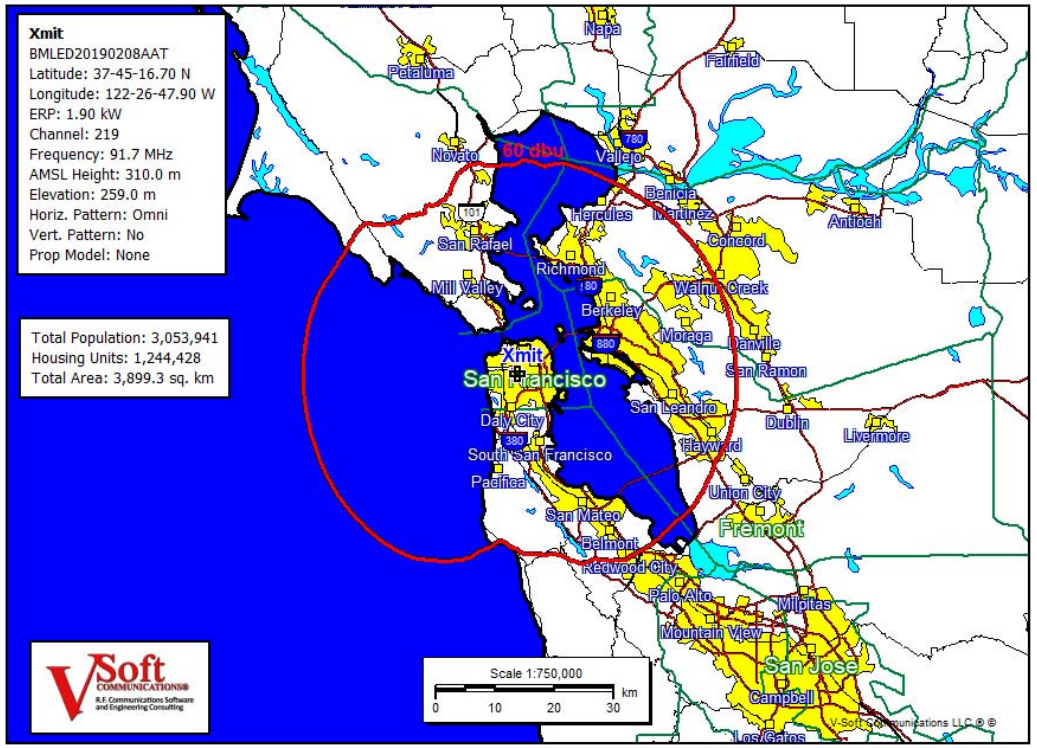
Visualizing Radio Propagation through Prediction

Doug Vernier

Broadcaster's Clinic

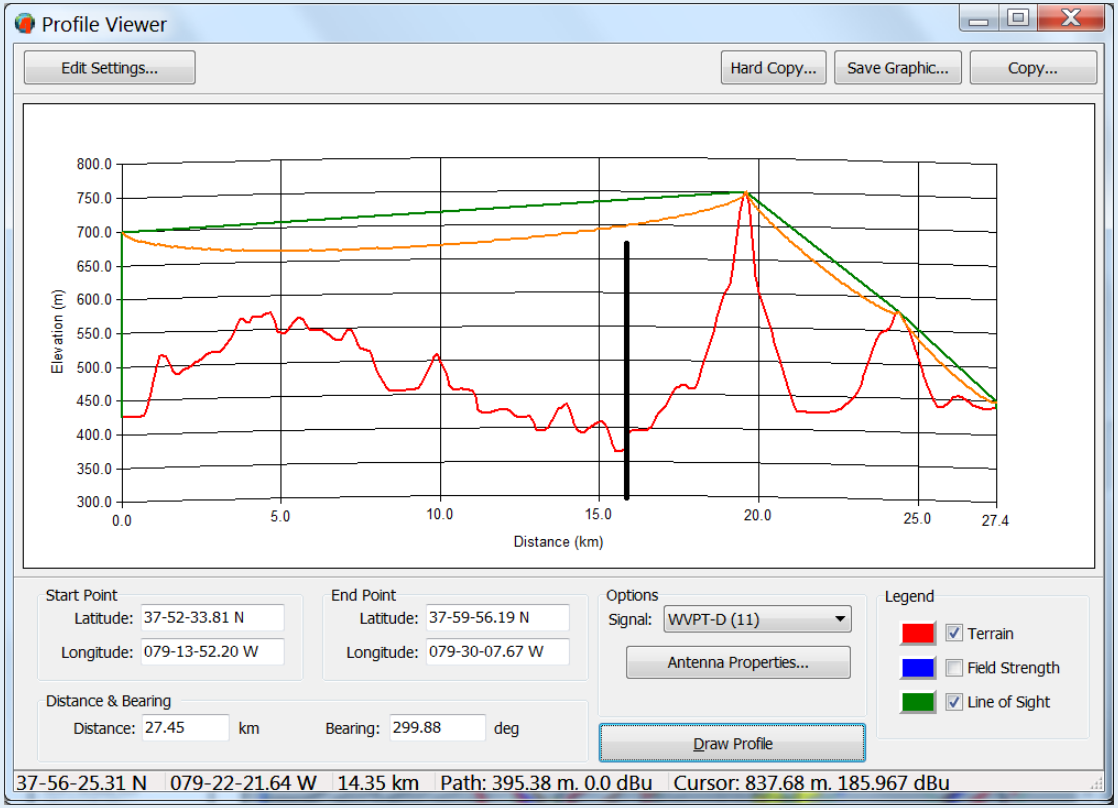
2022

Standard FCC

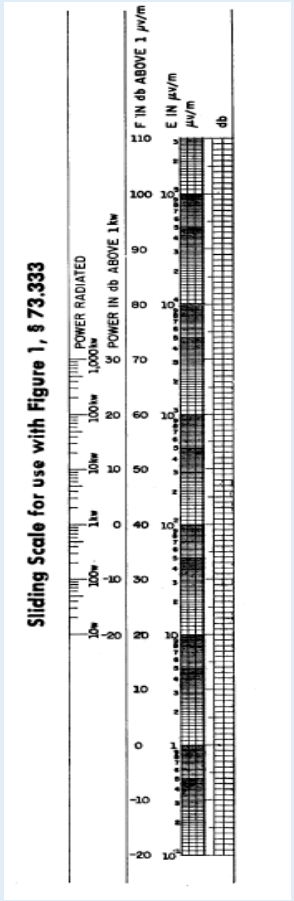


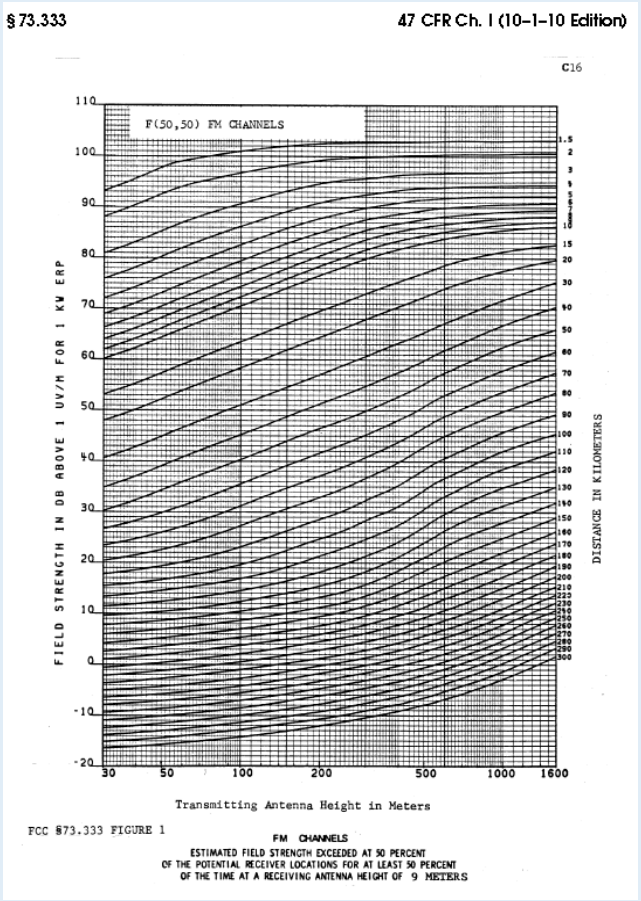
HAAT FM - radial 3 to 16 km

Minimum of 51 elevation points along a radial

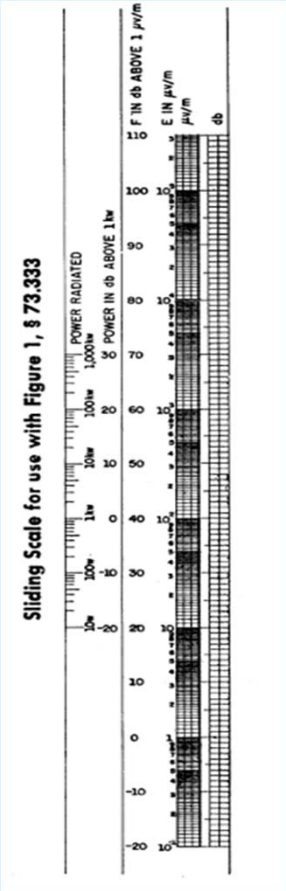


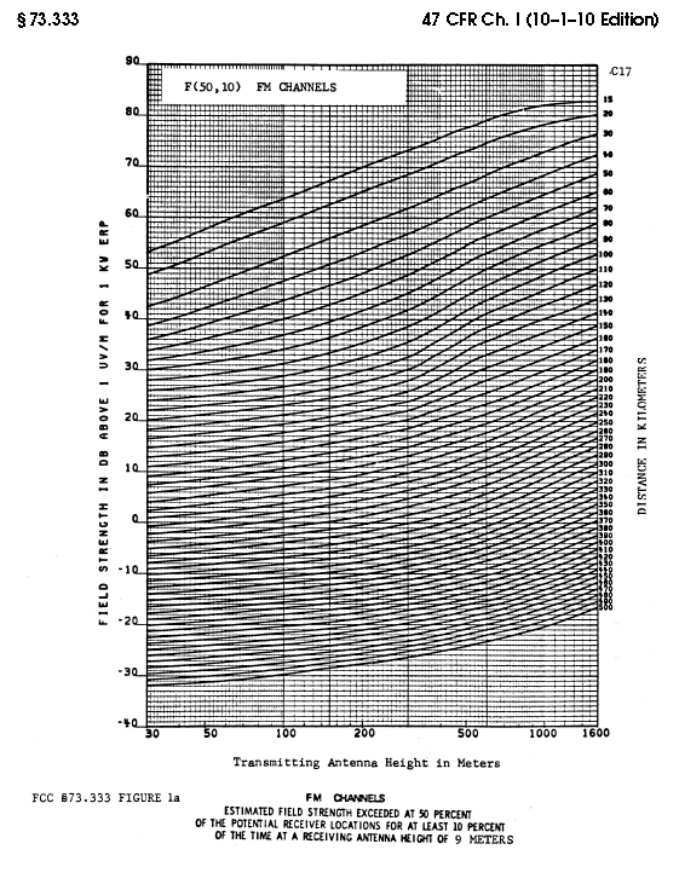
FCC Coverage CURVES F(50-50)

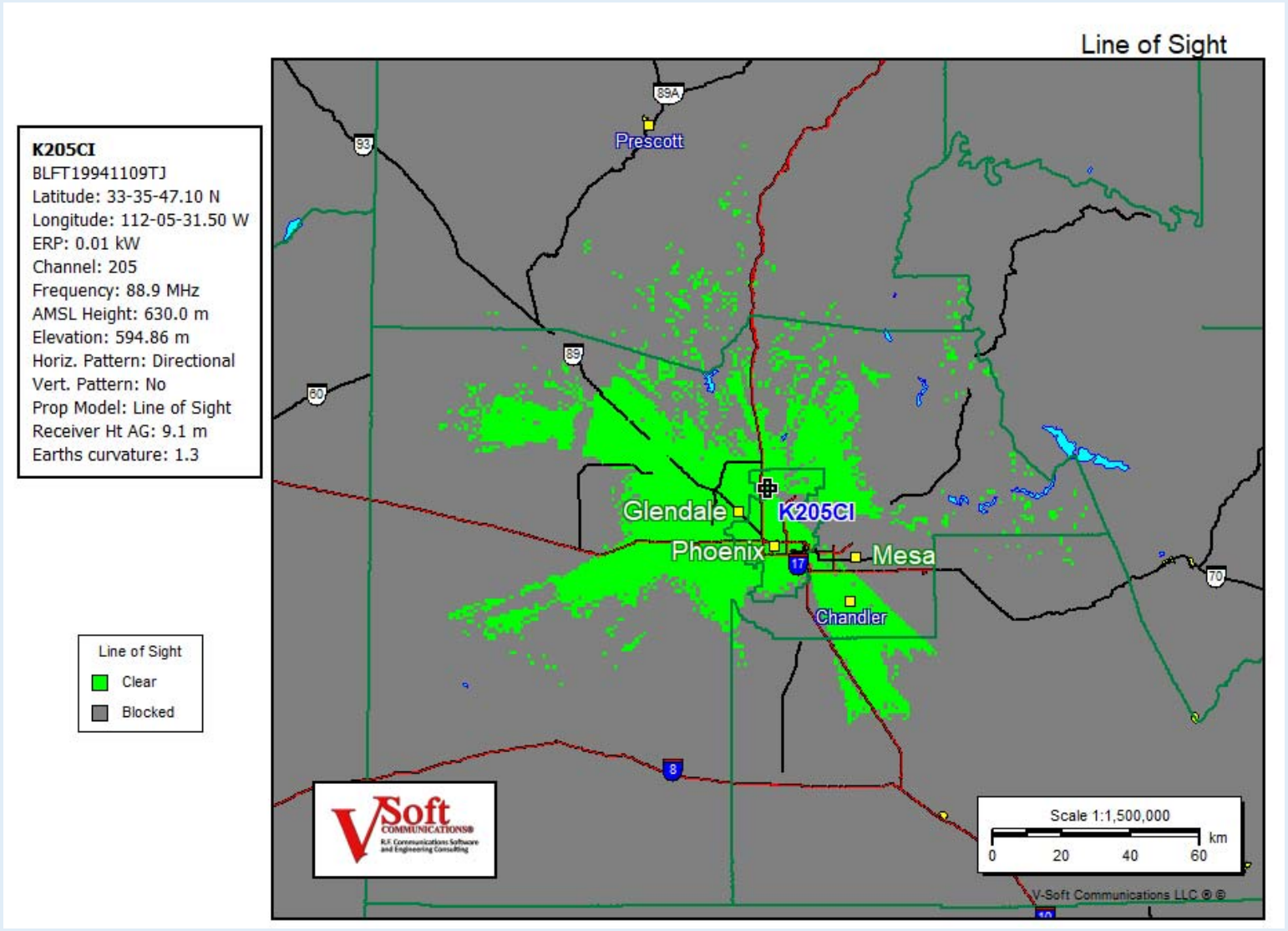




Interference Curves F(50-10)

