

## The New WSR-88D Wind Energy Evaluation Scheme

The Radar Operation Center’s interaction with the wind energy industry has continued to increase as that industry continues to grow and installs more wind farms near WSR-88D sites. At the same time, the emphasis has grown on cooperative efforts to ensure the growing renewable energy industry can coexist beneficially with the WSR-88D network. One of the results arising from those interactions was the desire for a more easily understood schema to identify areas of potential wind farm impacts on the WSR-88D.

Originally we provided maps depicting the area of radar coverage at or below 130 meters above ground level (AGL) and 200 meters AGL. The original yellow gold coverage maps were then enhanced at the request of many of the wind energy developers with an additional cov-

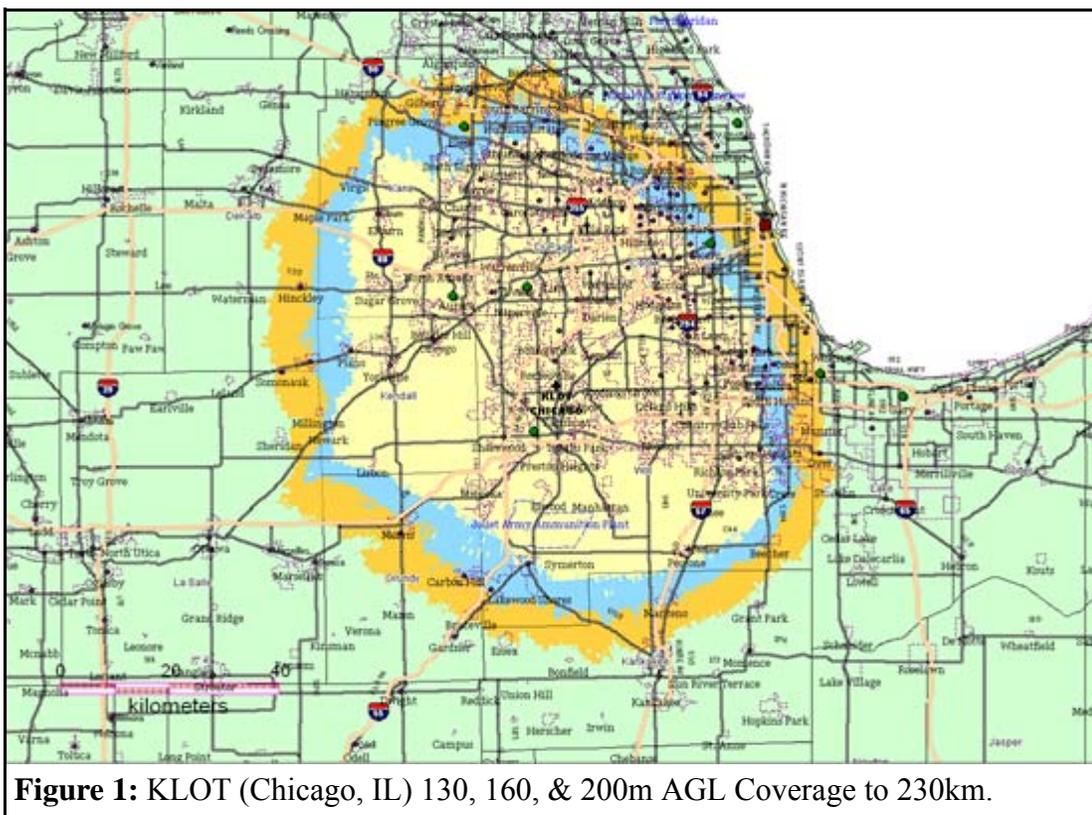
erage depiction, the blue layer, for 160 meter AGL coverage. These heights were originally selected as they best represented the state of the wind turbine architecture in the United States, and accommodated the expected increases in turbine heights.

The assessments for many of the wind energy proposals falling in these original color-coded areas were either negative or nominal impacts. The maps only indicated if the turbines were in or out of the radar line of sight (RLOS). Our desire to provide a more definitive first-look evaluation, more clearly qualify the levels of impact, and communicate where mitigation of those impacts might be requested, led to a new scheme.

To provide that more definitive evaluation, we considered additional radar characteristics

when determining the new coverage zones. In Figure 2 we depict those zones for the same radar as in Figure 1.

