Data Development

Using ArcGIS-based Analysis to Recalculate Data to Suit your Geography

- Data-related limiting factors
- Using GIS to analyze and recalculate data
- Data creation/recalculation workflow

- Examine some examples of data processing applications
- Data processing using GIS in support of decision-making concerning environmental issues related to noise & vibration and air quality
    - Example One: Residential dwelling count calculations within specific spatial geometries
    - Example Two: Calculated estimates of expected emissions within an air quality modelling grid (also known as Spatial Surrogates)

- Data availability
  - "Best" sources of GIS data are government bodies – municipal, provincial/state, federal
  - Various governmental departments and agencies now employ and store information in GIS formats
  - Despite movement towards Open Data, access to data can still be quite limited

- Data suitability
  - Data suitability should be evaluated early on in a project / application
  - measures should be taken to correct data where possible
    - Is the data current?
    - Is the source reputable?
    - Does it cover my area of interest?
    - Are there better sources of data available?

- Data limitations
  - Level of detail, spatial extent, spatial and temporal resolution, etc.
  - Understanding the limitations of your data will help to guide steps to data processing
    - Are the limitations going to effect end result?
    - If so, can the data be processed to help mitigate the limitations?
    - Is the effort of processing the data going to make a worthwhile impact in the end result?

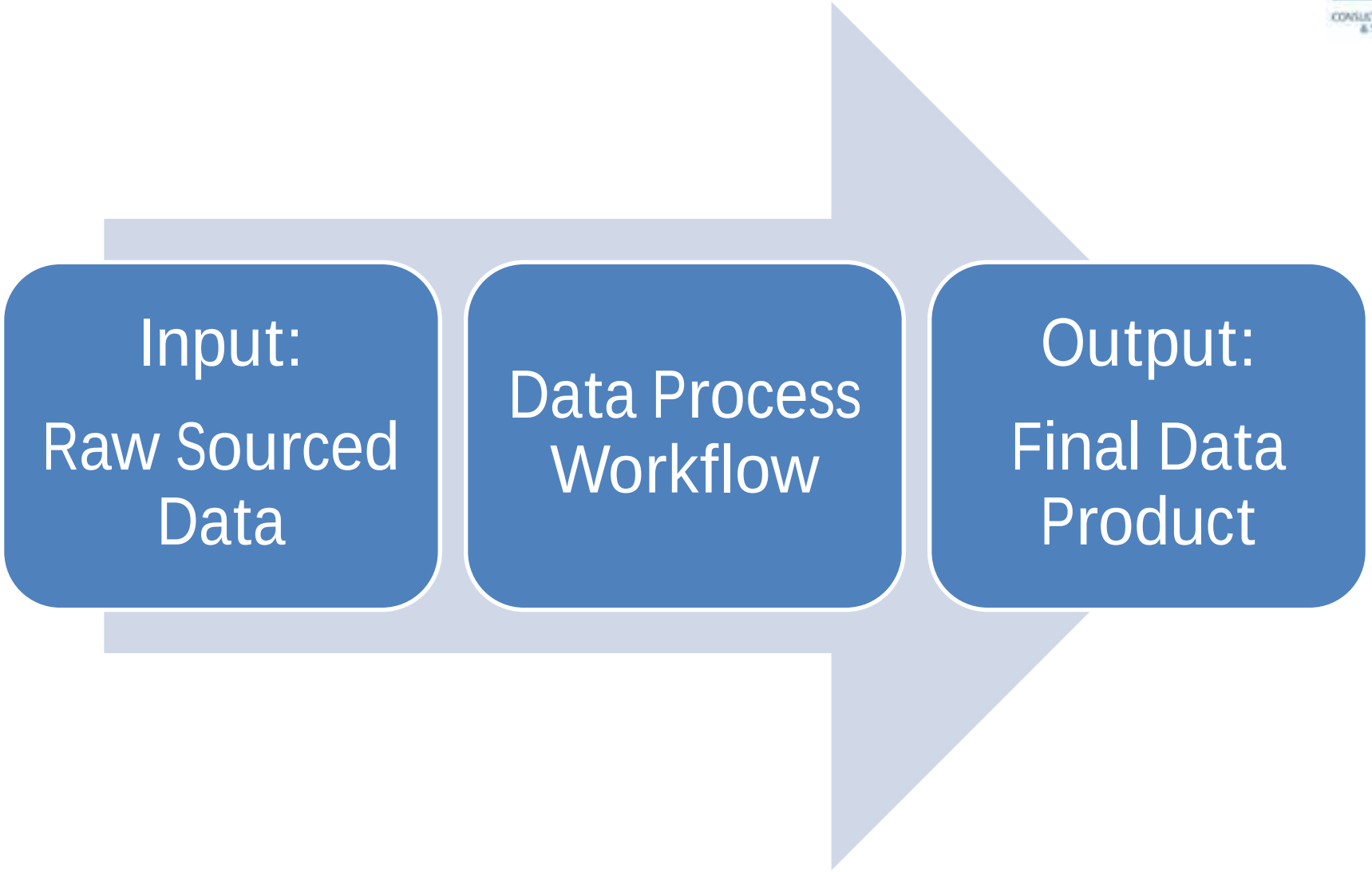
Using GIS to Analyze and Recalculate Data

- GIS software, such as ArcGIS Desktop offers many tools to aid spatial data manipulation
- Offers a visual interface so the user can see and check the data, and view changes made in each step as it is processed

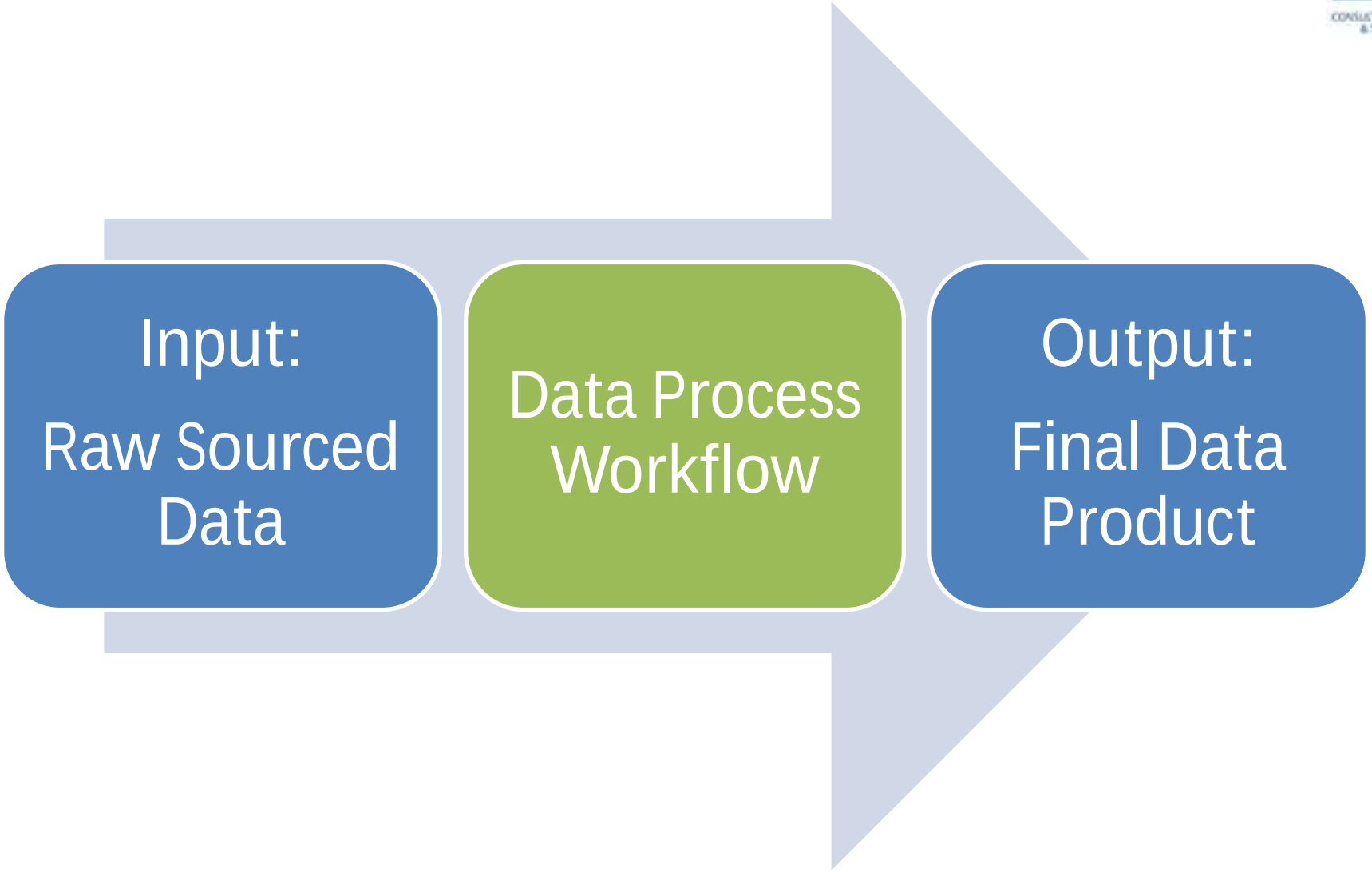
Tools Available in ArcGIS for Data Analysis & Recalculation

