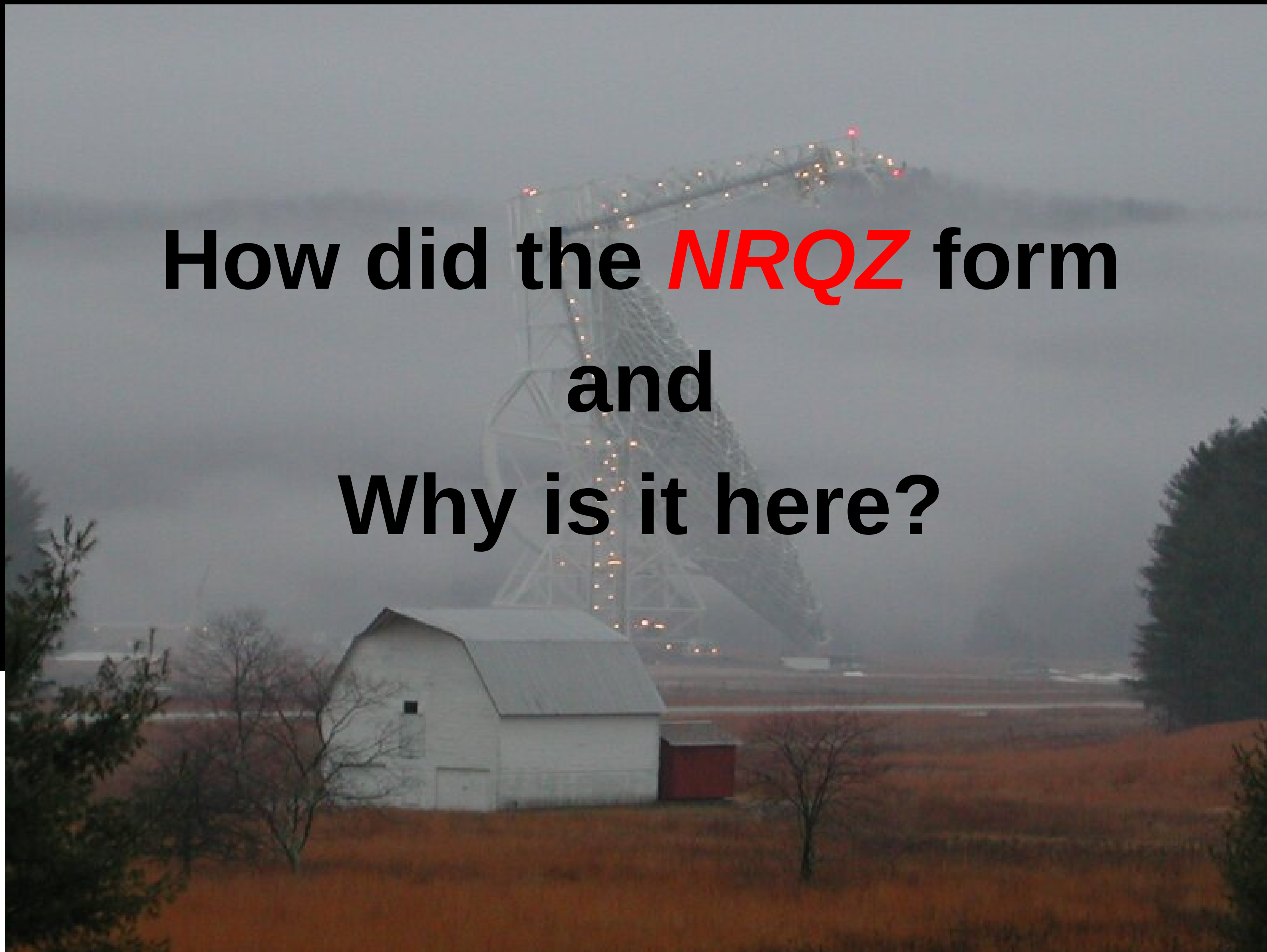

The National Radio Quiet Zone
Paulette Woody
Administrator
NATIONAL
RADIO
QUIET
ZONE



How did the *NRQZ* form

and

Why is it here?

January 1954 – Conference in Washington

sponsored by NSF, Cal Tech, Carnegie Institute of Washington

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If the United States is to keep abreast of developments in radio astronomy, our scientists must have at their disposal larger and more powerful research equipment than is now available to them… there are no instruments in this country comparable with the large steerable paraboloid under construction in England, nor with the large interferometer arrays in Australia and England. The cost of such equipment places it beyond the likely means of any single institution. An observatory available to all qualified scientists is an obvious solution for the problem of inadequate research facilities.

(R. Emberson, AUI, 1954)

The level of radio noise or interference … must be ***extraordinarily low***.

