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All About Contours

The use of Contours in Frequency Coordination

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Coordination Methods

- Manual records of licenses and testing to be sure there is no interference
- Computer database for license records and fixed distance between base stations
- Computer database for license records and a propagation model to predict interference

History of R6602 Contours

- R6602 refers to the FCC Report that established interference protections in the TV Broadcast Service
- The docket was approved in 1966 and used curves printed on graph paper to estimate signal strengths for TV stations at various distances and antenna heights. This was before computers were in wide use and digital terrain databases were available
- The curves date back to the early 1950's. They were developed from measurements of different paths of TV Stations mainly in the east coast areas of the US

History of R6406 (Carey) Contours

- This Report by Roger B. Carey (an FCC engineer) established propagation curves, similar to the R6602 curves
- These curves were used for interference protection in the Domestic Public Land Mobile Radio Service (DPLMR)
- The R6602 TV curves used a 10-meter RX antenna height and the DPLMR used a 2-meter RX antenna height. This resulted in a 9 dB correction factor
- Based on radio bandwidth and noise figure for the 1950 era radios the Report determined the low band, VHF and UHF signal levels needed for 90% service reliability

R6406 Service Reliability

- From the report, minimum field strength for service:

Band	F for 90% Reliability
35 - 44 Mc/s	31 dBu
152 - 162 Mc/s	37 dBu
450 - 460 Mc/s	39 dBu

Interference Field Strength Levels

Band	Frequencies	Service Contour	Interference Contour	Adjacent Channel Deratings, if applicable
VHF Low Band	30-50 MHz	31 dBµ F(50,50)	13 dBµ F(50,10)	
VHF High Band	150-174 MHz	37 dBµ F(50,50)	19 dBµ F(50,10)	44 dBµ F(50,10) 7.5 kHz adjacent channel*
UHF	450-512 MHz	39 dBµ F(50,50)	21 dBµ F(50,10)	
	700 and 800	40 dBµ F(50,50)	22 dBµ F(50,10)	
	800 NPSPAC	40 dBµ F(50,50)	5 dBµ F(50,10) co-channel	25 dBµ F(50,10) 12.5 kHz adjacent channel

Pro and Cons of R6602 Contours

Pros:

1. Fast easy to generate
2. In most cases gives a conservative result vs. interference potential
3. Easy to understand results (curves overlap or they don't)

Cons:

1. In most cases provides too much protection and therefore is inefficient in reusing frequencies
2. Results in many requests for LOC that should not be needed
3. In some cases, does not show potential interference cases

How are the contours constructed?

- The calculation of service and interference contours shall be performed using generally accepted engineering practices and standards, including appropriate derating factors, agreed to by a consensus of all certified frequency coordinators. Frequency coordinators shall make this information available to the Commission upon request. (90.187 (d)(1)(ii)(B)
- First the antenna HAAT is calculated for each radial direction. From this the signal strength is looked up for the appropriate service or interference curves based on the TX ERP normalized to 1kW. Linear interpellation is used to connect the radials that are calculated. Note there is a 9dB derating of the TV R6602 curves due to use of 10 M RX height for TV and 2 M Rx height for LMR

What about terrain?

- The antenna height is calculated based on the average terrain between 3 and 16 kM
- Any terrain obstruction beyond 16 kM is not factored into the calculation.
- Also, the R6602 assumed a 50-foot average terrain roughness factor
- Any antenna HAAT less than 30 meters is changed to 30 meters