- ArcGIS Tools
  - Large selection of out-of-the-box tools
- Projections, Transformations
  - Customizable, re-projection on the fly
- Basemaps
  - Adds quick context layers for cross-checks
- Model Builder, Python tools
  - Automation of repetitive tasks, build customized tools and workflows

Workflow


Input:
Raw Sourced Data
Data Process Workflow
Output:
Final Data Product

Workflow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Model Builder Screen Shot

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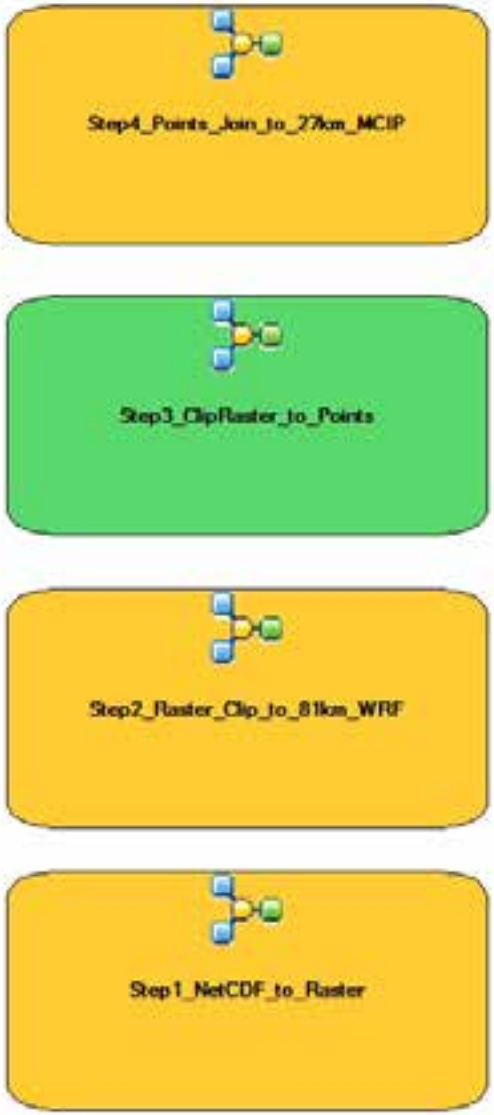
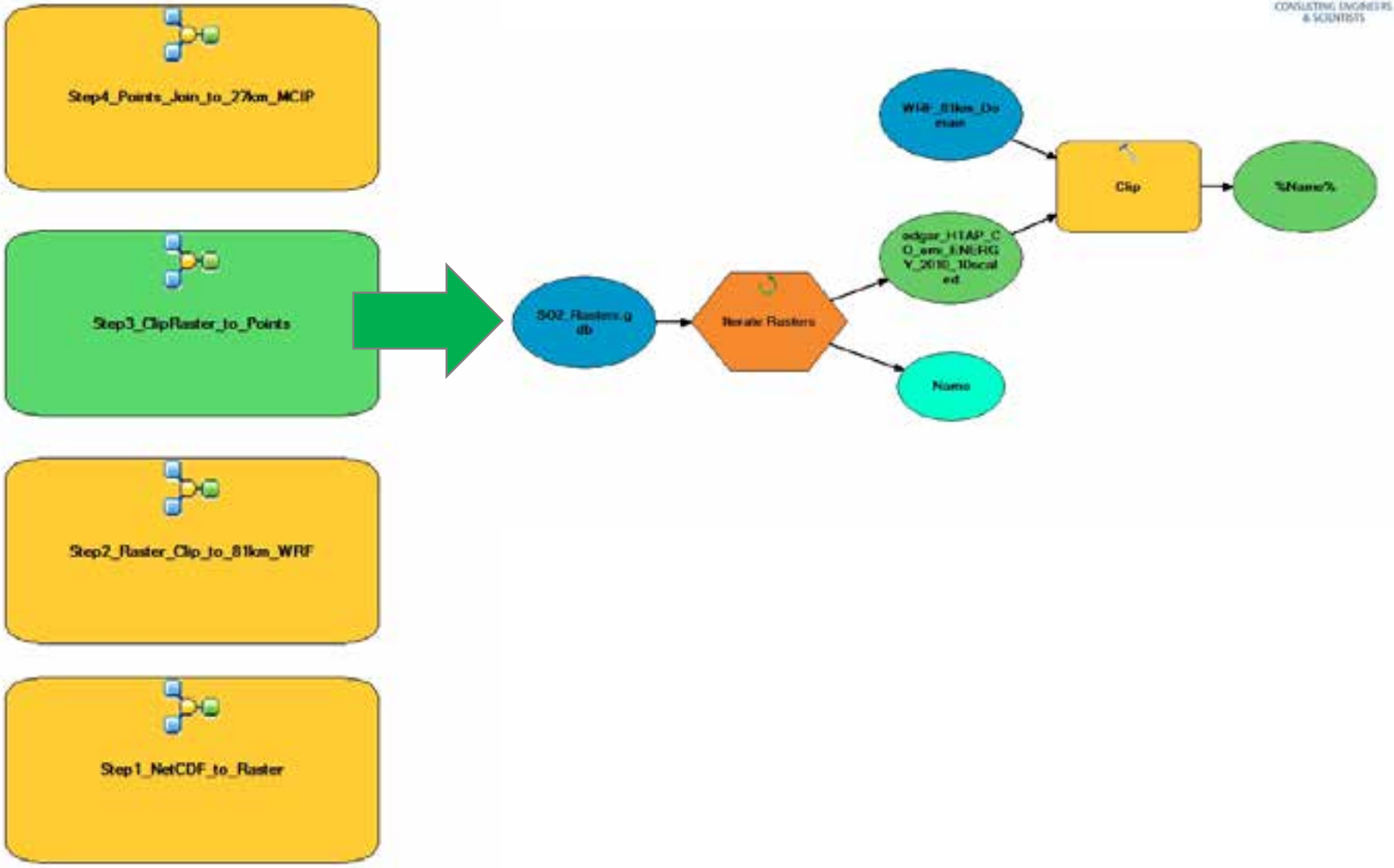


Model Builder Screen Shot



Let's Look at Some Examples

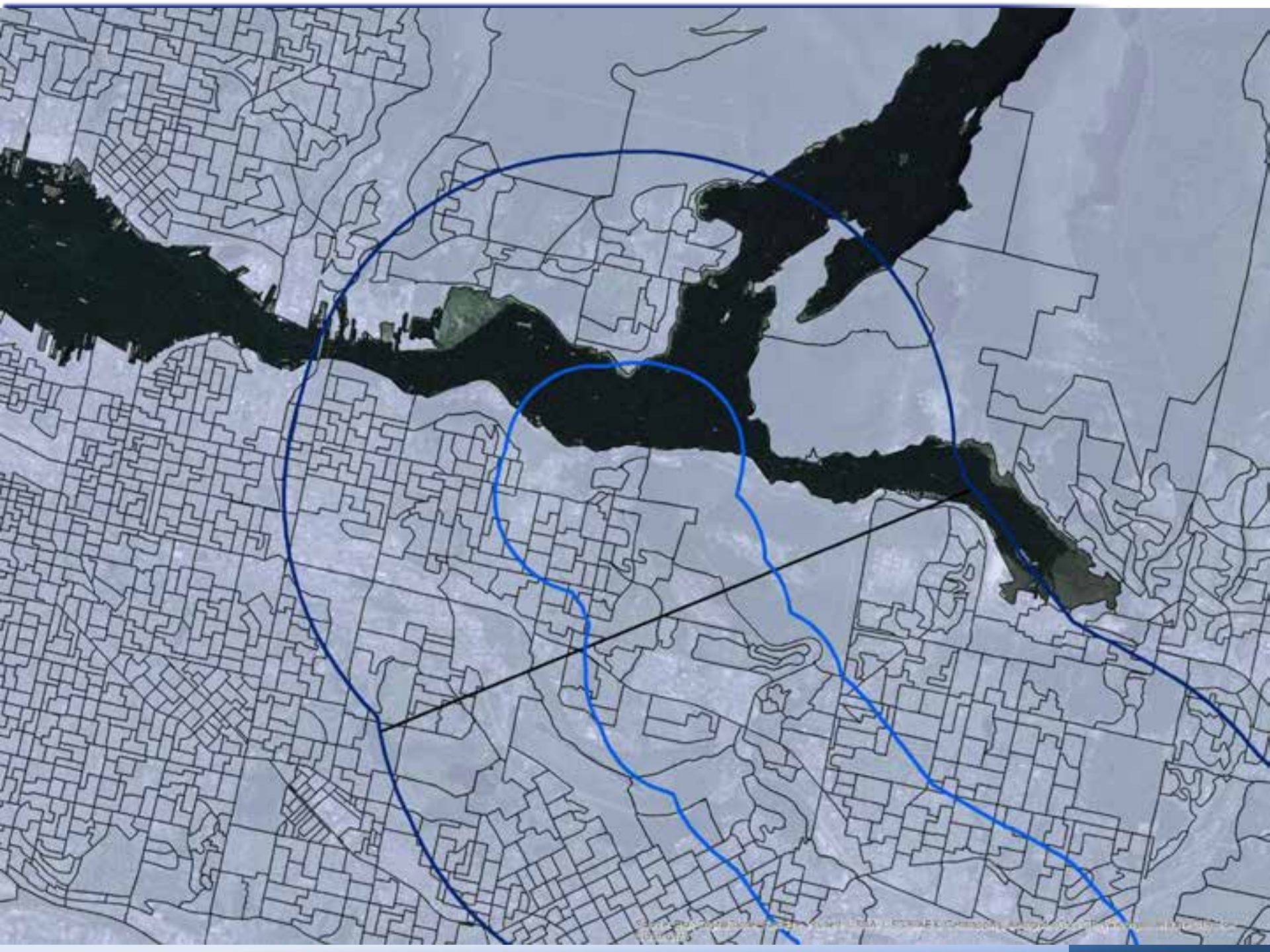
- Data analysis and recalculations that were performed using GIS-based tools workflows
- Input data were manipulated to suit particular application, solve a problem, or fill a need

