2023 IM^{2}C
Using Land: A valuable resource

The Context

Optimal land use planning and the balancing of community values and business profits often require models that include geography, climate, business options, and community needs, and local culture to make important decisions. The community leaders and business planners are trying to decide the '*best use*' of an available 3 square kilometer parcel of land available for development. A satellite view of the property is provided in **Figure 1**. The property's boundaries are defined by five roads:

- Northern boundary: Maiden Lane
- Eastern boundary: Upton Road
- Southern boundary: Maroney Road
- Southwest boundary: Red Creek Road*
- Western boundary: County Line Road#

*Listed as "Red Creek" on the map (Figure 1), but may be identified as Kasson Way or County Road 108 on other maps.
#Listed as "County Line" on the map (Figure 1), but may be identified as County Road 118 on other maps. This roadway also serves as the boundary between Cayuga County, New York (NY) and Wayne County, NY.

A larger version of the maps in Figure 1, as well as several additional maps of the property highlighting different aspects or the property and showing the property from different vantage points, are available to support your modeling and are accessible in the **Appendix**. Information about the current terrain of the parcel is noted in Figure 2. The terrain statistics include elevation, slope, **aspect**, tree and land cover data for the interior of the parcel.

The land is located in a rural area at a latitude of 43°N in a temperate marine climate with all four seasons including a snowy winter and has adequate water and power supplies. The soil is sufficiently rich for crop farming or grazing animals. Syracuse, NY, USA, an urban population center is approximately 50 kms away with adequate roads and transit systems to access the land.

So far in their process, the decision makers have considered the *options* of an outdoor sports complex, cross-country skiing facility (3-month season), a crop farm, a grazing farm/ranch, a **regenerative farm**, a **solar array,** an **agrivoltaic farm,** and an **agritourist center**. They are willing to consider other options or even divide the property into sections for different uses. They need your help to model the options and construct a decision method that will make 'best use' of the land.

Figure 1. Left, a satellite image of the parcel of land. Right, location of the parcel of land. (Shaded region.)[1]

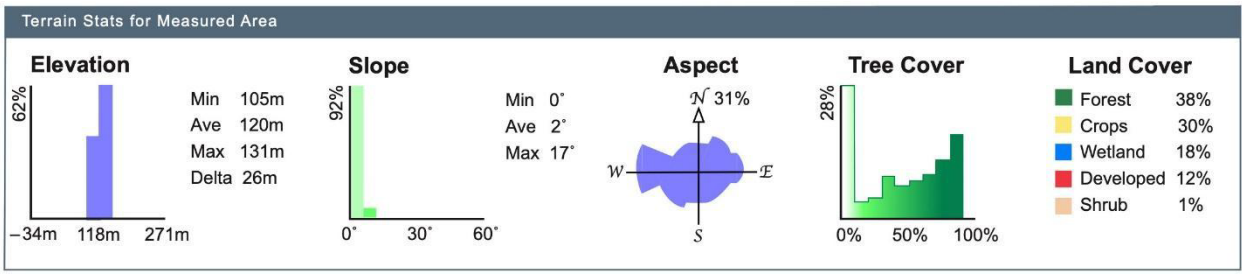


Figure 2. Terrain statistics for the parcel of land.[1]

Your Task:

1. Determine a **quantitative** decision **metric** that defines "best" so the decision makers can feel confident in their final use of the land. The metric should consider short- and long-term benefits and costs.
2. Choose at least two of the options listed above and determine the values of those options in your "best" metric. You may need to find data. You will need to decide which factors to focus and why and make assumptions including on values in order to use your metric. Explain and defend your values or use a range of values to better understand the effects and sensitivities of your assumptions.
3. In October 2022, it was announced that Micron Technology, Inc. will build a very large semiconductor fabrication facility (fab) in Clay, NY, USA, a town just north of Syracuse, NY. Soon after the announcement, it was reported by news outlets that "If fully built, the fabs could employ up to 9,000 people making an average of $100,000 each year. They would create some 40,000 other jobs among suppliers, construction firms and other businesses. the new plant will directly support 9,000 jobs and create nearly 40,000 additional jobs."[2] How will the new fab impact your metric? Re-evaluate the options you identified in the previous question using your "best" metric.
   You may *also* consider alternative options for using the land (either an additional item from the initial list or any other option not listed above) and evaluate that option using your "best" metric; justify your decision to consider and evaluate another option.

