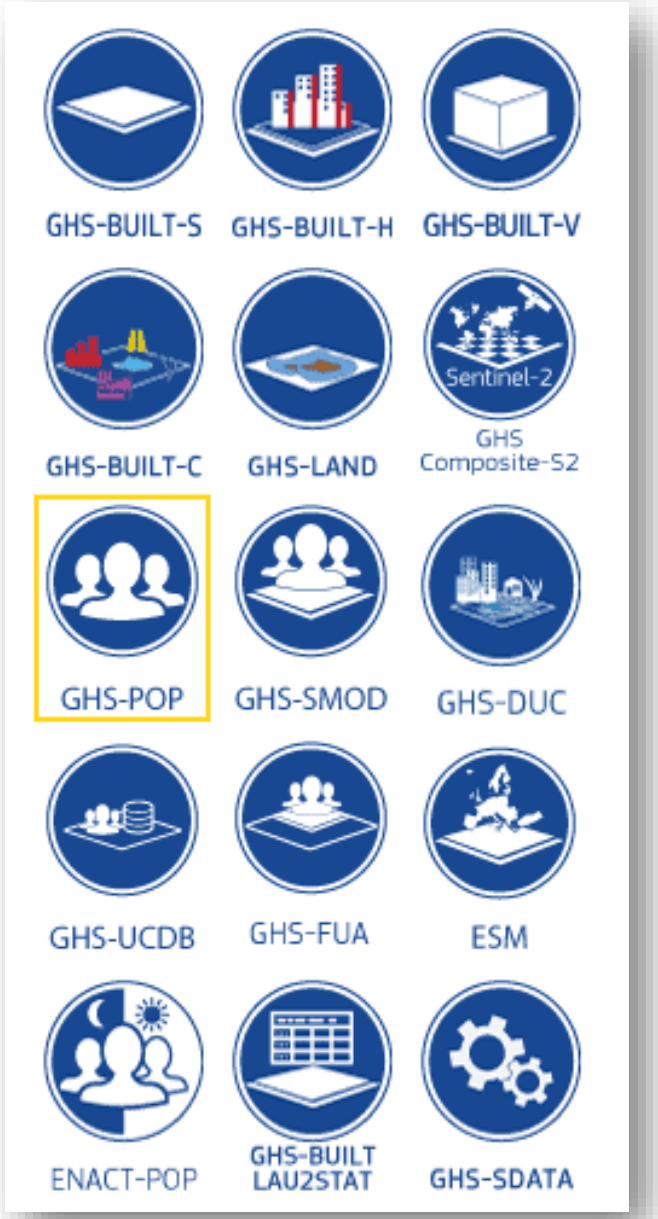
Key geographic units	Description	Count
Dissemination block	Smallest area for which population and dwelling counts are disseminated (~30-60 households)	498,786
Dissemination area	One or more neighboring dissemination blocks (~500 people), smallest standard geographic area for which ALL census data are disseminated	57,936
Census subdivision	Municipalities or equivalent territories	5,161
Census division	Group of neighboring municipalities joined together for regional planning, intermediate level between municipality and province/territory	293