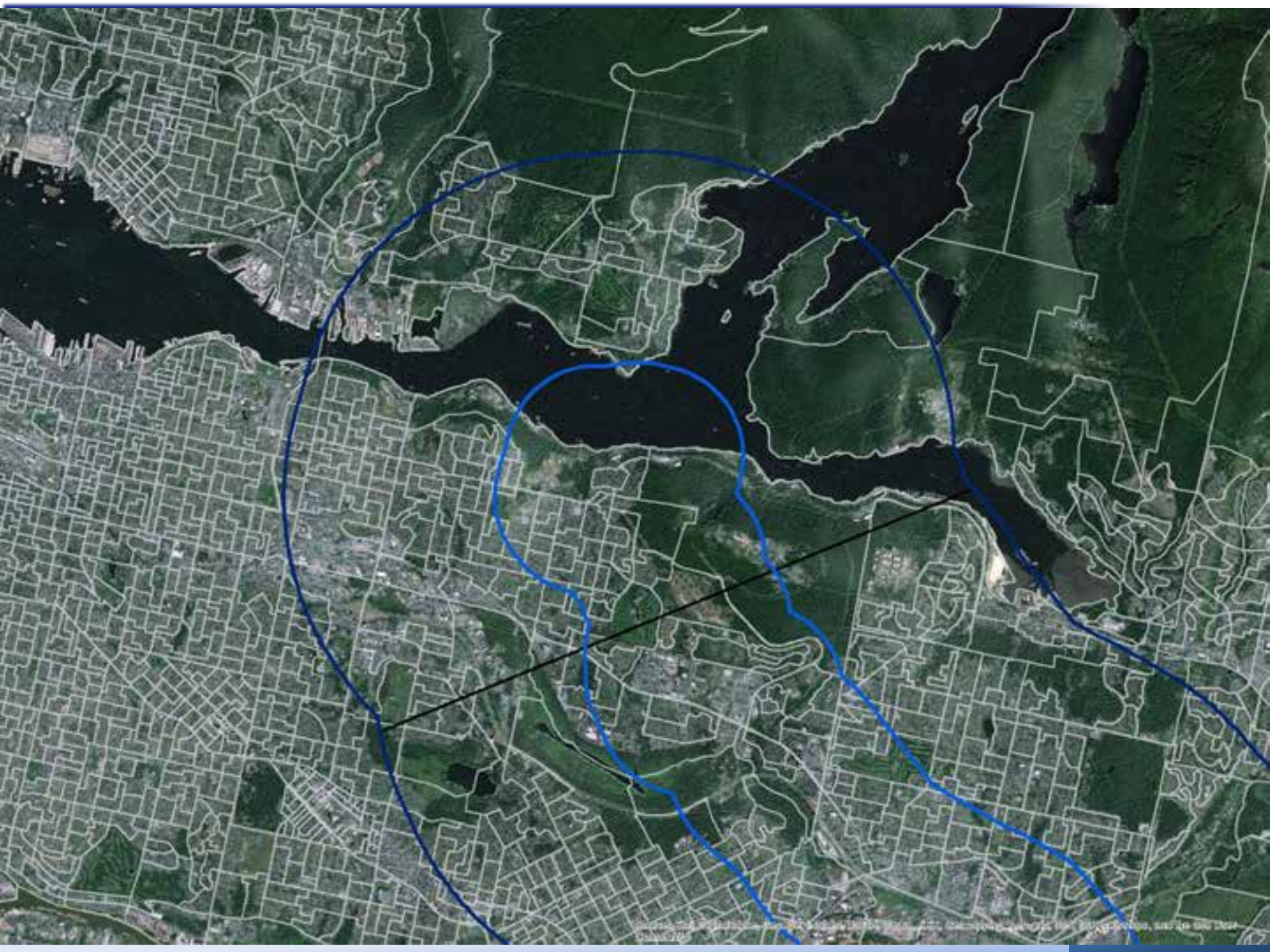
Example 1: Dwelling Count Calculations

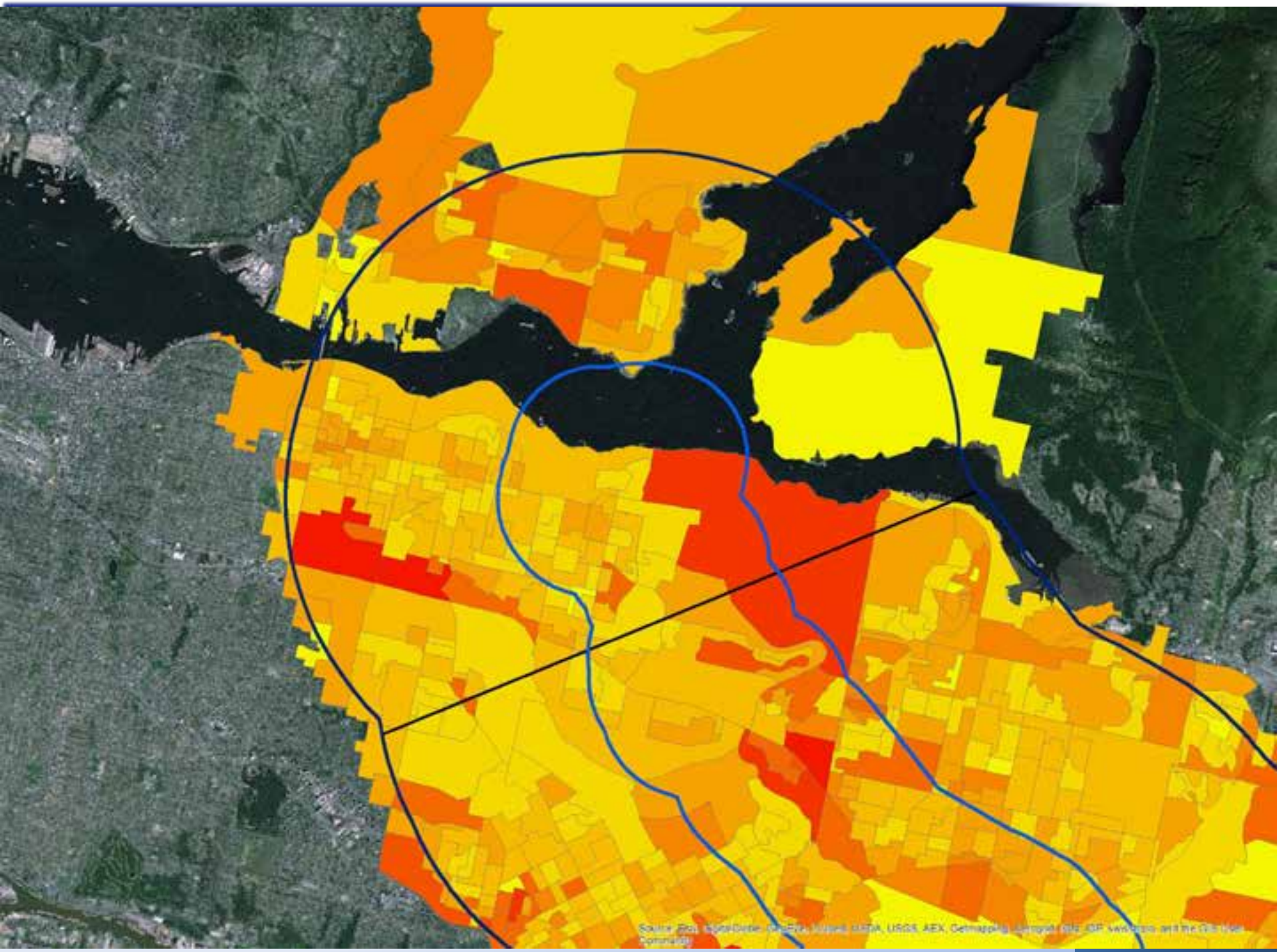
- Noise and vibration assessment as part of environmental assessment of construction activity
- involved quantifying potentially affected residential dwellings
- 600m, 5km and 10km buffer areas of the pipeline project, each broken into several segment areas

