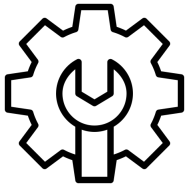
GGR321
5G Cell Tower Analysis

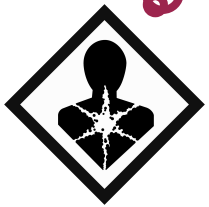
What Problem are we Solving?

Fact: 5G mobile networks DO NOT spread COVID-19



What are the optimal locations for 5G Cell Towers in Mississauga?

Why are these the most effective locations and what are the alternatives?



Are there health concerns regarding the placement of 5G Cell Towers?

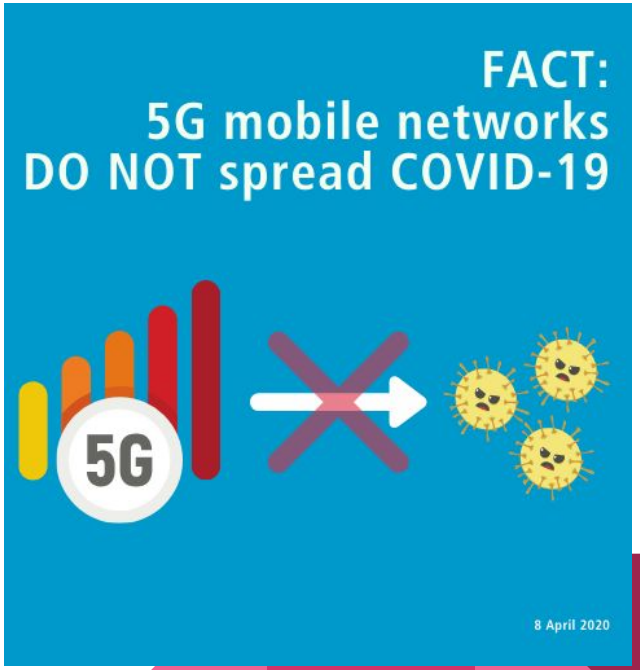
Problem we're solving and Scope of project

Optimizing Cell Tower Locations for 5G Network in Mississauga

To find the most effective placement of 5G cell towers for optimal coverage and communication in Mississauga.

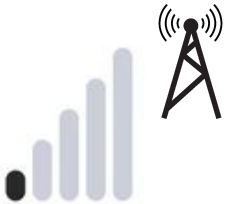
In our final results, we want to be able to display why this is the ideal placement using coverage maps and combined with viewsheds for communication.

While lots of controversy regarding the 5G cell towers in regards to health, although it is not officially proven. Another objective can be consider those concerns when planning optimal locations for the towers.



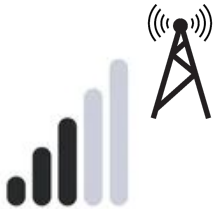
Background

Low-Band



Microwaves of 1 GHz
Speed of 30-70 Mbps
Can easily pass through buildings

Mid-Band



Microwaves of 1 to 6 GHz
Speed of 115-223 Mbps
Range of 5km radius

High-Band

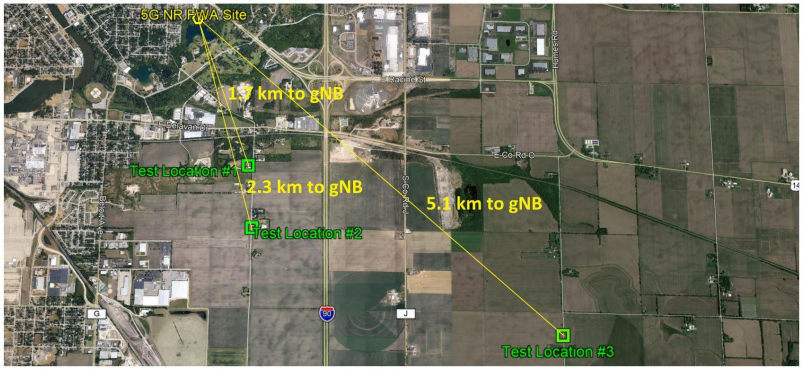
Uses mmWave (millimetre-wave)
Speed of 450 MBps to 1 Gbps
Easily disrupted by buildings, glass and foliage

Low-band cell towers have a range and coverage area similar to 4G towers.

Mid-band 5G uses microwaves of 2.3–4.7 GHz, allowing speeds of 100–900 Mbit/s, with each cell tower providing service up to **5 kilometers** in radius. This level of service is the most widely deployed.Some regions are not implementing the low band, making Mid-band the minimum service level.