4. Briefly (no more than 1 page) discuss how appropriate your model would be for use in an environment you are familiar with. Make some comments about what might have to change if the land was in a different location or country. That is, consider how generalizable your model is to other locations.

Your PDF submission should consist of:

- One page Summary Sheet.
- One page *Letter to the Decision Makers* with your recommendation.

  The audience is the 'The community leaders and business planners' tasked with solving the problem who have asked for your advice. They are already familiar with the problem (and have just read your Summary Sheet so don't restate or repeat this). The purpose of the letter is to provide important information to the decision makers, communicating key details of your recommendation.

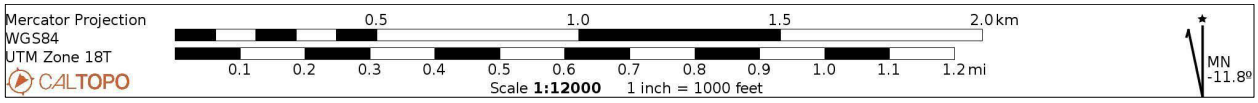
- One page Table of Contents.
- Twenty pages (maximum) communicating essential aspects of your solution.
- The following items *do not count* toward the 23-page limit: Reference List and Appendices.

Note: Your PDF submission must be A4 or letter size, written using no smaller than 12-point font size. For detailed information about IM^{2}C submission guidelines and the general expectations for each portion of your solution please review the **Full Submission Guidelines**.

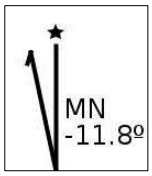
Glossary

Aspect (geography) – the compass direction that a topographic slope faces.
Metric – a measure that can be determined for each option.
Quantitative – a value that can be computed.
Regenerative farm – a farm that uses a variety of sustainable agricultural practices.
Solar array – is a collection of solar panels to generate electricity.
Agrivoltaic farming – planting crops under the solar array
Agritourist center – a farm that caters to visitors to experience and learn about farming methods.

Map Glossary



All our maps utilize a **Mercator projection** to flatten the spherical globe into a two dimensional map. More specifically, our maps use the World Geodetic System 84 (**WGS84**) ellipsoid model to approximate planet earth in conjunction with the Universal Transverse Mercator (**UTM**), a projected coordinate system that divides the world into sixty north and south zones, each 6 degrees of longitude wide.



The diagram at the bottom right of the six maps shows two north arrows--true north (represented by the star) and magnetic north--and the angle between them. **True north**, also referred to as geographic north, represents the direction of the line of longitude that converges at the north and south poles. **Magnetic north** (MN) represents the direction a magnetic compass would point if used at the center of the provided map location and at the time of publication.

The location of the parcel of land is represented by the blue shaded area on maps 2, 5, and 6.

Appendix

Map_1_Satellite
Map_2_Parcel_Shaded
Map_3_Topographical&Relief
Map_4_CurrentCellCoverage
Map_5_Regional_smaller
Map_6_Regional_larger

References

[1] CALTOPO Maps generated from CalTopo.com, reproduced with permission. All maps, including map data, accessed online via CalTopo.com retrieved on January 23, 2023.
[2] Knauss, T. (2022, October 7). Micron would change Syracuse area for decades to come. Are we up to the challenge? Syracuse.com. Retrieved January 20, 2023, from https://www.syracuse.com/news/2022/10/micron-would-change-syracuse-area-for-decades-to-come-are-we-up-to-the-challenge.html.