Dissemination blocks are extremely detailed in urban areas
0
0.5
1 km

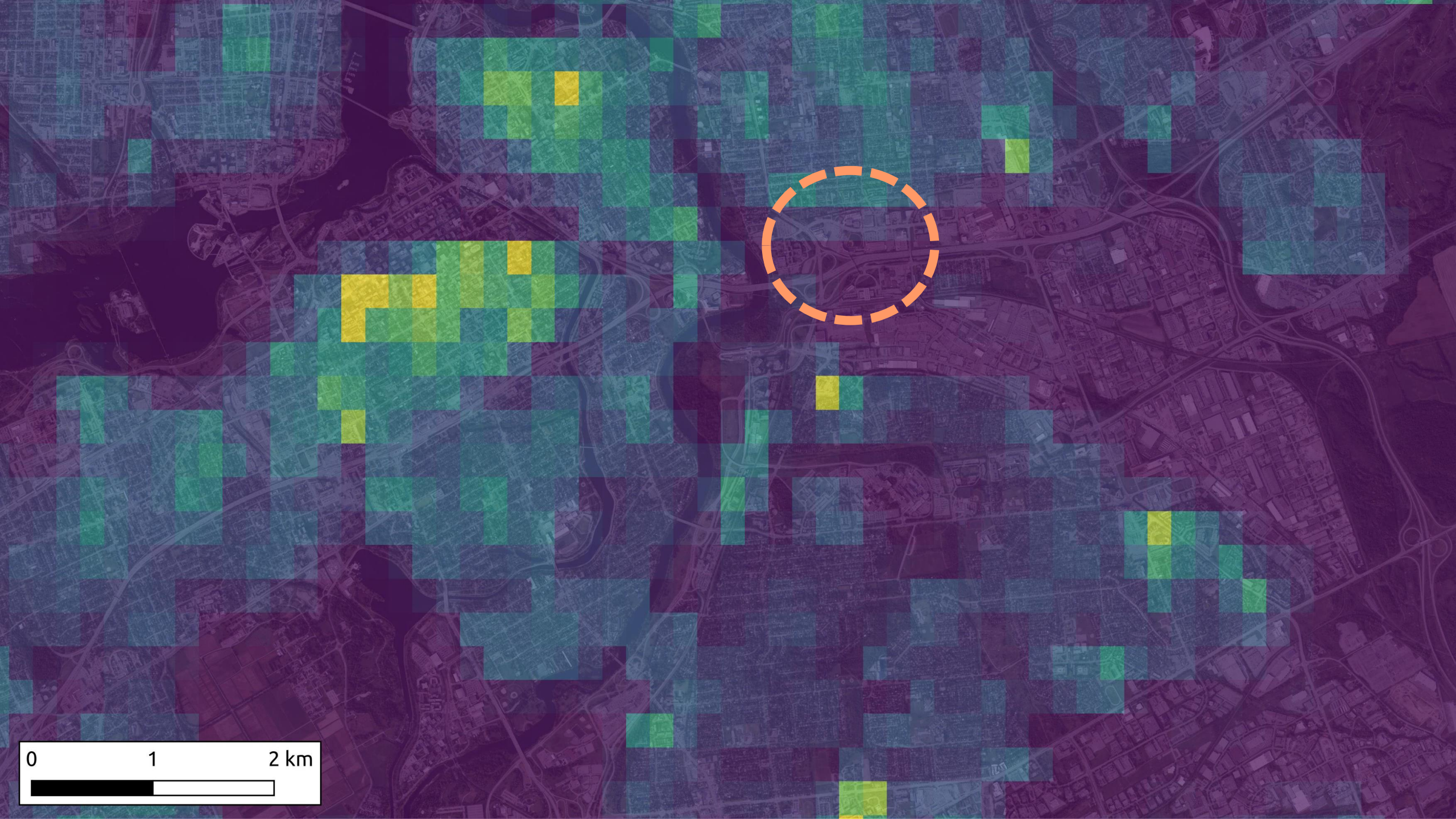

But, different picture in rural areas
Try to intersect some features such as rivers or lakes and you will quickly select half a province!
0
7.5
15 km

Existing population data

- Statistics Canada:
  - Population of Canada, 10Km Gridded
  - Canada Ecumene Population Density (qualitative rating)
- European Union Human Settlement Layer
  - Residential population estimates for multiple years, informed by the distribution of built-up (GHSL)
  - Disaggregated from census units to grid cells
  - Resolution: 250 m worldwide



European Union, 2025


0
1
2 km

Existing population data

- GHS-Pop showed good potential for many use cases, but could it be refined?
- Started the process of developing a more detailed gridded product for Canada and assigning population based on buildings and census data in each grid cell
- Wait a minute… why not just produce data at the building level directly?