High-band 5G uses frequencies of 24–47 GHz, However, millimeter waves (mmWave or mmW) have a more limited range, can be impeded or blocked by materials in walls or windows. Due to their higher cost, plans are to deploy these cells only in dense urban environments and areas.

FWA Testing in Wisconsin



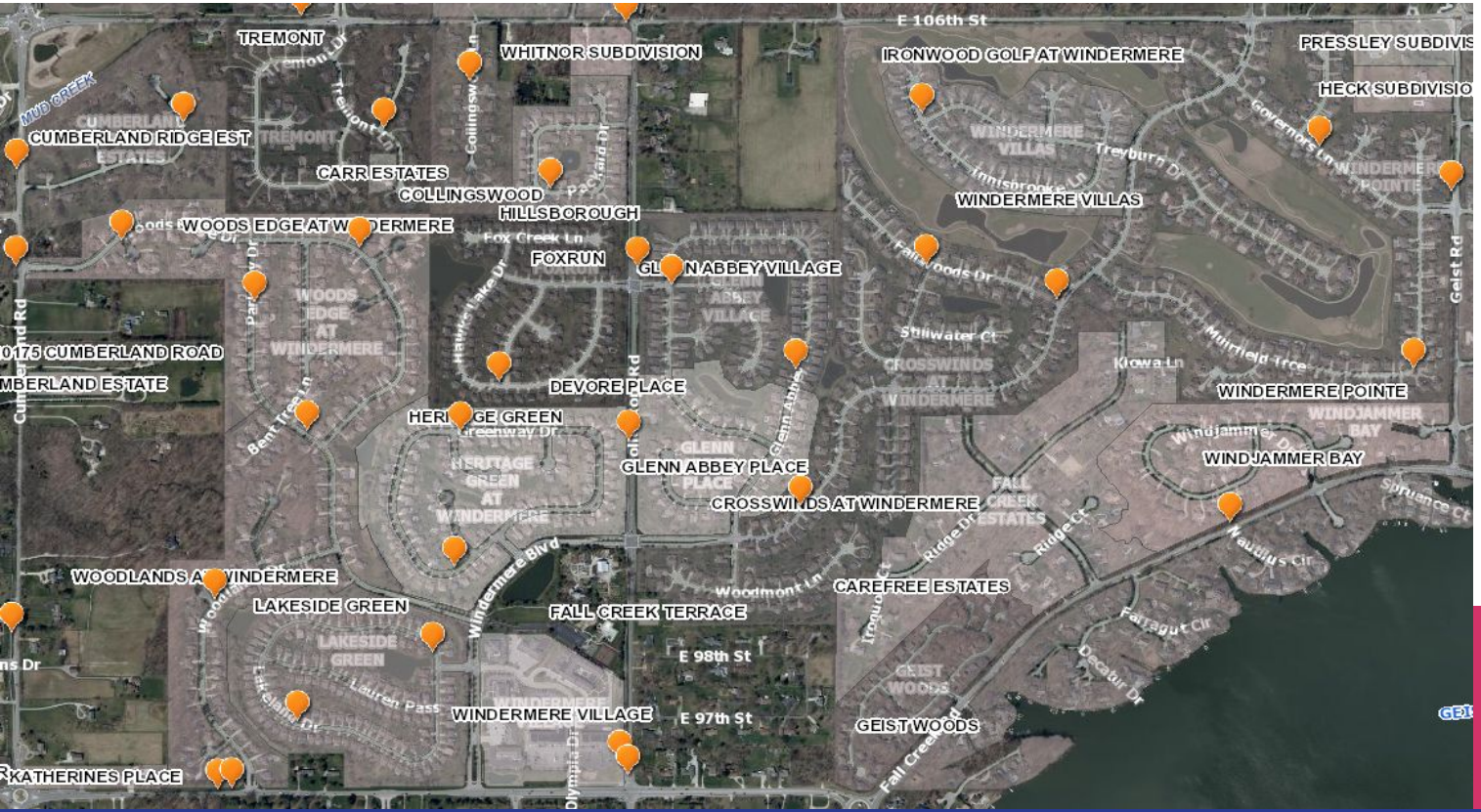
Background on the problem

Low-band cell towers have a range and coverage area similar to 4G towers

For mid-band, this level of service is the most widely deployed

For high-band 5G, They are to deploy these cells only in dense urban environments and areas where crowds of people congregate