Map_1_Satellite

Mercator Projection
WGS84
UTM Zone 18T

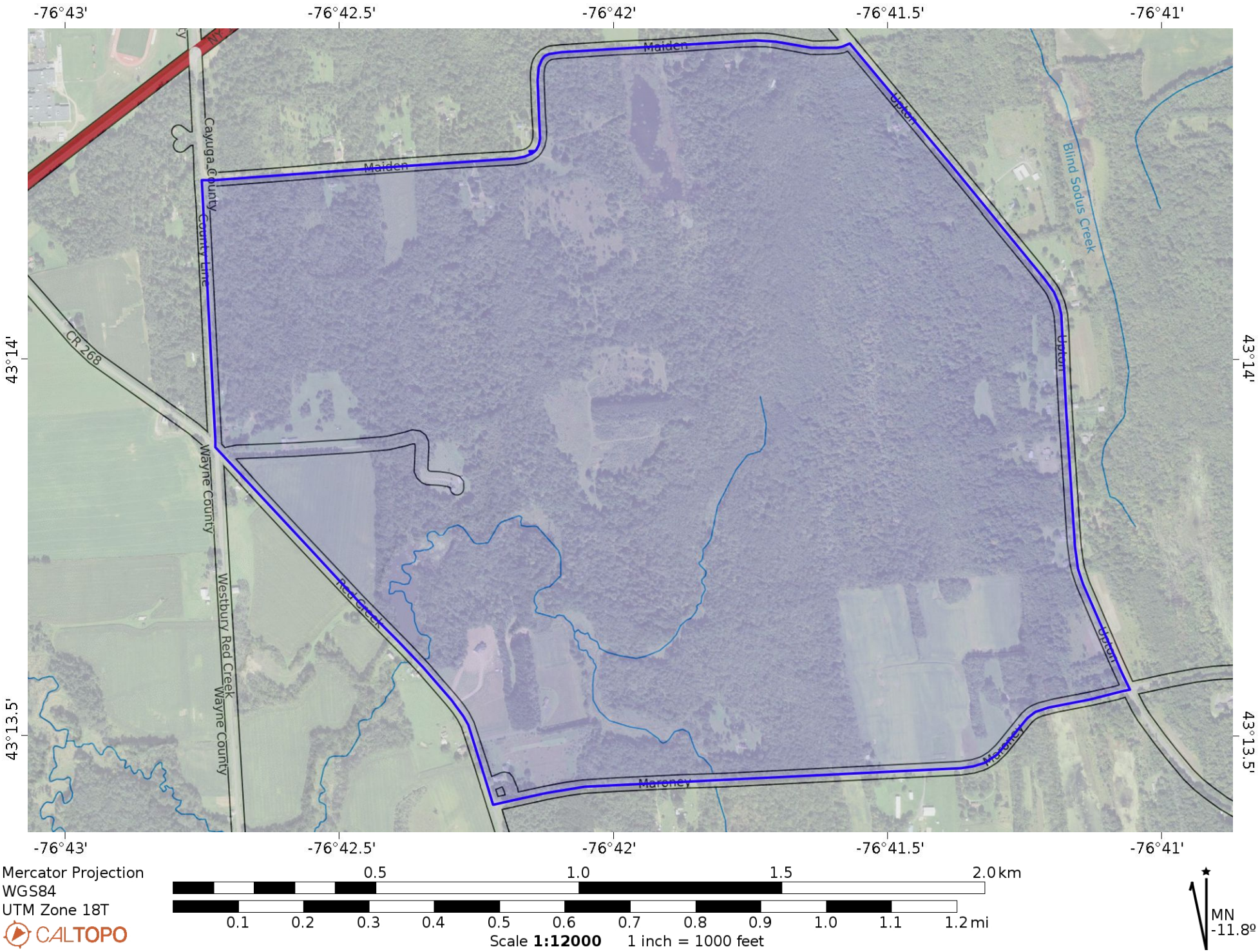
0.5 1.0 1.5 2.0 km

0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 mi

Scale **1:12000** 1 inch = 1000 feet

MN
-11.8º