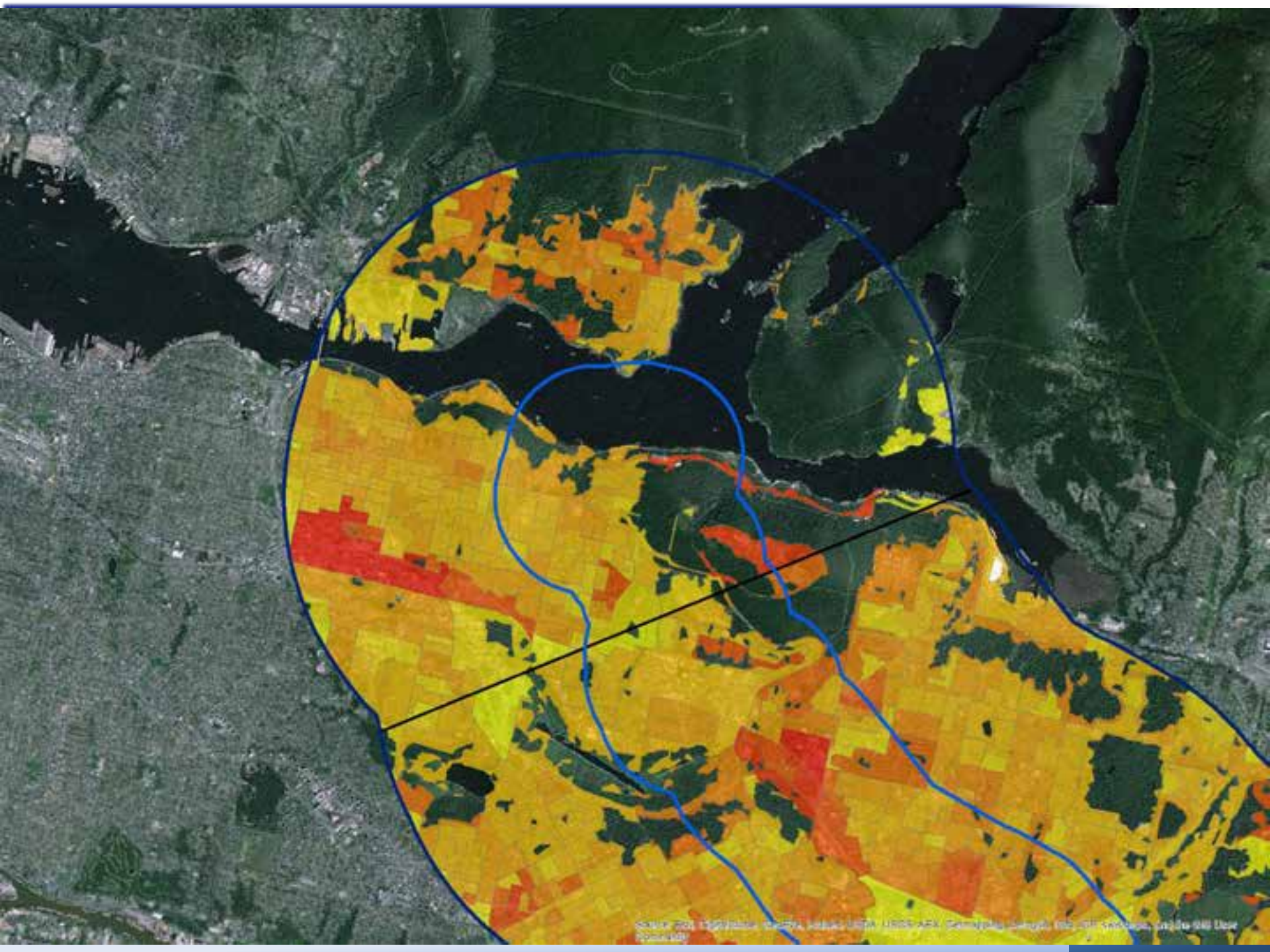
Example 1: Dwelling Count Calculations

- Due to size and timeline of project heads-up digitization was not an option
- Leveraged dwelling counts in the 2011 Census data from Statistics Canada, along with federal land use datasets
- Allowed us to isolate and modify census boundaries down to the areas that would have dwellings (eg: urban areas)
- Estimates of dwellings were then calculated based on study area vs. modified census area geometries







