Sandia National Laboratories

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Preliminary Assessment of Potential for Wind Energy Technology on the Turtle Mountain Band of Chippewa Reservation

PRESENTED BY

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Introduction

- Grew up in the Turtle Mountains
- Began attending North Dakota State University in 2016
  - Majoring in Mechanical Engineering
  - American Indian Science and Engineering Society

NDSU

AMERICAN INDIAN SCIENCE AND ENGINEERING SOCIETY

Background

- Several tribes throughout the country have implemented or are beginning to consider wind energy for their communities
  - Oceti Sakowin Power Authority (OSPA)
  - Kumeyaay wind farm
  - Rosebud wind project
- Some benefits tribes can experience include:
  - Increased ability to control energy decisions to remain in line with cultural and spiritual values
  - Economic development
  - Savings on electricity costs
  - Increased energy sovereignty and resilience

Kumeyaay Wind Farm

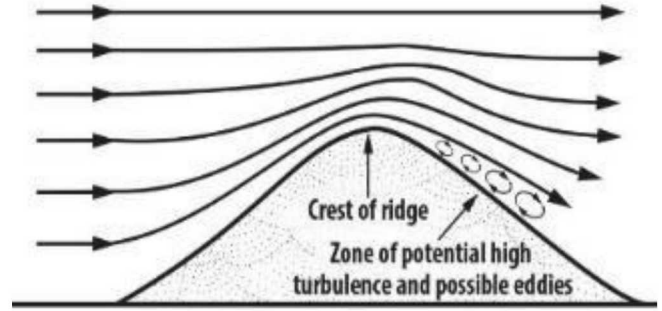
Rosebud Project

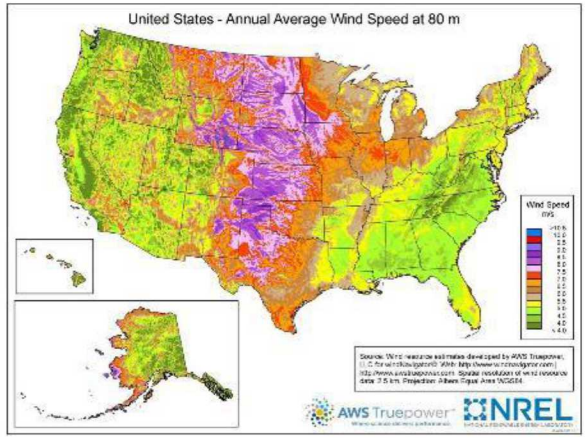
Background

- Turtle Mountain Band of Chippewa
  - Main reservation is 12 miles by 6 miles, with scattered allotments
  - High rate of unemployment and poverty
  - 0.66 MW turbine currently supplies electricity to Turtle Mountain Community College
- Development of a community or utility-scale wind energy project at Turtle Mountain could boost economic development, supply energy, and/or reduce electricity costs for tribal members

Background

- When siting an area for a wind energy project, there are many factors that must be considered, including but not limited to:
  - Availability of wind resources
  - Slope of the land/terrain
  - Cultural or historical protected areas
  - Availability of transmission infrastructure