To avoid noise the following conditions are necessary:

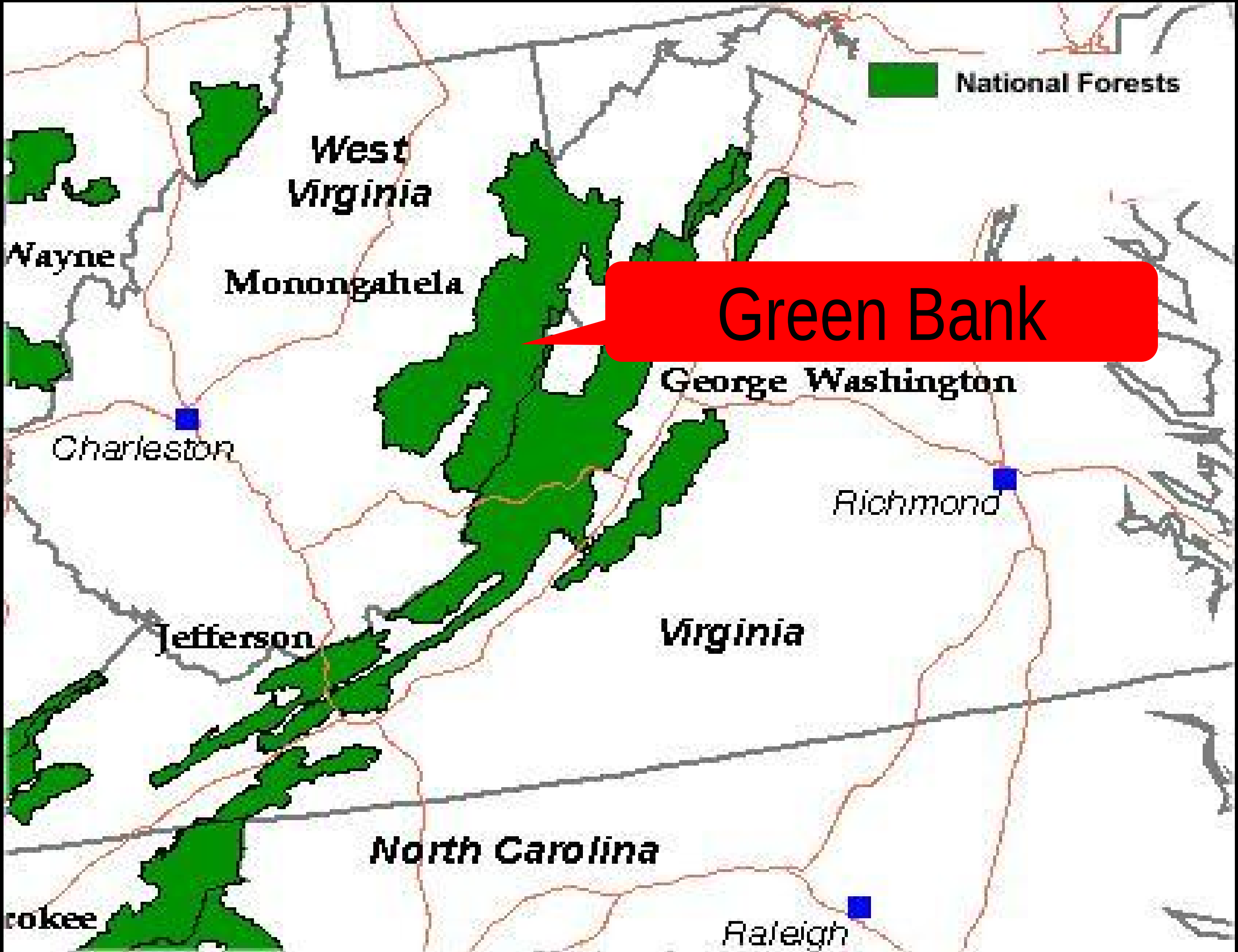
1. **The telescopes should be within the view of the smallest possible number of close-by inhabitants who might generate noise in the course of their daily work.**

2. **The telescopes should not view high tension power lines that radiate radio noise through corona discharges or otherwise.**