The most noticeable difference is that there appears to be less area in the RLOS. This is the result of limiting the RLOS coverage to turbines no taller than 160 meters AGL as opposed to the 200 meters AGL as in the previous scheme. To differentiate the



**Figure 1:** KLOT (Chicago, IL) 130, 160, & 200m AGL Coverage to 230km.

# Wind Energy Evaluation

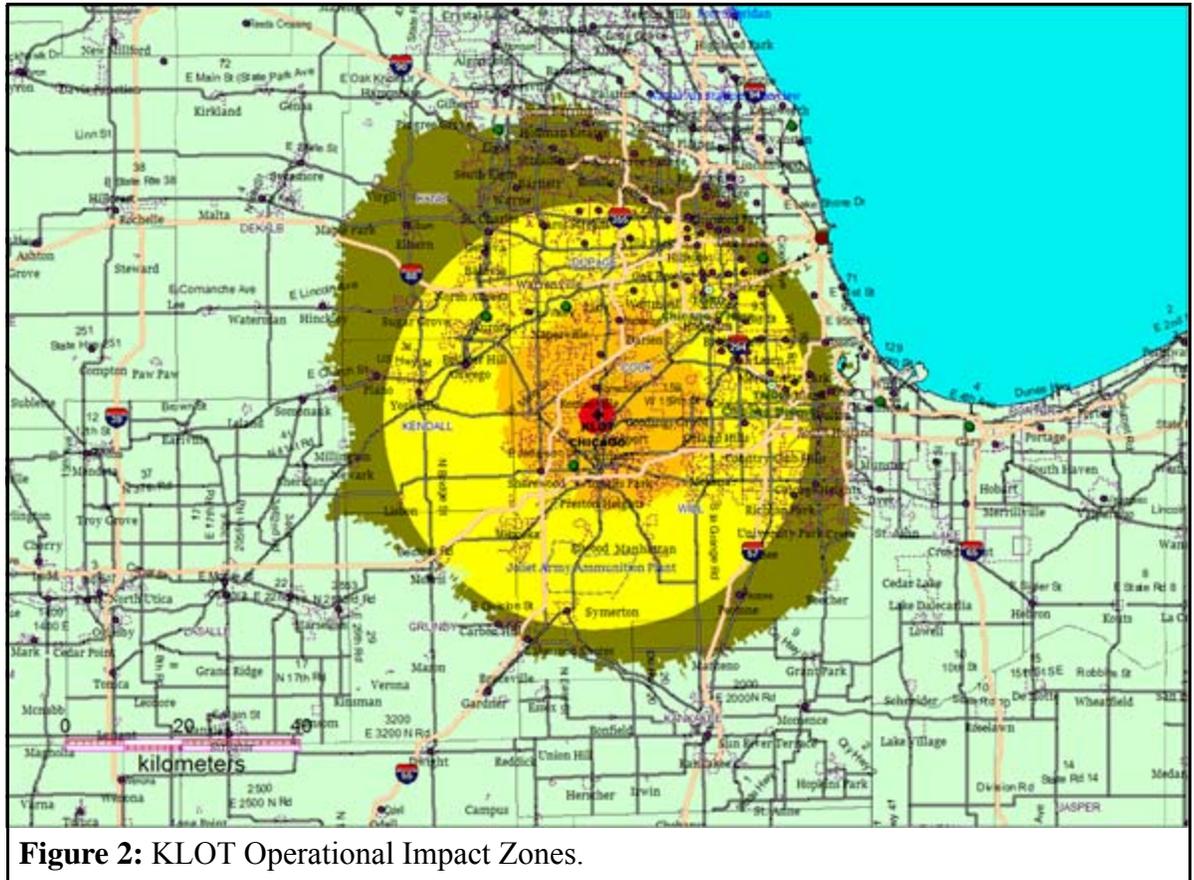
Continued from Page 16

potential impacts and communicate our desired action to the wind farm developers, we created new color-coded zones within the new RLOS area.

There are four different color zones. The first, the RED zone, is a 3km area around the radar that is a preferred *No Build*

*Zone*. Within this zone, large turbines have the potential to damage the radar receiver, cause partial or complete azimuthal data loss throughout the entire radar coverage range, and eliminate feasible work-arounds by radar end-users.

The next zone, the *Mitigation Zone*, is depicted in AMBER. It extends from 3km to as much as 36km from the radar, and indicates where a 160-meter tall turbine tip will penetrate the first two WSR-88D elevation angles (VCPs 12 and 212). As the name suggests, the potential results of wind turbine-radar interaction in this area are significant and require mitigation. We suggest options that can mitigate the impact of wind turbines on the radar's ability to provide



**Figure 2:** KLOT Operational Impact Zones.

warning information necessary for protecting lives and property.

The third zone, the *Consultation Zone*, is depicted in YELLOW. This zone extends from as close as 3km, depending on terrain, to 60km from the radar. For an area to be included in this zone it must meet one of two criteria. The first criterion is potential wind turbine penetration of the first elevation angle in the area from 3km up to 36km from the radar. The second criterion includes areas where penetration of the first two elevation angles occurs from 36km to 60km from the radar. We request ongoing consultation with the developer to ensure that we document

Continued on Page 18

# Wind Energy Evaluation

Continued from Page 17

the final turbine configuration and that it still permits the critical warning mission to be accomplished.