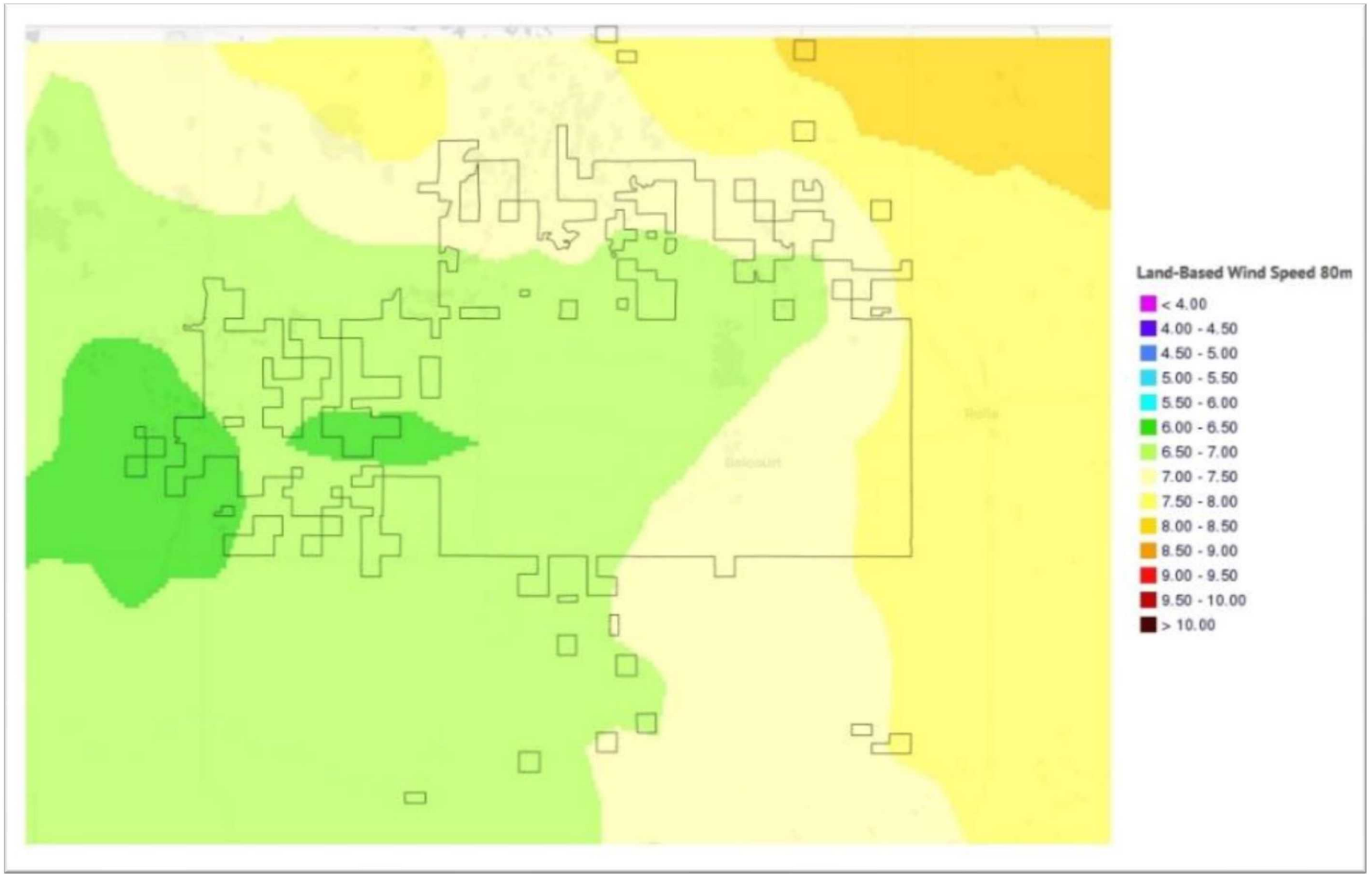
Making a Preliminary Assessment of Wind Energy Potential

- To investigate possible areas for wind energy on Turtle Mountain, available land area was evaluated based on the described siting considerations
  - Used publicly available data
    - Wind resource data
    - GIS tools and maps
  - Expert input

Wind Resources

- Evaluated using the NREL Wind Prospector tool
- Annual average wind speeds were measured at 80 m, a typical height for many modern turbines.
- According to the Wind Prospector, wind speeds of at least 6.5 m/s (14.5 mph) at 80 m are suitable for wind technology development
- About half the tribal lands have a wind speed of 6.5 to 7 m/s (14.5-15.6 mph), with much of the rest of the land having 7+
- The wind resource map shows that the southeastern corner of the reservation experiences the highest average annual wind speeds at 7.5-8 m/s (~16-19 mph)