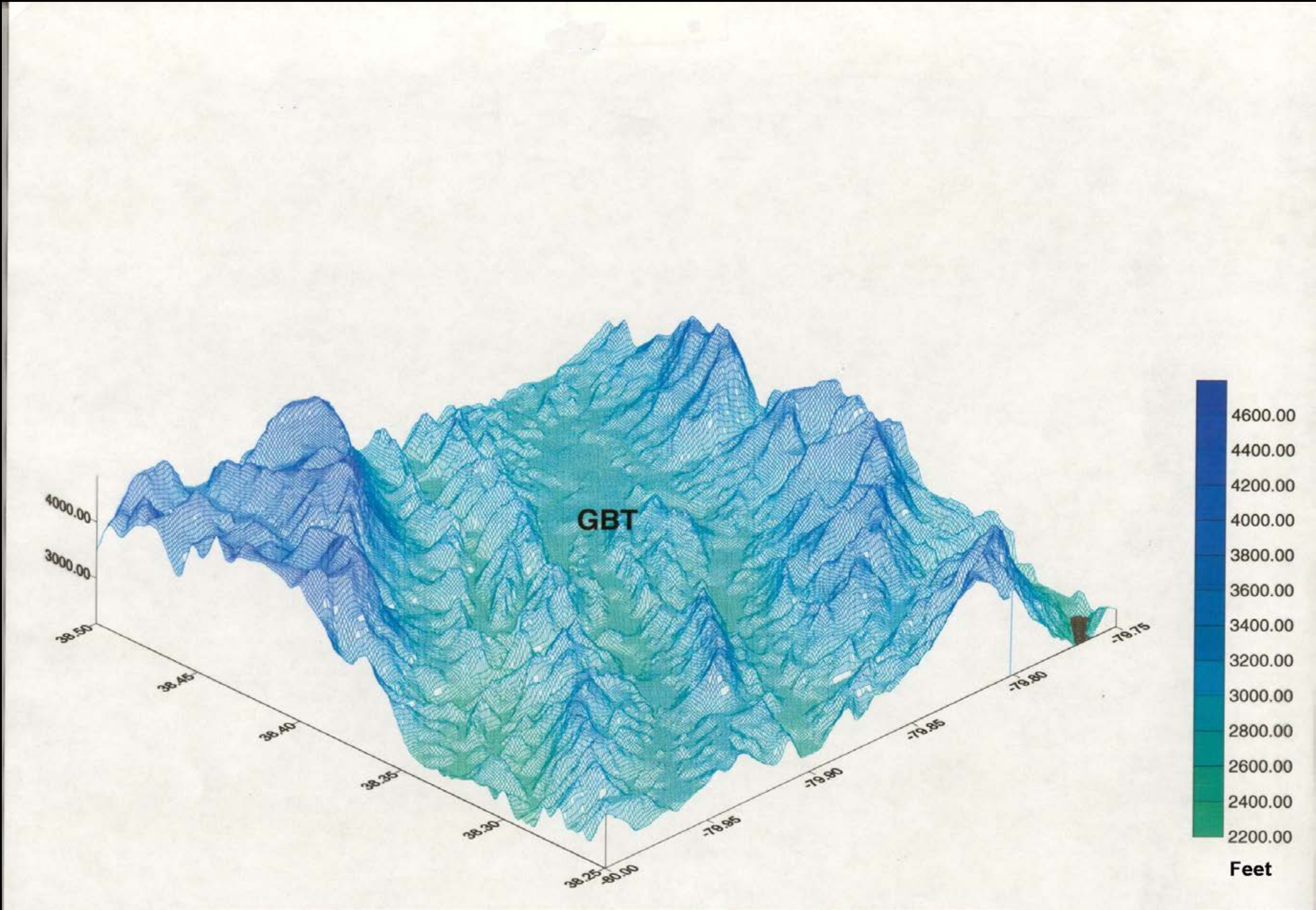
3. **The site should be in a valley surrounded by as many ranges of high mountains in as many directions as possible, to attenuate direct radio propagation from neighboring radio stations and to reduce diffraction of tropospheric propagation into the valley.**

4. **The site should be at least 50 miles distant from any city or other concentration of people or industries, and should be separated from more distant concentrations by surrounding mountain ranges.**

National Forest Around Green Bank



Topography Around Green Bank



National Radio Quiet Zone

- NRAO founded in Green Bank, WV in 1956
- NRQZ established by:
  - the Interdepartment Radio Advisory Committee (IRAC) in Document 3867/2 (March 26, 1958)
  - the Federal Communications Commission (FCC) in Docket No. 11745 (November 19, 1958)
- Established in law *before* radio telescopes were built and *before* any frequency allocations to Radio Astronomy were made.
- +13,000 square mile area in West Virginia, Virginia and small portion of Maryland.

Purpose of the NRQZ

To restrict radiation so as to minimize possible interference on the operations the NRAO in Green Bank, W.V., and the Sugar Grove Research Station in Sugar Grove, WV.

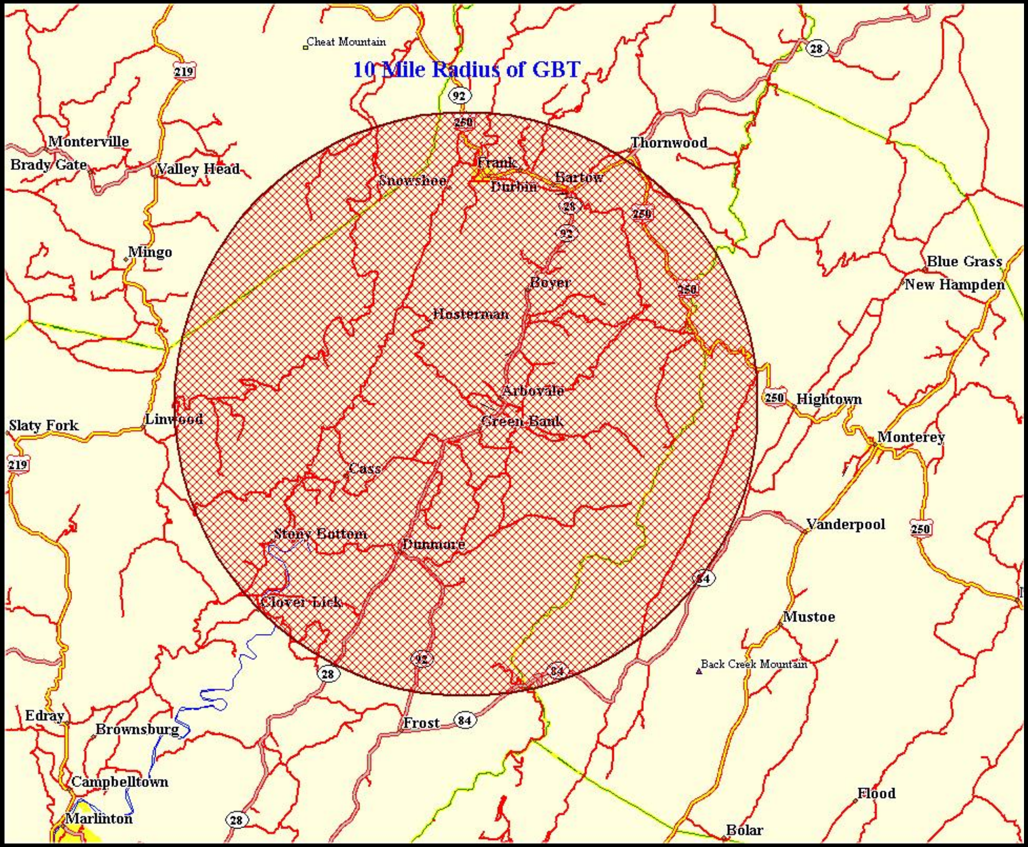
It is the only designated quiet zone in the US; a one of a kind, unique, and irreplaceable resource.