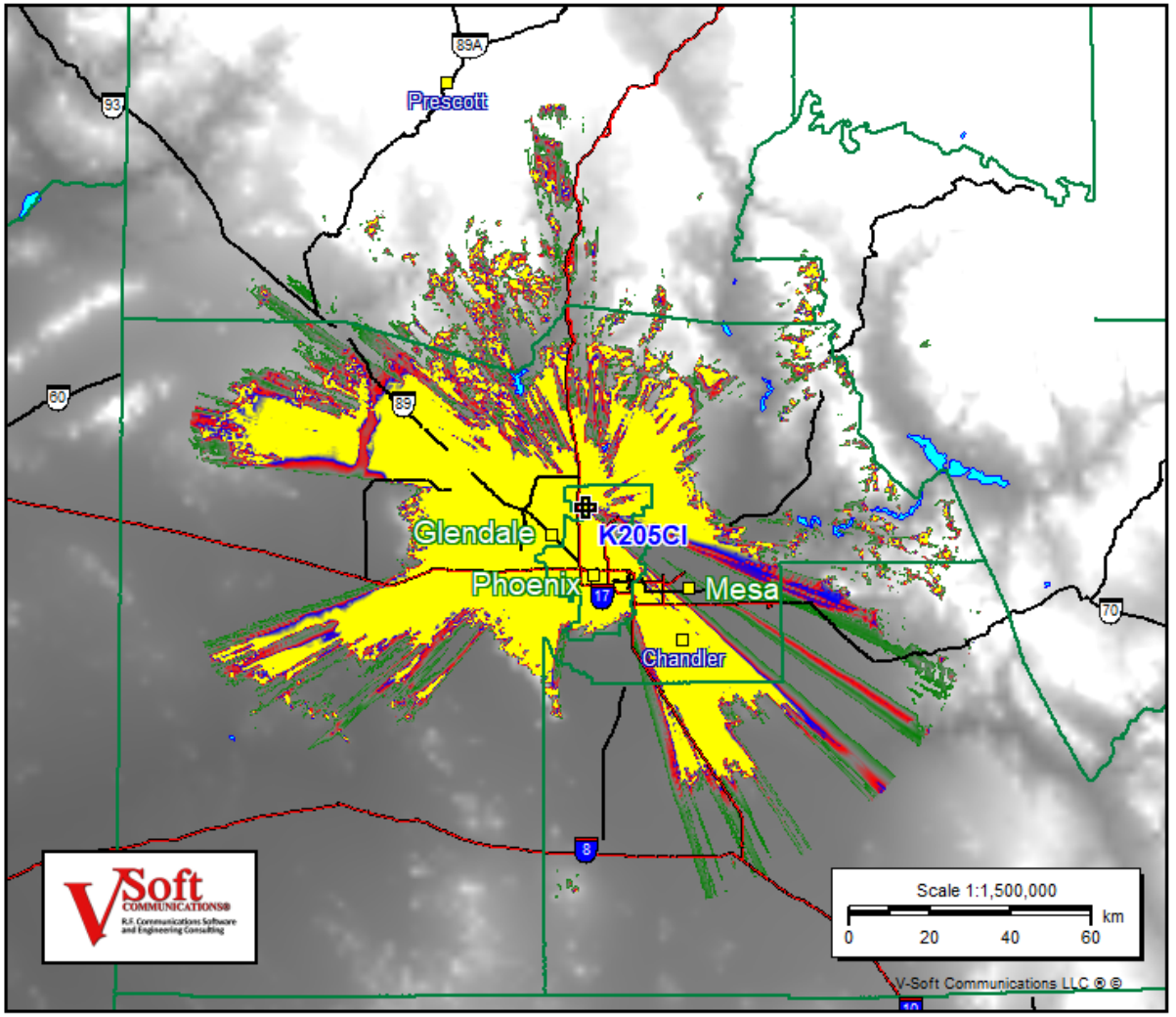


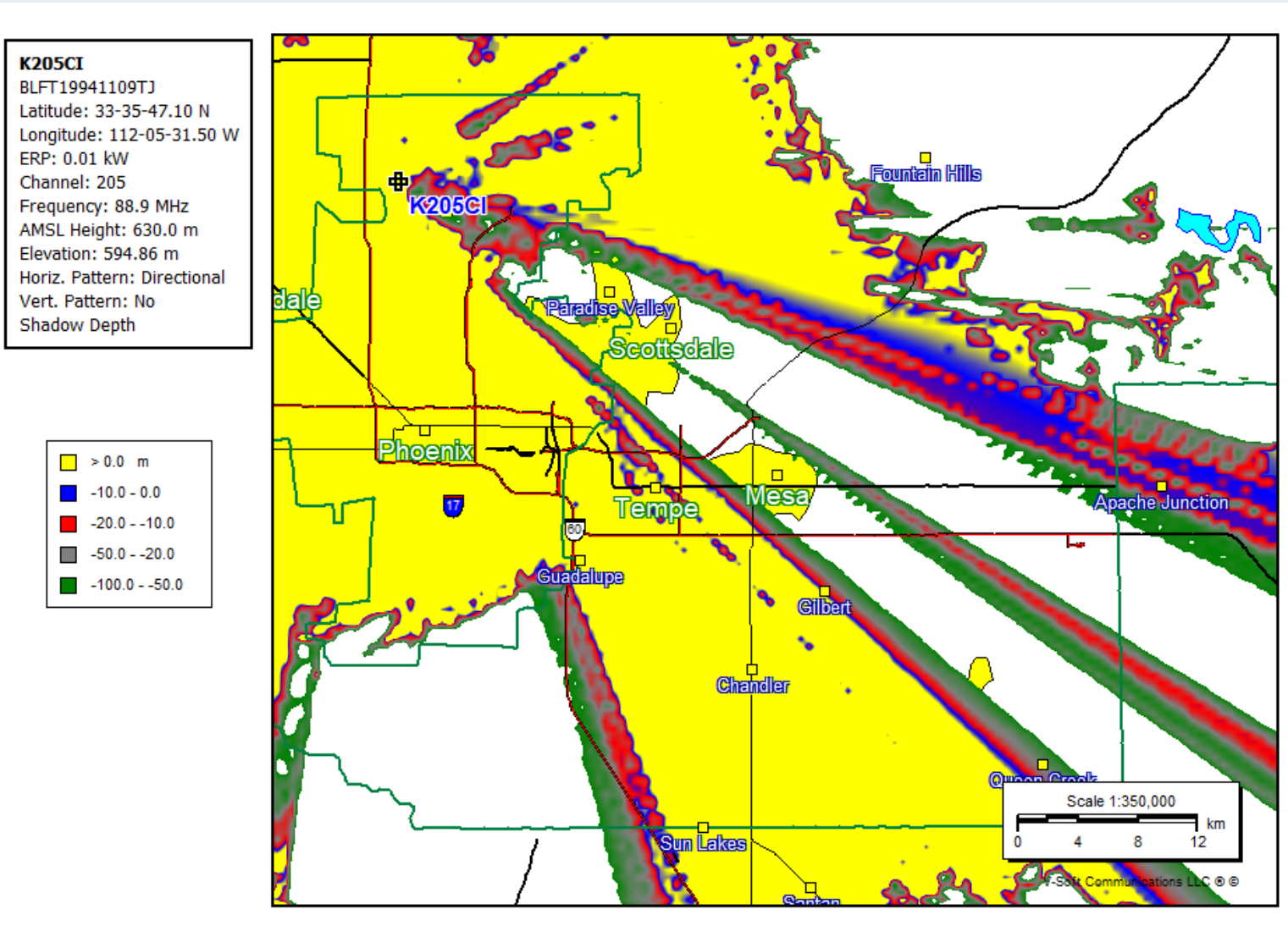


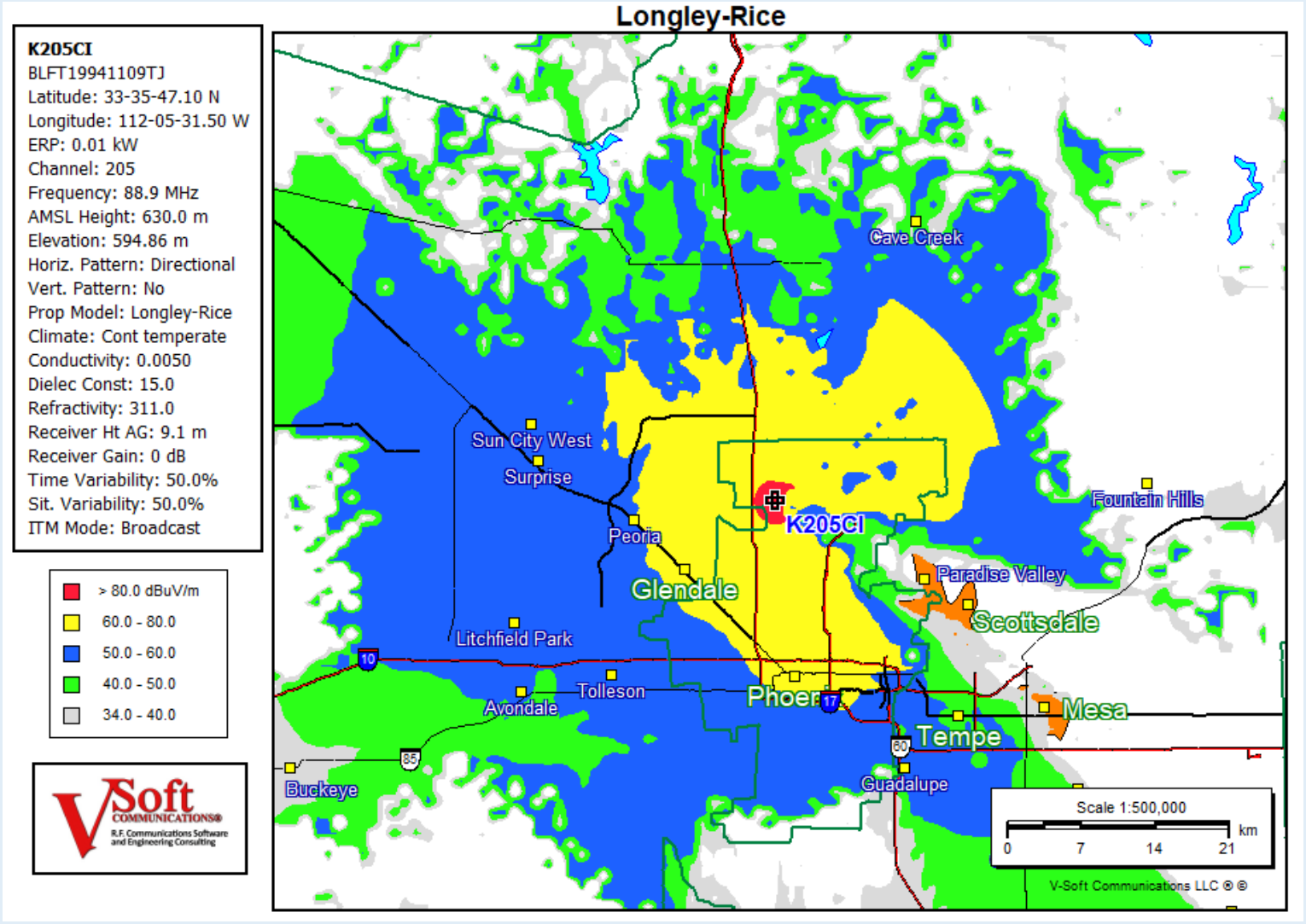

Line of Sight
K205CI
BLFT19941109TJ
Latitude: 33-35-47.10 N
Longitude: 112-05-31.50 W
ERP: 0.01 kW
Channel: 205
Frequency: 88.9 MHz
AMSL Height: 630.0 m
Elevation: 594.86 m
Horiz. Pattern: Directional
Vert. Pattern: No
Prop Model: Line of Sight
Receiver Ht AG: 9.1 m
Earths curvature: 1.3
Line of Sight
Clear
Blocked
Prescott
Glendale
K205CI
Phoenix
Mesa
Chandler
89A
93
89
60
17
70
8
Scale 1:1,500,000
km
0
20
40
60
V-Soft Communications LLC ® ©

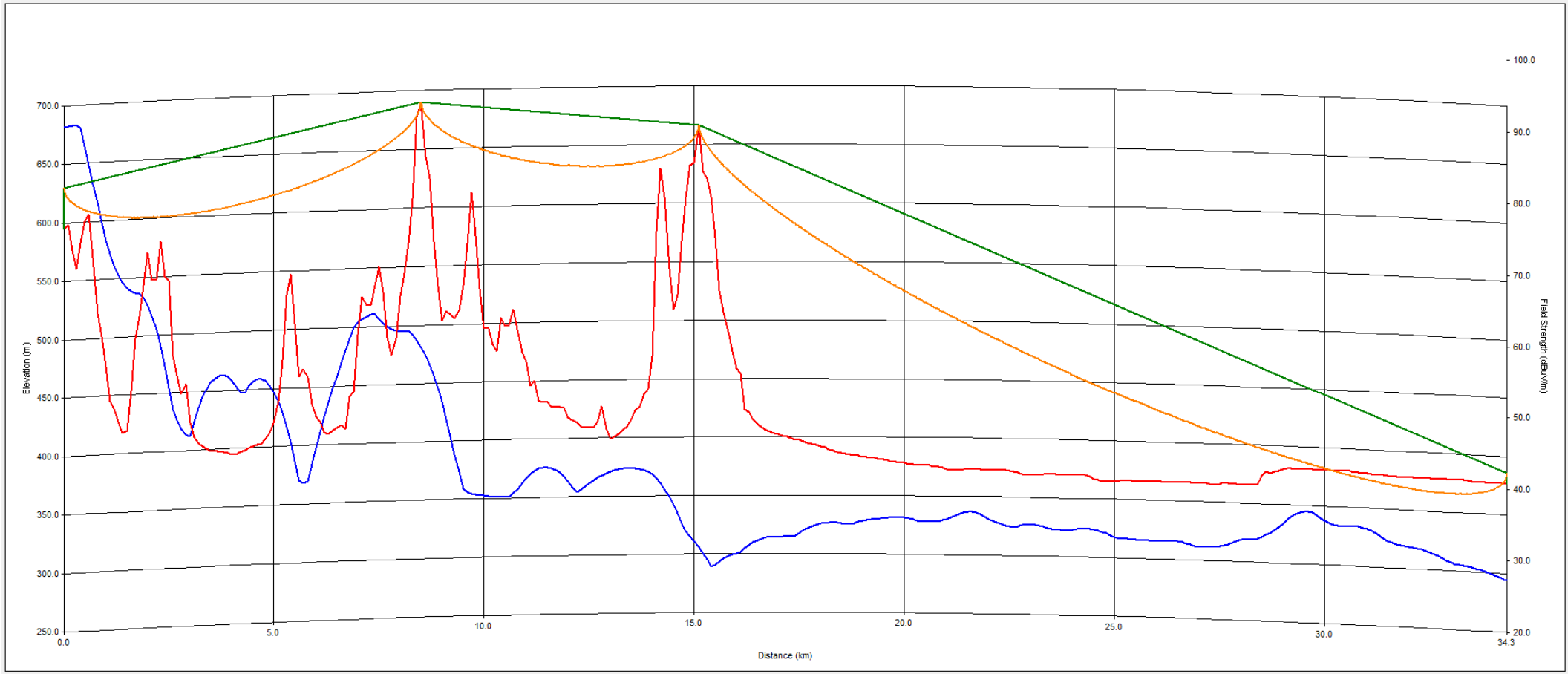
Shadow Depth with Terrain

K205CI
BLFT19941109TJ
Latitude: 33-35-47.10 N
Longitude: 112-05-31.50 W
ERP: 0.01 kW
Channel: 205
Frequency: 88.9 MHz
AMSL Height: 630.0 m
Elevation: 594.86 m
Horiz. Pattern: Directional
Vert. Pattern: No
Shadow Depth




K205CI
BLFT19941109TJ
Latitude: 33-35-47.10 N
Longitude: 112-05-31.50 W
ERP: 0.01 kW
Channel: 205
Frequency: 88.9 MHz
AMSL Height: 630.0 m
Elevation: 594.86 m
Horiz. Pattern: Directional
Vert. Pattern: No
Shadow Depth
> 0.0 m
-10.0 - 0.0
-20.0 - -10.0
-50.0 - -20.0
-100.0 - -50.0
K205CI
Fountain Hills
Paradise Valley
Scottsdale
Phoenix
Tempe
Mesa
Apache Junction
Guadalupe
Gilbert
Chandler
Sun Lakes
Scale 1:350,000
km
0
4
8
12


Longley-Rice
K205CI
BLFT19941109TJ
Latitude: 33-35-47.10 N
Longitude: 112-05-31.50 W
ERP: 0.01 kW
Channel: 205
Frequency: 88.9 MHz
AMSL Height: 630.0 m
Elevation: 594.86 m
Horiz. Pattern: Directional
Vert. Pattern: No
Prop Model: Longley-Rice
Climate: Cont temperate
Conductivity: 0.0050
Dielec Const: 15.0
Refractivity: 311.0
Receiver Ht AG: 9.1 m
Receiver Gain: 0 dB
Time Variability: 50.0%
Sit. Variability: 50.0%
ITM Mode: Broadcast
> 80.0 dBuV/m
60.0 - 80.0
50.0 - 60.0
40.0 - 50.0
34.0 - 40.0
V-Soft COMMUNICATIONS®
R.F. Communications Software and Engineering Consulting
Cave Creek
Sun City West
Surprise
Peoria
K205CI
Fountain Hills
Paradise Valley
Glendale
Scottsdale
Litchfield Park
Tolleson
Avondale
Phoenix
Mesa
Tempe
Guadalupe
Buckeye
10
17
60
85
Scale 1:500,000
km
0
7
14
21
V-Soft Communications LLC ® ©



Start Point
Latitude: 33-35-47.10 N
Longitude: 112-05-31.50 W

End Point
Latitude: 33-24-23.16 N
Longitude: 111-48-01.87 W

Distance & Bearing
Distance: 34.32 km
Bearing: 127.79 deg

Options
Signal: K205CI (205)
Antenna Properties...
Draw Profile

Legend
Terrain
Field Strength
Line of Sight

What is the Longley-Rice Model?

"Longley-Rice", named for Anita Longley & Phil Rice in 1968, models radio propagation between 20 MHz and 20 GHz.

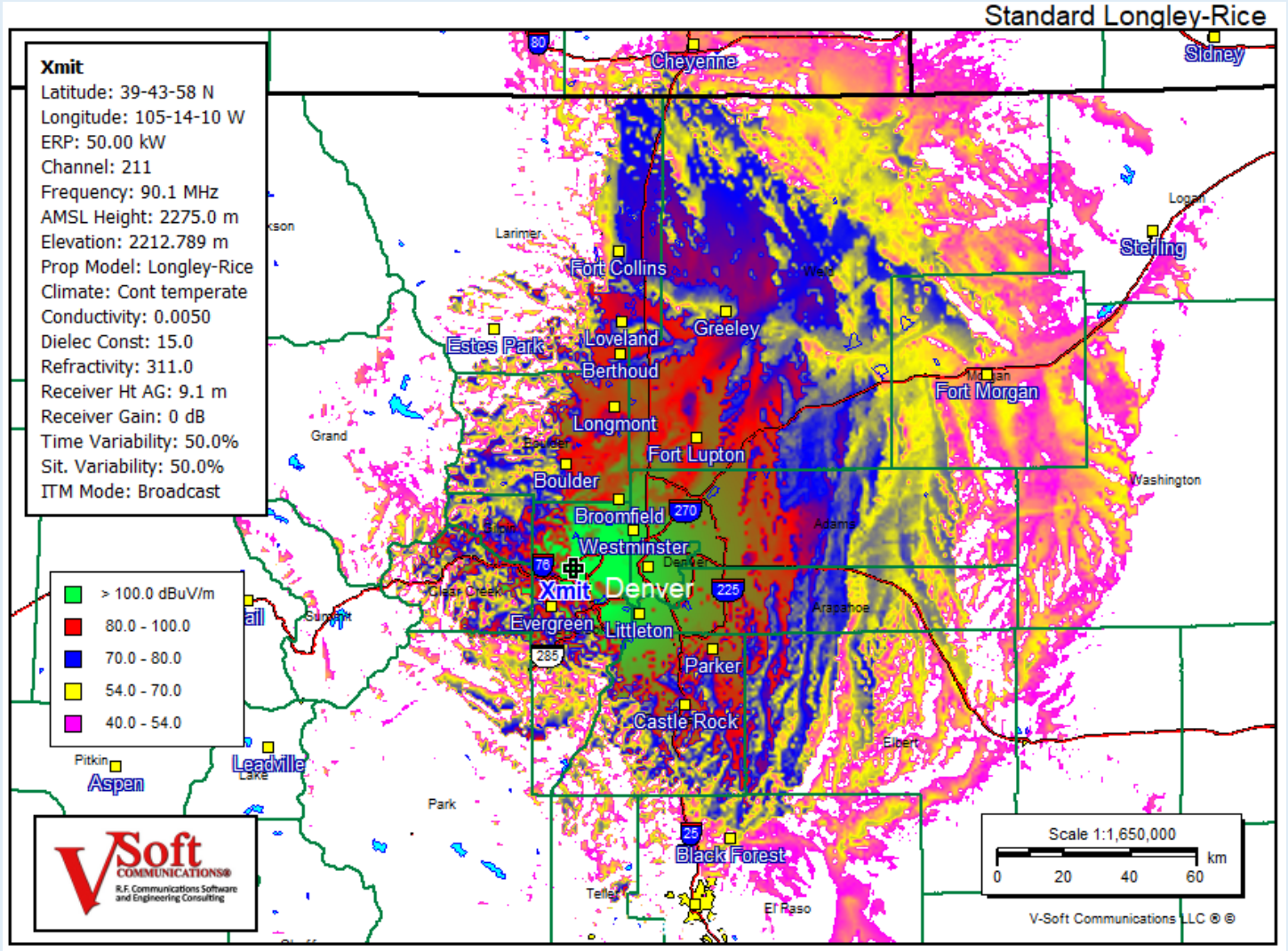
The model, based on electromagnetic theory and statistical analyses of terrain features and a cache of radio measurements, predicts the median attenuation of a radio signal as a function of distance and the variability of the signal in time and in space.