Annual Average Wind Speeds at Turtle Mountain

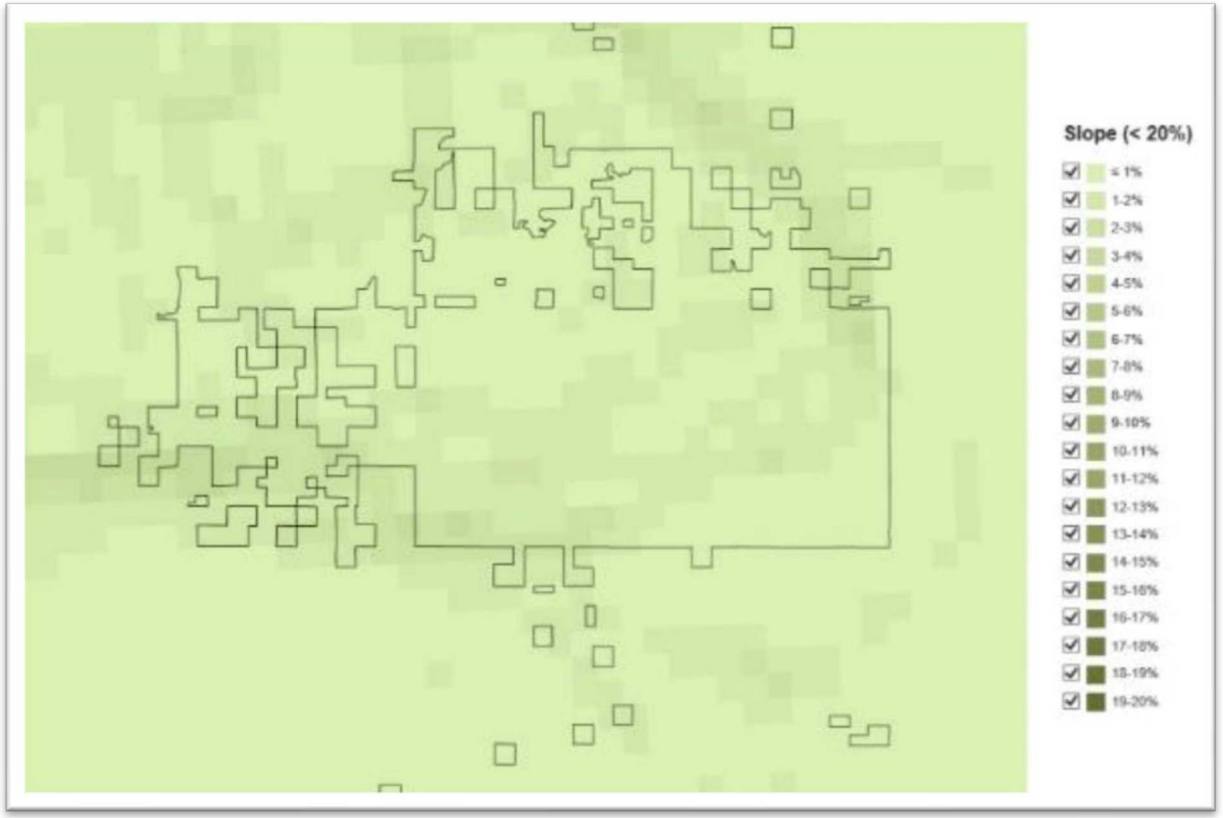


Slope/Terrain

- National Renewable Energy Laboratory (NREL) Wind Prospector slope and land cover layers
- The following exclusions were applied to the given land area:
  - Land with > 20% slope
  - Incompatible land use areas
    - Forested areas
    - Developed Areas
    - Open Water
    - Wetlands