Map_2_Parcel_Shaded



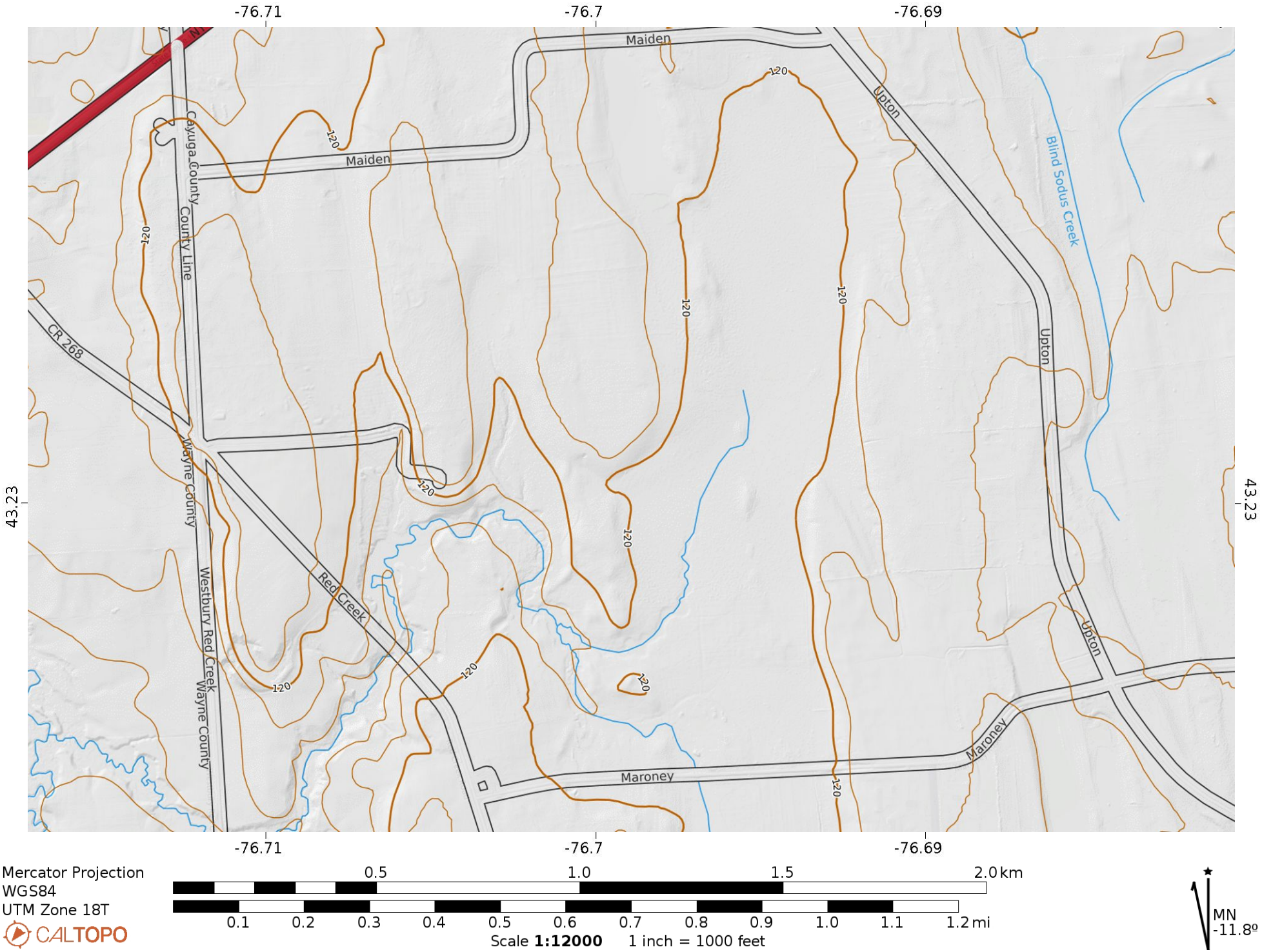
Mercator Projection
WGS84
UTM Zone 18T

0.5 1.0 1.5 2.0 km
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 mi

Scale **1:12000** 1 inch = 1000 feet

MN
-11.8º