Contour Examples

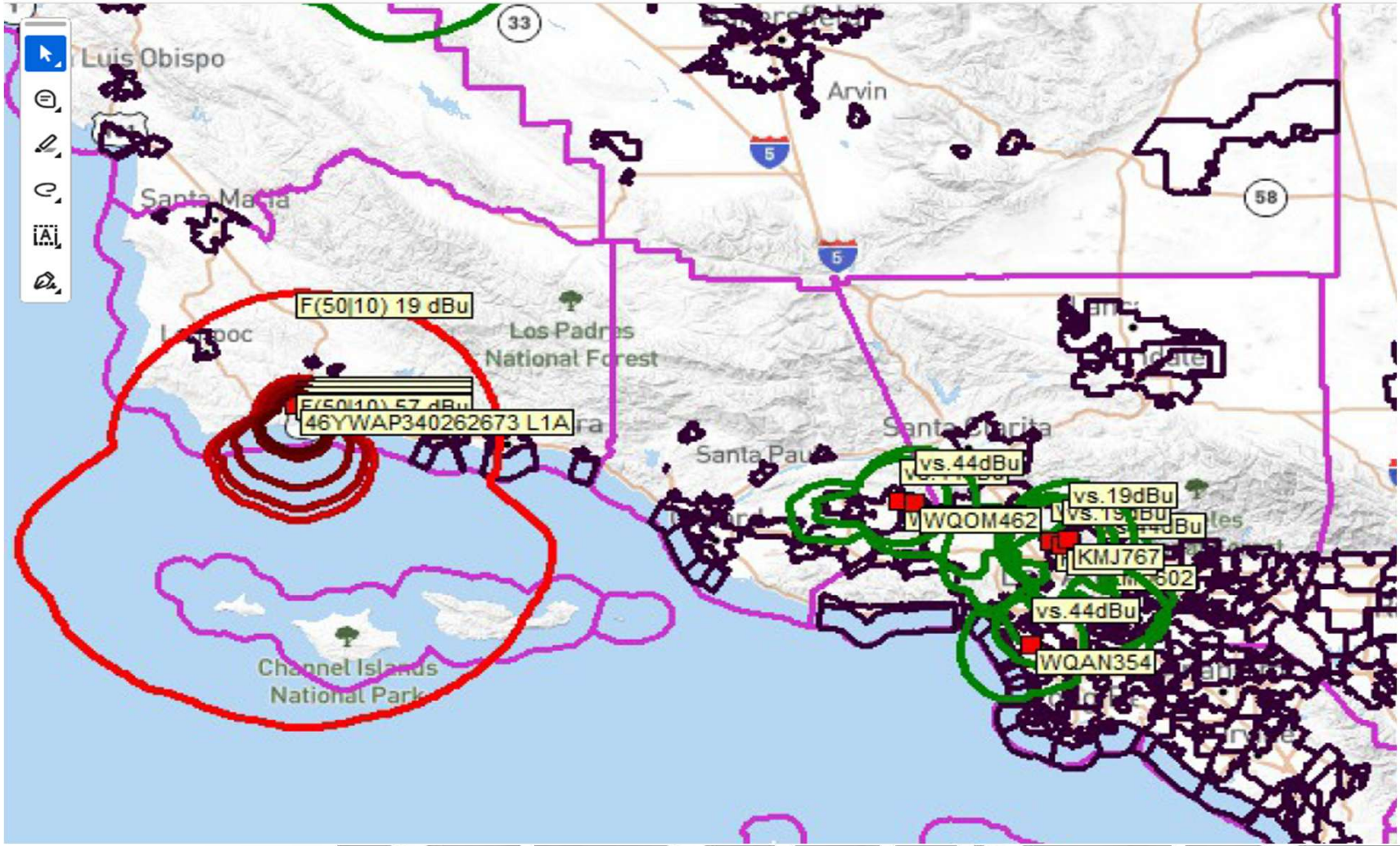
- The next slides will show examples based on different terrain types
- The contours will be compared to a contour based on a Longley/Rice Matrix Study
- All contours will be based on F50/10 interference