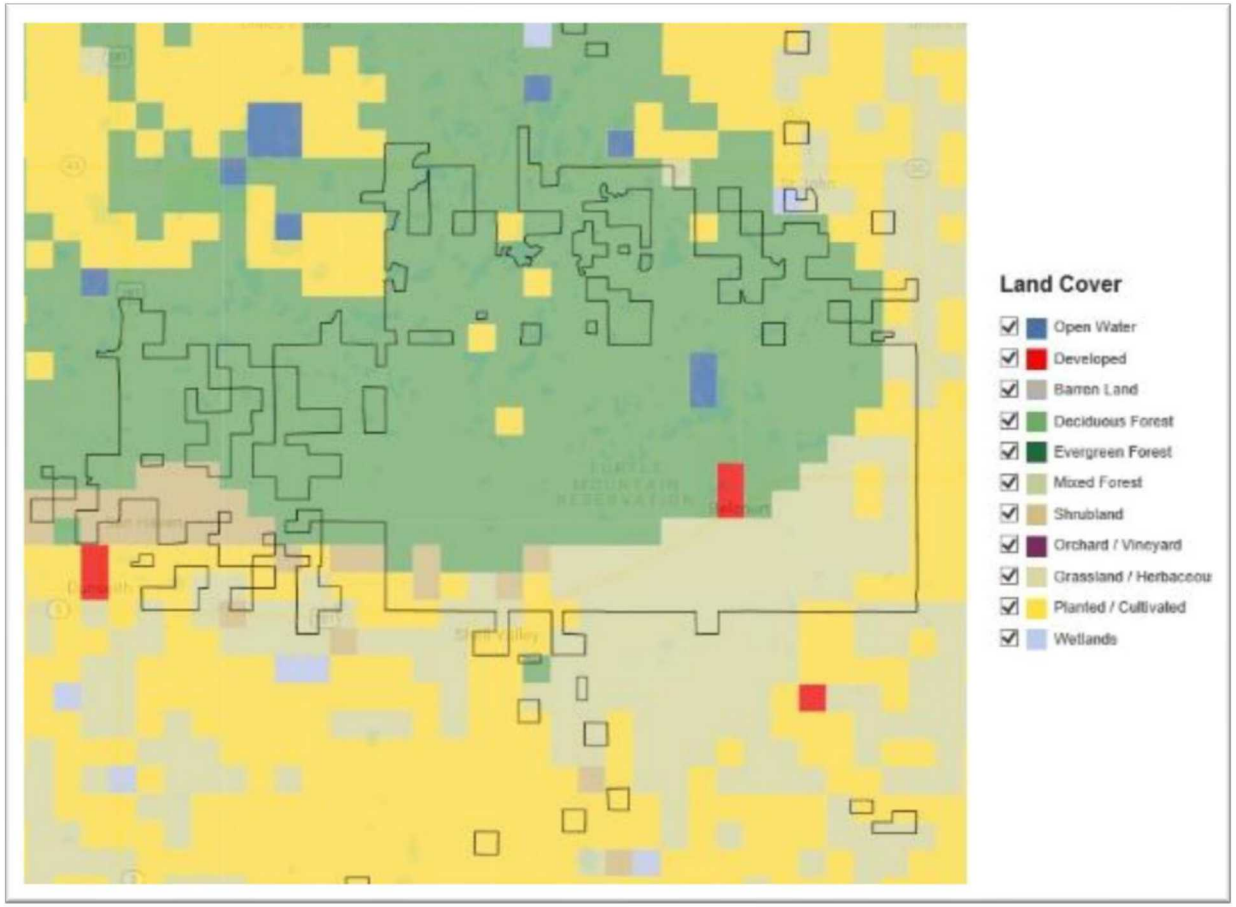
Slope

- Turtle Mountain was shown not to have any areas of land with a slope of >20%
- Does not show localized instances of steep topographic features that may affect the amount and quality of wind a turbine receives