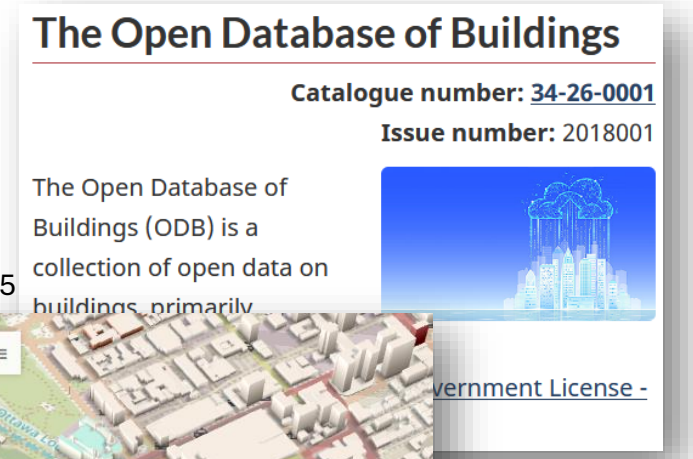
Art designed by Freepik, 2025

Existing building footprint data

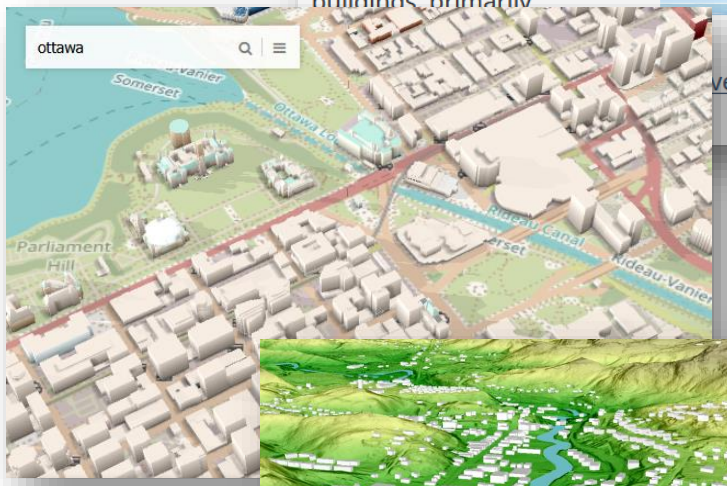
Building footprints in Canada:

- Statistics Canada - Open Database of Buildings (initially limited to 8 provinces and territories, but recently updated)
- Natural Resources Canada – Automatically-extracted lidar buildings
- OpenStreetMap building database
- Microsoft Bing Maps Global Building Footprints
- And many more…