Derated Contours

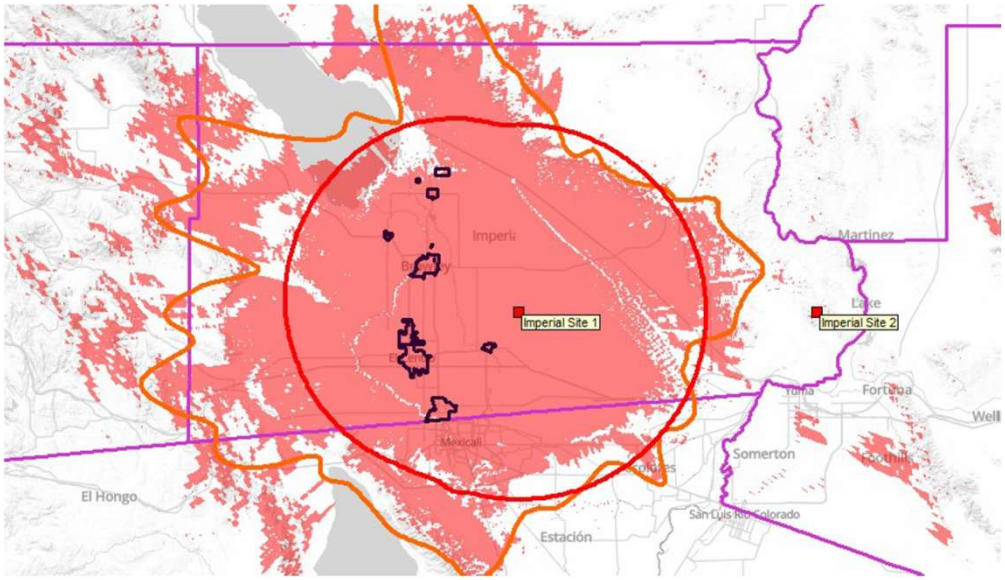
- With narrow banding of the bands plus new digital modulations, there came a need to consider the adjacent channels in most bands.
- The coordinators decided on using derated contours.
- The derated tables are roughly tied to TSB-88 Table A values.

Partial Derating Table

Adjacent Channel Derated Interference Contour Values							
If	the narrowband the values	proposed (7k, F(50,10) are:	operation 8k, interfering	is or contour	any 11k),		
					7.5 kHz	12.5 kHz	
Incumbent			type against a	6.25 adjacent (as above)	adjacent (as above)	adjacent (as above)	15 kHz adjacent (as above)
						coordination	coordination
4K00	(NXDN)			49	57	not required	not required
7K60	(DMR	2/TDMA)		36	42	coordination not required	coordination not required
8K10/8K30	(P25 NXDN)	and	wide	41	48	coordination not required	coordination not required
11K0-11K3	(analog) lines emissions same 7K60, etc.	with for on frequency, i.e., 8K10,	other digital the 4K00, 8K30,	41	48	coordination not required	coordination not required