NRQZ Coordination Process

- As part of the normal coordination process, the NRQZ office comments on new or modified, permanent, fixed, licensed radio transmitters.

- Works with applicants in finding a mutually acceptable solution to their coverage needs and our protection criteria.

WV Radio Astronomy Zoning Act

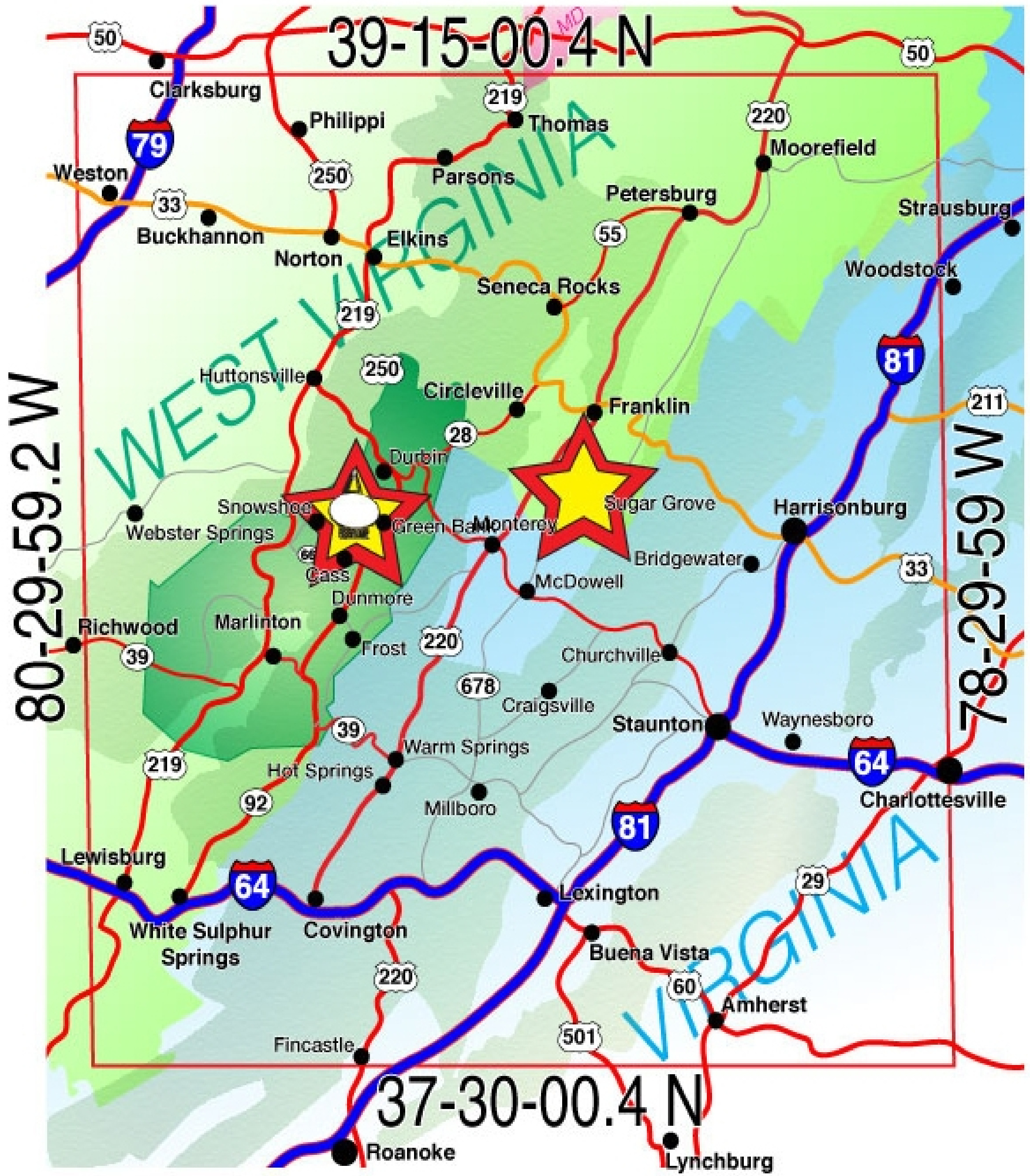


- Up to a 10 mile restriction zone
- Involves any electrical equipment source, such as VSAT installations

How do we coordinate transmitters?