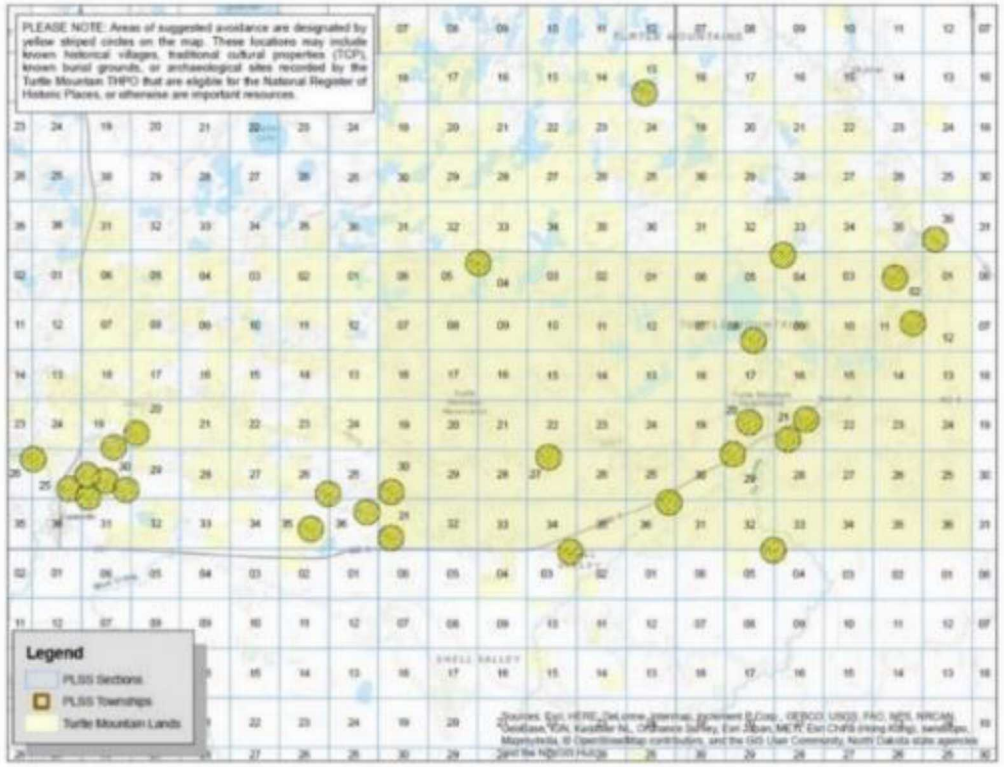
Terrain

- The figure shows a simplified representation of the types of land cover types in the Turtle Mountain region
- The south and southeastern portion of the reservation, made up of mostly grassland and farmland, would likely contain the most area suitable for development, particularly utility-scale



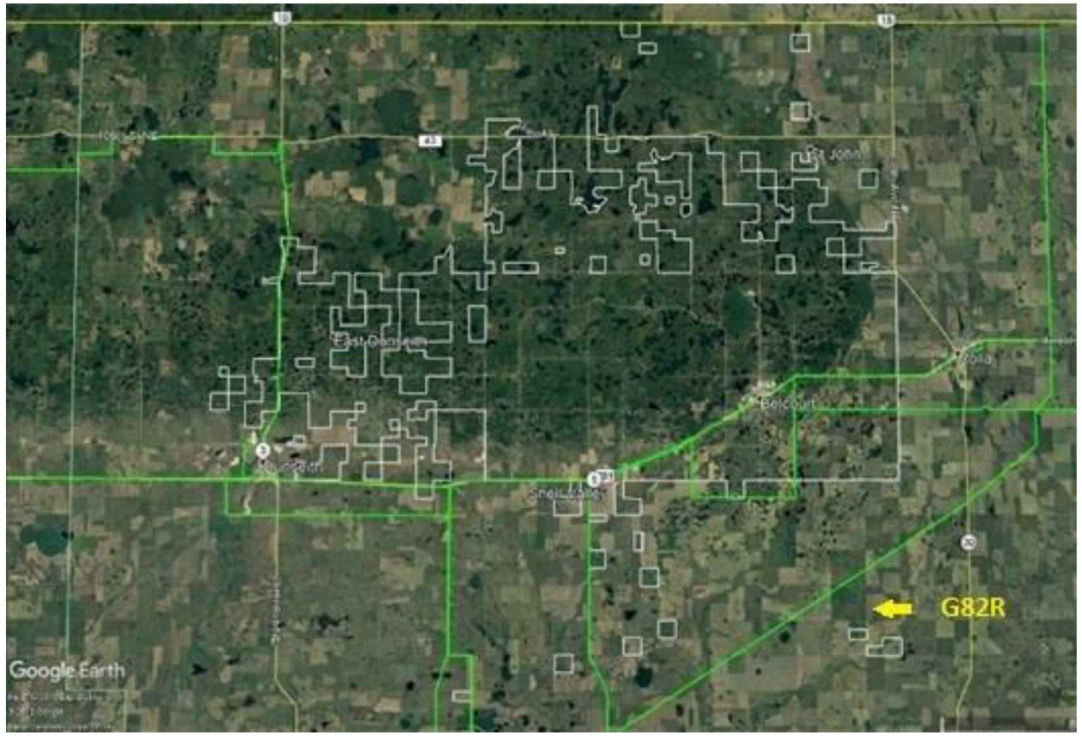
Culturally Significant Areas

- Consulted a tribal archaeologist with extensive knowledge and experience with Turtle Mountain sites
- Examples might be historical villages or archaeological sites
- A 0.25-mile radius of suggested avoidance surrounds each point. These areas were then excluded from the available land area.