Map_3_Topographical_&_Relief



Mercator Projection
WGS84
UTM Zone 18T

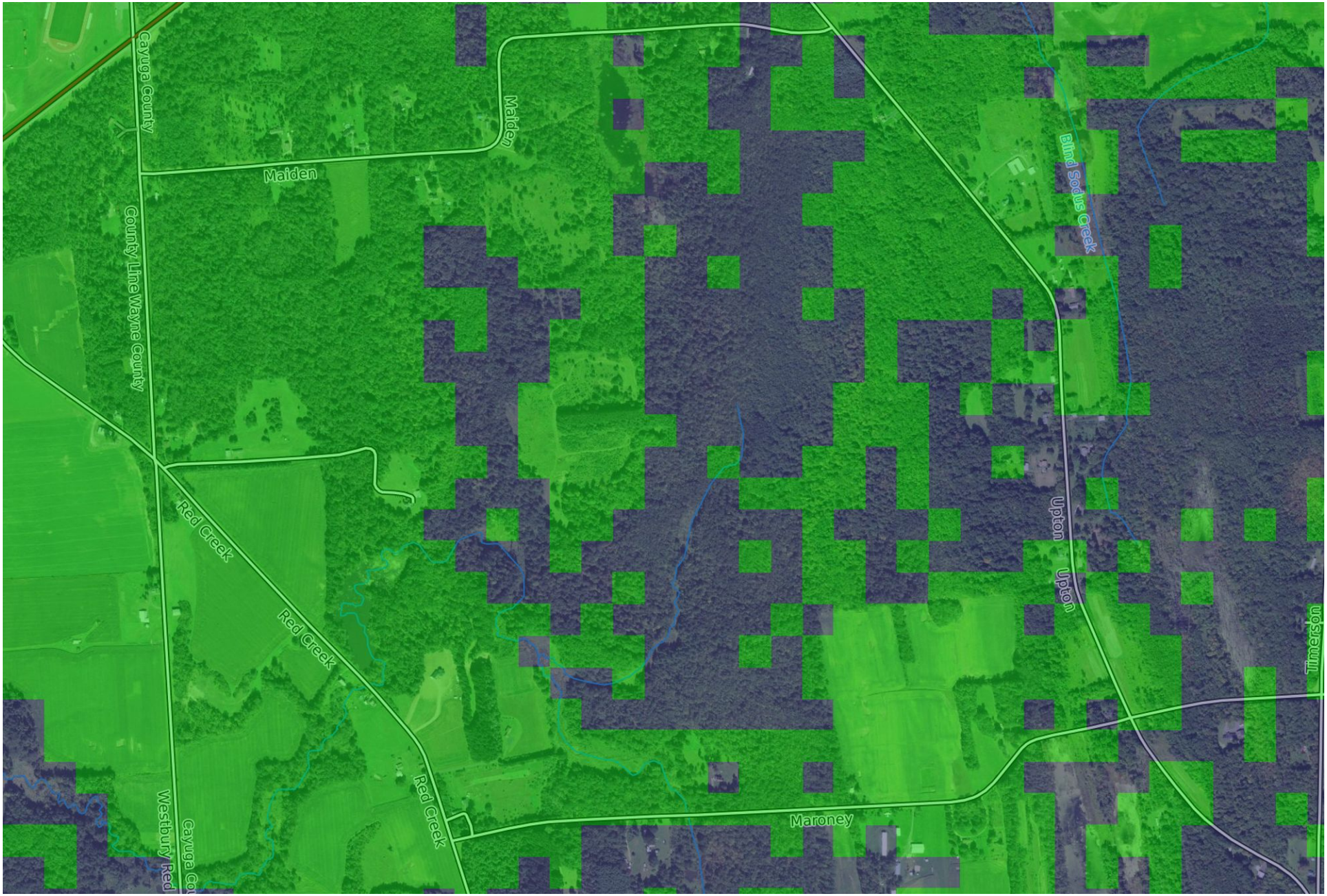
CALTOPO

0.5 1.0 1.5 2.0 km
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 mi

Scale **1:12000** 1 inch = 1000 feet

MN