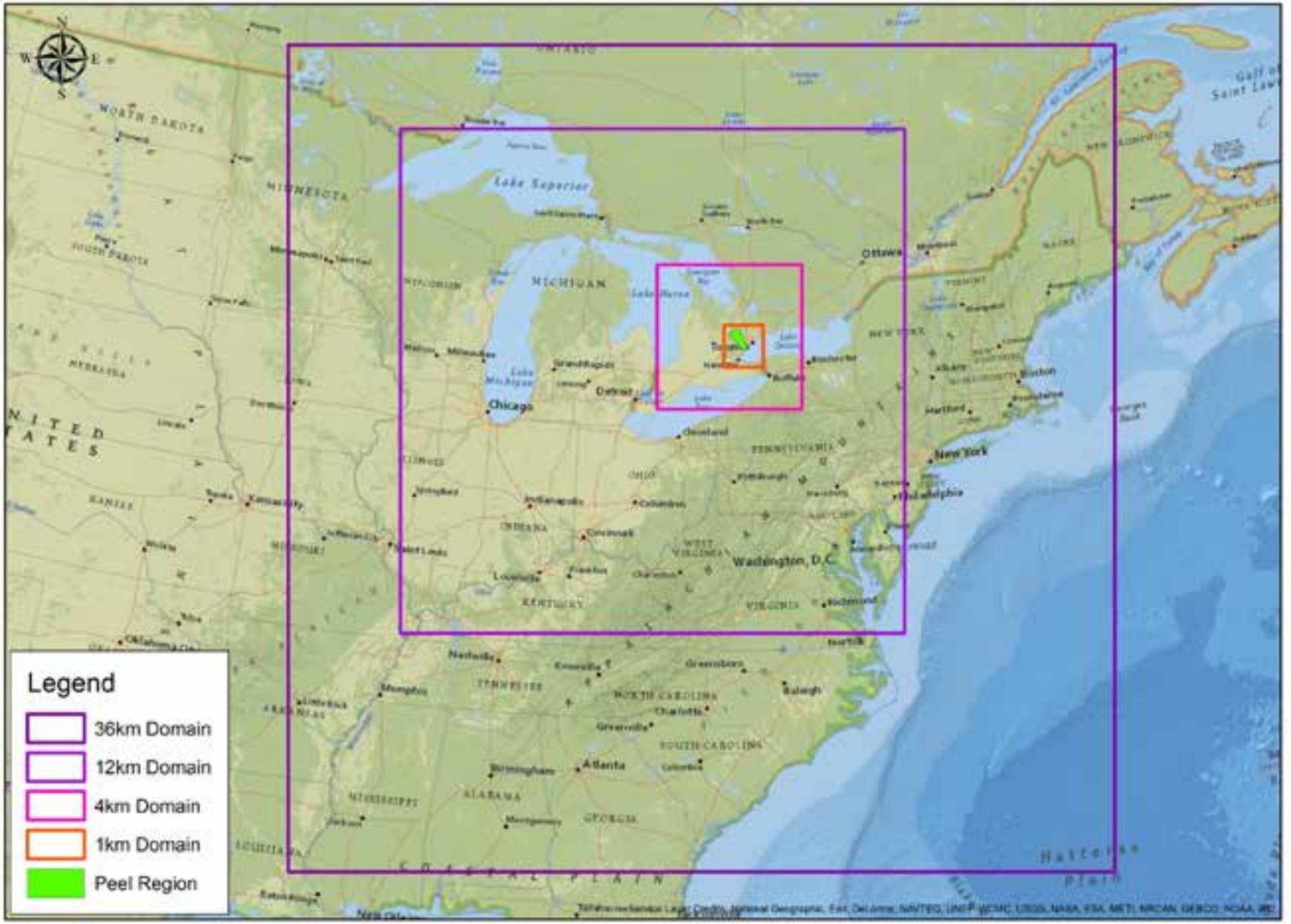


Example 2: Spatial Surrogates for Emissions Inventory Modelling

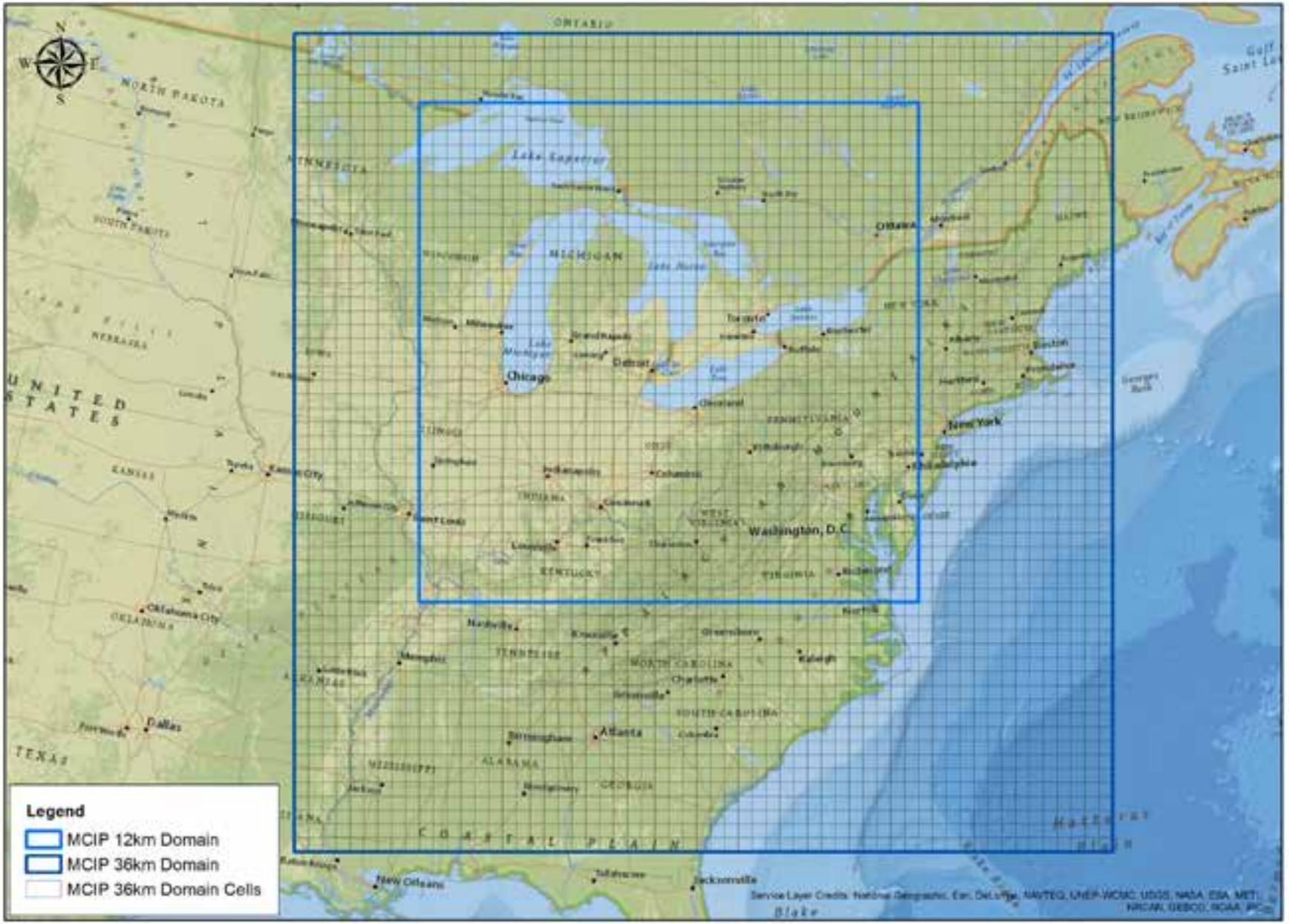
- Regional airshed modelling project for Region of Peel, located in southwestern Ontario, Canada
- Purpose of project as a whole is to assist in evaluating public policy decisions and their potential effect on regional and local air quality and human health

Example 2: Spatial Surrogates for Emissions Inventory Modelling

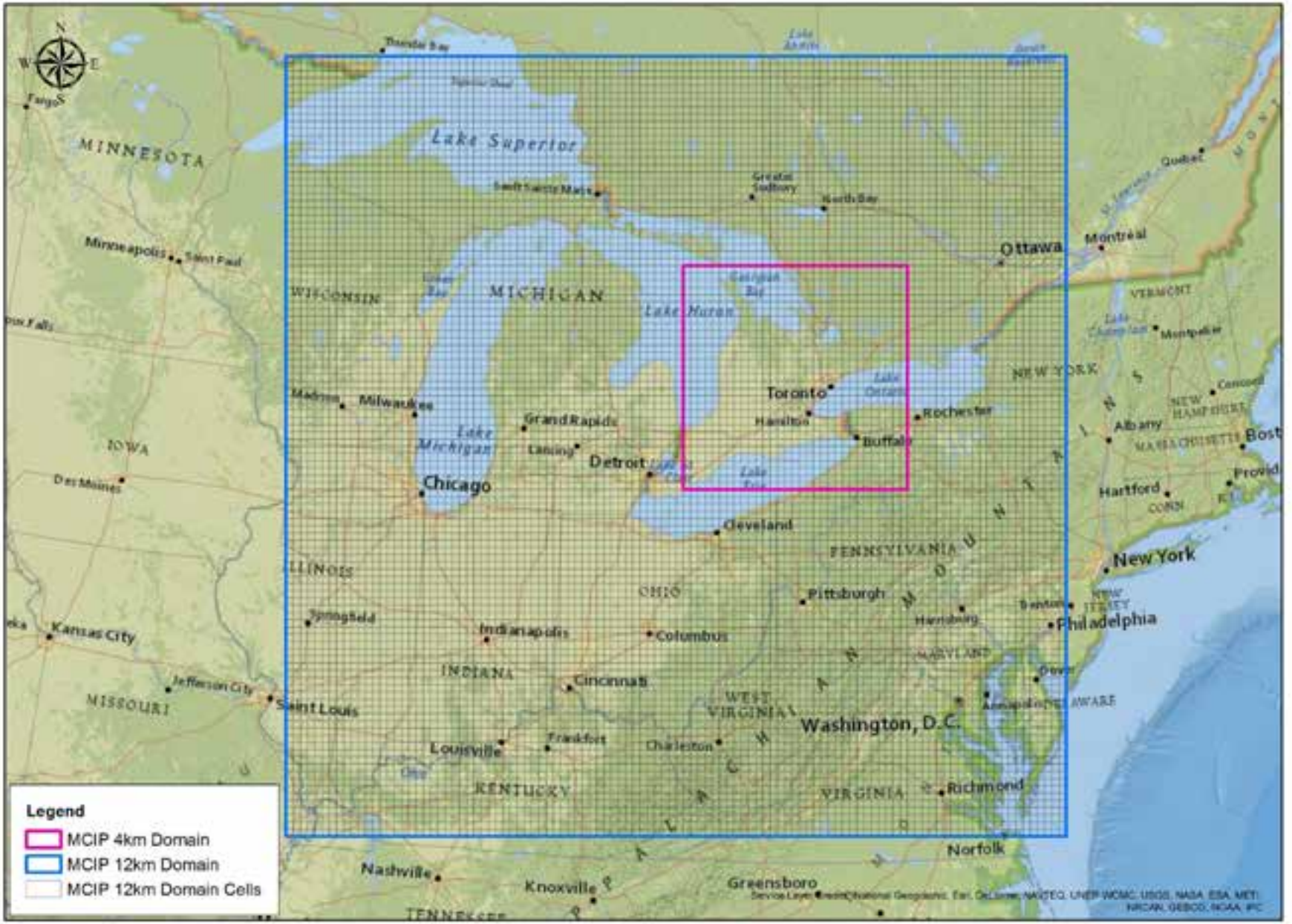
- GIS was used to calculate spatial surrogates
- Surrogates are used to spatially allocate provincially-aggregated emissions totals across a model area
- Surrogates for multiple emissions sources were generated for 4 different modelling grids – 36km,12km, 4km and 1km
- Some surrogates were found to be “problematic” – these were improved during Year 2 of the project using GIS to create and process new datasets