Stats Can, 2023



OSM Buildings, 2025

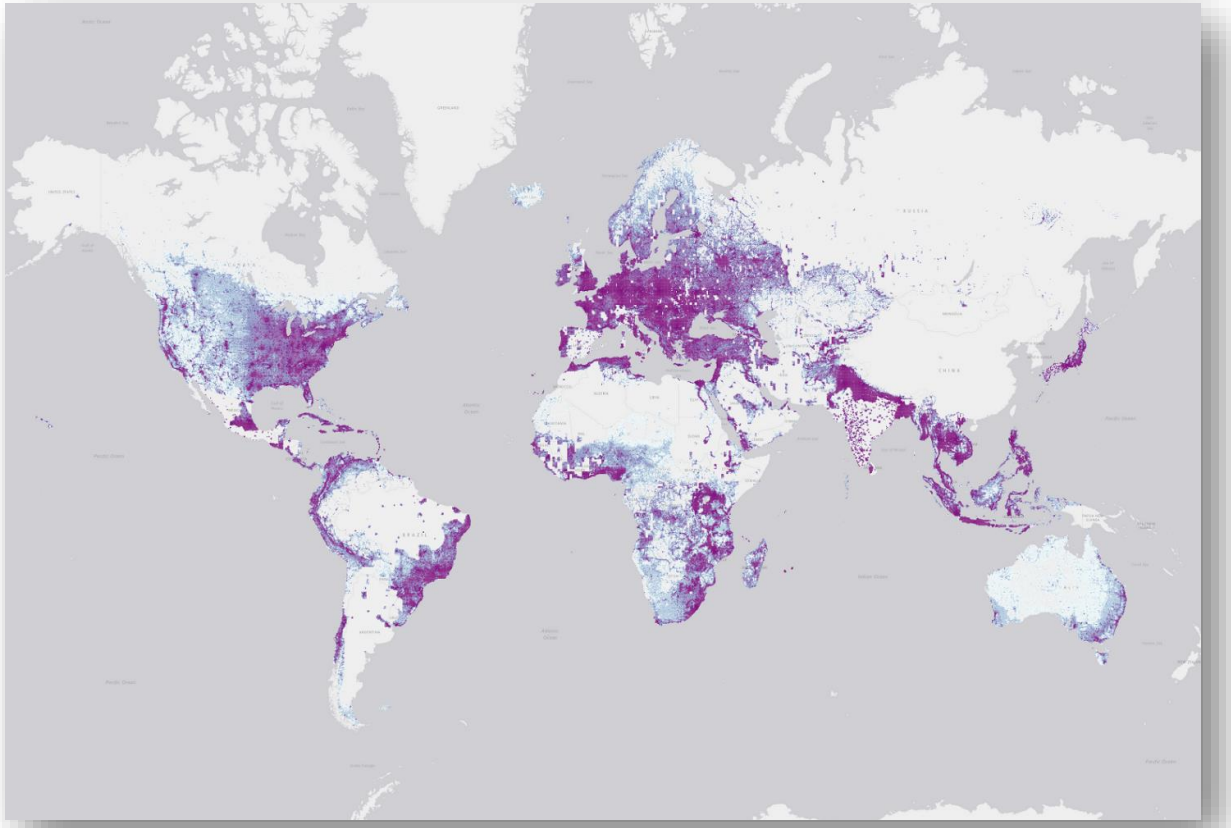


NRCan, 2025

Data sources

Data sources selected:

- Microsoft Bing Maps Global Building Footprints
  - 12.3M building footprints in Canada
  - Extracted from Maxar & Airbus imagery – 2014-2023
  - Includes building height
  - Consistent and comprehensive coverage in Canada
  - Open Data Commons Open Database License (ODbl)
- 2021 Canada Census



Microsoft, 2024

How was the data layer developed?

Methodology:

Step 1

- Calculate number of buildings per dissemination area, census subdivision and census division

Step 2

- Calculate average population per building ratio for each census unit, using 2021 census population