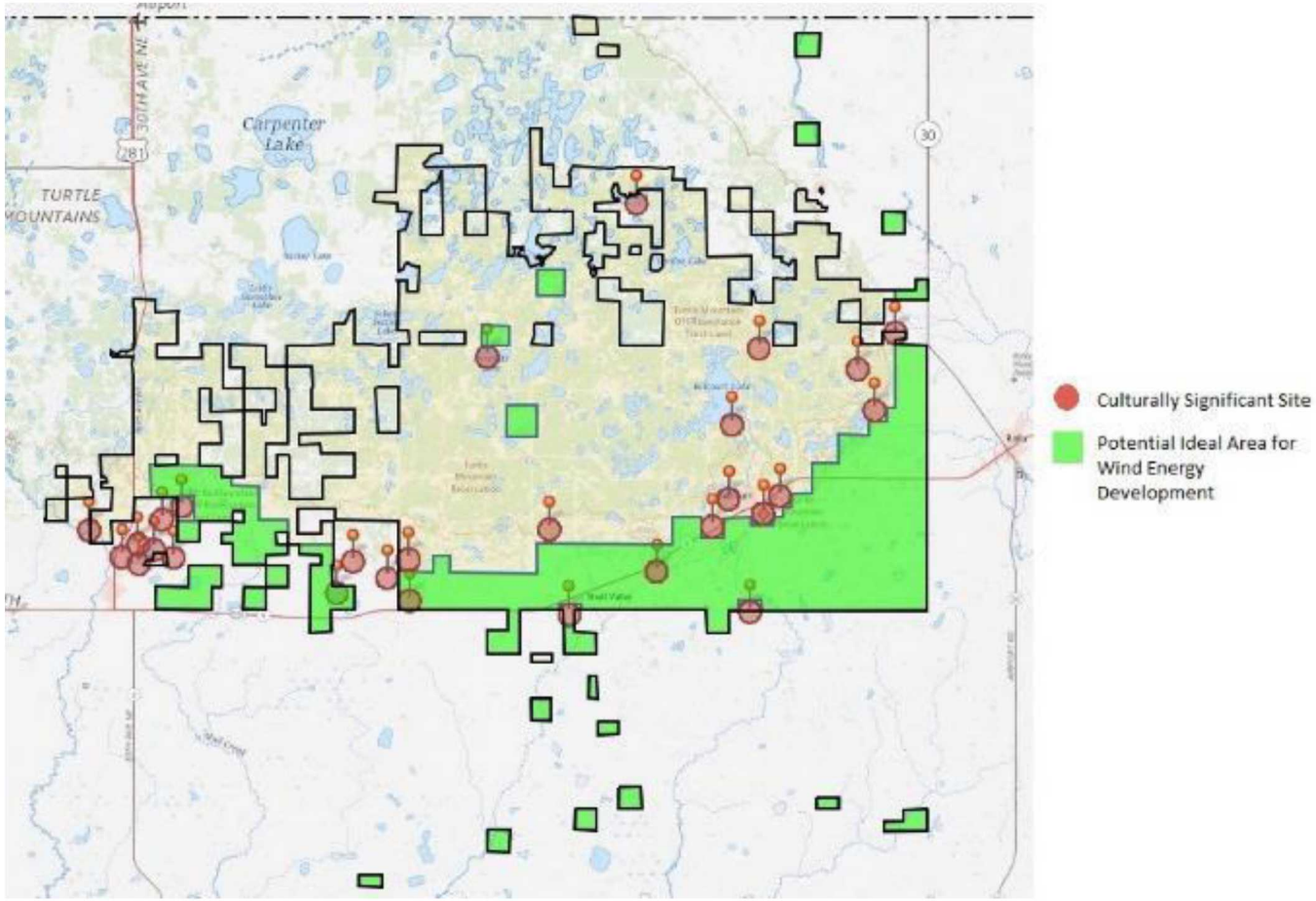
Proximity to Transmission Infrastructure

- A shapefile containing major transmission line data from the U.S Department of Homeland Security Homeland Infrastructure Foundation-Level Data website was imported into Google Earth
- The G82R line, a point of discussion in previous plans for a wind farm on Turtle Mountain, can be seen near the southeastern corner of the reservation.



Overall

- A map was made highlighting remaining available land area after all exclusions. This was done using USGS's The National Map