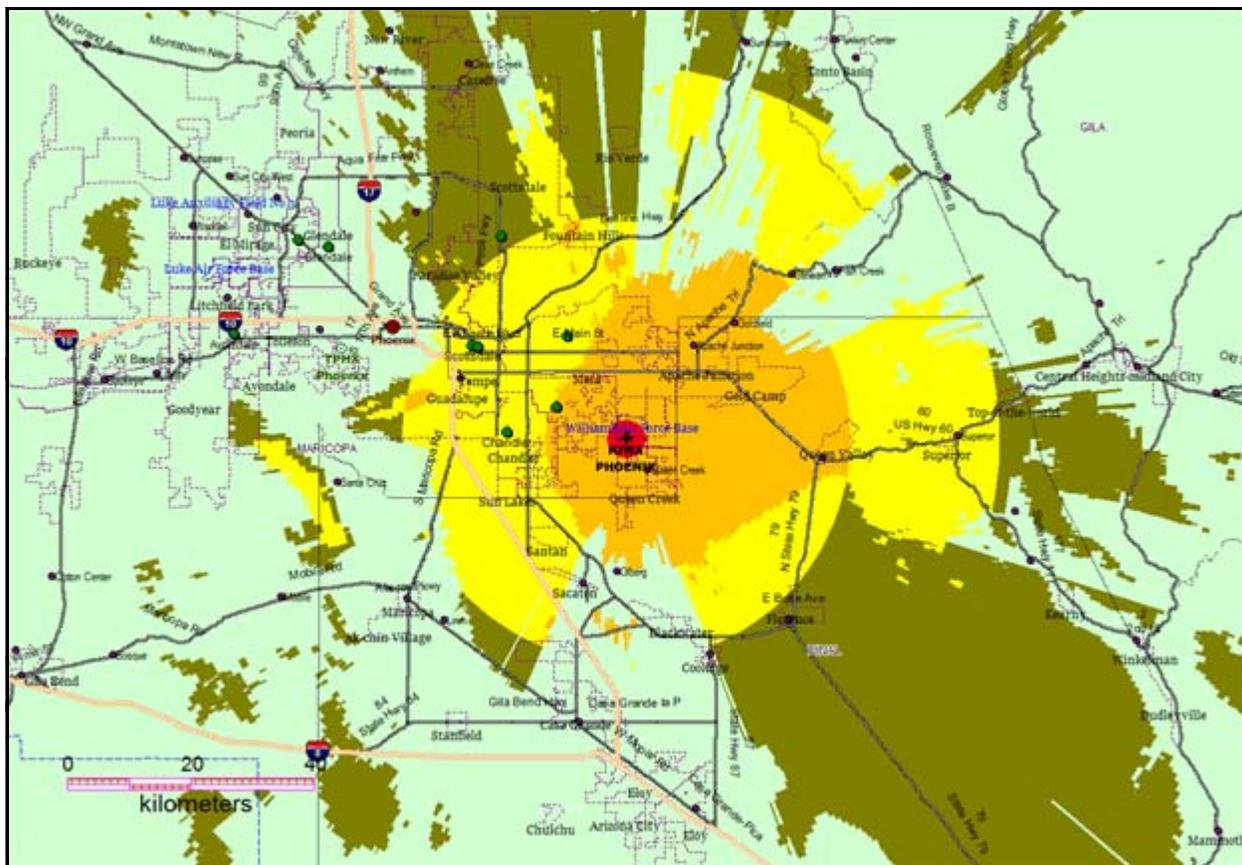
The fourth zone, the *Notification Zone*, is depicted in OLIVE-GREEN. This zone contains areas from 36km extending outward to 230km. The potential penetration need only be in the first elevation angle. We request that developers advise NOAA of development in these areas. A turbine configured in these areas will be routinely visible on the radar, but will typically have limited impact on the warning operations.

Figure 3 below provides examples of terrain's influence upon the areal extents of the second through fourth zones. Rising terrains, as

well as terrain blockage create a complex geometry for the zones. To the east of the KIWA (Phoenix, AZ) radar, the mitigation zone extends to 36km and the consultation zone to 60km. The areas in the northeast, south, and west clearly demonstrate the influence of complex terrain.

For additional information on the potential impacts, actions requested, and other information related to this scheme, please see the article at [http://www.roc.noaa.gov/WSR88D/Publicdocs/WINDPOWER2011\\_Final.pdf](http://www.roc.noaa.gov/WSR88D/Publicdocs/WINDPOWER2011_Final.pdf).

Ron Guenther  
ROC Engineering Branch



**Figure 3:** KIWA Terrain Influence upon Operation Impact Zones