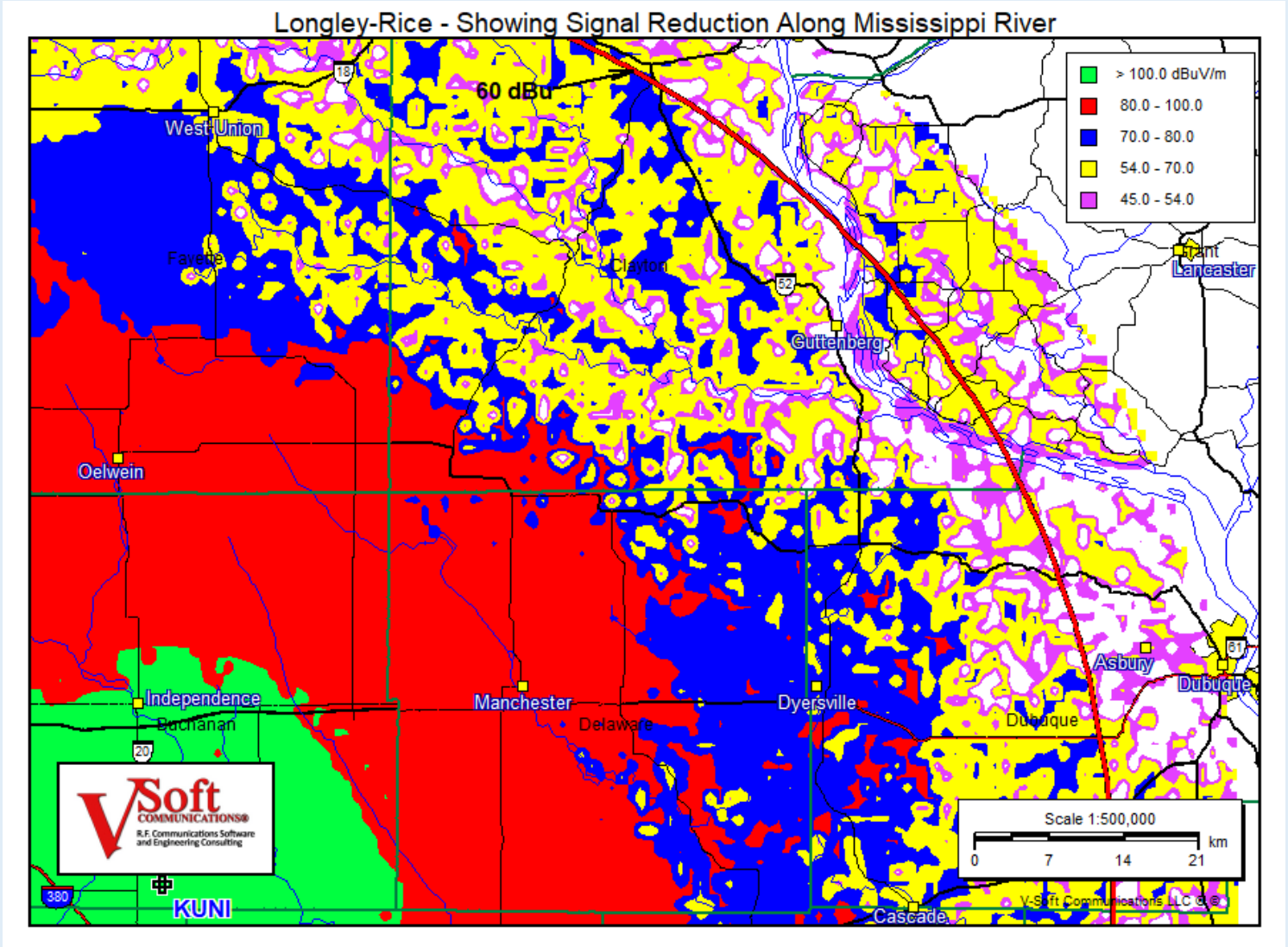
Mathematical Statistics

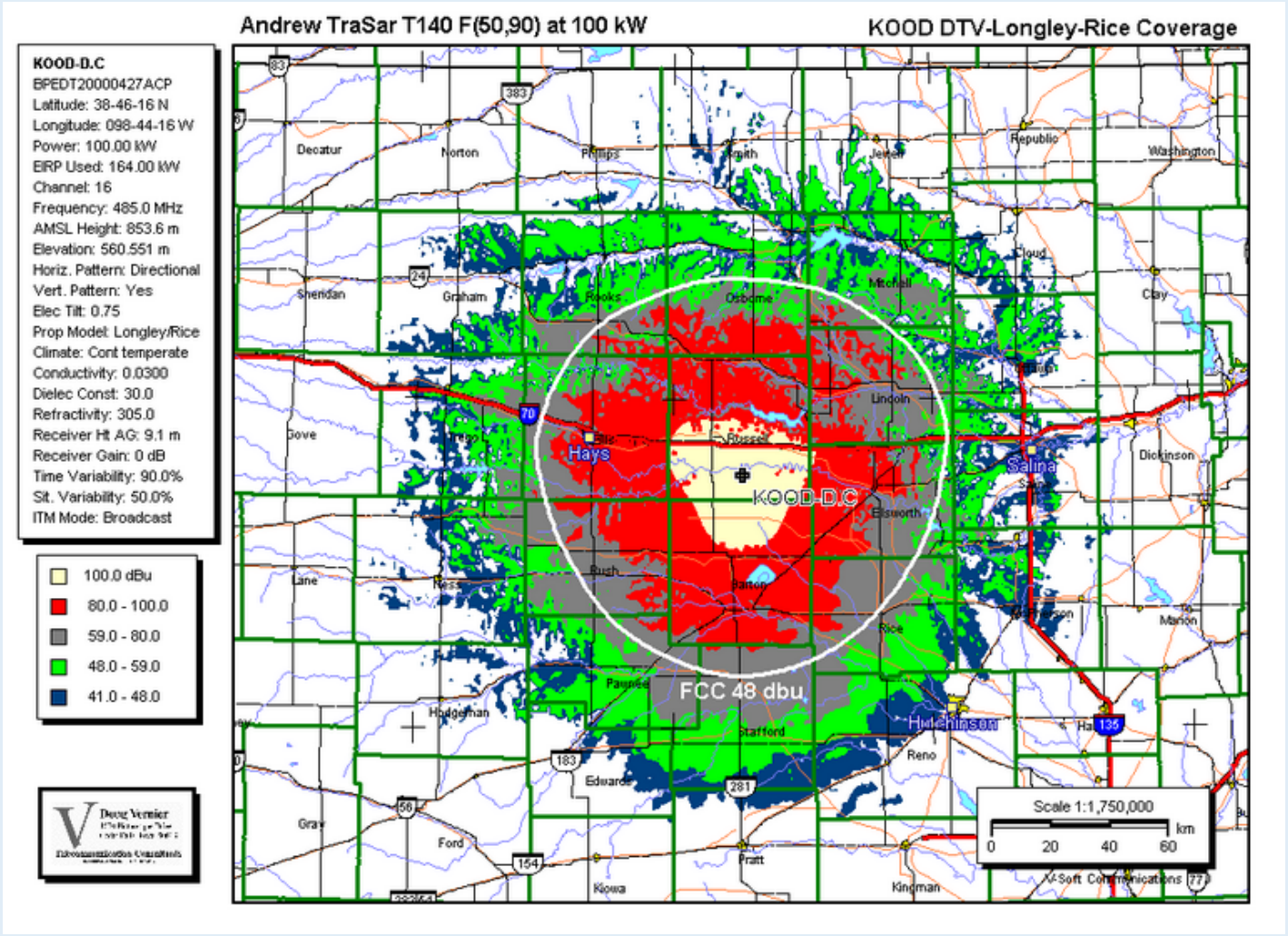
Inputs:

- Frequency (20 – 20,000 MHz)
- Transmitter antenna parameters:
- Transmitter antenna height (above mean sea level – meters.)
- Transmitter antenna height (above ground – meters.)
- Transmitter power. Transmitter antenna pattern.
- Receiver antenna height above ground – meters, and gain
- System antenna polarization (vertical or horizontal)
- System Ground Conductivity (mhoS/m)
- System dielectric constant (Permittivity)
- System surface refractivity (Adjusted to sea level.)
- Climate Zone
- Time, Location and Situation Variability

Longley-Rice, as is the case of all propagation algorithms, delivers a value of attenuation at a point. Interpreting this on a larger scale is up to you. This is where visualization comes in.


Standard Longley-Rice
Xmit
Latitude: 39-43-58 N
Longitude: 105-14-10 W
ERP: 50.00 kW
Channel: 211
Frequency: 90.1 MHz
AMSL Height: 2275.0 m
Elevation: 2212.789 m
Prop Model: Longley-Rice
Climate: Cont temperate
Conductivity: 0.0050
Dielec Const: 15.0
Refractivity: 311.0
Receiver Ht AG: 9.1 m
Receiver Gain: 0 dB
Time Variability: 50.0%
Sit. Variability: 50.0%
ITM Mode: Broadcast
> 100.0 dBuV/m
80.0 - 100.0
70.0 - 80.0
54.0 - 70.0
40.0 - 54.0
Cheyenne
Sidney
Sterling
Fort Collins
Greeley
Loveland
Estes Park
Berthoud
Longmont
Fort Lupton
Fort Morgan
Boulder
Broomfield
Westminster
Xmit
Denver
Evergreen
Littleton
Parker
Castle Rock
Aspen
Leadville
Black Forest
Scale 1:1,650,000
km
0 20 40 60
V-Soft Communications LLC ® ®
V-Soft COMMUNICATIONS®
R.F. Communications Software and Engineering Consulting


Longley-Rice - Showing Signal Reduction Along Mississippi River
60 dBu
> 100.0 dBuV/m
80.0 - 100.0
70.0 - 80.0
54.0 - 70.0
45.0 - 54.0
West Union
Fayette
Clayton
Guttenberg
Lancaster
Oelwein
Independence
Buchanan
Manchester
Delaware
Dyersville
Dubuque
Asbury
Cascade
KUNI
V-Soft COMMUNICATIONS®
R.F. Communications Software and Engineering Consulting
Scale 1:500,000
km
0
7
14
21
V-Soft Communications LLC ©