NRQZ

Only bounded area in the US requiring coordination of new or modified, permanent, fixed, licensed transmitters.



US Frequency Allocations Chart

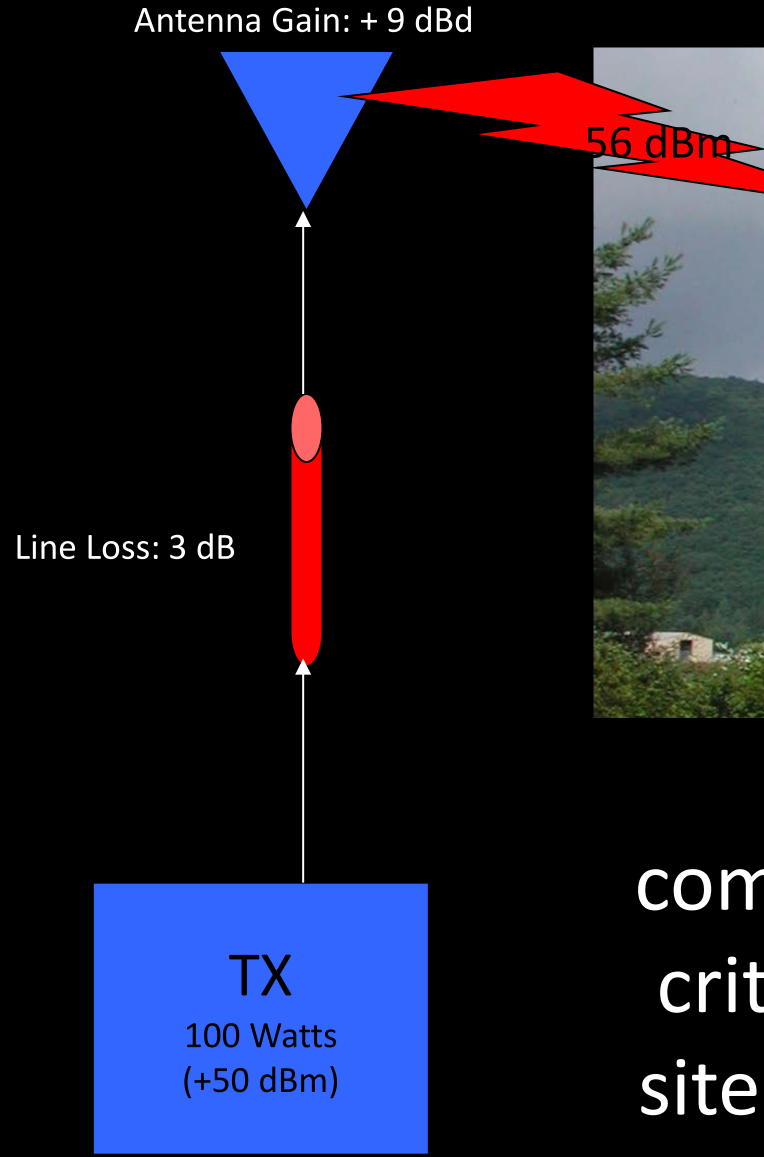
Fixed Transmitters in the NRQZ

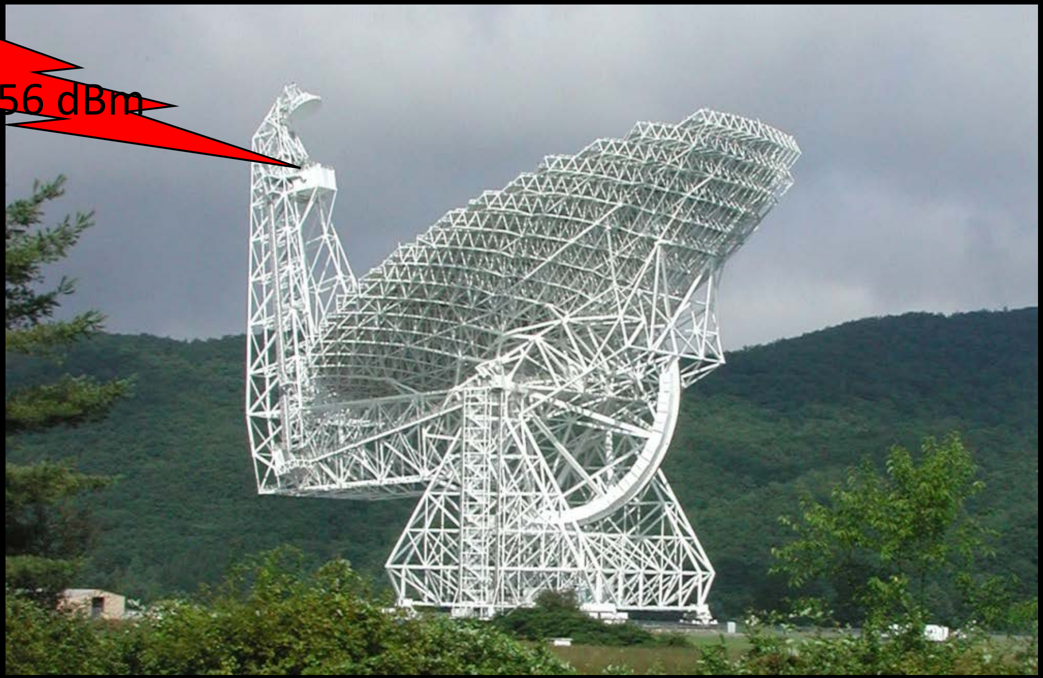
(Rich Mountain near Elkins, WV)