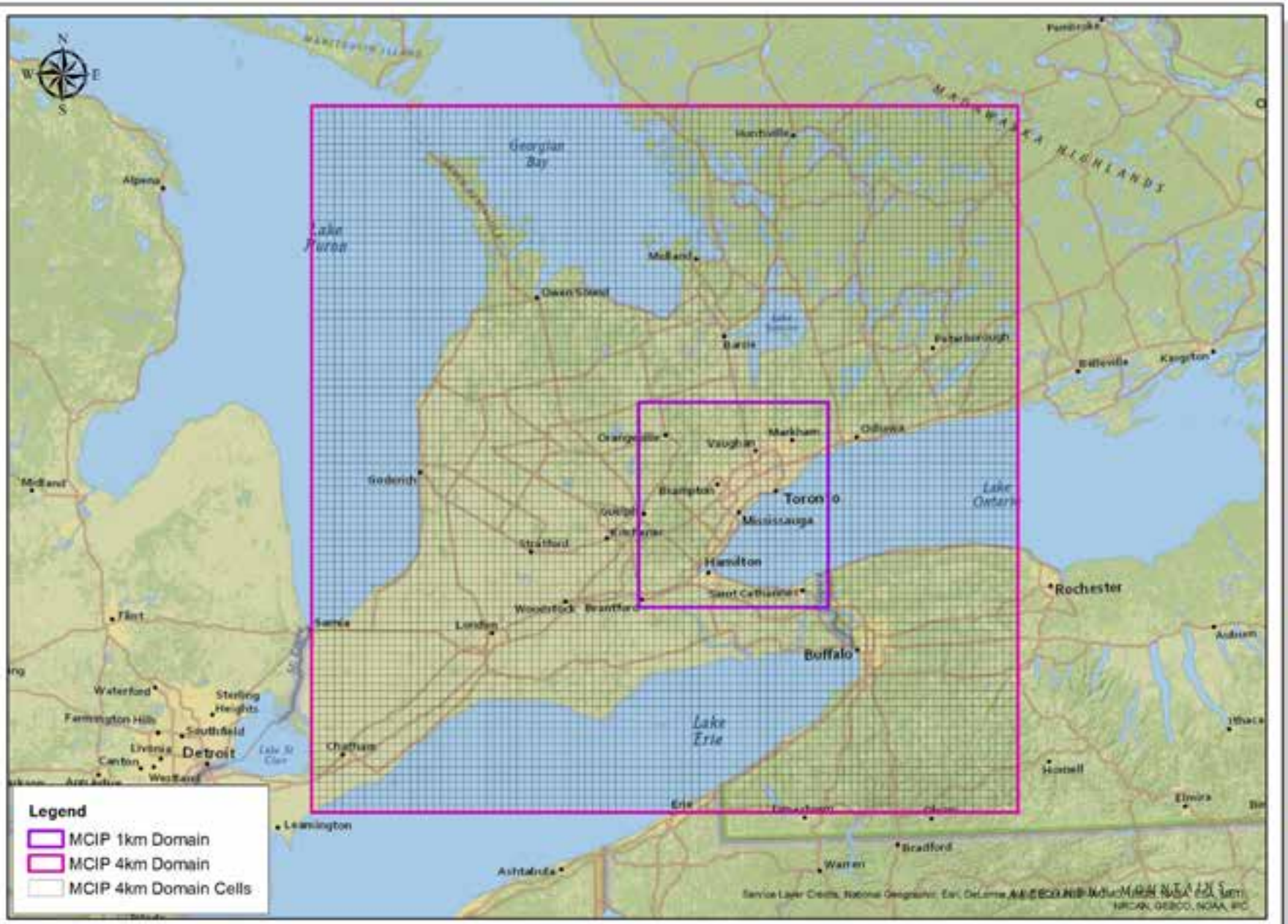
Peel Region CMAQ Modeling Domains



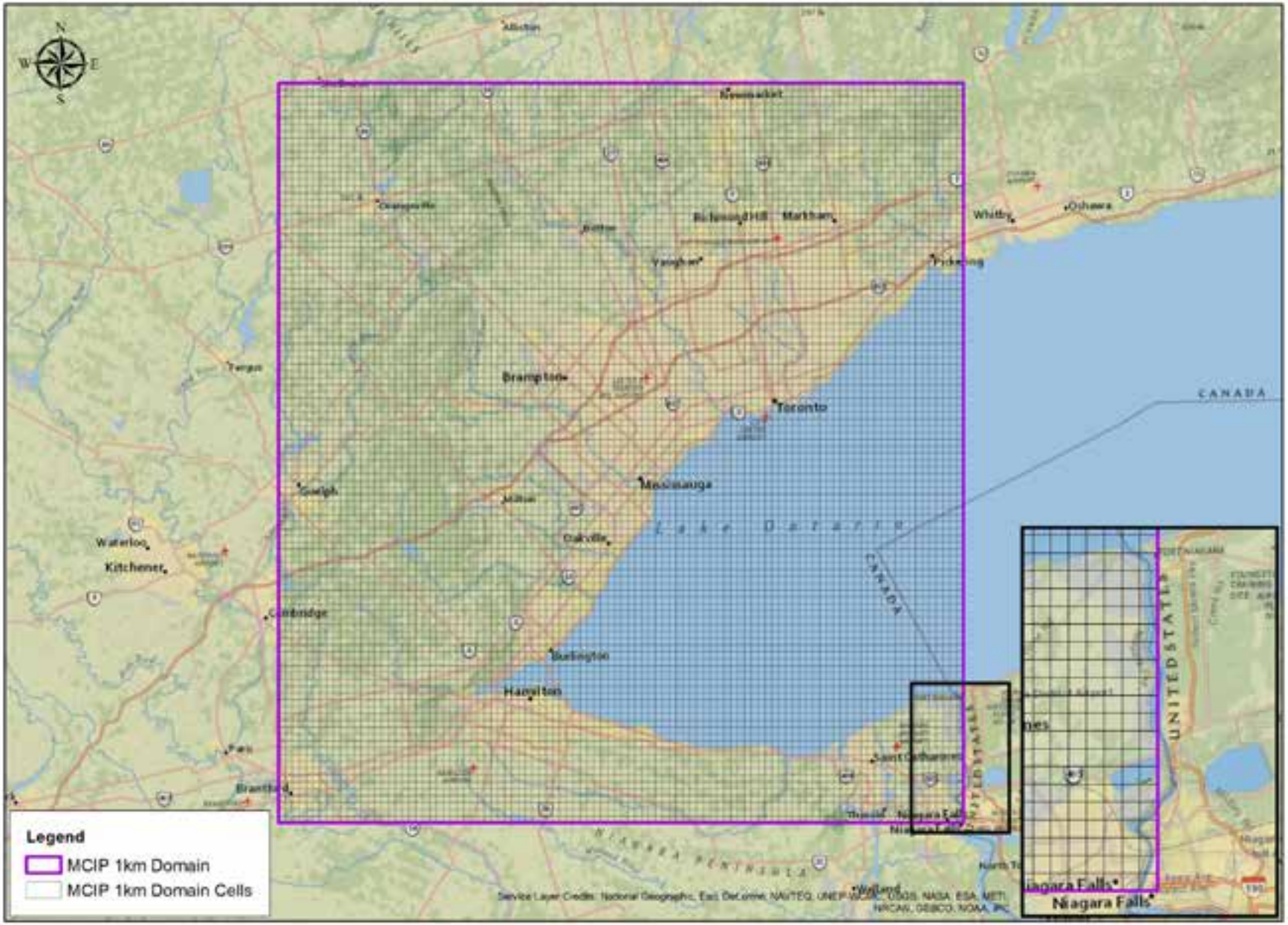
MCIP 36km Model Domain & Cells



MCIP 12km Model Domain & Cells



MCIP 4km Model Domain & Cells

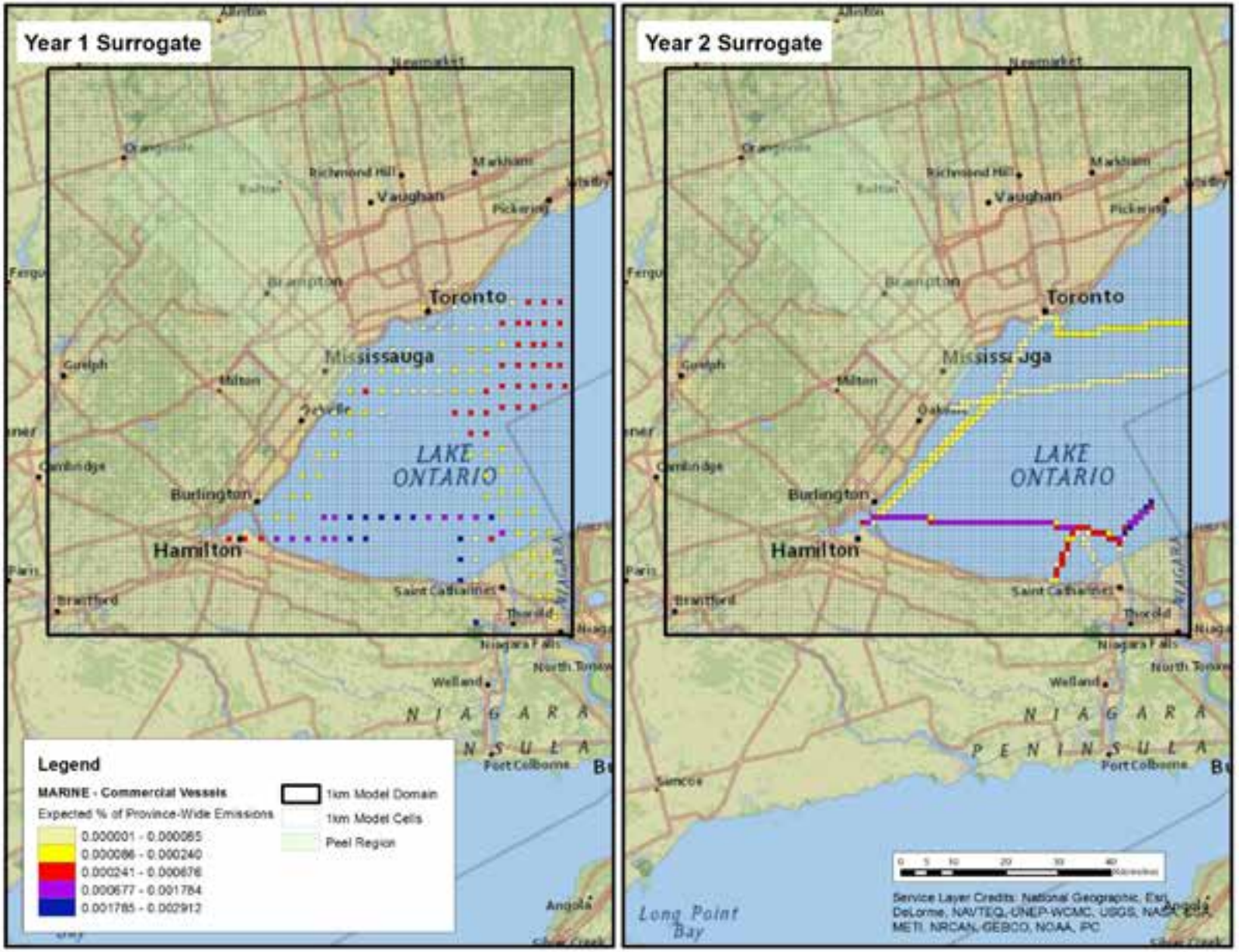


MCIP 1km Model Domain & Cells

Marine Surrogate Improvement

- In Year 1, a traditional surrogate method and dataset was used to generate surrogates for commercial marine vessel emissions
- The result for the 1km surrogate was problematic due to the coarseness of the input dataset
- To correct this, a different dataset with a refined geometry of vessel routes was sourced and modified in the 1km model area
- Modifications to the dataset were based on information collected from nautical charts and satellite imagery