Andrew TraSar T140 F(50,90) at 100 kW
KOOD DTV-Longley-Rice Coverage
KOOD-D.C
BPEDT20000427ACP
Latitude: 38-46-16 N
Longitude: 098-44-16 W
Power: 100.00 kW
ERP Used: 164.00 kW
Channel: 16
Frequency: 485.0 MHz
AMSL Height: 853.6 m
Elevation: 560.551 m
Horiz. Pattern: Directional
Vert. Pattern: Yes
Elec Tilt: 0.75
Prop Model: Longley/Rice
Climate: Cont temperate
Conductivity: 0.0300
Dielec Const: 30.0
Refractivity: 305.0
Receiver Ht AG: 9.1 m
Receiver Gain: 0 dB
Time Variability: 90.0%
Sit. Variability: 50.0%
ITM Mode: Broadcast
100.0 dBu
80.0 - 100.0
59.0 - 80.0
48.0 - 59.0
41.0 - 48.0
Hays
KOOD-D.C
FCC 48 dbu
Hutchinson
Salina
Scale 1:1,750,000
0 20 40 60 km
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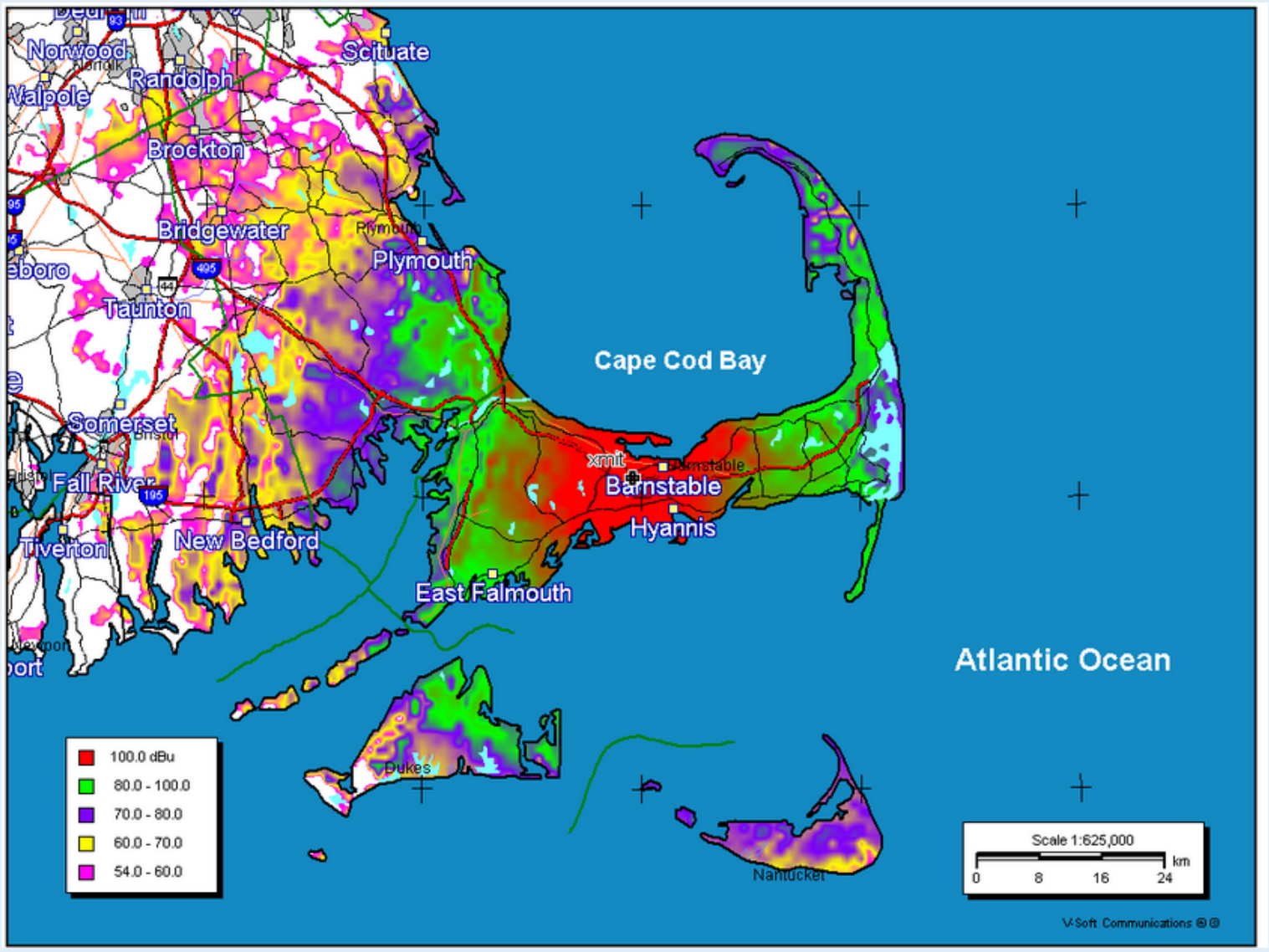
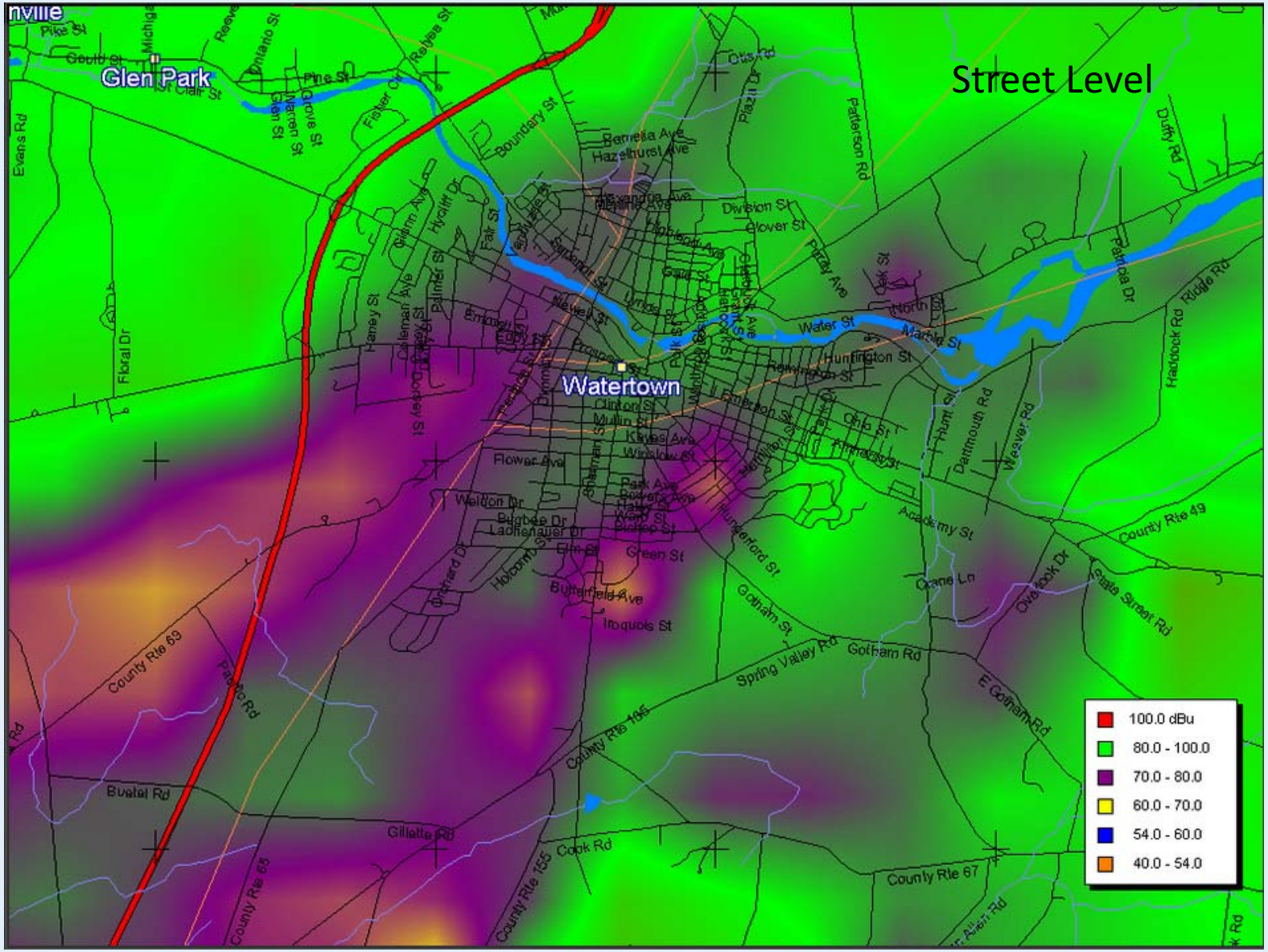
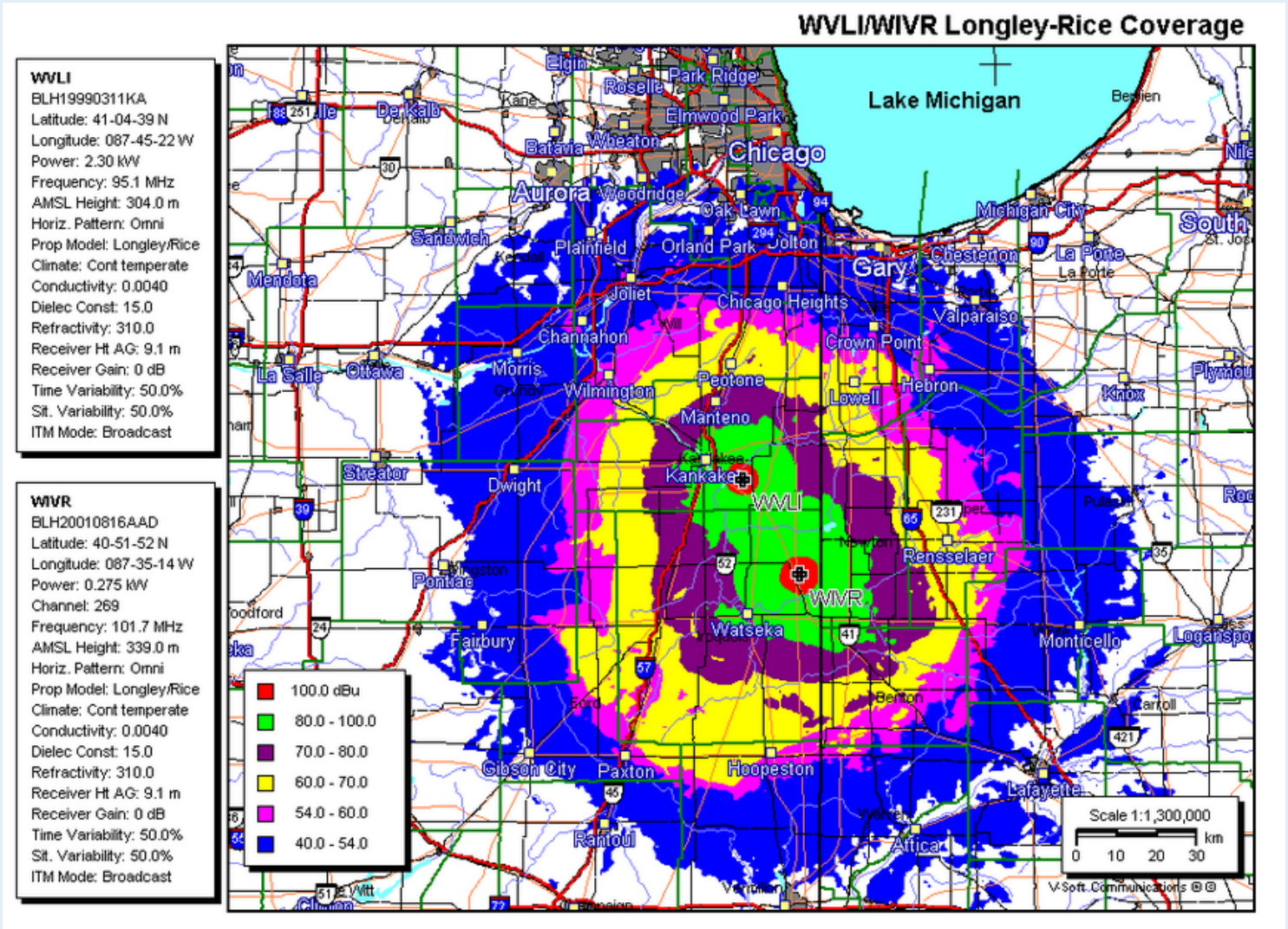
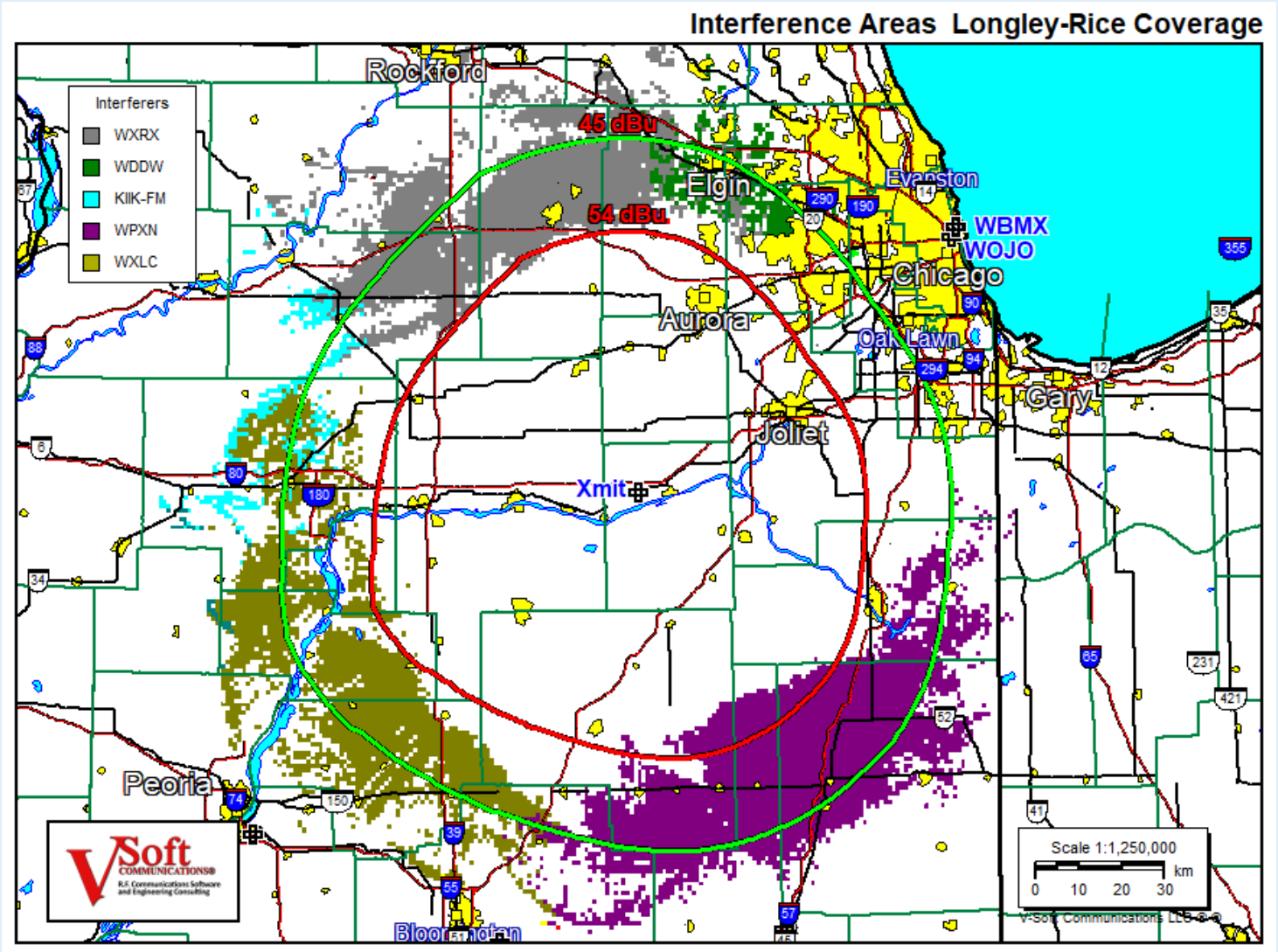
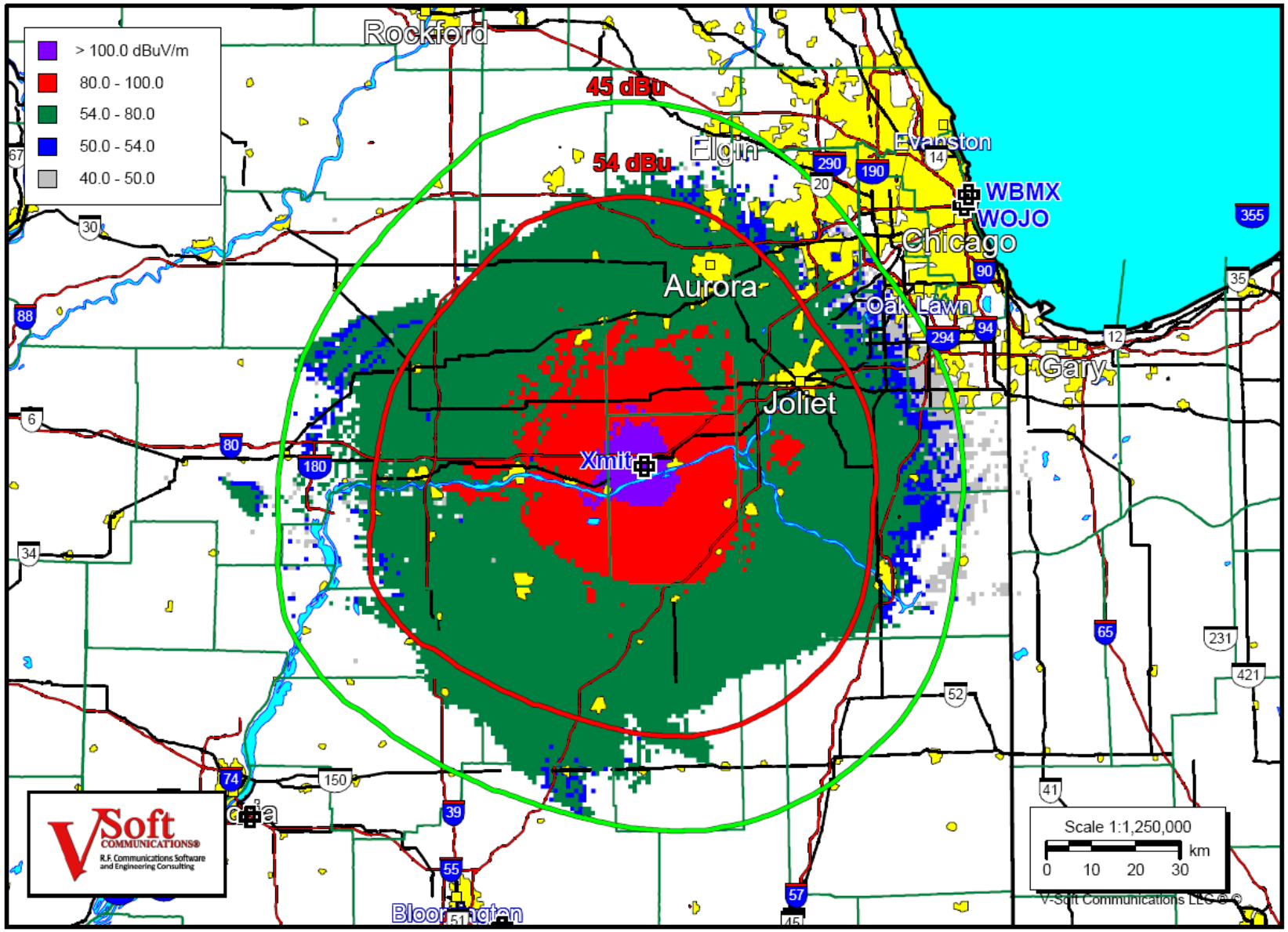

Norwood
Randolph
Scituate
Walpole
Brockton
Bridgewater
Plymouth
Taunton
Somerset
Fall River
Tiverton
New Bedford
Cape Cod Bay
xmit
Barnstable
Hyannis
East Falmouth
Atlantic Ocean
Dukes
Nantucket
100.0 dBu
80.0 - 100.0
70.0 - 80.0
60.0 - 70.0
54.0 - 60.0
Scale 1:625,000
km
0
8
16
24
V-Soft Communications


Street Level
Glen Park
Watertown
100.0 dBu
80.0 - 100.0
70.0 - 80.0
60.0 - 70.0
54.0 - 60.0
40.0 - 54.0


WVLI/WIVR Longley-Rice Coverage
WVLI
BLH19990311KA
Latitude: 41-04-39 N
Longitude: 087-45-22 W
Power: 2.30 kW
Frequency: 95.1 MHz
AMSL Height: 304.0 m
Horiz. Pattern: Omni
Prop Model: Longley/Rice
Climate: Cont temperate
Conductivity: 0.0040
Dielec Const: 15.0
Refractivity: 310.0
Receiver Ht AG: 9.1 m
Receiver Gain: 0 dB
Time Variability: 50.0%
Sit. Variability: 50.0%
ITM Mode: Broadcast
WIVR
BLH20010816AAD
Latitude: 40-51-52 N
Longitude: 087-35-14 W
Power: 0.275 kW
Channel: 269
Frequency: 101.7 MHz
AMSL Height: 339.0 m
Horiz. Pattern: Omni
Prop Model: Longley/Rice
Climate: Cont temperate
Conductivity: 0.0040
Dielec Const: 15.0
Refractivity: 310.0
Receiver Ht AG: 9.1 m
Receiver Gain: 0 dB
Time Variability: 50.0%
Sit. Variability: 50.0%
ITM Mode: Broadcast
100.0 dBu
80.0 - 100.0
70.0 - 80.0
60.0 - 70.0
54.0 - 60.0
40.0 - 54.0
Lake Michigan
Chicago
Aurora
Gary
Kankakee
WVLI
WIVR
Scale 1:1,300,000
0 10 20 30 km
V-Soft Communications


Interference Areas Longley-Rice Coverage
Interferers
WXRX
WDDW
KIIK-FM
WPXN
WXLC
45 dBu
54 dBu
Rockford
Elgin
Evanston
WBMX
WOJO
Chicago
Aurora
Oak Lawn
Gary
Joliet
Xmit
Peoria
Scale 1:1,250,000
km
0 10 20 30
V-Soft Communications LLC


> 100.0 dBuV/m
80.0 - 100.0
54.0 - 80.0
50.0 - 54.0
40.0 - 50.0
Rockford
45 dBu
54 dBu
Elgin
Evanston
WBMX
WOJO
Chicago
Aurora
Oak Lawn
Gary
Joliet
Xmit
Bloomington
V-Soft COMMUNICATIONS®
R.F. Communications Software and Engineering Consulting
Scale 1:1,250,000
km
0 10 20 30
V-Soft Communications LLC © ©

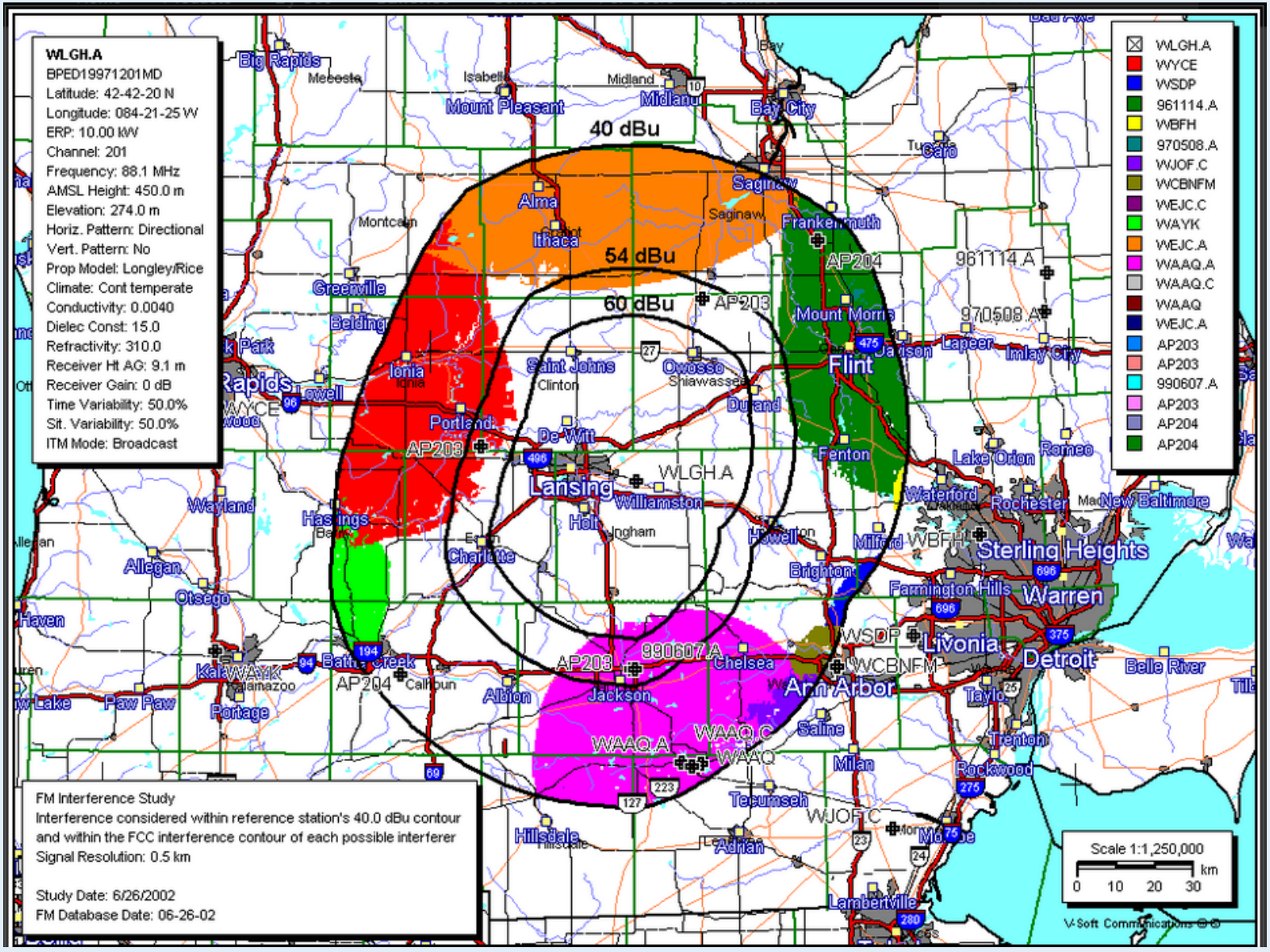
Calculation of Population with No Interference