Evaluation Parameters

Site specific information for all evaluations:

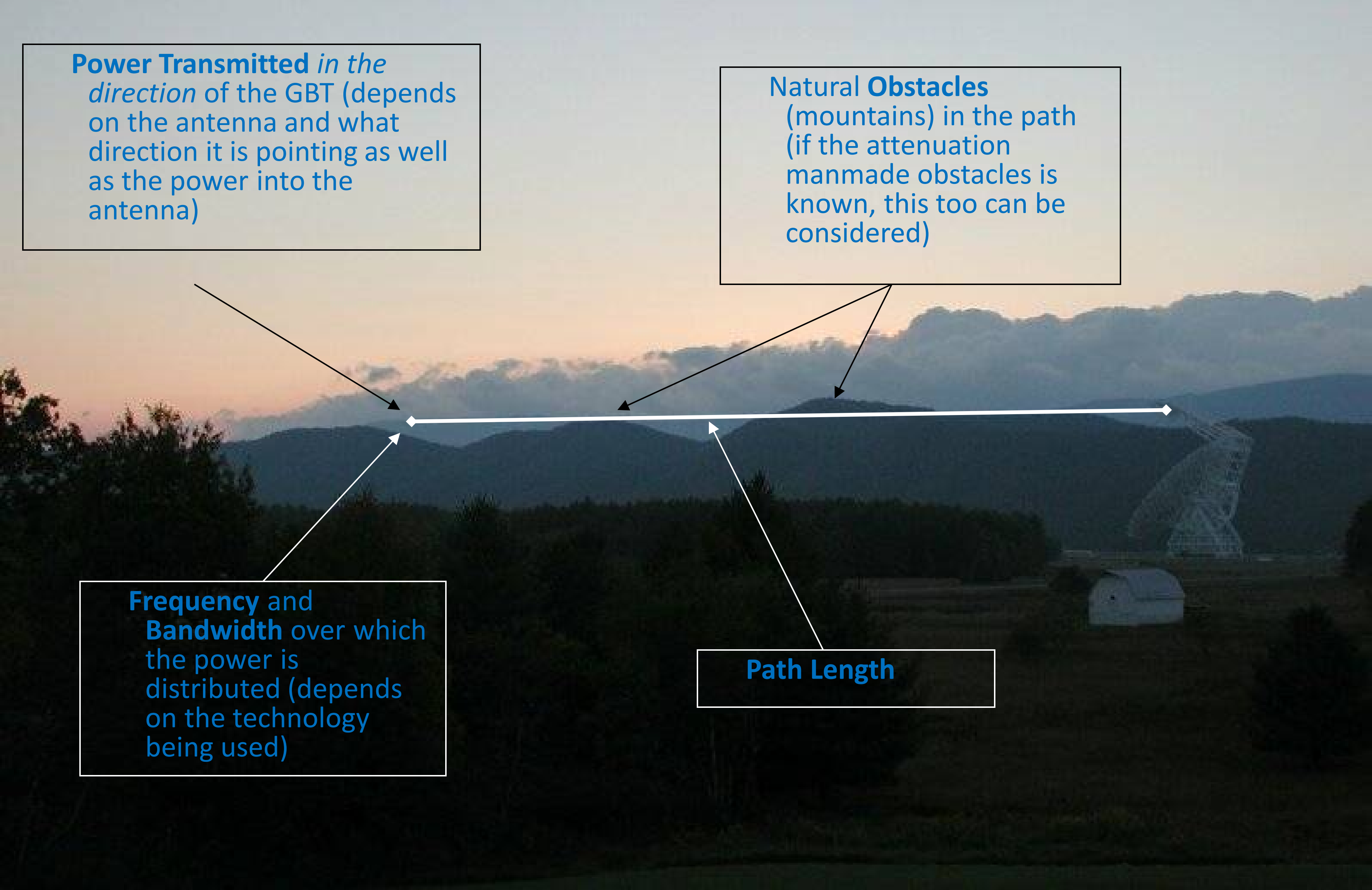
1. ***Coordinates*** (to decimal second accuracy)
2. ***Ground elevation*** (AMSL)
3. ***Antenna height*** (centerline)
4. ***Operating frequency or frequency band(s)***
5. ***Occupied bandwidth*** (Emission designator)
6. Analysis