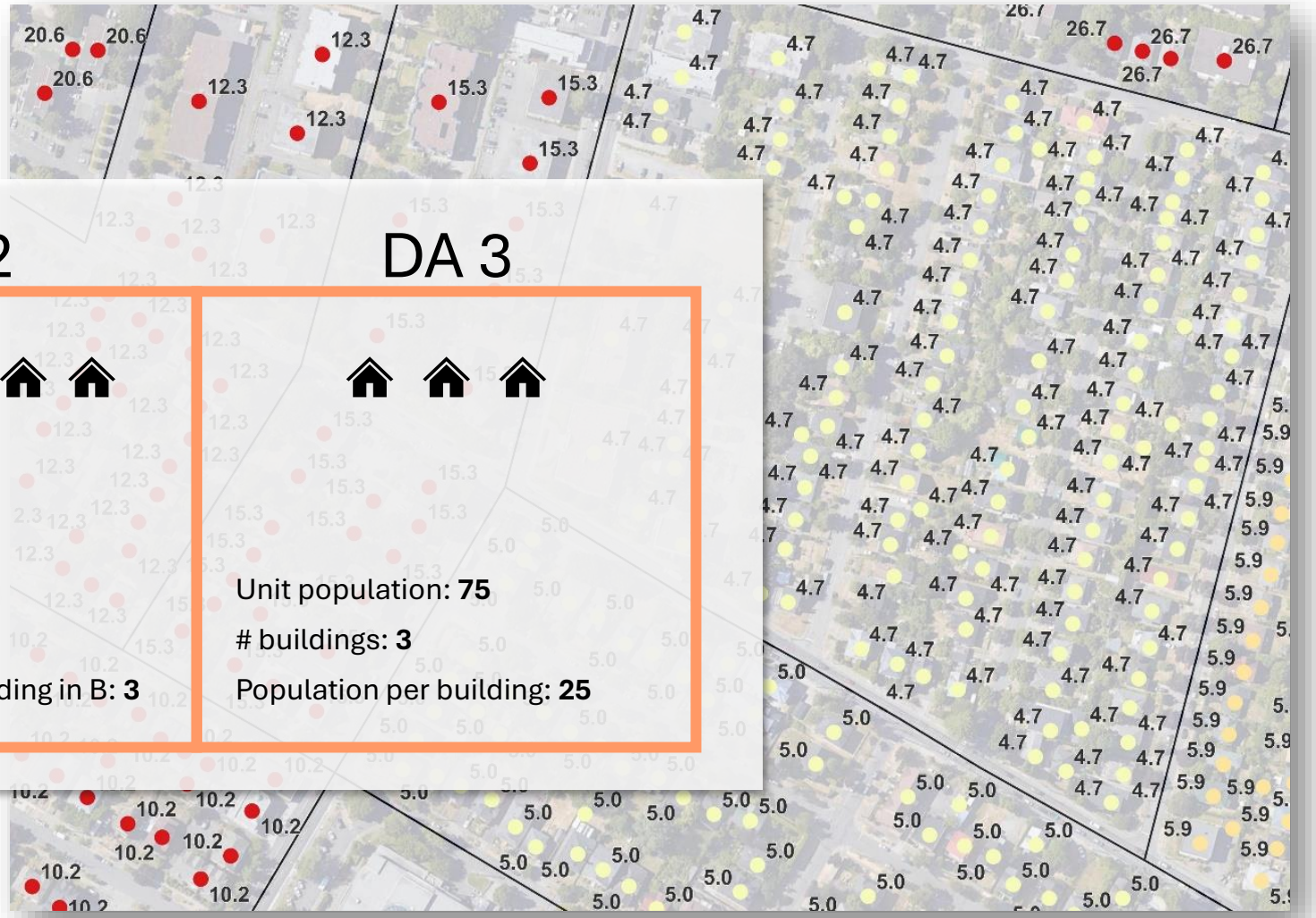
Step 3

- Assign most detailed population ratio available for each building (DA > CSD > CD)

How was the data layer developed?

Example:

DA 1	DA 2	DA 3
Unit population: **45** # buildings: **9** Population per