ISSUE PAPER SERIES

The Montague Doppler Radar, An Overview

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NEW YORK STATE TUG HILL COMMISSION

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The Tug Hill Commission Technical and Issue Paper Series are designed to help local officials and citizens in the Tug Hill region and other rural parts of New York State. The Technical Paper Series provides guidance on procedures based on questions frequently received by the Commission. The Issue Paper Series provides background on key issues facing the region without taking advocacy positions. Other papers in each series are available from the Tug Hill Commission. Please call us or visit our website for more information.

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Introduction

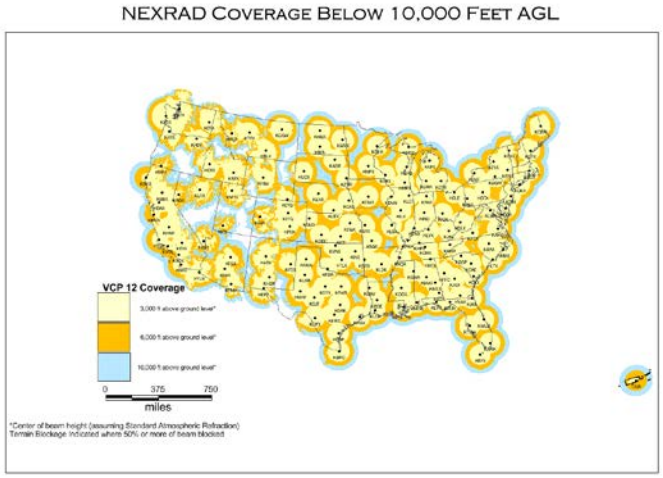
Tug Hill is famous for receiving the most snowfall east of the Rocky Mountains. The Montague Doppler weather radar station is integral to forecasting that snowfall, much of which comes in locally intense lake-effect snow storms. Recent wind farm development proposals have created numerous questions about the radar. This issue paper gathers the best available information to inform Tug Hill's communities.

Who owns the Montague radar?

The Department of Defense (DOD) owns and maintains the Montague Doppler weather radar (Montague radar), located on Sears Pond Road in the town of Montague. The Montague radar was originally located in the town of Lewis on State Route 294 and was attached to the Griffiss Air Force Base (AFB). It was moved to its current location in 1996, after Griffiss AFB was closed by the Base Realignment and Closure Commission in 1995. The radar was specifically sited at its current location to serve the mission of Fort Drum.

Who uses the Montague radar?

The National Weather Service (NWS) operates the Montague radar as part of its WSR-88D system, which stands for Weather Surveillance Radar-1988 Doppler. The radar station is one of 159 the National Weather Service, Department of Defense, and Federal Aviation Administration use throughout the country and in select overseas locations. All 159 radars are part of a tri-agency investment, used by all three federal agencies. The Montague radar's "call sign" is KTYX.



The operation of the Montague radar is also done in cooperation with the Air Force's 18th Weather Squadron stationed at Fort Drum. The NWS shares resulting weather data with many entities, including the public, media, academia, and private weather sector. The Montague radar is a critically valuable tool for the NWS' ability to monitor, forecast, and warn the region of hazardous weather, including lake effect snow. Fort Drum uses the data to forecast weather conditions for aircraft using the Wheeler-Sack Army Airfield, located on Fort Drum, to support their mission and resource protection. The Federal

Aviation Administration uses the data for their mission of safety of air navigation for both commercial and general aviation.

How does the radar system work?

Doppler radar systems scan weather by emitting an energy beam and rotating 360 degrees at different elevation angles, from 0.5 degrees to 19.5 degrees from the horizon. The radar scans up to 14 elevations. Because the Montague radar is located at a local high elevation point, its elevation angles can scan long distances without being interrupted by terrain.

The Montague radar collects two primary types of data: Doppler data that identifies wind velocities, and reflectivity data to identify precipitation. Additionally, the Montague radar was upgraded in 2013 to become a dual polarization system. This allows the unit to transmit and receive pulses in both a horizontal and vertical orientation, allowing forecasters to better estimate the size, shape, and variety of targets, such as raindrops and frozen precipitation. Prior to the upgrade, pulses were transmitted and received only in a horizontal orientation. Benefits of dual polarization include improved accuracy of precipitation estimate; the ability to discern between heavy rain, hail, snow, and sleet; and improved detection of non-meteorological items like ground clutter, birds, and tornado debris.