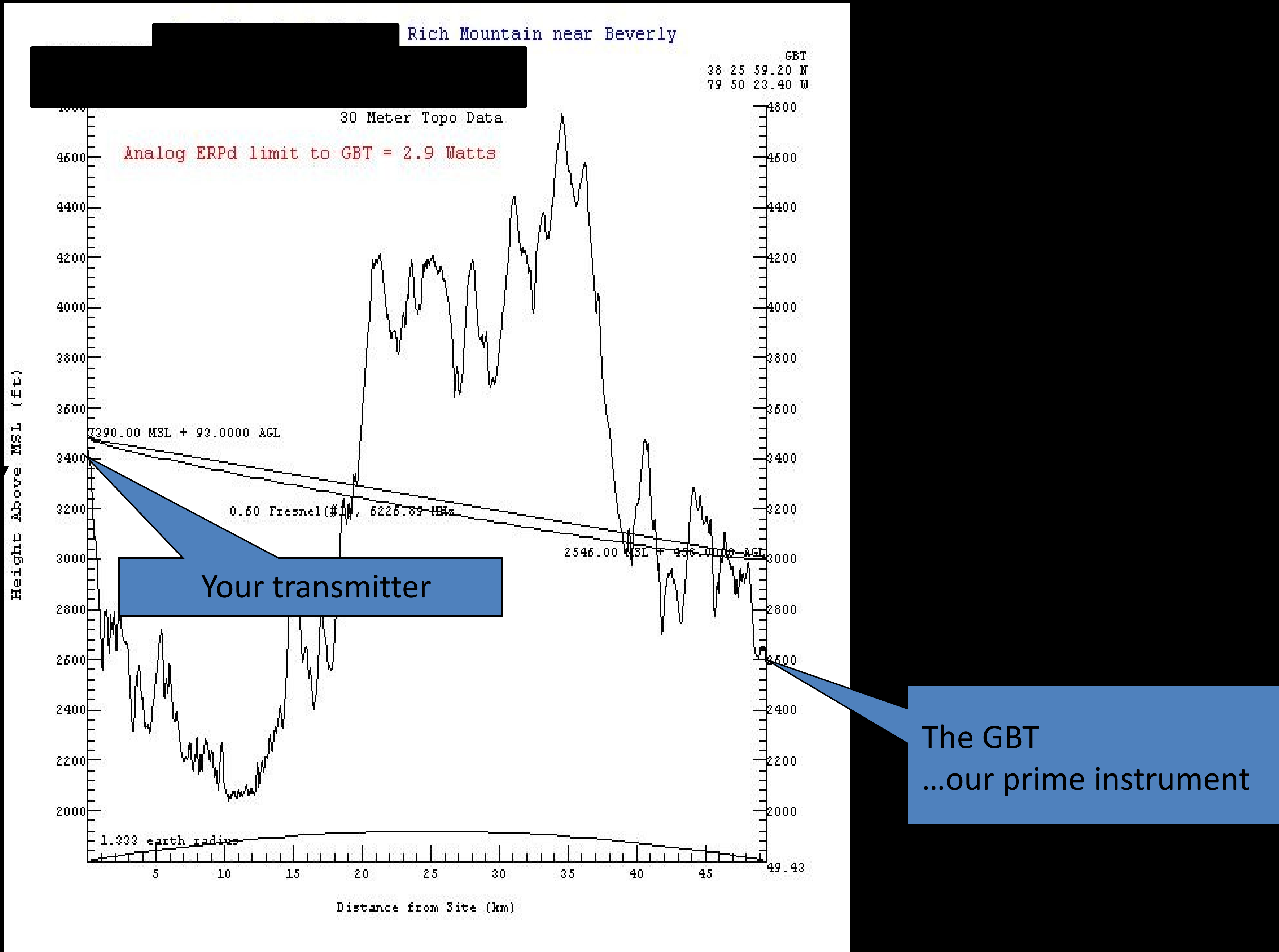


Analysis results are compared to our protection criteria to determine if the site is a potential source for harmful interference.

Factors in The Evaluation Process



Propagation Study….*point to point*



Propagation Study Text

TAP Single Point Field Calculation Parameters
April 02, 2003 15:03

[redacted]

Frequency: 6226.89000 MHz ERP: 1.0000 W
GBT: 38 25 59.20 N 79 50 23.40 W
Path: 49.4349 km; Azimuth 171.1038
Step: 0.0300 km; Effective Earth Curvature: 1.333
Topo Data: 30-meter
Interpolation: FCC Interpolation (4 points)