Example tower placement image



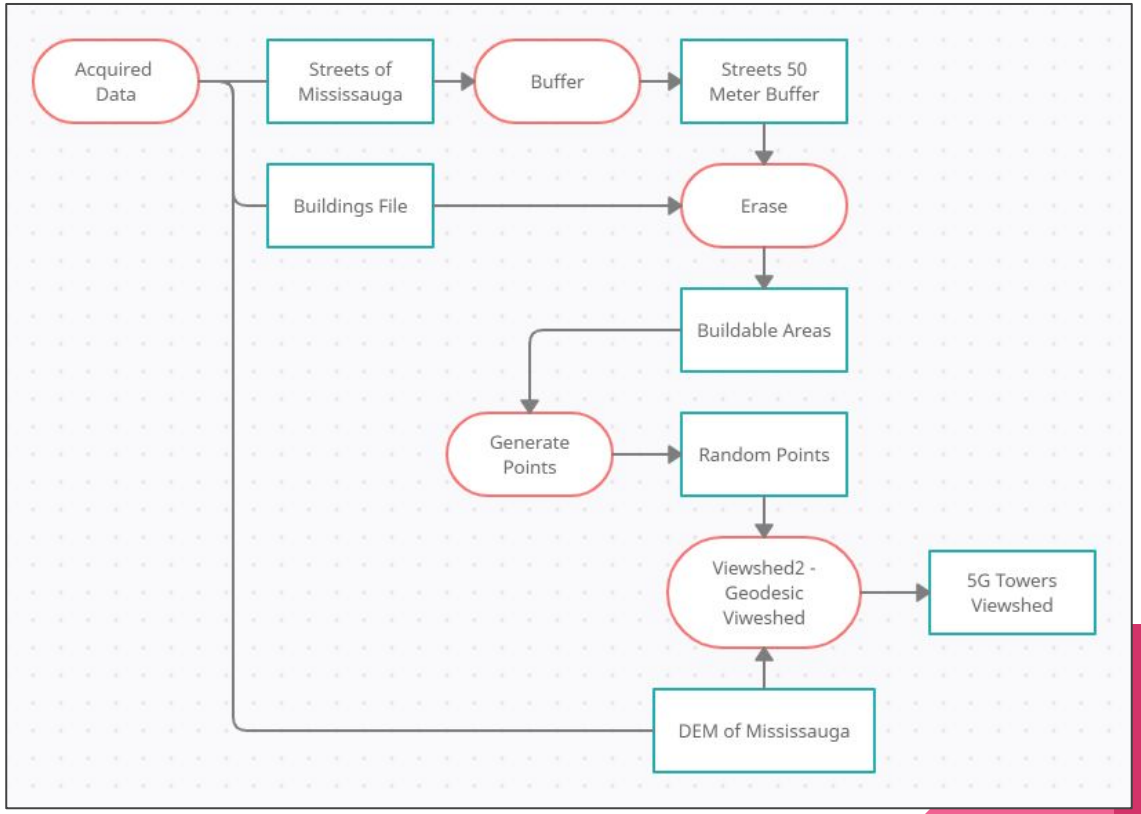
What tool did we create to help with this?

- Flexible tool; lots of input parameters
  - Allows for analysis to be performed on any city so long as it's provided the proper files