-11.8º

Map 4 Current Cell Coverage

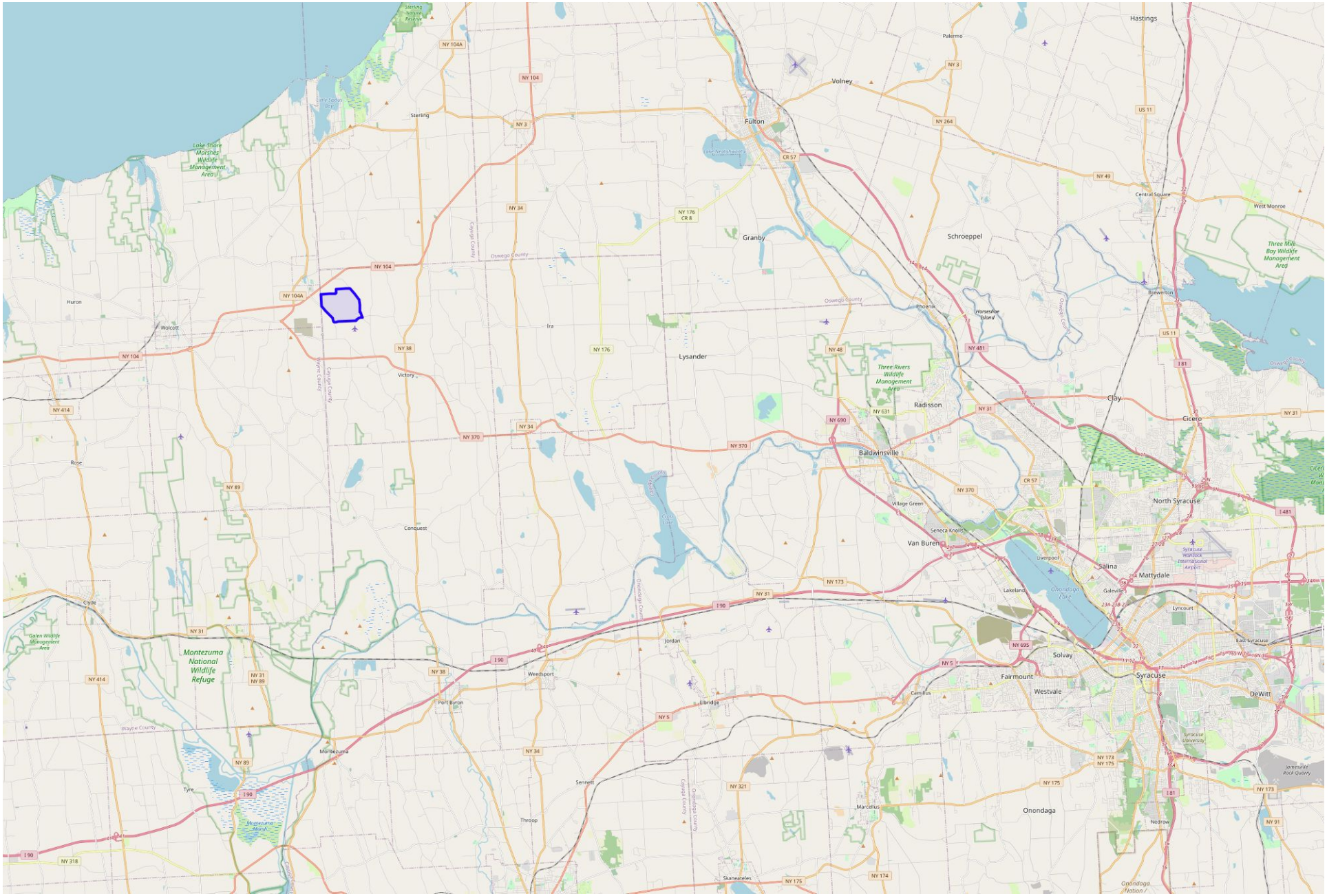


Mercator Projection
WGS84
UTM Zone 18T
CALTOPO

0.5 1.0 1.5 2.0 km
0.1 0.2 0.3 0.4 0.5 0.6 0.7 0.8 0.9 1.0 1.1 1.2 mi
Scale **1:12000** 1 inch = 1000 feet