building: **5**	Unit population: **15** # buildings: **5** Population per building in B: **3**	Unit population: **75** # buildings: **3** Population per building: **25**



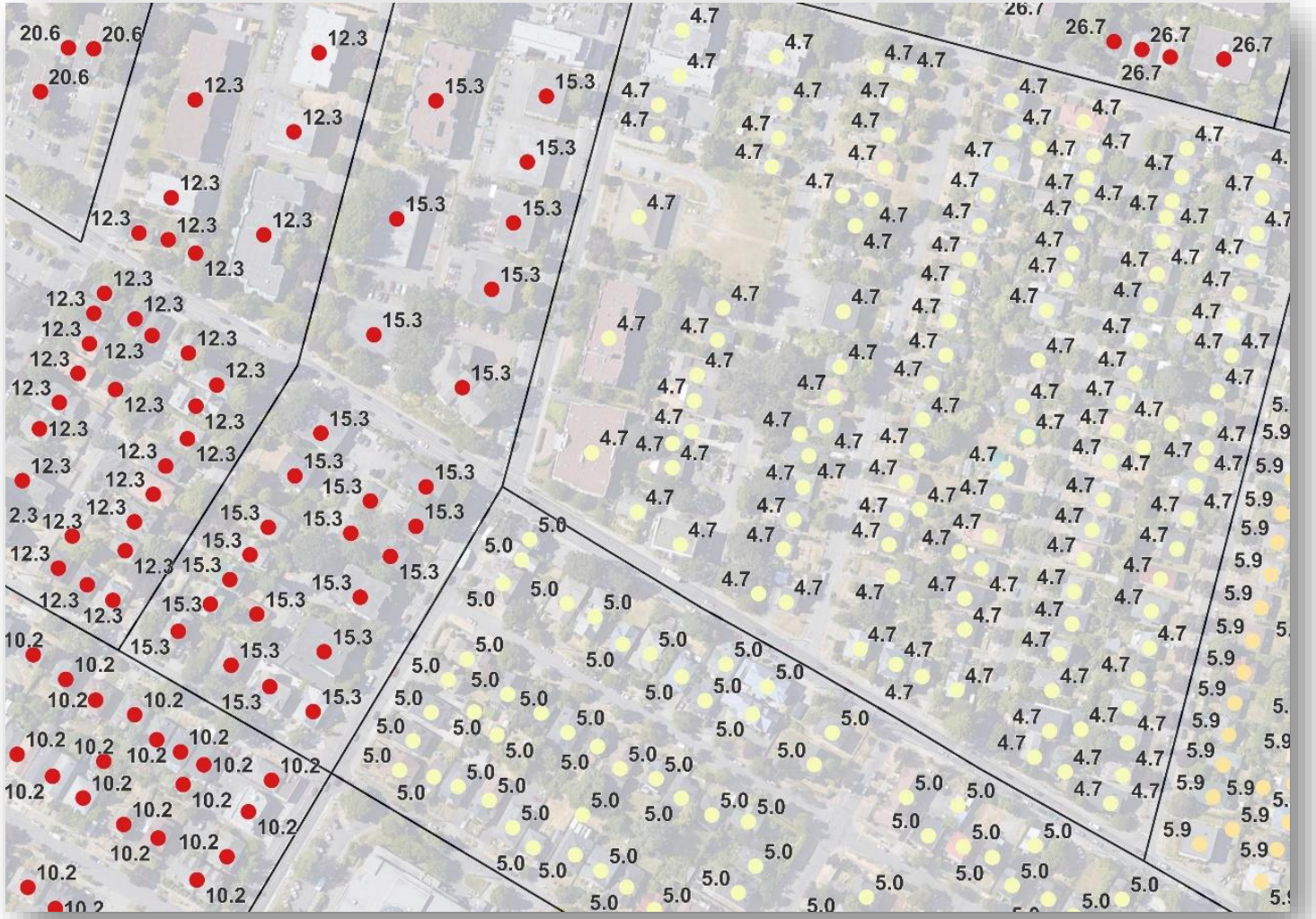
Open Building Population Layer (Canada), 2025