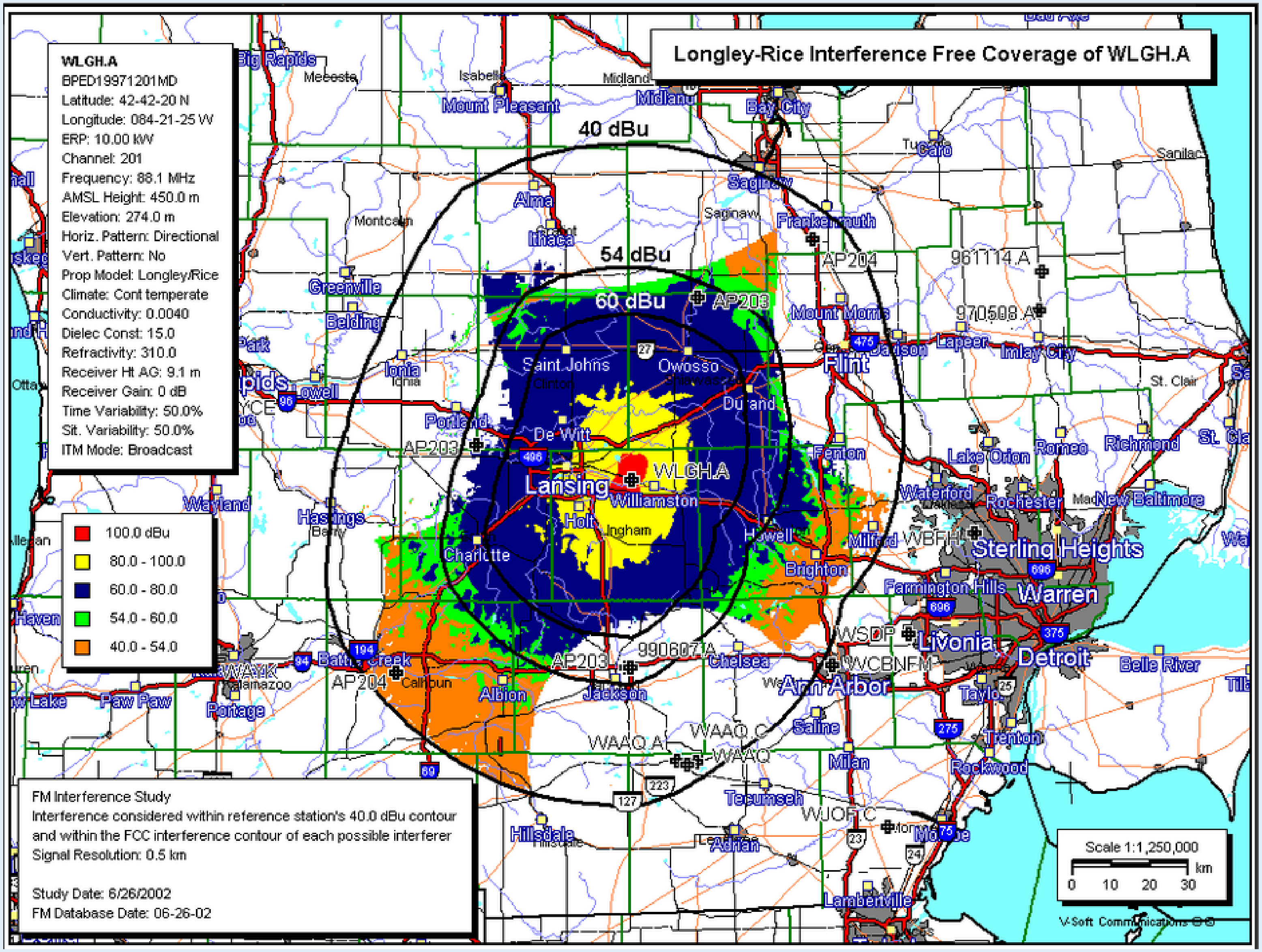
Totals for Xmit (284) to the 45 dBu, (using 30 meter terrain)

	Population	Area
Calculation Area Population:	9,471,751	[38017.9 sq. km]
Not Affected by Terrain Loss:	2,942,759	[22484.3 sq. km]
Interfered Population:	773,030	[8623.1 sq. km]
Interference Free:	2,169,729	[13861.2 sq. km]
Percent Interference:	26.27 %	
Terrain Blocked Population:	6,528,992	[15533.6 sq. km]

Interference Free Breakdown:

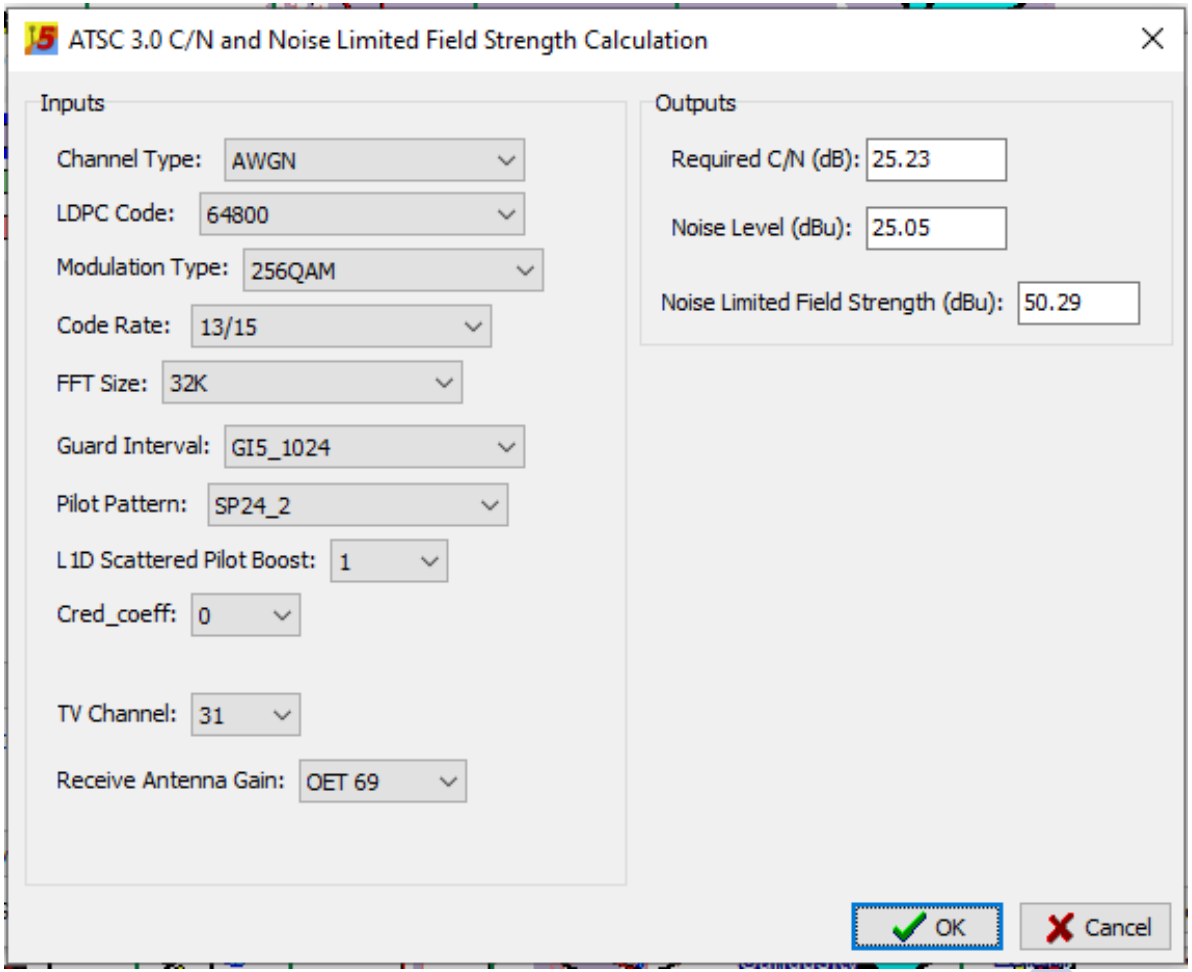
White:	1,380,981	[63.6%]
Black:	214,332	[9.9%]
Hispanic:	361,535	[16.7%]
Native American:	2,131	[0.1%]
Asian:	133,528	[6.2%]
Pacific Islander:	385	[0.0%]
Mixed Race:	69,961	[3.2%]
Other:	6,876	[0.3%]
Total:	2,169,729	

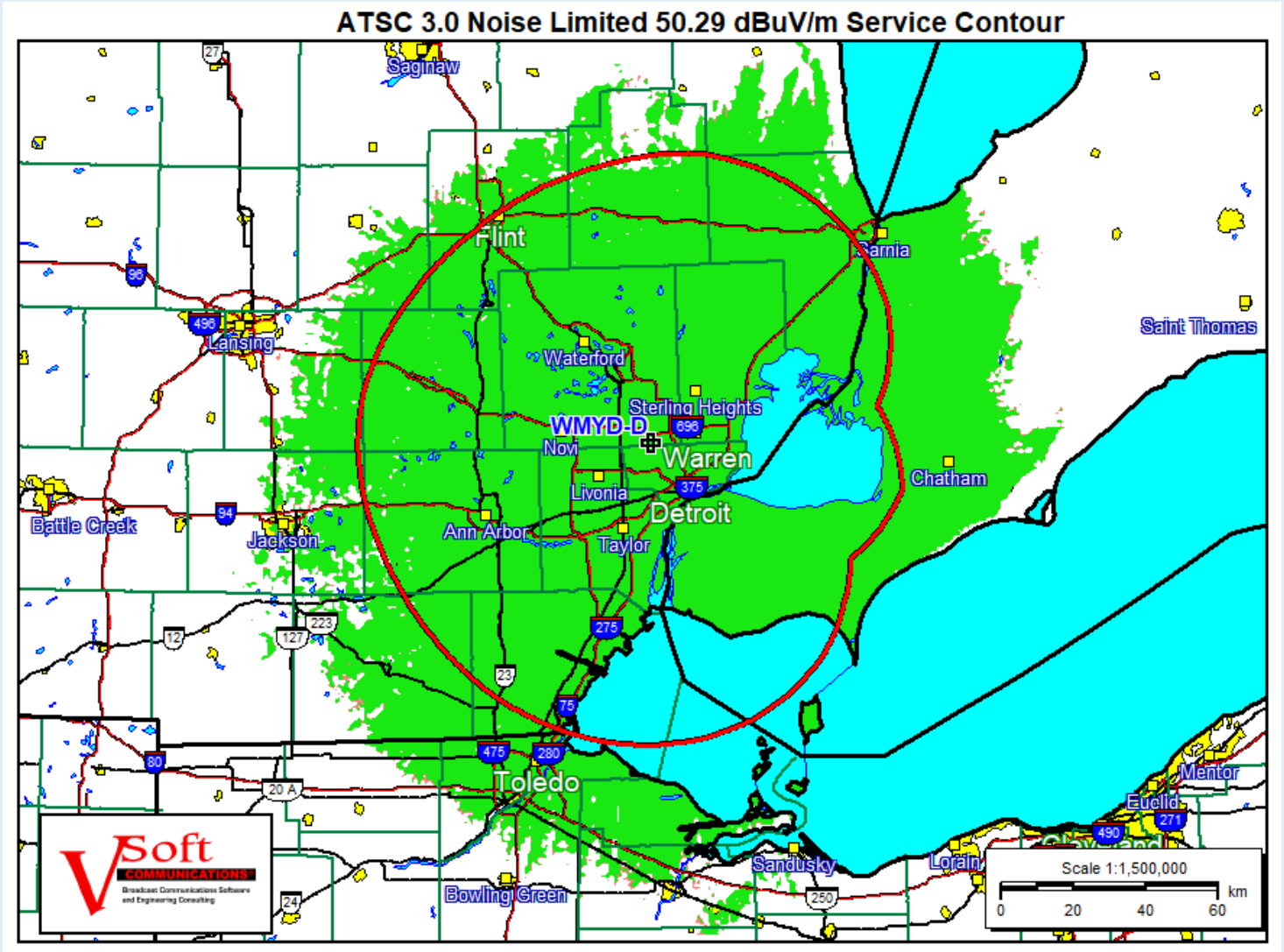

WLGH.A
BPED19971201MD
Latitude: 42-42-20 N
Longitude: 084-21-25 W
ERP: 10.00 kW
Channel: 201
Frequency: 88.1 MHz
AMSL Height: 450.0 m
Elevation: 274.0 m
Horiz. Pattern: Directional
Vert. Pattern: No
Prop Model: Longley/Rice
Climate: Cont temperate
Conductivity: 0.0040
Dielec Const: 15.0
Refractivity: 310.0
Receiver Ht AG: 9.1 m
Receiver Gain: 0 dB
Time Variability: 50.0%
Sit. Variability: 50.0%
ITM Mode: Broadcast
40 dBu
54 dBu
60 dBu
WLGH.A
WYCE
WSDP
961114.A
WBFH
970508.A
WJOF.C
WCBNFM
WEJC.C
WAYK
WEJC.A
WAAQ.A
WAAQ.C
WAAQ
WEJC.A
AP203
AP203
990607.A
AP203
AP204
AP204
FM Interference Study
Interference considered within reference station's 40.0 dBu contour
and within the FCC interference contour of each possible interferer
Signal Resolution: 0.5 km
Study Date: 6/26/2002
FM Database Date: 06-26-02
Scale 1:1,250,000
km
0 10 20 30
Soft Communications

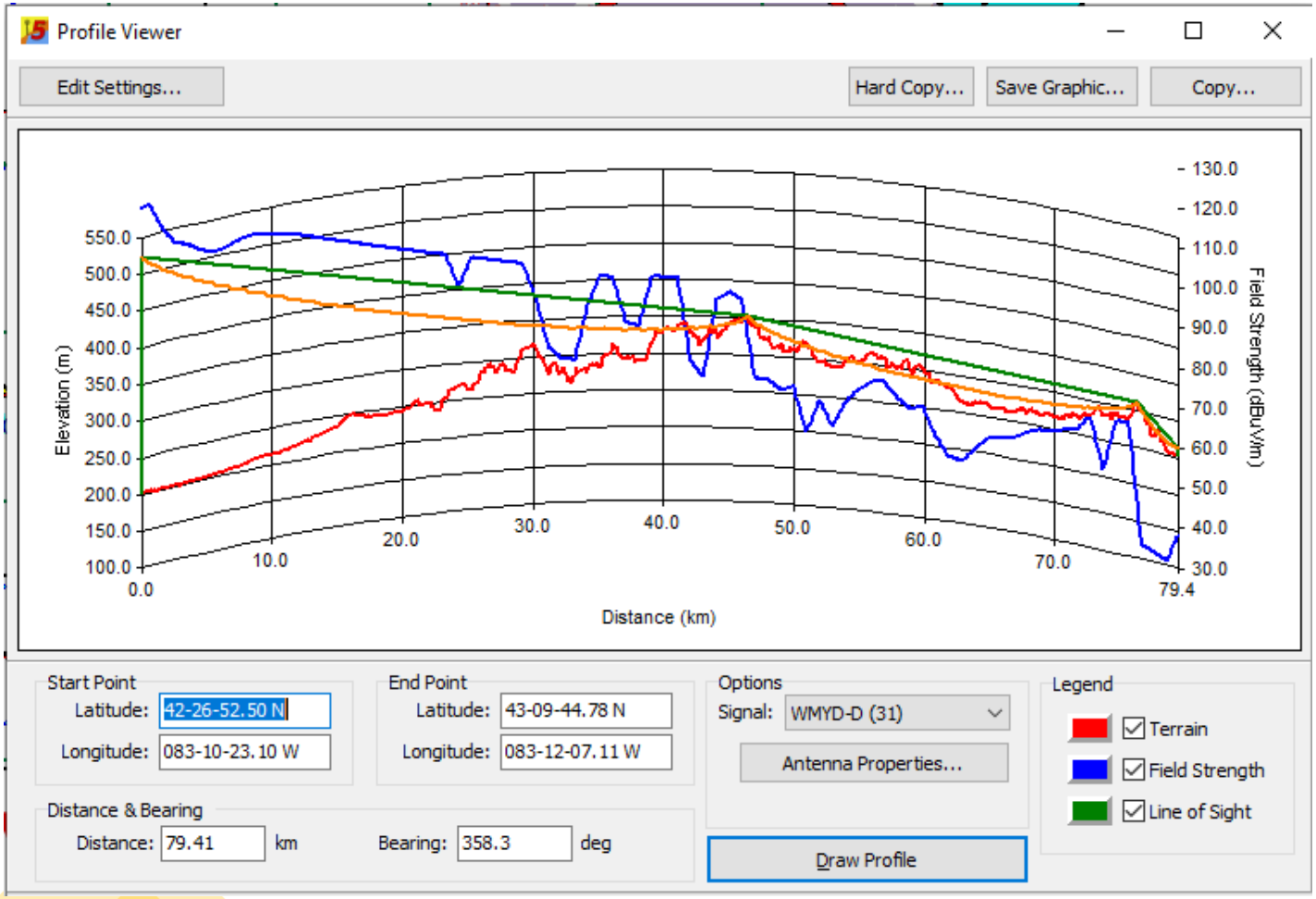

Longley-Rice Interference Free Coverage of WLGH.A
WLGH.A
BPED19971201MD
Latitude: 42-42-20 N
Longitude: 084-21-25 W
ERP: 10.00 kW
Channel: 201
Frequency: 88.1 MHz
AMSL Height: 450.0 m
Elevation: 274.0 m
Horiz. Pattern: Directional
Vert. Pattern: No
Prop Model: Longley/Rice
Climate: Cont temperate
Conductivity: 0.0040
Dielec Const: 15.0
Refractivity: 310.0
Receiver Ht AG: 9.1 m
Receiver Gain: 0 dB
Time Variability: 50.0%
Sit. Variability: 50.0%
ITM Mode: Broadcast
40 dBu
54 dBu
60 dBu
100.0 dBu
80.0 - 100.0
60.0 - 80.0
54.0 - 60.0
40.0 - 54.0
FM Interference Study
Interference considered within reference station's 40.0 dBu contour
and within the FCC interference contour of each possible interferer
Signal Resolution: 0.5 km
Study Date: 6/26/2002
FM Database Date: 06-26-02
Scale 1:1,250,000
0 10 20 30 km