MN
-11.8º

Map_5_Regional_smaller



Mercator Projection
WGS84
UTM Zone 18T

CALTOPO

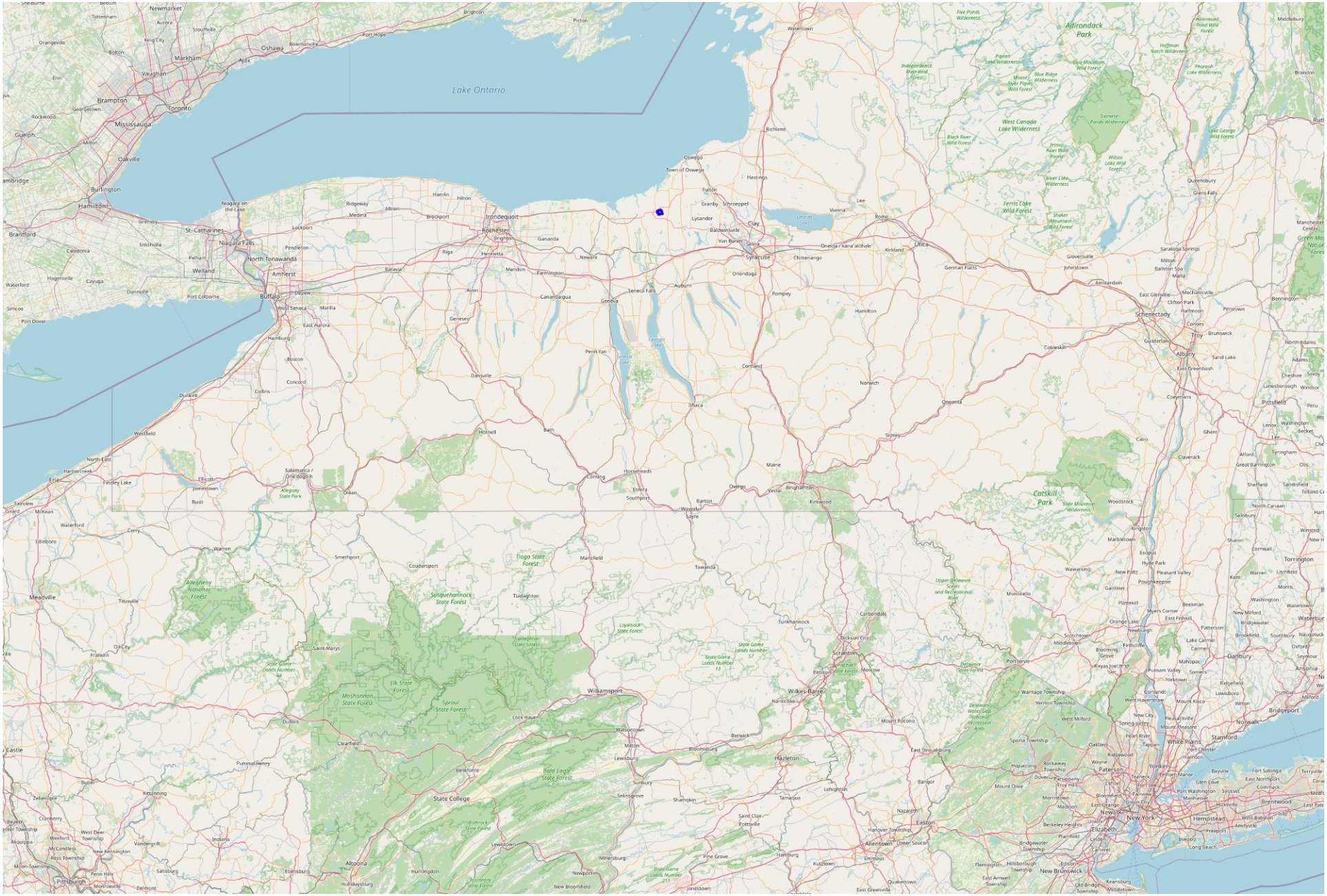
5 10 15 20 25 30 35 40 45 50 km

5 10 15 20 25 30 mi

Scale **1:287429** 1 inch = 4.5 miles

MN
-11.9º

Map_6_Regional_larger



Mercator Projection
WGS84
UTM Zones 17T-18T

CALTOPO

125 250 375 km

25 50 75 100 125 150 175 200 225 mi

Scale **1:2396933** 1 inch = 37.8 miles

MN
-11.6º

2023 IM^{2}C Full Submission Guidelines

Teams may use any inanimate source of data, materials, computers, software, references, websites, books, etc. Be sure to credit all sources used.

Teams may not use any person (other than team members) to discuss or obtain ideas for solving their problem **nor may they seek help in obtaining an answer from the teams' advisor or anyone else**. Any team that discusses the problem with anyone in a position to supply them with information reflecting experience or professional expertise will be disqualified. The relevant issue is one of intent: each team of students is expected to develop all of its substantive analysis without the help of others.

Partial solutions are acceptable. There is no passing or failing cutoff score, nor will numerical scores be assigned. The IM^{2}C judges are primarily interested in a teams' approach and methods.

The solution must consist entirely of written text and possibly figures, charts, or other written material only. No non paper support such as computer disks or applications will be accepted.

Each page of the solution should contain the team control number and the page number at the top of the page; we suggest using a page header on each page for example: Team # 2023000 page 6 of 13.

The names of the students, advisor, or institution must not appear on any page of the solution. The solution must not contain any identifying information other than the team Control Number.

Teams should keep in mind the following guidelines while preparing their solution papers:

- Conciseness and organization are extremely important. Key statements should present major ideas and results.
- Present a clarification or restatement of the problem as appropriate.
- Present a clear exposition of all variables, assumptions, and hypotheses.
- Present an analysis of the problem, motivating or justifying the modeling to be used.
- Include a design of the model. Discuss how the model could be tested.
- Discuss any apparent strengths or weaknesses to your model or approach.