Rinse and repeat a few thousand times, thanks to: GeoPandas

How was the data layer developed?

Considering multiple levels of census units:

- Process completed for all dissemination areas, census sub-divisions and census divisions independently
- In rare cases where a ratio could not be obtained at the dissemination area level, the average census subdivision ratio is used for buildings within that dissemination area to reduce no-data instances
- Final census unit source is included in metadata for each building



Open Building Population Layer (Canada), 2025

Building footprints

Building points

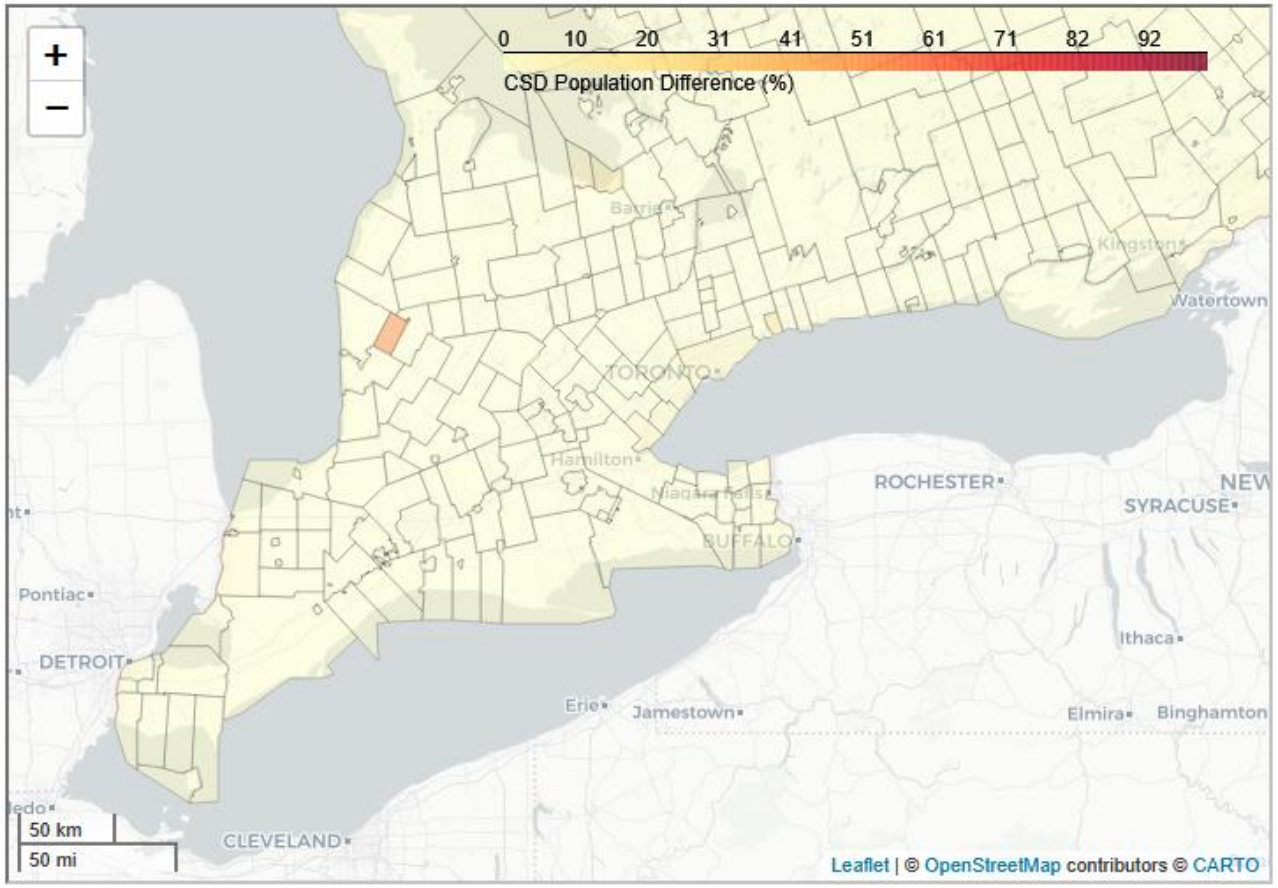
QA/QC

- Microsoft Bing global footprint layer was evaluated to be most comprehensive at the time, but there are some gaps
- Implemented workflow to identify gaps in building coverage
- Reverse-calculate population from building population data layer and compare back with census units

Open Building Population Layer (Canada), 2025

QA/QC

Gaps are rare in the South, but do happen
Differences are more pronounced in the North
Detailed comparison results available online



Province & territory	Sum from census data 2021	Sum from Open Building Population Layer 2021	Difference	Difference (%)
AB	4,262,635	4,267,891	5,256.34	0.12
BC	5,000,879	5,000,388	-490.73	-0.01
MB	1,342,153	1,341,703	-449.75	-0.03
NB	775,610	775,776	165.5	0.02
NL	510,550	507,157	-3,392.74	-0.66
NS	969,383	968,790	-593.06	-0.06
NU	36,858	15,423	-21,435.16	-58.16
NT	41,070	39,334	-1,736.39	-4.23
ON	14,223,942	14,080,420	-143,522.45	-1.01
PE	154,331	154,414	82.82	0.05
QC	8,501,833	8,464,929	-36,904.24	-0.43
SK	1,132,505	1,132,039	-465.56	-0.04
YK	40,232	38,828	-1,404.42	-3.49
Total	**36,991,981**	**36,787,091**	**-204,890**	**-0.56%**

Project timeline

- Winter 2022:
  - Released Open Building Population Layer (Canada) based on 2016 census
- Spring 2022:
  - Released Open Building Population Layer (United States) based on 2018 census
- Winter 2023:
  - Released detailed QA/QC and building gaps data on Canada layer
- Winter 2024:
  - Released Open Building Population Layer (Canada) based on 2021 census

Open Building Population Layer (Canada) - 2016 - Deprecated

Open Building Population Layer for Canada, derived from open-source computer-generated footprints and census data (2016)

Open Building Population Layer (United States) - beta

Open Building Population Layer for the United States, derived from open-source computer-generated footprints and census data (beta version)

A GIS-based method for identifying gaps in building footprint coverage

This article presents a method for identifying areas where there are gaps in large-scale building footprint layers, using building population and census datasets

Open Building Population Layer (Canada) - 2021

Open Building Population Layer for Canada, derived from open-source computer-generated footprints and census data (2021)