ATSC 3.0 Inputs:

- **Channel type** - AWGN - Additive White Gaussian Noise or Rayleigh – Model of multipath and fading effects
- **LPDC** - Low-Density Parity Check, 64,800 bits, 64k, or 16,200 bits, 16k
- **Modulation** constellation used - QPSK, 16QAM, 64QAM, 256QAM, 1024QAM, 2048QAM
- **Code Rate** - Forward error correction code
- **FFT Size**, (Fast Fourier Transform) for Doppler Protection
- **Guard Intervals** - Protection from time-delay interference caused by multi-path SFN's
- **Pilot Pattern** - Indicates the frequency separation of pilots and the length of the scattered pilot pattern
- **L1D Scattered Pilot Boost** - Higher pilot boosting improves channel estimation accuracy
- **Cred_coeff** -corresponds to increased data capacity and degree of adjacent channel interference
- **Other inputs** - the use of OET 69 & received antenna gain


ATSC 3.0 C/N and Noise Limited Field Strength Calculation
Inputs
Channel Type: AWGN
LDPC Code: 64800
Modulation Type: 256QAM
Code Rate: 13/15
FFT Size: 32K
Guard Interval: GI5_1024
Pilot Pattern: SP24_2
L1D Scattered Pilot Boost: 1
Cred_coeff: 0
TV Channel: 31
Receive Antenna Gain: OET 69
Outputs
Required C/N (dB): 25.23
Noise Level (dBu): 25.05
Noise Limited Field Strength (dBu): 50.29
OK
Cancel


ATSC 3.0 Noise Limited 50.29 dBuV/m Service Contour
Saginaw
Flint
Sarnia
Saint Thomas
Lansing
Waterford
Sterling Heights
WMYD-D
Novi
Warren
Chatham
Livonia
Detroit
Battle Creek
Jackson
Ann Arbor
Taylor
Toledo
Mentor
Euclid
Sandusky
Lorain
Bowling Green
VSoft
COMMUNICATIONS
Broadcast Communications Software and Engineering Consulting
Scale 1:1,500,000
km
0
20
40
60


Profile Viewer
Edit Settings...
Hard Copy...
Save Graphic...
Copy...
Elevation (m)
550.0
500.0
450.0
400.0
350.0
300.0
250.0
200.0
150.0
100.0
0.0
10.0
20.0
30.0
40.0
50.0
60.0
70.0
79.4
Distance (km)
130.0
120.0
110.0
100.0
90.0
80.0
70.0
60.0
50.0
40.0
30.0
Field Strength (dBuV/m)
Start Point
Latitude: 42-26-52.50 N
Longitude: 083-10-23.10 W
End Point
Latitude: 43-09-44.78 N
Longitude: 083-12-07.11 W
Options
Signal: WMYD-D (31)
Antenna Properties...
Legend
Terrain
Field Strength
Line of Sight
Distance & Bearing
Distance: 79.41 km
Bearing: 358.3 deg
Draw Profile

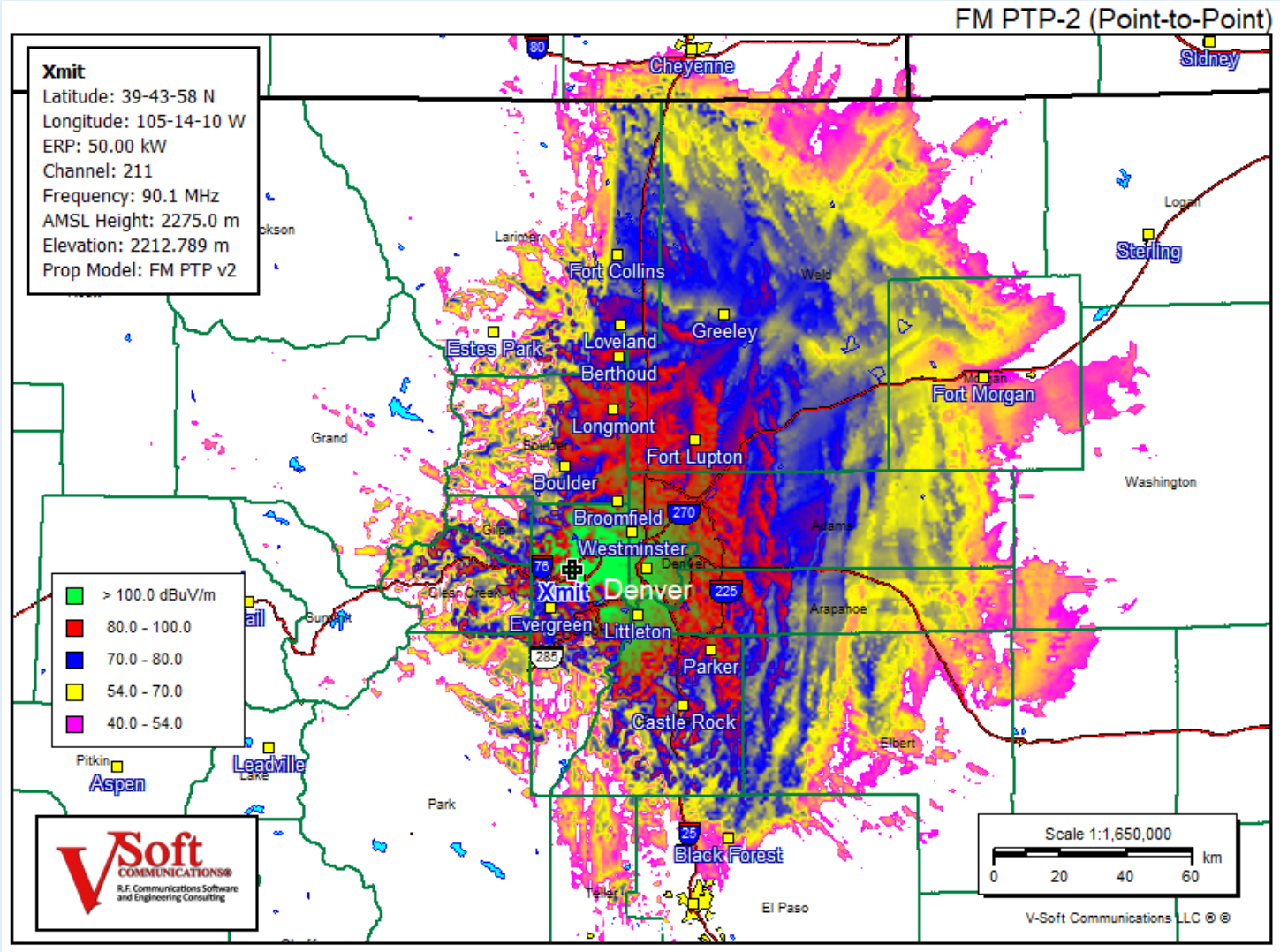
A few Other Propagation Models

- **PTP-2**, created by Harry Wong at the FCC, uses the terrain value for each point in the specified area of calculation

- **ITU R-P model:** Developed by the International Telecommunications Union, is used widely through out the world, except for in the U.S.

- **Cost-231/Hata** version of the COST-231 propagation model (For use in Urban Areas)
- This model uses HAAT along each radial to determine the attenuation based the equation:
- Path Loss (dB) = 46.3 + 33.9*log(F) - 13.82*log(H) + [44.9 - 6.55*log(H)]*log(D) + C

- **Okamura-Hata:**
- Also, a widely used urban model, applicable for frequencies in the range [illegible] MHz