How does the radar predict lake-effect snowstorms?

Lake-effect snowstorms occur in the late fall and winter, when cold air flows over a relatively warm lake. Lake Ontario has a long east-west axis that produces heavy snowfall in a narrow zone, with Tug Hill being the recipient of that snowfall.

Lake-effect snowstorms are typically found in the lower elevations of the atmosphere (to a height of approximately 2 km above the water). Capturing radar data in those lower elevations is important to accurately forecasting winter storms.

How does the existing Maple Ridge Wind Farm affect the Montague radar?

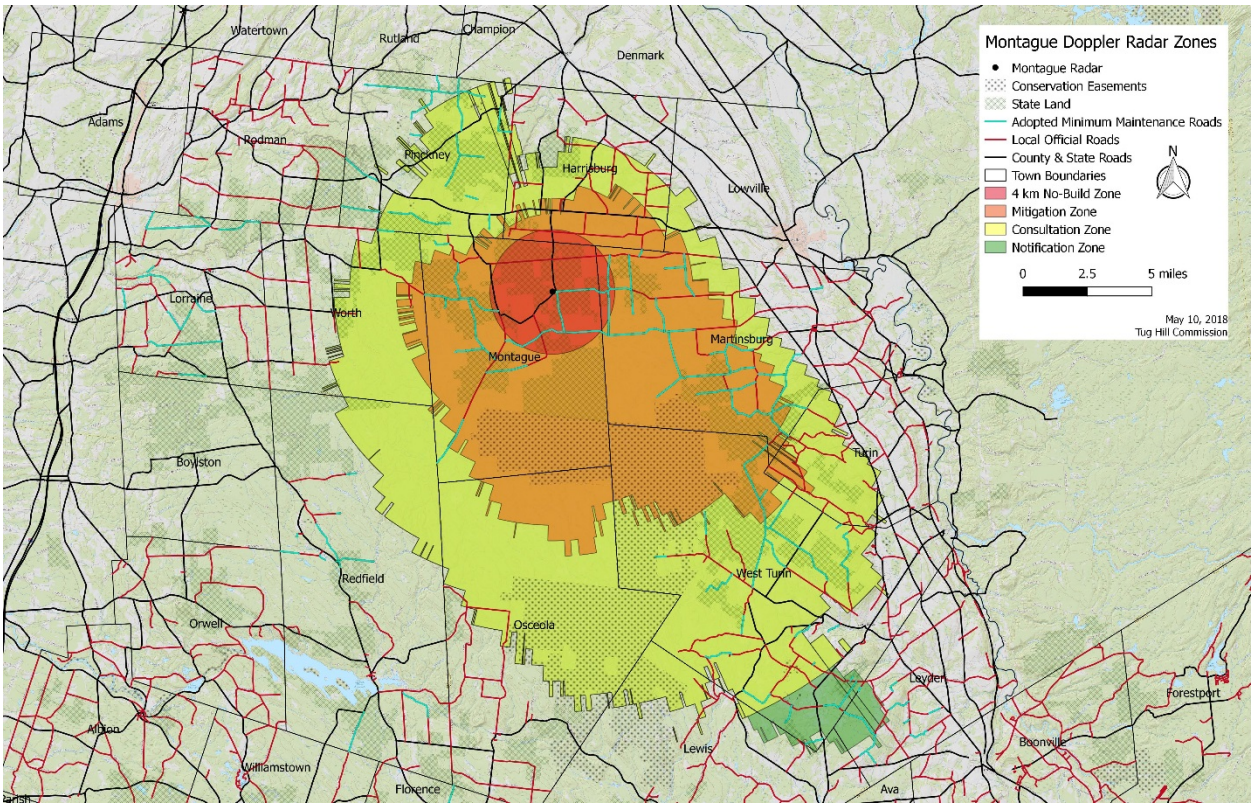
The Maple Ridge Wind Farm is located to the north east of the Montague radar. The spinning turbines create some clutter that can be seen when viewing the radar online. The radar interference is not limited to areas directly over the wind farm itself. Due to the close proximity of the turbines to the radar, the clutter also extends approximately 30 miles down range of the wind farm. This masks true weather signatures by contaminating the real weather with false returns from the turbines.