Conceptual Projects

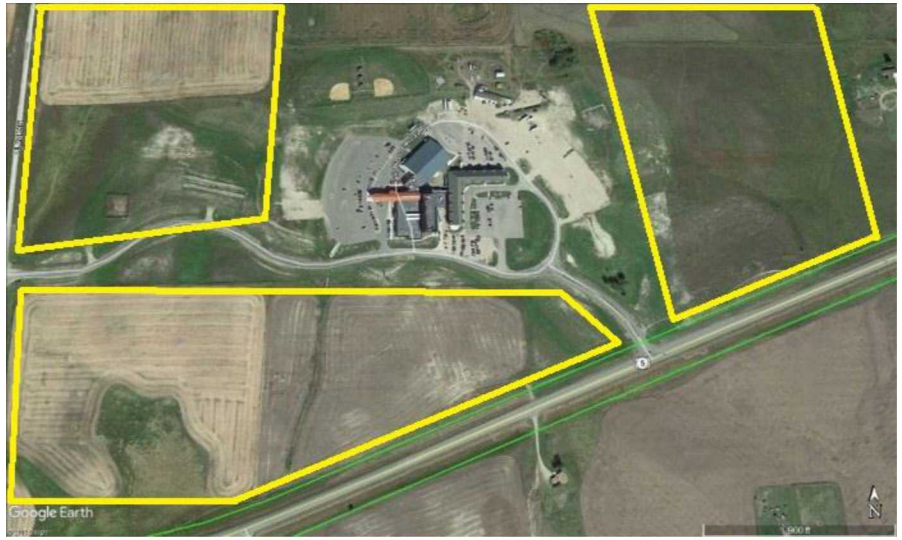
- Chose several specific sites on the reservation to look further into
  - Applied the same siting considerations as before
- Site 1
  - Community-scale (single turbine)
- Site 2
  - Utility-scale wind farm

Site 1

- Sky Dancer Casino & Resort
  - Recently underwent renovations, adding hotel rooms, an updated casino area, and an event center
  - Major source of economic development for Turtle Mountain (attracts tourism, jobs for tribal members)
  - Electricity consumption estimated to be around 6,427,320 kWh per year, presumably a major energy consumer for the tribe
  - Based on this estimate, Approximately 1,800 kW of turbine capacity would be needed to completely offset the Sky Dancer's energy consumption
  - A wind turbine could cut energy costs for the casino, as well as add to its modern, state-of-the-art image

Site 1

- Siting Considerations
  - Wind Resource- falls within 6.5-7 m/s region on wind map
  - Terrain- Surrounding land mostly grassland/farmland. Appears to sit near the top of an elevated landform
  - Cultural Sites- does not fall within 0.25-mile radius of a culturally significant site
  - Transmission- turbine would most likely be interconnected with casino