FM PTP-2 (Point-to-Point)
Xmit
Latitude: 39-43-58 N
Longitude: 105-14-10 W
ERP: 50.00 kW
Channel: 211
Frequency: 90.1 MHz
AMSL Height: 2275.0 m
Elevation: 2212.789 m
Prop Model: FM PTP v2
> 100.0 dBuV/m
80.0 - 100.0
70.0 - 80.0
54.0 - 70.0
40.0 - 54.0
Cheyenne
Sidney
Sterling
Fort Collins
Greeley
Loveland
Estes Park
Berthoud
Longmont
Fort Lupton
Fort Morgan
Boulder
Broomfield
Westminster
Xmit
Denver
Evergreen
Littleton
Parker
Castle Rock
Black Forest
Aspen
Leadville
Pitkin
Park
Grand
Larimer
Weld
Logan
Washington
Adams
Arapahoe
Elbert
El Paso
Teller
Summit
Clear Creek
Gilpin
Scale 1:1,650,000
km
0 20 40 60
V-Soft Communications LLC ® ®
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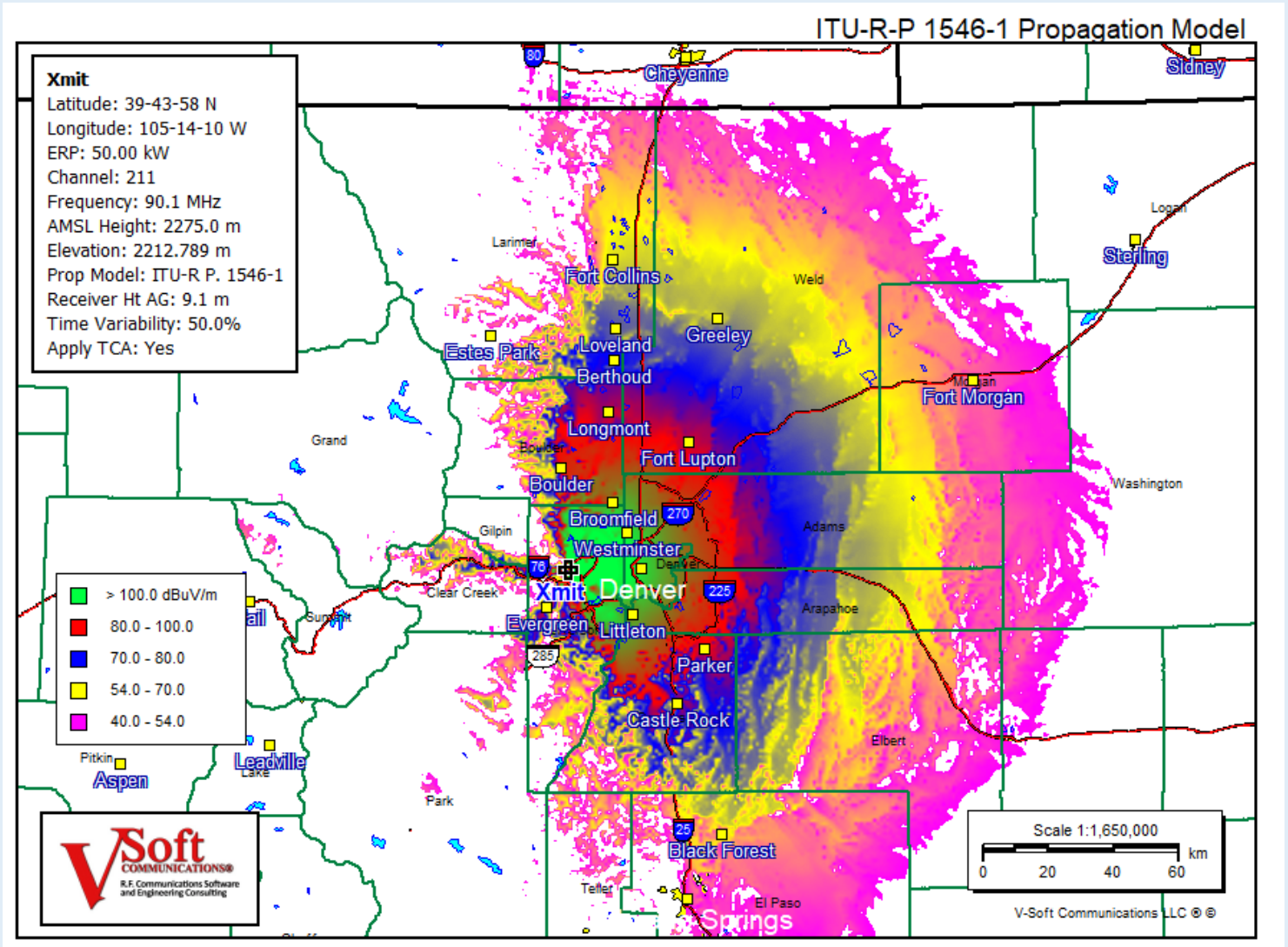
ITU-R-P 1546-1 Propagation Model
Xmit
Latitude: 39-43-58 N
Longitude: 105-14-10 W
ERP: 50.00 kW
Channel: 211
Frequency: 90.1 MHz
AMSL Height: 2275.0 m
Elevation: 2212.789 m
Prop Model: ITU-R P. 1546-1
Receiver Ht AG: 9.1 m
Time Variability: 50.0%
Apply TCA: Yes
> 100.0 dBuV/m
80.0 - 100.0
70.0 - 80.0
54.0 - 70.0
40.0 - 54.0
Cheyenne
Sidney
Sterling
Fort Collins
Greeley
Loveland
Estes Park
Berthoud
Fort Morgan
Longmont
Fort Lupton
Boulder
Broomfield
Westminster
Xmit
Denver
Evergreen
Littleton
Parker
Castle Rock
Aspen
Leadville
Black Forest
Springs
Larimer
Weld
Logan
Grand
Boulder
Gilpin
Clear Creek
Adams
Arapahoe
Washington
Park
Elbert
Teller
El Paso
Pitkin
Lake
Scale 1:1,650,000
km
0
20
40
60
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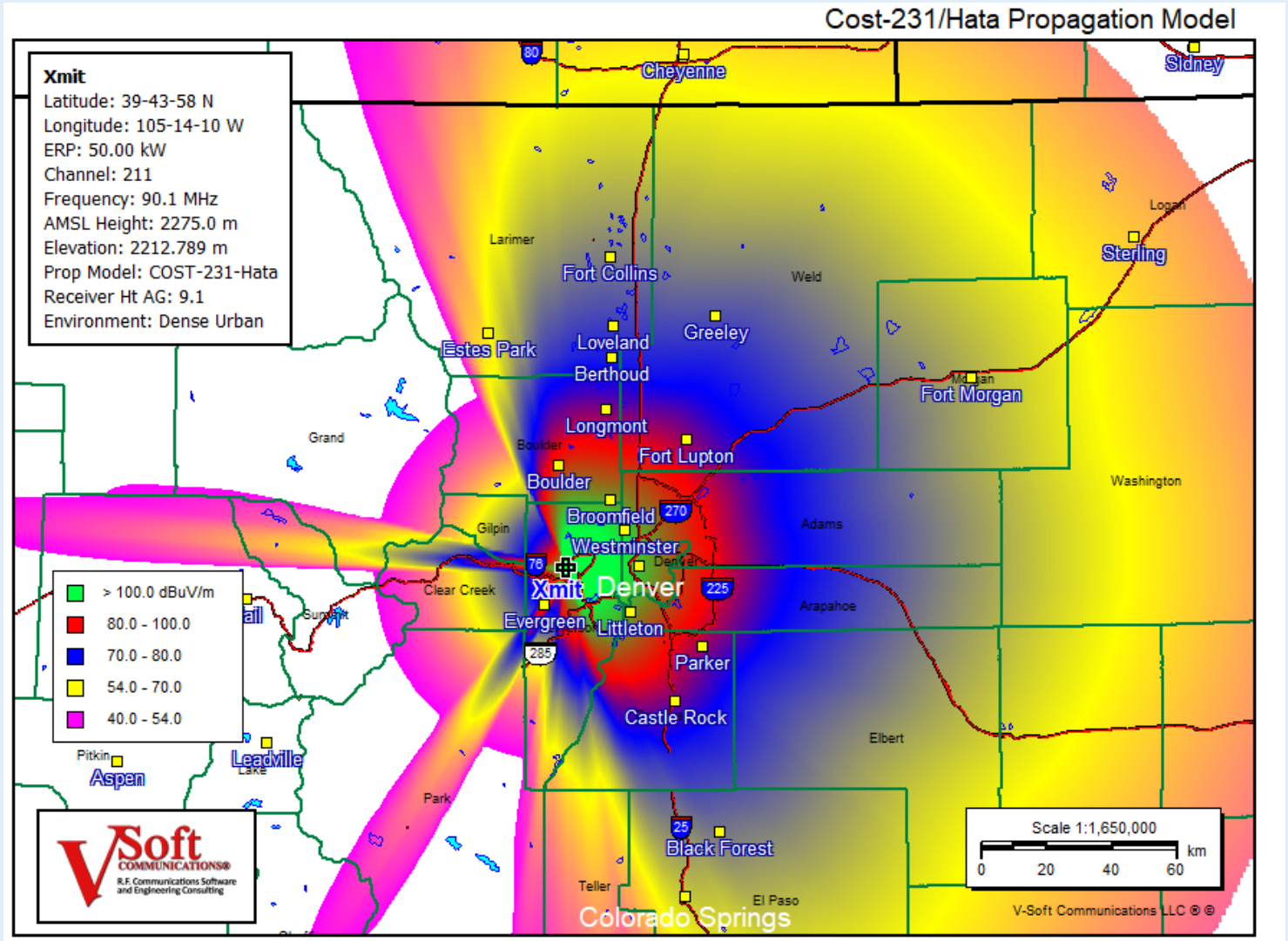
Cost-231/Hata Propagation Model
Xmit
Latitude: 39-43-58 N
Longitude: 105-14-10 W
ERP: 50.00 kW
Channel: 211
Frequency: 90.1 MHz
AMSL Height: 2275.0 m
Elevation: 2212.789 m
Prop Model: COST-231-Hata
Receiver Ht AG: 9.1
Environment: Dense Urban
> 100.0 dBuV/m
80.0 - 100.0
70.0 - 80.0
54.0 - 70.0
40.0 - 54.0
Cheyenne
Sidney
Sterling
Fort Collins
Greeley
Estes Park
Loveland
Berthoud
Fort Morgan
Longmont
Fort Lupton
Boulder
Broomfield
Westminster
Denver
Xmit
Evergreen
Littleton
Parker
Castle Rock
Aspen
Leadville
Black Forest
Colorado Springs
Larimer
Weld
Logan
Grand
Boulder
Gilpin
Clear Creek
Washington
Adams
Arapahoe
Elbert
Park
Teller
El Paso
Pitkin
Lake
Scale 1:1,650,000
km
0 20 40 60
V-Soft Communications LLC ® ©
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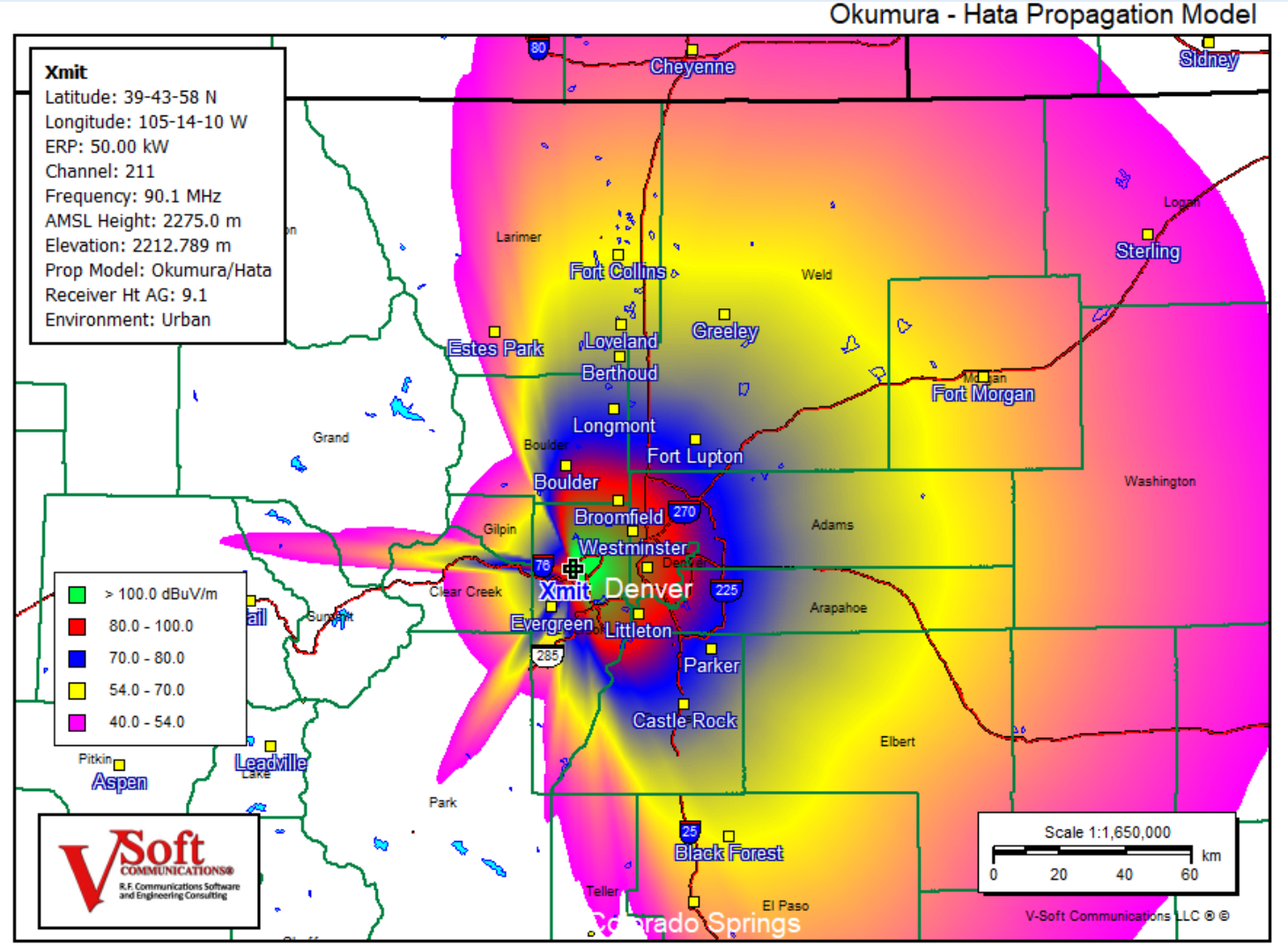
Okumura - Hata Propagation Model
Xmit
Latitude: 39-43-58 N
Longitude: 105-14-10 W
ERP: 50.00 kW
Channel: 211
Frequency: 90.1 MHz
AMSL Height: 2275.0 m
Elevation: 2212.789 m
Prop Model: Okumura/Hata
Receiver Ht AG: 9.1
Environment: Urban
> 100.0 dBuV/m
80.0 - 100.0
70.0 - 80.0
54.0 - 70.0
40.0 - 54.0
Cheyenne
Sidney
Sterling
Fort Collins
Greeley
Loveland
Berthoud
Estes Park
Fort Morgan
Longmont
Fort Lupton
Boulder
Broomfield
Westminster
Xmit
Denver
Evergreen
Littleton
Parker
Castle Rock
Aspen
Leadville
Black Forest
Colorado Springs
Larimer
Weld
Grand
Gilpin
Clear Creek
Adams
Arapahoe
Elbert
Park
Teller
El Paso
Washington
Logan
Pitkin
Lake
Scale 1:1,650,000
km
0 20 40 60
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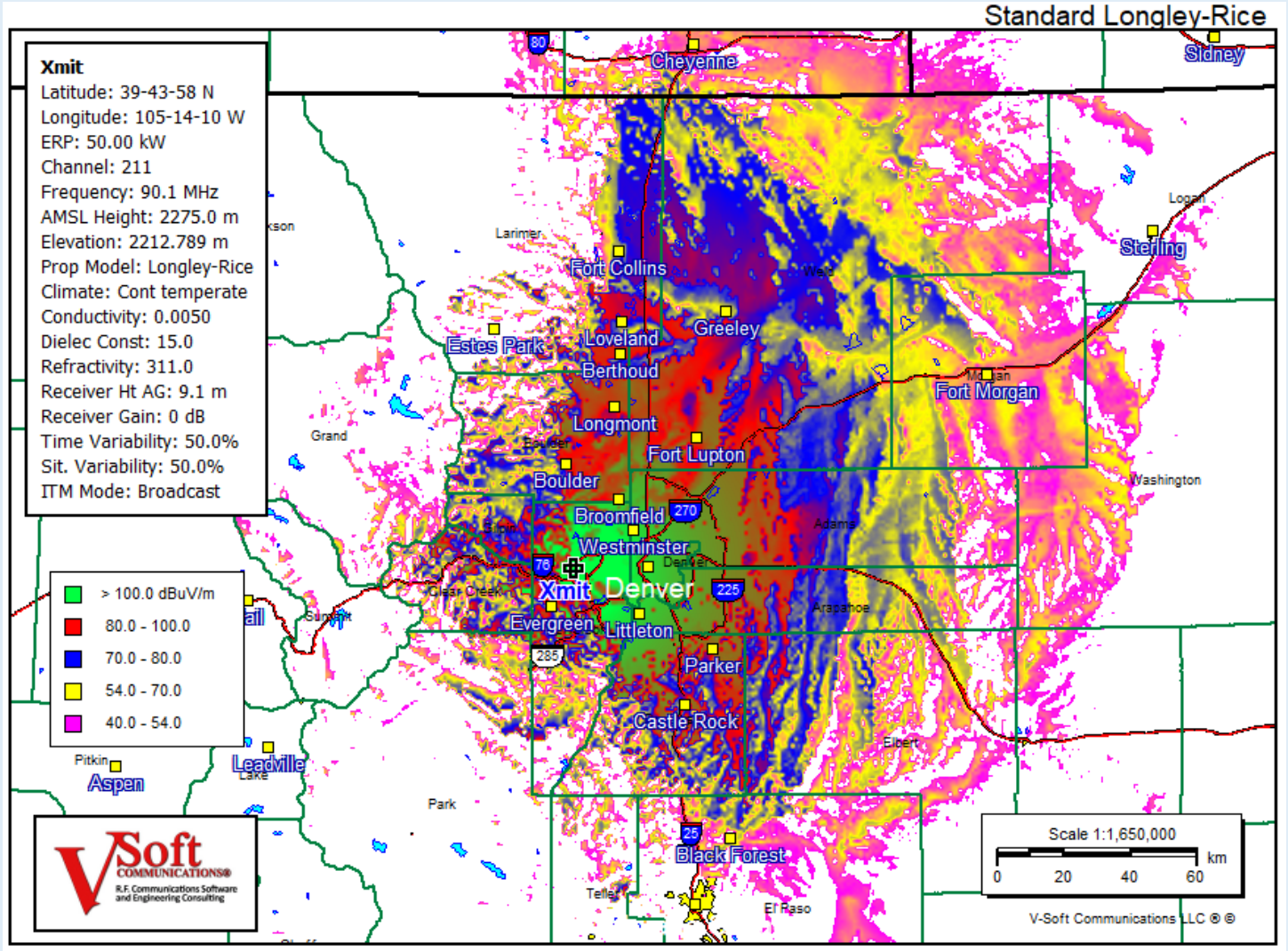
Standard Longley-Rice
Xmit
Latitude: 39-43-58 N
Longitude: 105-14-10 W
ERP: 50.00 kW
Channel: 211
Frequency: 90.1 MHz
AMSL Height: 2275.0 m
Elevation: 2212.789 m
Prop Model: Longley-Rice
Climate: Cont temperate
Conductivity: 0.0050
Dielec Const: 15.0
Refractivity: 311.0
Receiver Ht AG: 9.1 m
Receiver Gain: 0 dB
Time Variability: 50.0%
Sit. Variability: 50.0%
ITM Mode: Broadcast
> 100.0 dBuV/m
80.0 - 100.0
70.0 - 80.0
54.0 - 70.0
40.0 - 54.0
Cheyenne
Sidney
Sterling
Fort Collins
Greeley
Loveland
Estes Park
Berthoud
Longmont
Fort Lupton
Fort Morgan
Boulder
Broomfield
Westminster
Xmit
Denver
Evergreen
Littleton
Parker
Castle Rock
Aspen
Leadville
Black Forest
Scale 1:1,650,000
km
0 20 40 60
V-Soft Communications LLC ® ®
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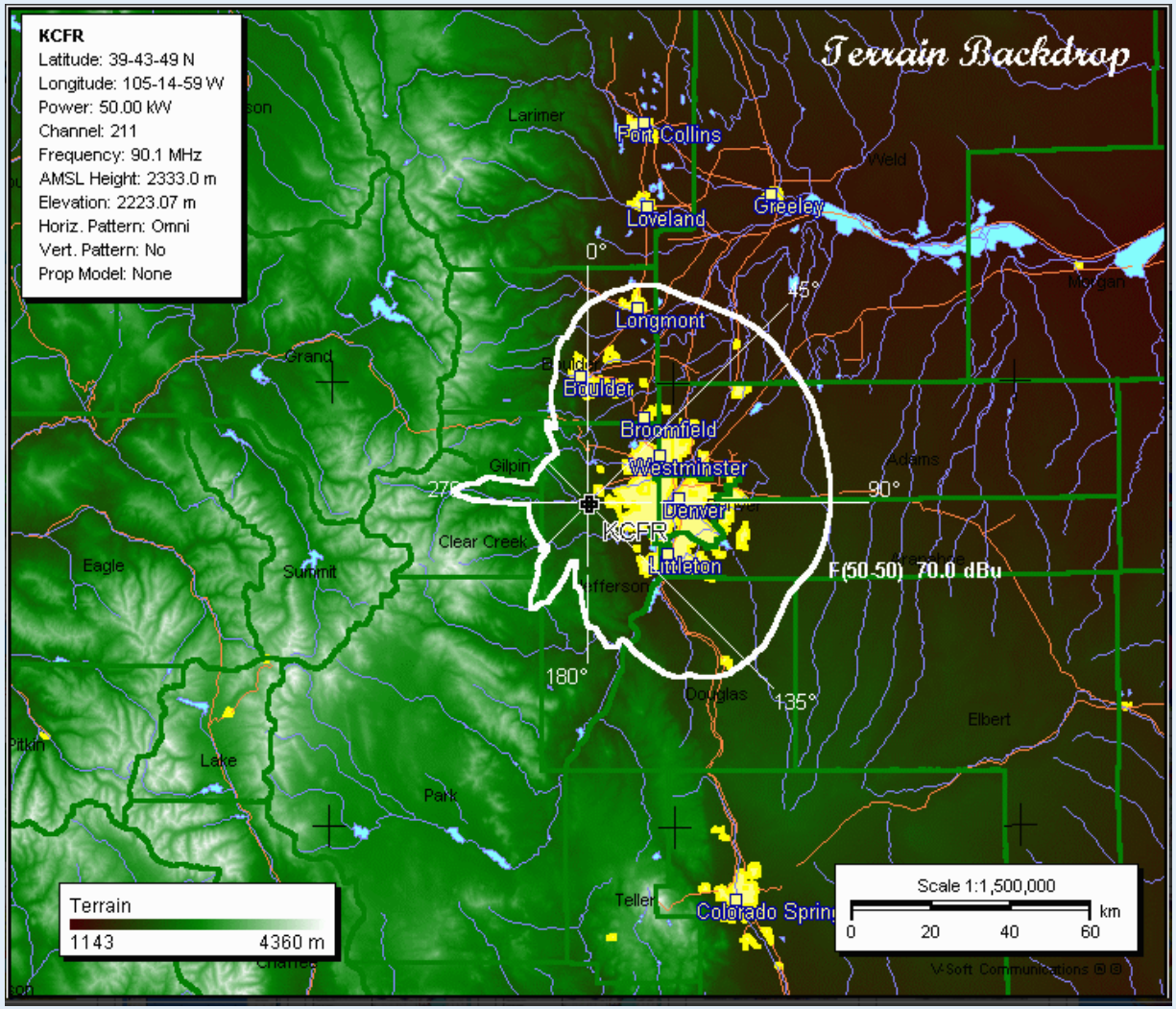
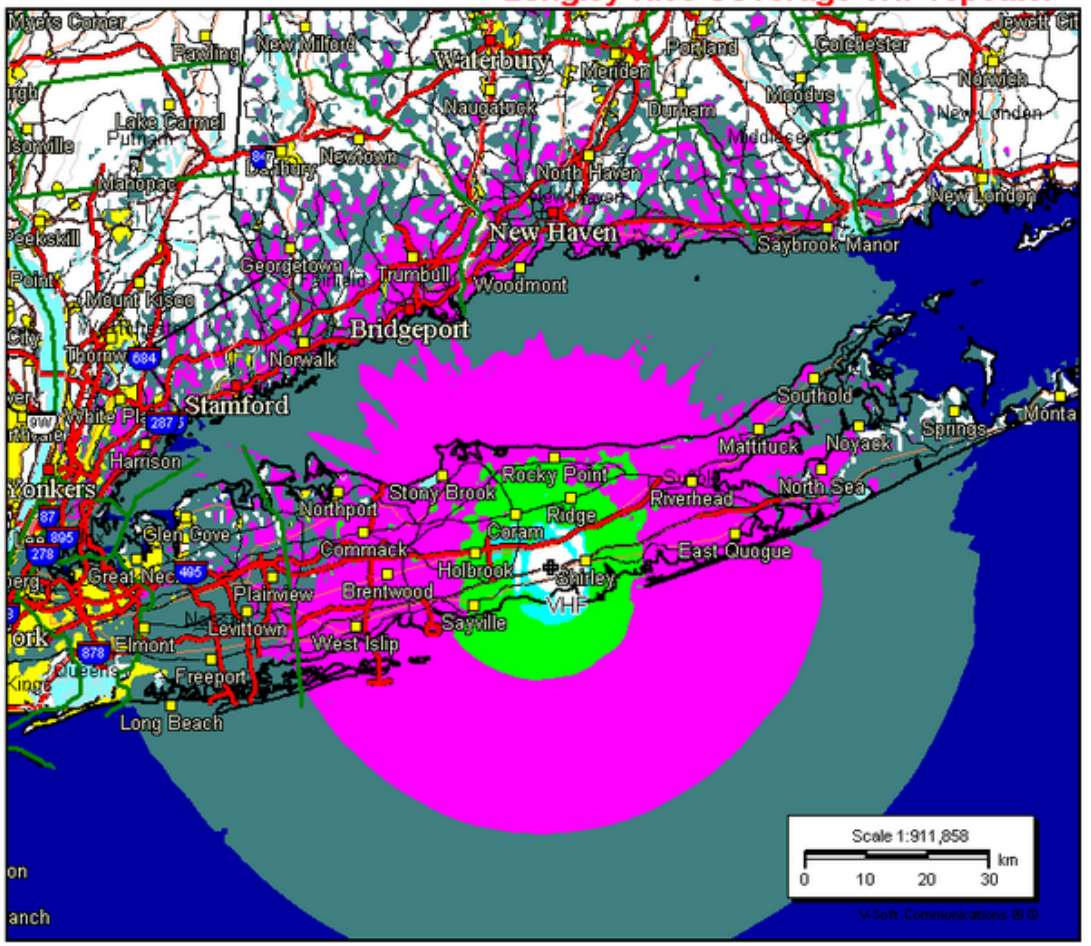

KCFR
Latitude: 39-43-49 N
Longitude: 105-14-59 W
Power: 50.00 kW
Channel: 211
Frequency: 90.1 MHz
AMSL Height: 2333.0 m
Elevation: 2223.07 m
Horiz. Pattern: Omni
Vert. Pattern: No
Prop Model: None
Terrain Backdrop
Larimer
Fort Collins
Weld
Loveland
Greeley
Morgan
0°
45°
Longmont
Grand
Boulder
Broomfield
Gilpin
Westminster
Adams
270°
90°
Denver
KCFR
Clear Creek
Littleton
Eagle
Summit
F(50-50) 70.0 dBu
180°
135°
Douglas
Elbert
Lake
Park
Teller
Terrain
1143
4360 m
Scale 1:1,500,000
km
0
20
40
60