Data availability

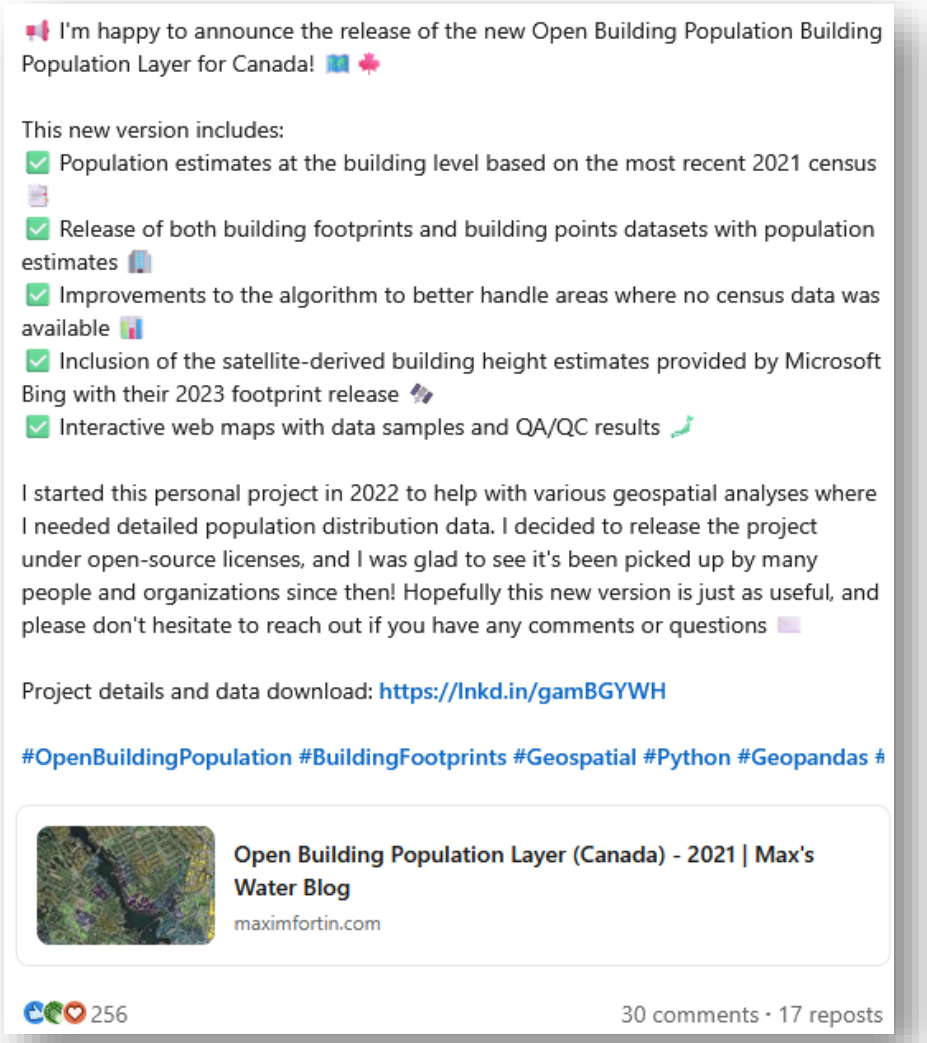
- Building population in polygon and point format:
  - Data samples in interactive maps
  - Data package for each province & territory or entire country
  - Dataset released under ODbL allowing free use, distribution and modification with attribution
- Python code available on Github:
  - Code released under Apache 2.0 License
- QA/QC results in interactive map and data available for download
- No warranty is given as to the accurateness or completeness of the data & information provided

Building footprints

Province/Territory	Zipped MB
Alberta	199
British Columbia	183
Manitoba	73
New Brunswick	39
Newfoundland and Labrador	26
Northwest Territories	1
Nova Scotia	42
Nunavut	1
Ontario	478
Prince Edward Island	8
Quebec	301
Saskatchewan	73
Yukon	1
Canada (all)	1,390

Initial reception

- The power of… LinkedIn! (and Google)
- Over 15,000 impressions & hundreds of interactions in the geospatial community
- Thousands of website visits since launch in 2022
- Feedback from dozens of researchers, organizations and teams using the data for their analyses



Limitations and potential improvements

- **Population detail:**
  - Population averages within a dissemination area, can be used for high-level assessments and approximation but not as an authoritative estimate for a specific building or address
- **Gaps in building layer:**
  - Microsoft Bing open footprint dataset provides comprehensive but has gaps; would be best to implement process with a combination / compilation of building data sources
- **Land occupation:**
  - No differentiation is made for type of building or zoning; however, dissemination area data indirectly reflects population density and land use
- **Dissemination areas & blocks:**
  - Could be recalculated to consider dissemination block population where available, instead of starting from dissemination areas

Next steps

New version:

- Improved building footprint source
  - Statistics Can - Open Database of Buildings v3, recently released with compilation of 530 datasets from 107 sources of data (April 2025)
  - 14.4M buildings, deduplicated, harmonized & enriched
  - Open Government License
- Revision to algorithm to start from dissemination blocks:
  - Higher level of detail for population where available

Hopefully completed before 2026 census data is available ☺

Stats Can, 2023

New!

The Open Database of Buildings

Catalogue number: 34-26-0001

Issue number: 2018001

The Open Database of Buildings (ODB) is a collection of open data on buildings, primarily building footprints, and is made available under the Open Government License - Canada.

Dissemination blocks

Closing thoughts

- Not the most complex project, but sometimes simple solutions can be useful to many
- 20% of effort to produce the data, 80% to release it!
- Open-source licenses, copyright and copyleft… from beginning to end
- Great personal journey in the open data world, not over yet!

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