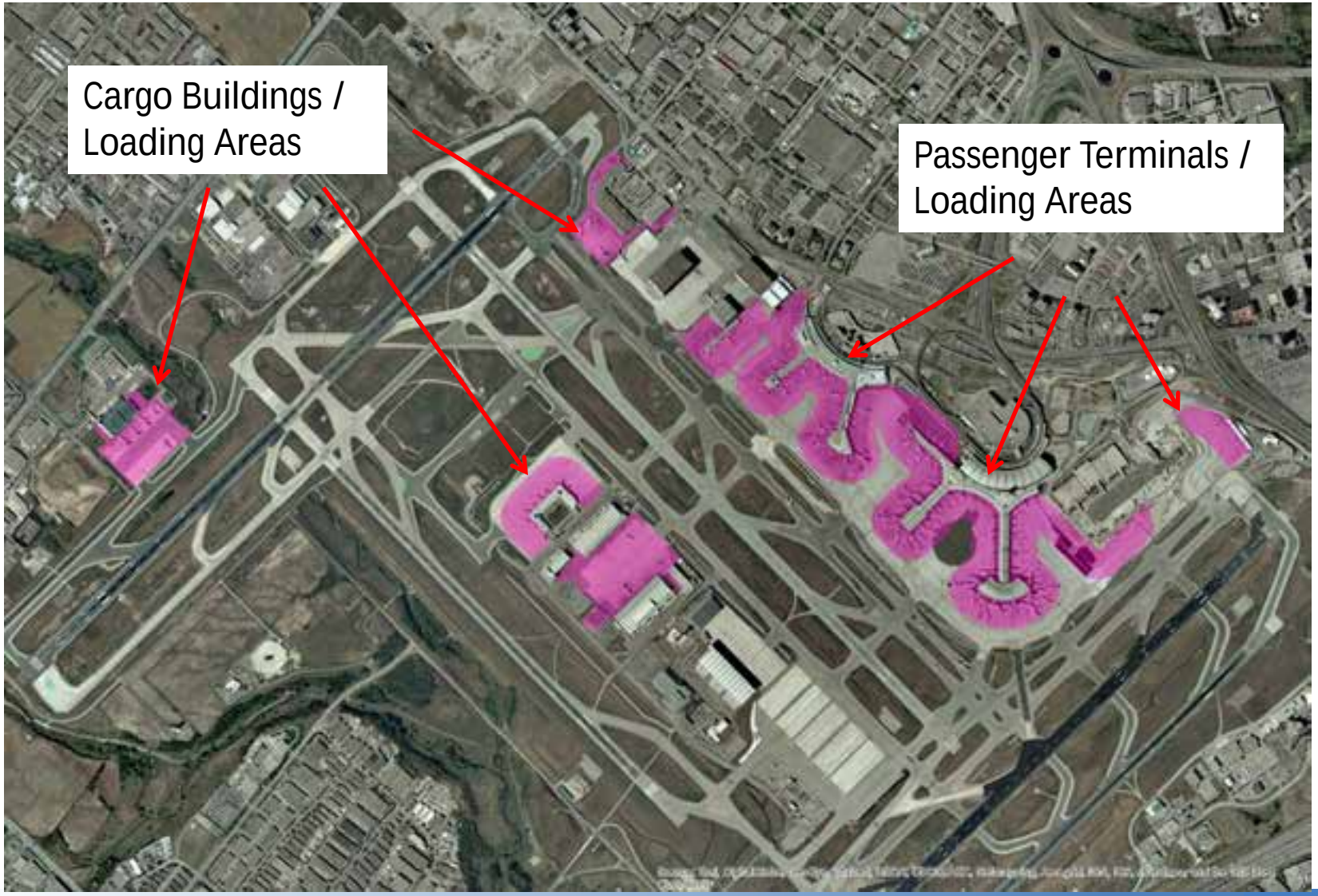
SSC 945 – MARINE – Commercial Vessels



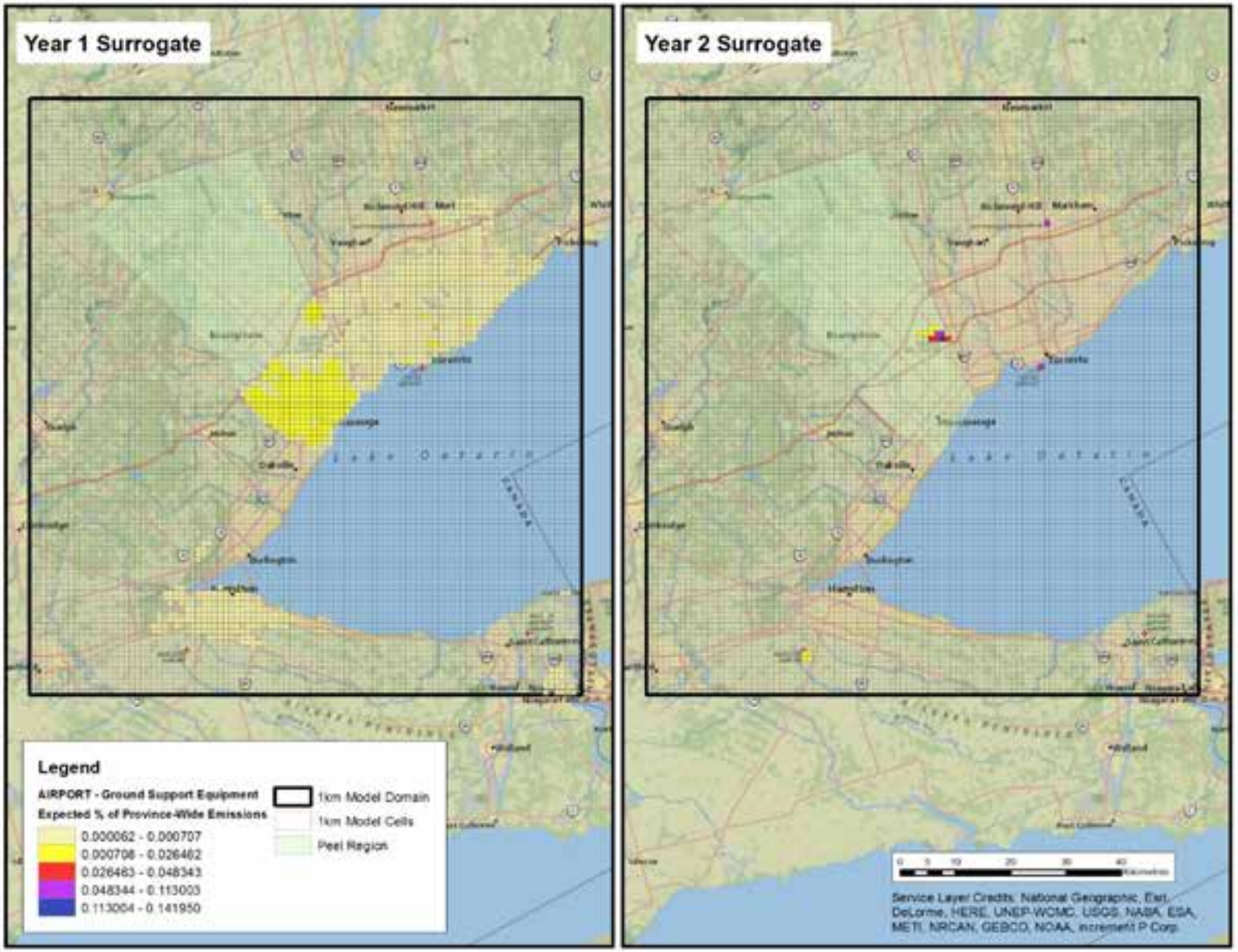
Airport Surrogate Improvement

- Geometry for a surrogate related to airport Ground Support Equipment (GSE) was digitized using imagery and airport diagrams to isolate areas where GSE activity on airport properties
- Geometry was added in areas where aircraft loading/unloading occurs - in the vicinity of passenger terminal buildings and air cargo buildings
- Additionally, the number of movements by airport (2011 data) was added into the GIS data attributes and used in the surrogate calculation
- Resultant surrogate concentrated the GSE emissions to airport locations, with greatest emissions at Pearson International airport