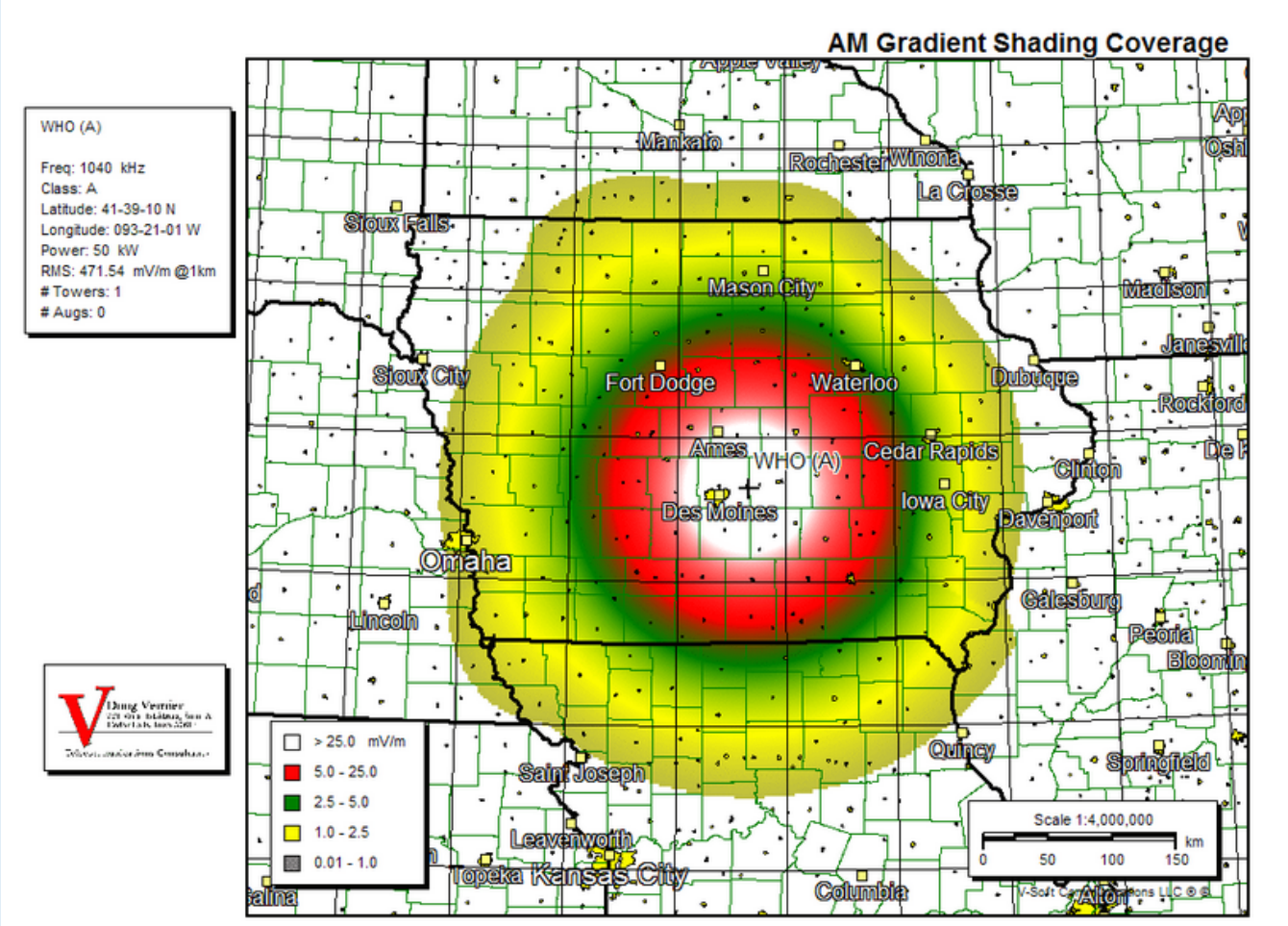
Image Over U.S. Topo Map

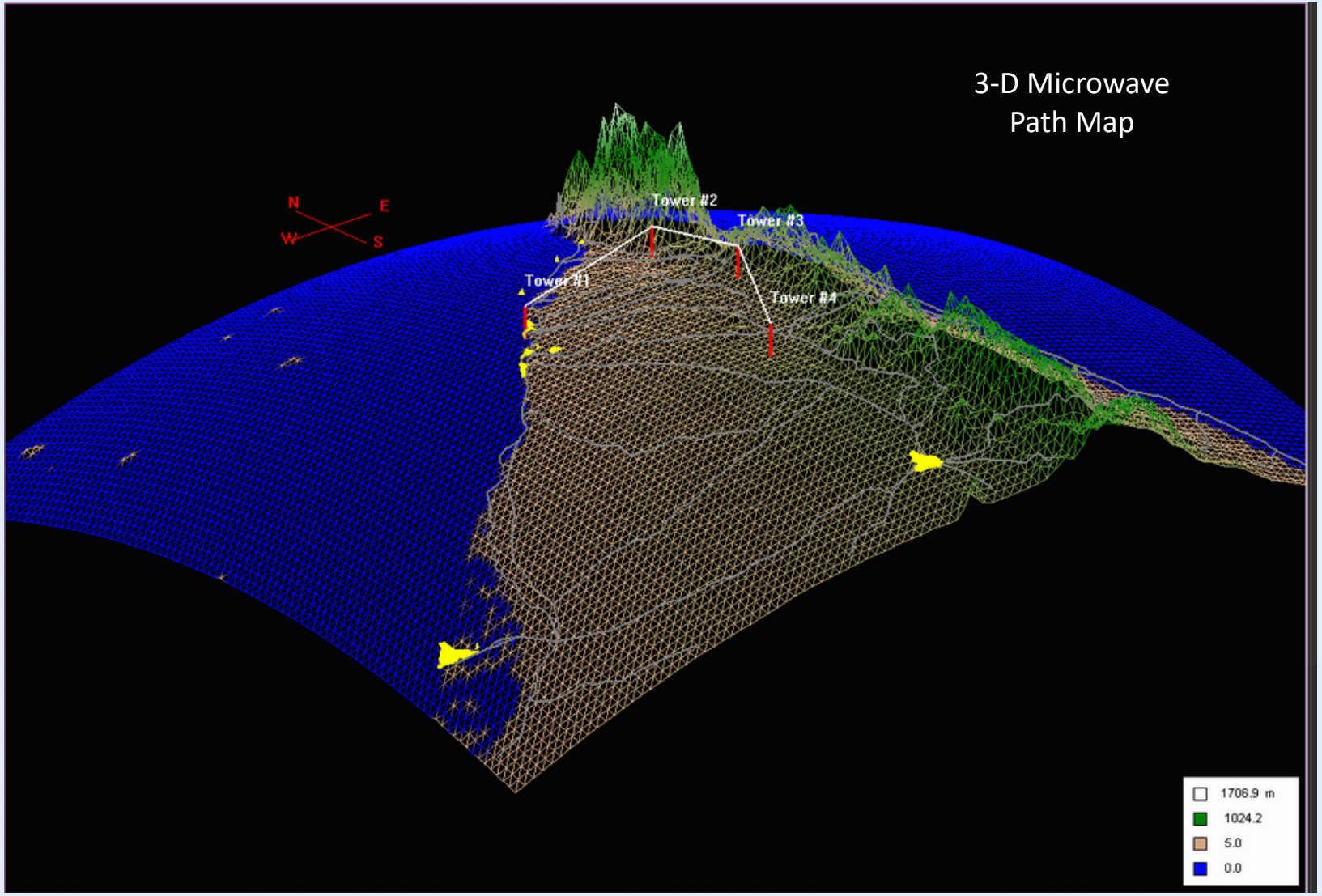
Longley-Rice Coverage VHF repeater

VHF
Latitude: 40-47-31.03 N
Longitude: 072-56-04.34 W
Power: 400.00 W
EIRP Used: 656.00 W
Frequency: 145.21 MHz
AMSL Height: 61.0 m
Elevation: 0.0 m
Horiz. Pattern: Omni
Vert. Pattern: No
Prop Model: Longley/Rice
Climate: Cont temperate
Conductivity: 0.0050
Dielec Const: 15.0
Refractivity: 311.0
Receiver Ht AG: 1.5 m
Receiver Gain: 0 dB
Time Variability: 50.0%
Sit. Variability: 50.0%
ITM Mode: Broadcast
Legend starts at .01 mV/m

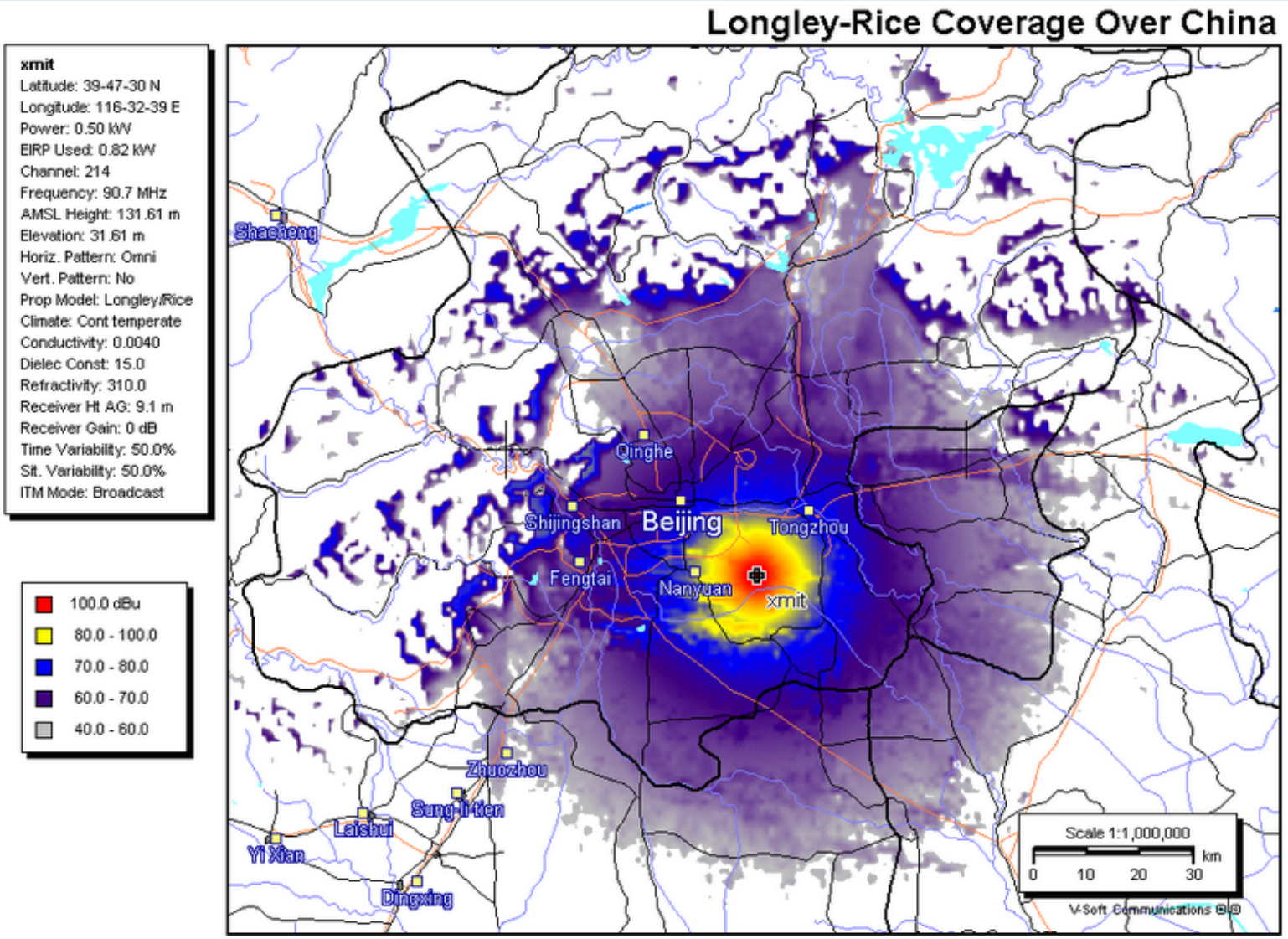
Prepared by:
Doug Vernier, K0DV
Web Address:
WWW.V-Soft.COM

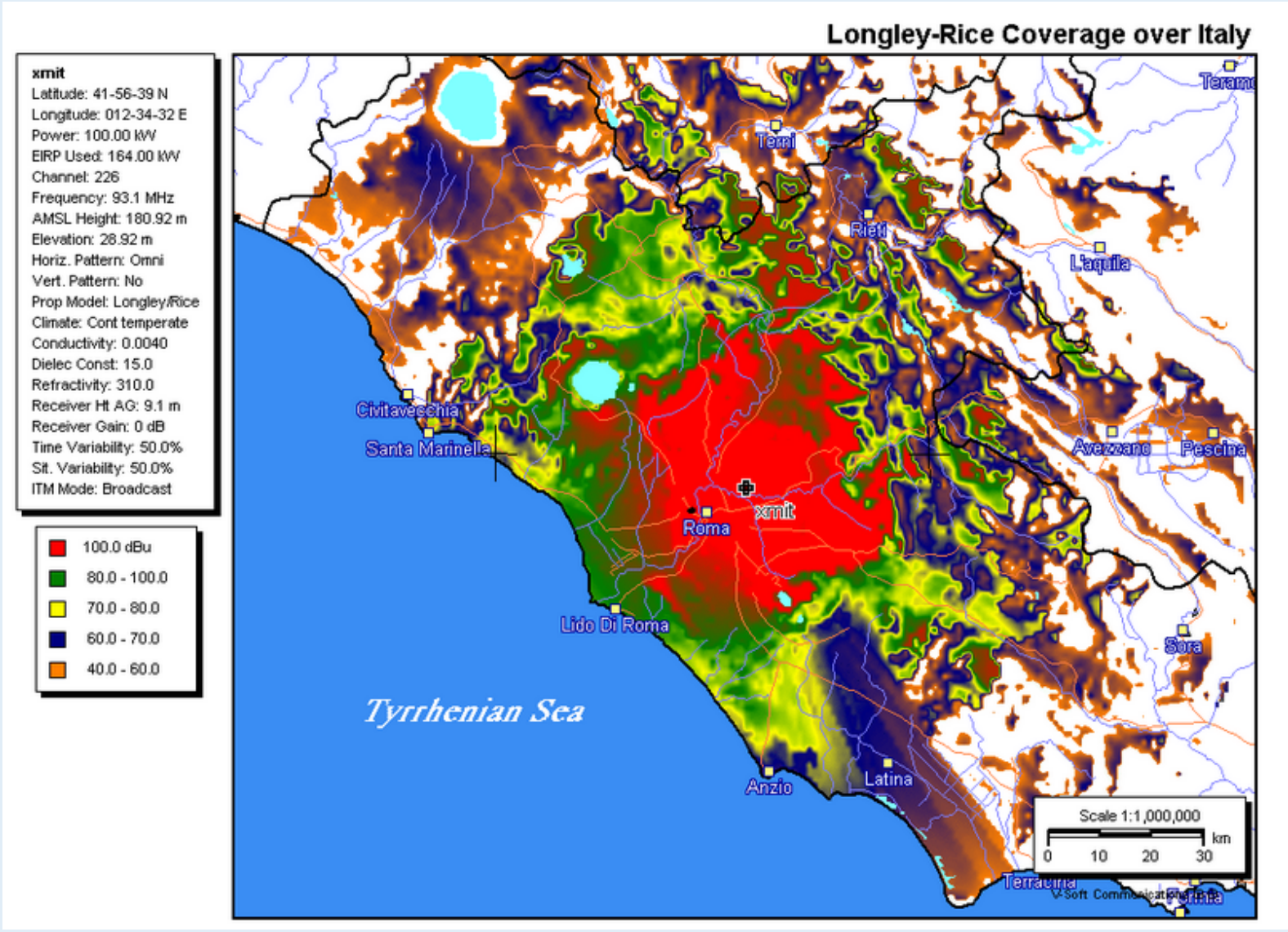



AM Gradient Shading Coverage
WHO (A)
Freq: 1040 kHz
Class: A
Latitude: 41-39-10 N
Longitude: 093-21-01 W
Power: 50 kW
RMS: 471.54 mV/m @1km
Towers: 1
Augs: 0
Doug Vernier
> 25.0 mV/m
5.0 - 25.0
2.5 - 5.0
1.0 - 2.5
0.01 - 1.0
Scale 1:4,000,000
0 50 100 150 km
Mankato
Rochester
Winona
La Crosse
Sioux Falls
Mason City
Madison
Sioux City
Fort Dodge
Waterloo
Dubuque
Rockford
Ames
WHO (A)
Cedar Rapids
Clinton
Iowa City
Des Moines
Davenport
Omaha
Lincoln
Galesburg
Peoria
Quincy
Springfield
Saint Joseph
Leavenworth
Topeka
Kansas City
Columbia


3-D Microwave
Path Map
N
E
W
S
Tower #1
Tower #2
Tower #3
Tower #4
1706.9 m
1024.2
5.0
0.0

Longley-Rice Coverage Over China




Longley-Rice Coverage over Italy
xmit
Latitude: 41-56-39 N
Longitude: 012-34-32 E
Power: 100.00 kW
EIRP Used: 164.00 kW
Channel: 226
Frequency: 93.1 MHz
AMSL Height: 180.92 m
Elevation: 28.92 m
Horiz. Pattern: Omni
Vert. Pattern: No
Prop Model: Longley/Rice
Climate: Cont temperate
Conductivity: 0.0040
Dielec Const: 15.0
Refractivity: 310.0
Receiver Ht AG: 9.1 m
Receiver Gain: 0 dB
Time Variability: 50.0%
Sit. Variability: 50.0%
ITM Mode: Broadcast
100.0 dBu
80.0 - 100.0
70.0 - 80.0
60.0 - 70.0
40.0 - 60.0
Tyrrhenian Sea
Civitavecchia
Santa Marinella
Roma
xmit
Lido Di Roma
Anzio
Latina
Terracina
Terni
Rieti
L'aquila
Avezzano
Pescina
Sora
Scale 1:1,000,000
km
0
10
20
30

Thank you

Visualizing Radio Propagation

Doug Vernier

Broadcaster's Clinic

2022