Rounded Obstacle: 12/19/97 02:42PM Rounded Obstacle
TX Ant: 3483.00ft MSL (Site 3390.00ft + 93.00ftAGL)
RX Ant: 3004.00ft MSL (Site 2546.00ft + 458.00ftAGL)
Azimuth: 171.103
TX Antenna Gain: Az 0.00 dB; El 0.00 dB (angle = -0.169)
Free Space Field: (1.000 W @ 49.434 km) 43.04 dBu
Free Space Loss: 137.93 dB (between dipoles)
Additional Estimated Transmission Loss 55.98 dB
Effective Earth Curvature: 1.333

Attenuation Mode: Minimum
Selected Profile:

N	PATH LOC	ELEVATION	RADIUS	DISTANCE
1	---------	3483.00 ft	---------	34.56 km
2	34.56 km	4665.56 ft	449.02 ft	1.65 km
3	36.21 km	4488.53 ft	555.70 ft	13.22 km
4	49.43 km	3004.00 ft	-------	--------

Path Attenuation for 6226.89 MHz

PATH	START	OBS	END	DIST 1	DIST 2	RADIUS	LOSS
1- 3	3483ft	4666ft	4489ft	34.56km	1.65km	449ft	44.22dB
2- 4	4666ft	4489ft	3004ft	1.65km	13.22km	556ft	11.76dB

Diffraction Attenuation: 55.98 dB
Troposcatter Attenuation: 86.10 dB
Free Space Attenuation: 142.23 dB
Total Path Attenuation: 198.20 dB (Free Space + Diffraction)

Net received power density: 1.35E-16 W/m2

Softwright TAP
Terrain Analysis Program

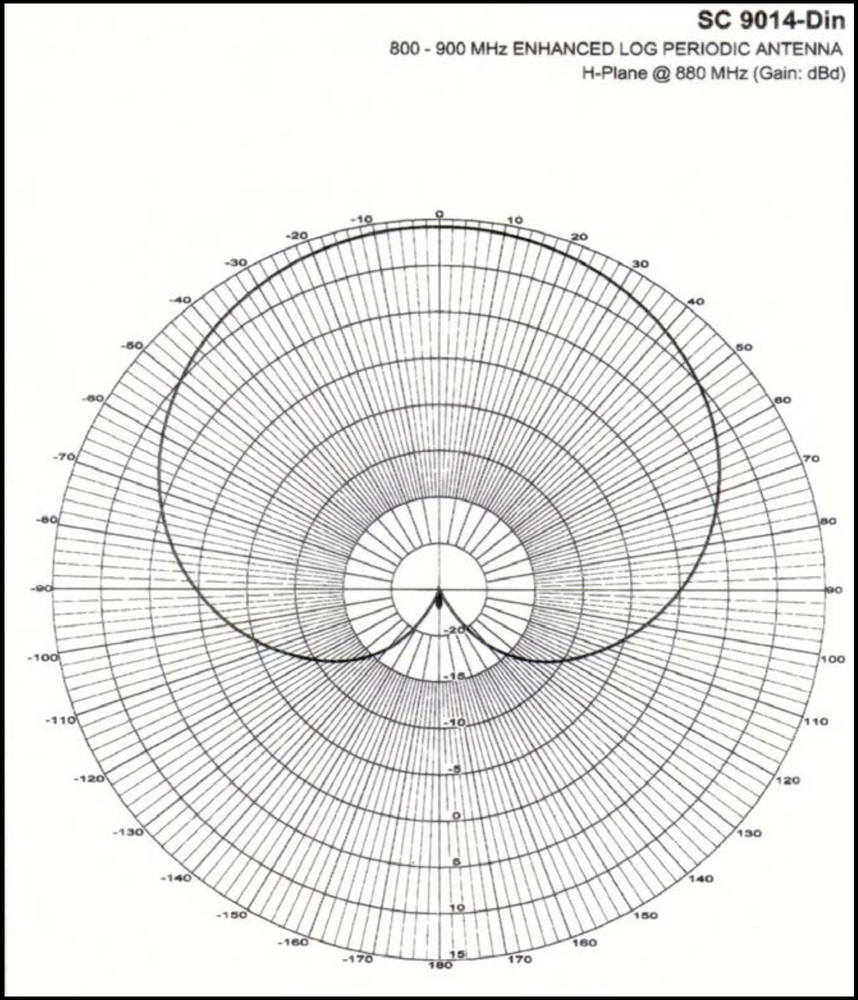
USGS 10 meter data

Longley Rice
Rounded obstacle

Obstacle information

Path attenuation

Mitigation efforts: Directional Antenna systems, etc



Transmitter output power reduction

Change of main beam Azimuth bearing

Reduction in antenna height

Use of directional or beam-forming type antenna systems

*All requested power restrictions are **directional** from the transmitter to the GBT.*

"Radio Frequency Management is done by experts who meld years of experience with a curious blend of regulation, electronics, politics and not a little bit of larceny. They justify requirements, horse-trade, coerce, bluff and gamble with an intuition that cannot be taught other than by long experience."

VADM Jon L. Boyes
U.S. Navy (Ret.)

Adm. **Boyes** was a three-star **admiral**, the second-highest rank in the Navy. After graduating in 1943 from the U.S. Naval Academy through an accelerated program, he served in World War II in the Pacific, where he was wounded in a Japanese attack on his ship. After the war, he became a submarine commander.