- Example of geometry creation at YYZ (Pearson International) airport

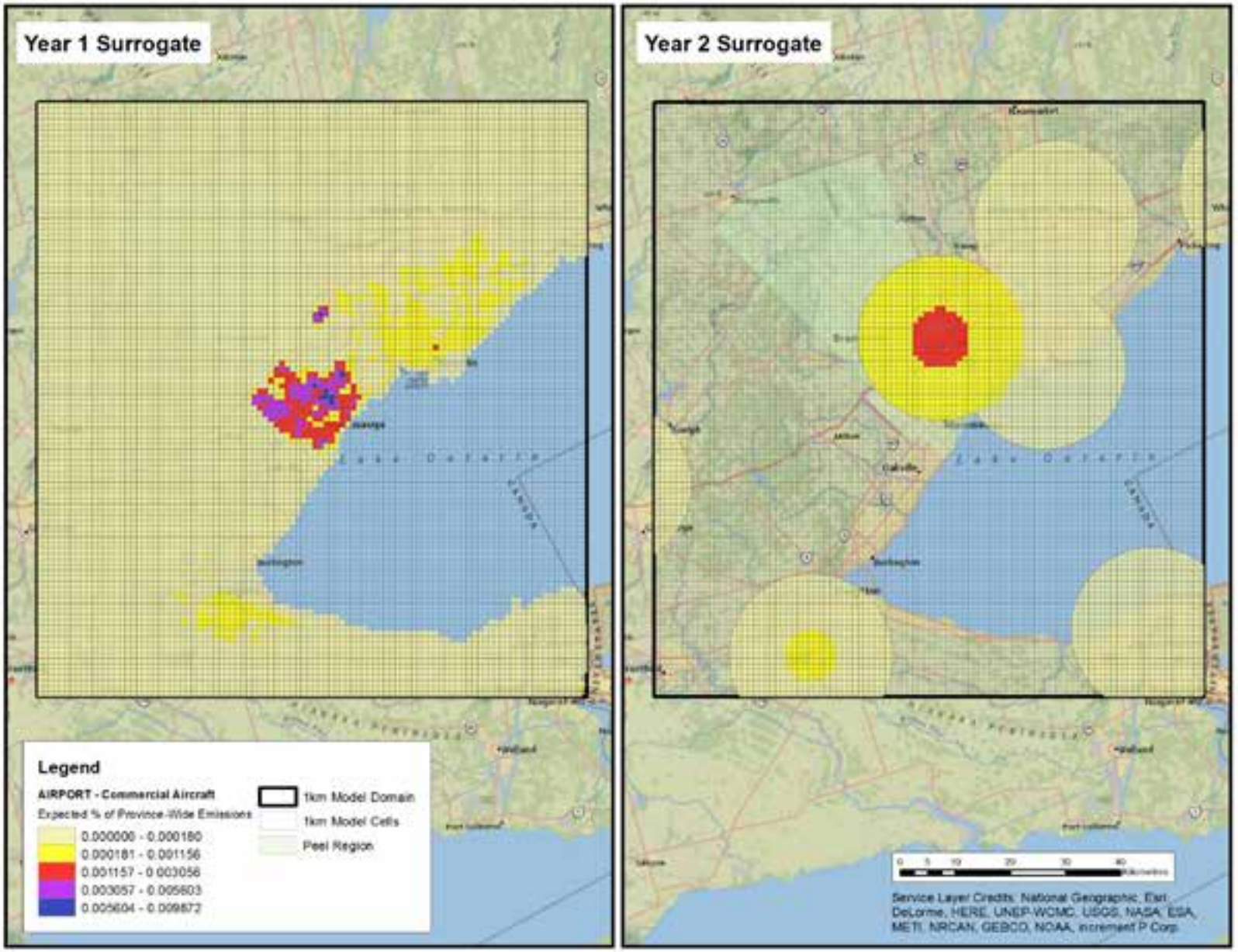


SSC 901 – AIRPORTS – Ground-Support Equipment



- Surrogates for commercial aircraft were also traditionally based on census data as input data
- Changing the input dataset to a dataset that was a multi-ring buffer of the airports with LTO data as attributes improved the resultant surrogate dramatically, concentrating the aircraft emissions around airports

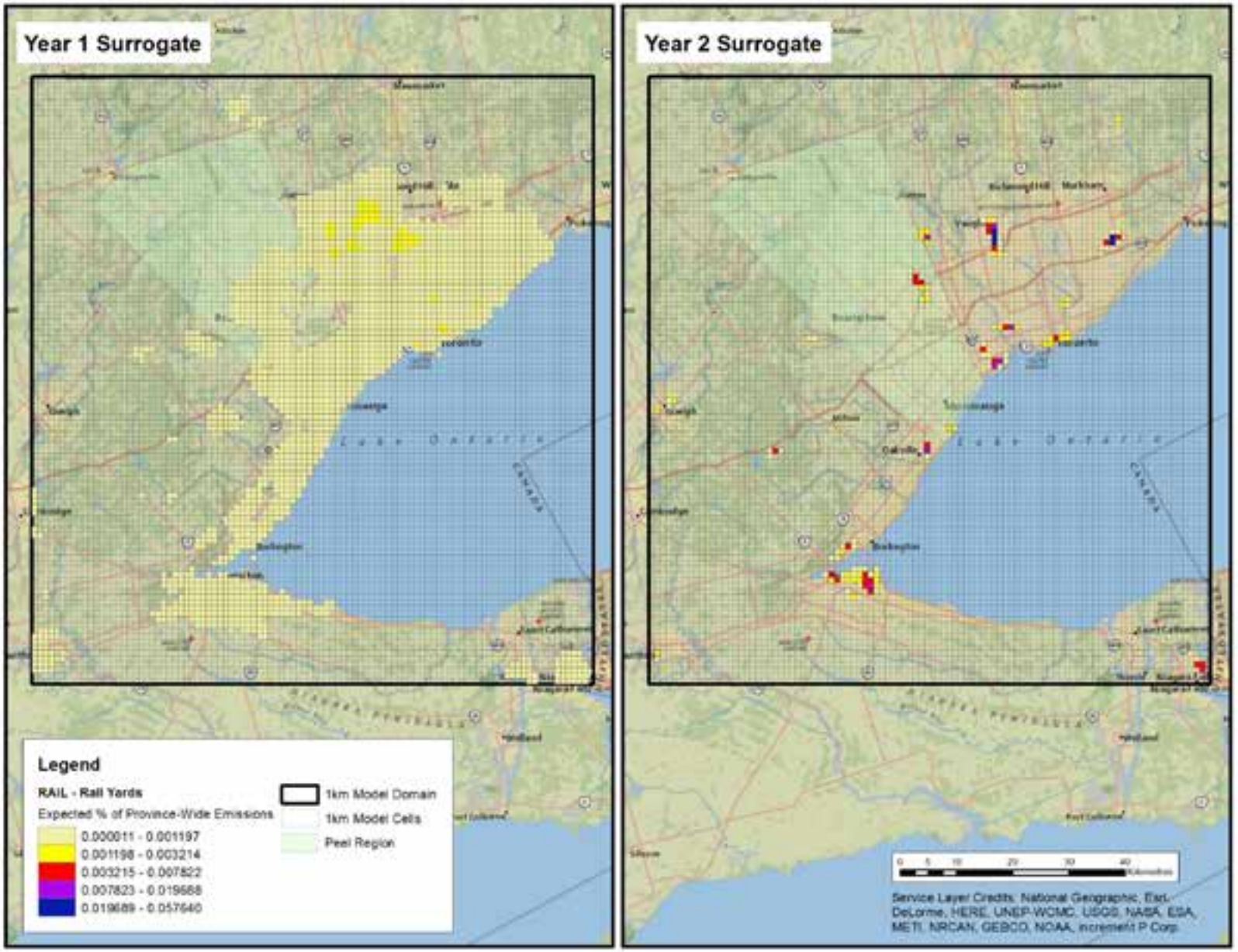
SSC 903 – AIRPORTS – Commercial Aircraft



Rail Surrogate Improvement

- In Year 1, a traditional surrogate method and census dataset was used to generate surrogates for emissions related to rail yards
- Newly released federal rail network dataset included classifications of rail line geometries
- Classifications allowed different rail geometries to be isolated from one another
- Drastic improvements were realized as a result, especially to the rail yards surrogate

SSC 482 – RAIL – Rail Yards



- GIS offers many tools that help to assess the suitability and limitations of data for use in different applications
- Tools and models can also be used to manipulate existing data and automate data processing workflows
- Data that has been processed with the particular application in mind can drastically improve the quality of results
- *Better quality input = better quality output*
- Better quality, more informed decisions can then be made on scientific model results

Thank You!

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