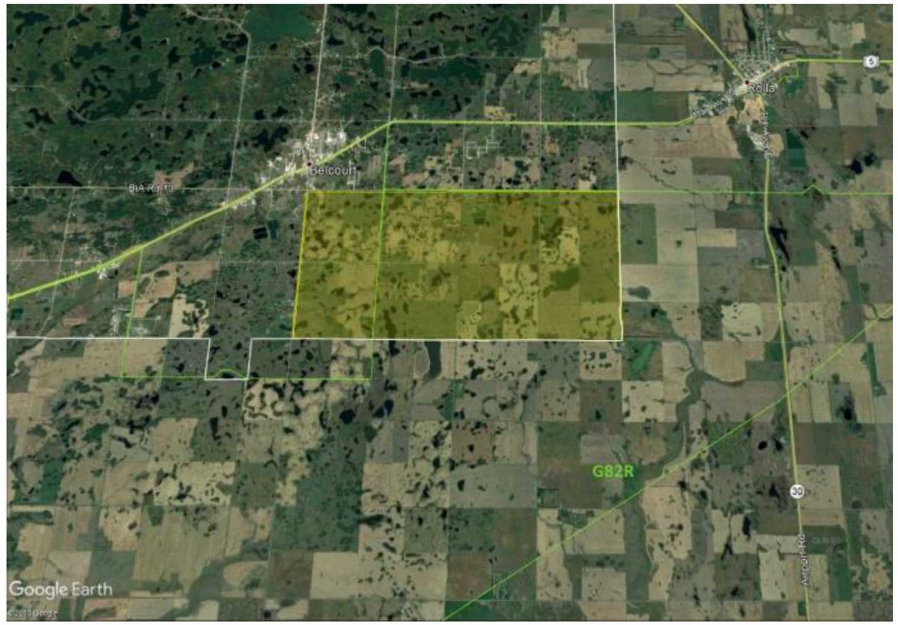


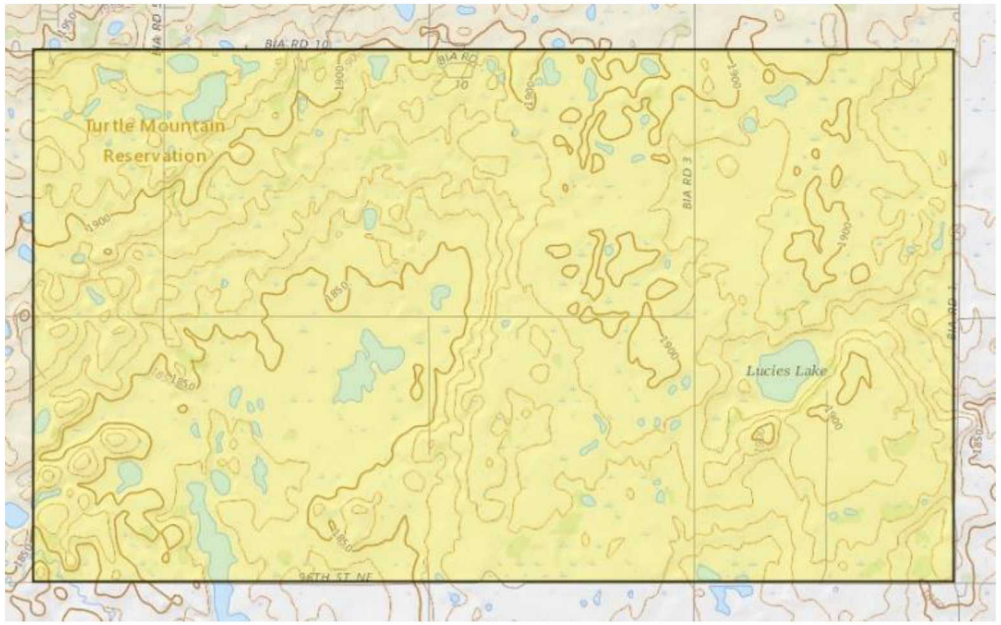
Site 2

- Southeastern corner of the reservation had been a point of discussion during the development of the TMCC turbine, due to its proximity to a new transmission line
- Outlined approximately 20.6 km^2 of land in this area
- Assuming a power density of 5 MW/km^2, the capacity for this site would be about 103 MW
- A utility-scale wind farm could provide the tribe with a source of revenue, which can be reinvested back into the community

Site 2

- Siting Considerations
  - Wind Resource: Annual average wind speeds of 7-8 m/s
  - Terrain: Primarily grassland and farmland with scattered trees/shrubs and small bodies of water. Elevation ranges between 1840 to 1900 feet
  - Cultural sites: Does not overlap with any known sites
  - Transmission: Located near G82R line





Conclusions

- Based on preliminary evaluation of a limited number of siting considerations, Turtle Mountain shows some promise for both community-scale and utility-scale wind energy development
  - Overall capacity:
  - Site 1: Casino has promising nearby wind turbine sites that may justify further investigation
  - Site 2: Estimated 103 MW of potential utility-scale capacity, further assessment is needed
- Feasibility of a wind energy project depends on many factors that must be assessed professionally, including transmission capacity and economic feasibility
- Lessons learned:
  - Many tribes with existing renewable energy projects are willing to help and share advice
  - Collaboration with people of differing backgrounds, perspectives, and level of technical or cultural expertise during the planning process is key
  - It's important to ensure that energy goals are in line with the values of the community
  - Practicing energy efficiency is very important, even when power is coming from a renewable source.
  - Education on the technology, how it works, and how to be energy efficient plays a major role in the success of a project

Next Steps

- Planning a renewable energy project takes lots of time and effort. Some steps that Turtle Mountain might take to begin this process might be:
  - Apply for funding for feasibility studies and technical analysis
  - Assess the tribe's energy usage and costs
  - Create a tribal energy office/department to more effectively plan and manage any future projects
  - Create a renewable energy standard for the tribe
  - Hold workshops to educate tribal members about energy efficiency, renewable energy, and other related topics
  - Implement energy efficient practices with any new homes or buildings being constructed on the reservation

Acknowledgements

I want to acknowledge the Department of Energy for making this internship program possible.

The Indian Energy Internship has been such a rewarding, educational, and eye-opening experience for me. I've learned so much not only about renewable energy, but about tribal communities and what they are doing to implement clean energy.

I'd also like to thank my mentors at Sandia National Labs, as well as my fellow interns.