- Incorporate lengthy derivations, computations, or illustrative examples in appendices. Summarize these in the main report. Results must be explicitly stated in the body of the report.

Your PDF solution should include:

- **One page Summary Sheet.**

  The Audience for the summary sheet is anyone unfamiliar with the problem. Hence, in your own words briefly outline the problem, the main solution approach, and your conclusion.

To write a good summary, imagine that a reader may choose whether to read the body of the paper based on your summary. Thus, a summary should clearly describe your approach to the problem and, most prominently, what your most important conclusions were. The summary should inspire a reader to learn the details of your work. Your concise presentation of the summary should inspire a reader to learn the details of your work.

- **One page *Letter to the Decision Makers* with your recommendation.**

  The audience is the 'The community leaders and business planners' tasked with solving the problem who have asked for your advice. They are already familiar with the problem (and have just read your Summary Sheet so don't restate or repeat this). The purpose of the letter is to provide important information to the decision makers, communicating key details of your recommendation.

- **One page Table of Contents.**

  This allows the reader to easily find various parts of your solution, especially if they chose not to read though in order (as is typical when reading long reports).

- **Twenty-page** (maximum) **report** communicating the essential aspects of your solution.

- The specifications of a complete solution:
  - A4, margins at least 1.5cm (OR) Letter, margins at least 0.6in
  - Papers must be typed and in English.
  - At least 12-point font size.
  - **Note that (excluding references and appendices, see below) you have a maximum of 23 pages to communicate your solution.** Your summary sheet, letter to the decision makers and your table of contents all count towards the 23-page limit (excluding references and appendices) of your solution.
- **Reference List and Appendices.**

  A list of references and any appendices ***do not count*** toward the 23-page limit and should appear after your completed solution. You should not make use of unauthorized images and materials whose use is restricted by copyright laws. Ensure you cite the sources of all ideas and materials (data, images, etc.) so it is clear to the reader what ideas and mathematical work was completed by your team and where you are building in ideas of others.