How could future wind farms affect the Montague radar?

Additional wind farm construction could create additional radar interference, depending on the final details of the various proposals. The wind turbines create clutter that appears to the radar to be real weather. The wind farm signatures can mask real, weak weather features that are precursors to lake effect snow development. They can also obscure tornadoes and high wind signatures during severe weather. The clutter also erroneously increases the precipitation estimates, making it harder for forecasters to gain an accurate picture of snow or rain totals for forecasts and warnings. Turbines located closer to the radar cause interference at more elevation angles of the radar, meaning more real weather data is masked through a deeper portion of the atmosphere, further hindering forecasters' ability to detect hazardous weather. Turbines also impact data for approximately 30 miles downrange of the wind farm, increasing the affected area.

What is the National Weather Service's role regarding wind farms?

The National Weather Service's Radar Operations Center (ROC, https://www.roc.noaa.gov/WSR88D/) has developed ways to analyze wind turbine siting proposals on a case-by-case basis. The analysis of the Montague radar and impacts from proposed wind farms is ongoing. Data used in the analysis includes: site topography, proposed turbine heights, distance from radar to turbines, and elevation of the radar's antenna. Ultimately, a map is generated that shows the locator of the radar site, and four zones around the radar. Below is the map showing the Montague radar site and the four zones generated by the ROC's analysis.



What do the zones around the radar site mean?

1. **No-build zone:** The no-build zone (4 km/~2.5 miles) is the red circle around the Montague radar. The NWS requests that developers not build turbines in this area due to the potential for serious impacts, including turbine nacelles blocking the radar beam and potential receiver damage if sited in the radar's near field.
2. **Mitigation zone:** The orange mitigation zone, is defined as the area between 4 km (~2.5 miles) and 36 km (~22 miles) where a 160-meter (~525 feet) turbine would penetrate more than one elevation angle. Wind farms sited within the mitigation zone have the potential for moderate to high impacts. The NWS would work with the developer to get detailed project information, do a thorough impact analysis, and discuss potential mitigation solutions.
3. **Consultation zone:** The yellow consultation zone is the area between 4 km (~2.5 miles) and 36 km (~22 miles) where a 160-meter (~525 feet) turbine only penetrates the 1st elevation angle or when a 160-meter tall turbine will penetrate more than one elevation angle between 36 km and 60 km. Due to the increased potential for impact to operations or medium impact, the NWS requests consultation with the developer to track the project and acquire additional information for a thorough impact analysis.
4. **Notification zone:** The Notification Zone, green areas on the map, is the area between 36 km (~22 miles)and 60 km (~37 miles) where a 160-meter (~525 feet) tall turbine will only

penetrate one elevation angle, or any area beyond 60 km that a 160-meter tall turbine is in the radar's line of site. Since impacts are typically minimal or low impact beyond 60 km and workarounds are available for penetration of only one elevation angle, NWS consultation is optional, but notification is encouraged.

What are potential mitigation options for wind farms in zones 1-3?

There are several possible mitigation measures that can be taken to eliminate or minimize wind farm impacts to the Doppler radar systems. All of these are site dependent and come with various costs attached.

- Eliminate or move turbines away to minimize blades entering the radar elevation angles.
- Reduce the height of wind turbines to minimize blades entering the radar elevation angles.
- Turn turbines off during specified conditions, to allow radar to gather needed data (referred to as curtailment).

Other ideas that have been mentioned to overcome radar interference include software updates to the radar systems, moving the Montague radar, installing a second radar, or installing a newer phased radar system. These all have technical and/or financial obstacles that make them difficult if not impossible to implement.

What do the zones mean for obstructions other than wind turbines?

While the four zones described above are meant for wind energy projects, in general the ROC recommends that nothing be built within a 1200' radius of the radar site. However, the 1200' radius does not cover all circumstances, and the range could be expanded based on height and width of proposed obstructions. It is recommend to contact the Radar Operations Center (https://www.roc.noaa.gov/WSR88D/Comments.aspx) for any new obstruction proposed near the radar (water towers, communication towers, etc.).