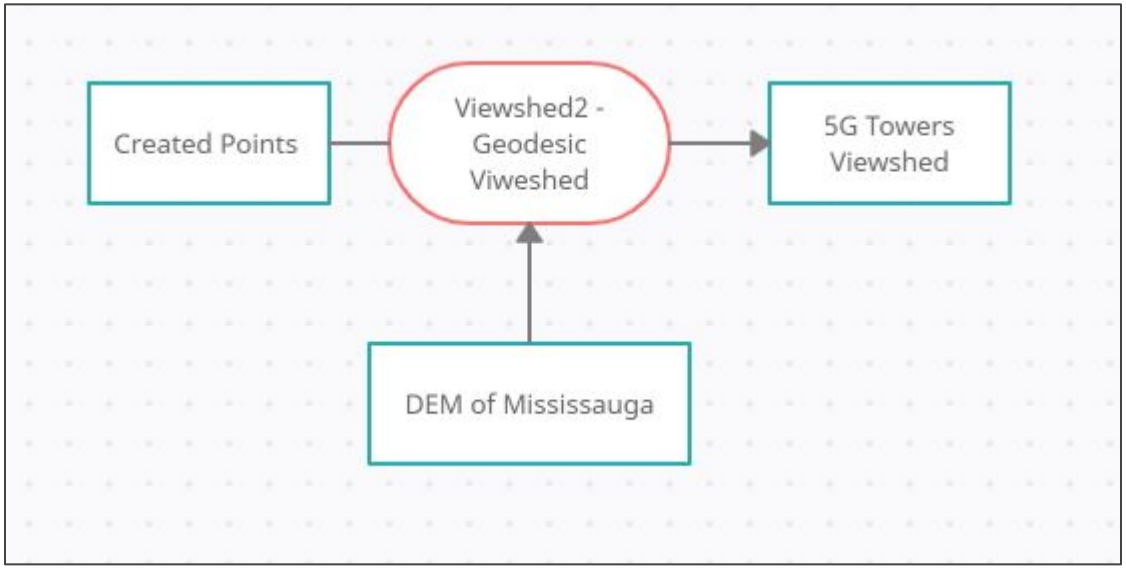
- Main tools used
  - Buffer
  - Erase
  - Create Random Points
  - Viewshed2
  - Clip

```
# == Get information ==
output_gdb = arcpy.GetParameterAsText(0)
OutFc = arcpy.GetParameterAsText(1)
dem = arcpy.GetParameterAsText(2)
streets = arcpy.GetParameterAsText(3)
buildings = arcpy.GetParameterAsText(4)
num_towers = arcpy.GetParameter(5)
tower_radius = arcpy.GetParameter(6)
tower_dist = arcpy.GetParameter(7)
```

Data Processing Workflow



Data Processing Workflow

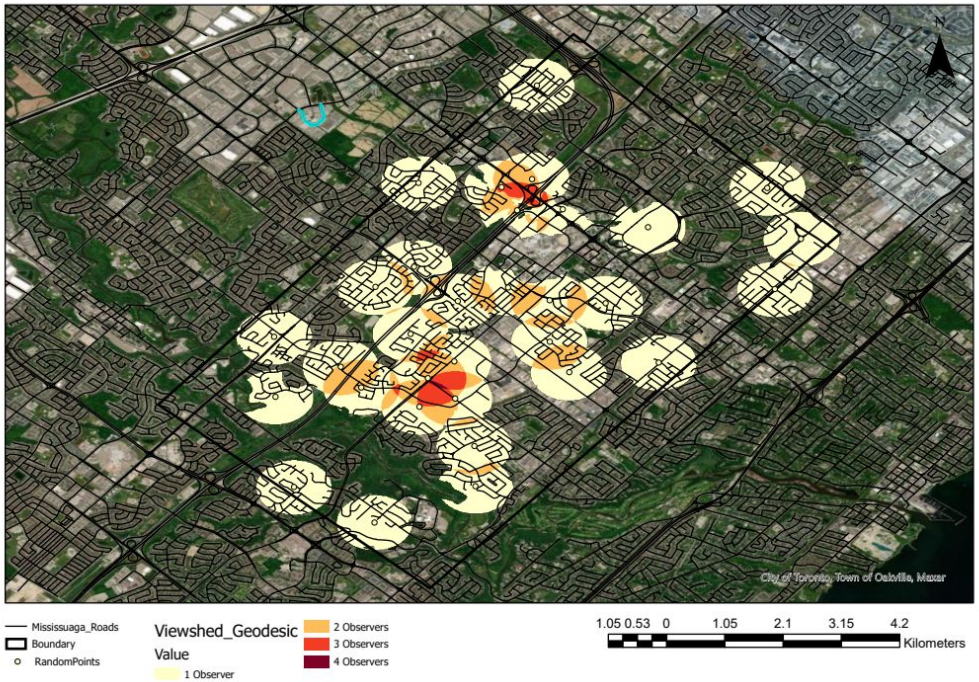


Viewshed 2 Variables:

- Tower Effective Radius
- Tower Height

Results

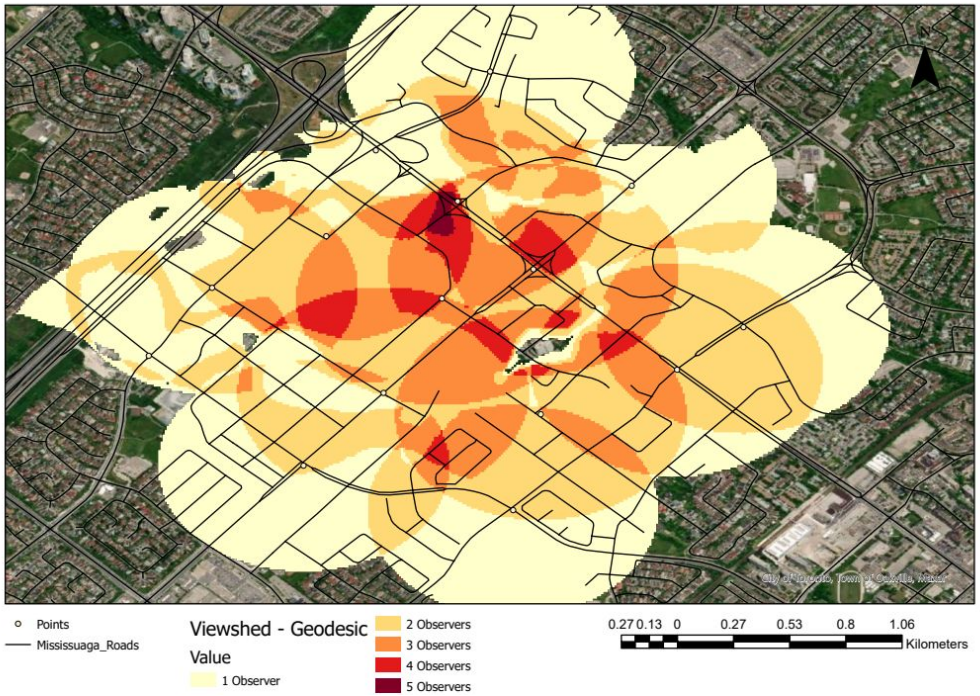
5G Tower Placement - Random



- Randomly placed 32 towers, limit for the geodesic viewshed
- Not much coverage and lots of isolated towers, so no communication

Results

5G Tower Placement - Closer

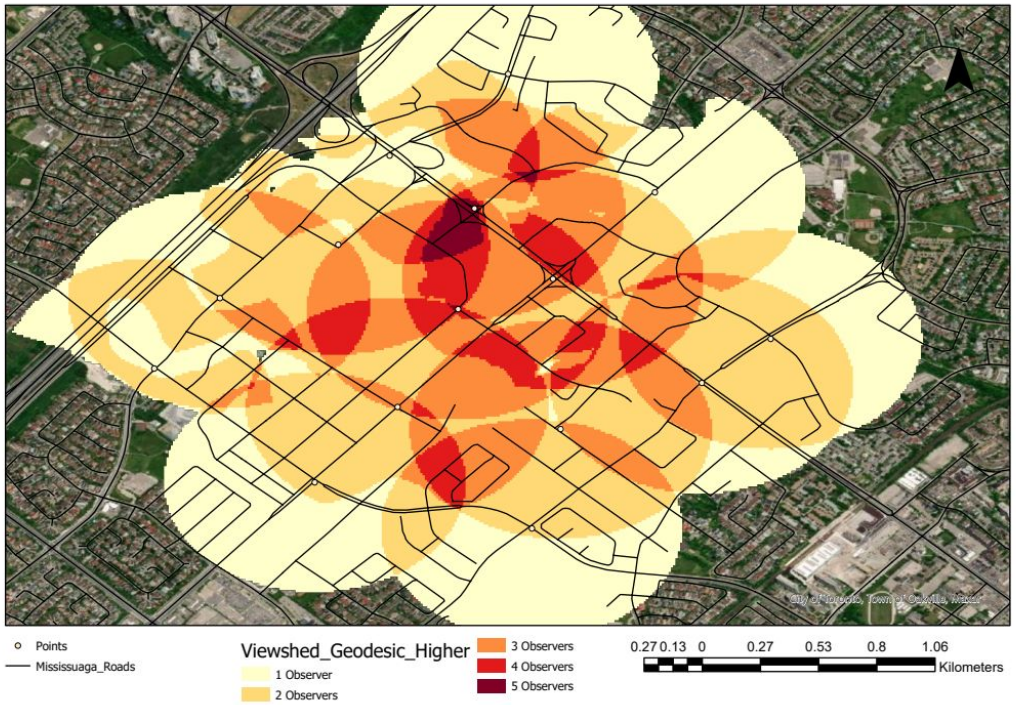


- Specified the placement of 15 towers close to core of Mississauga
- Much better coverage but still some parts are not covered due to viewshed
- Need all towers to be covered by at least 2 observers to have full communication between them

Analysis of Work

- Lack of range leads to the loss of coverage and communication
- Higher towers may be more efficient to reach more places
- It may be not be beneficial to have 5G coverage in all areas, only urban city centres

5G Tower Placement - Higher Towers



Reference

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