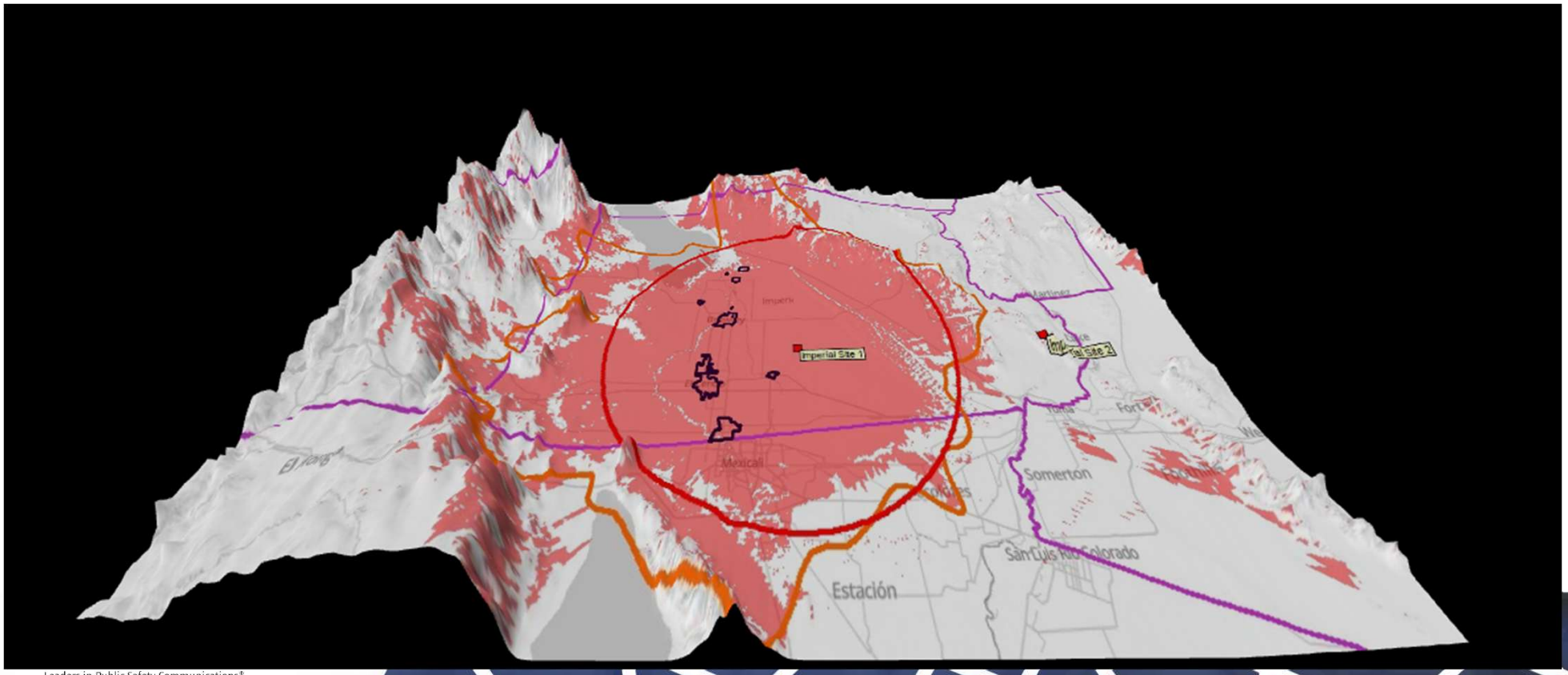

Luis Obispo
Arvin
Santa Maria
Los Padres
National Forest
F(50|10) 19 dBu
46YWAP340262673 L1A
Santa Paula
vs.44dBu
vs.19dBu
WQOM462
KMJ767
vs.44dBu
WQAN354
Channel Islands
National Park
33
5
58

Flat Terrain Contour

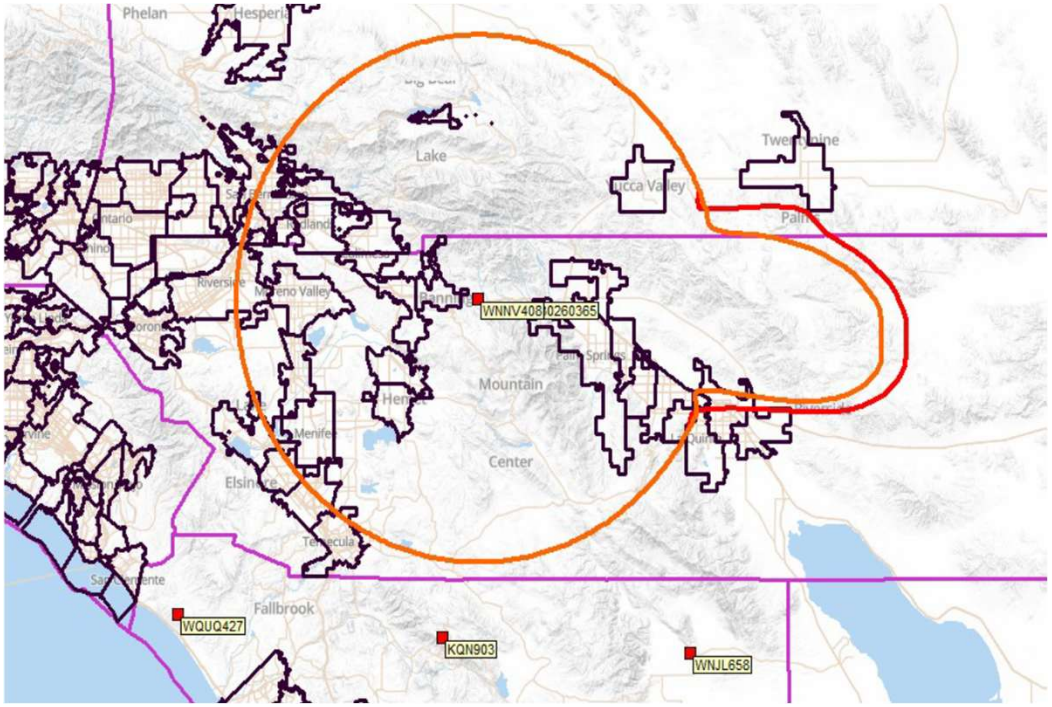


Red is standard R6602 interference contour of 19 dBu
Orange is a contour to fit a Longley/Rice Study 50/50 19dBu and contour settings of 90% and 100 % distance.
Background red is the 19dBu or greater signal levels from the L/R predictions

Flat Terrain 3D view

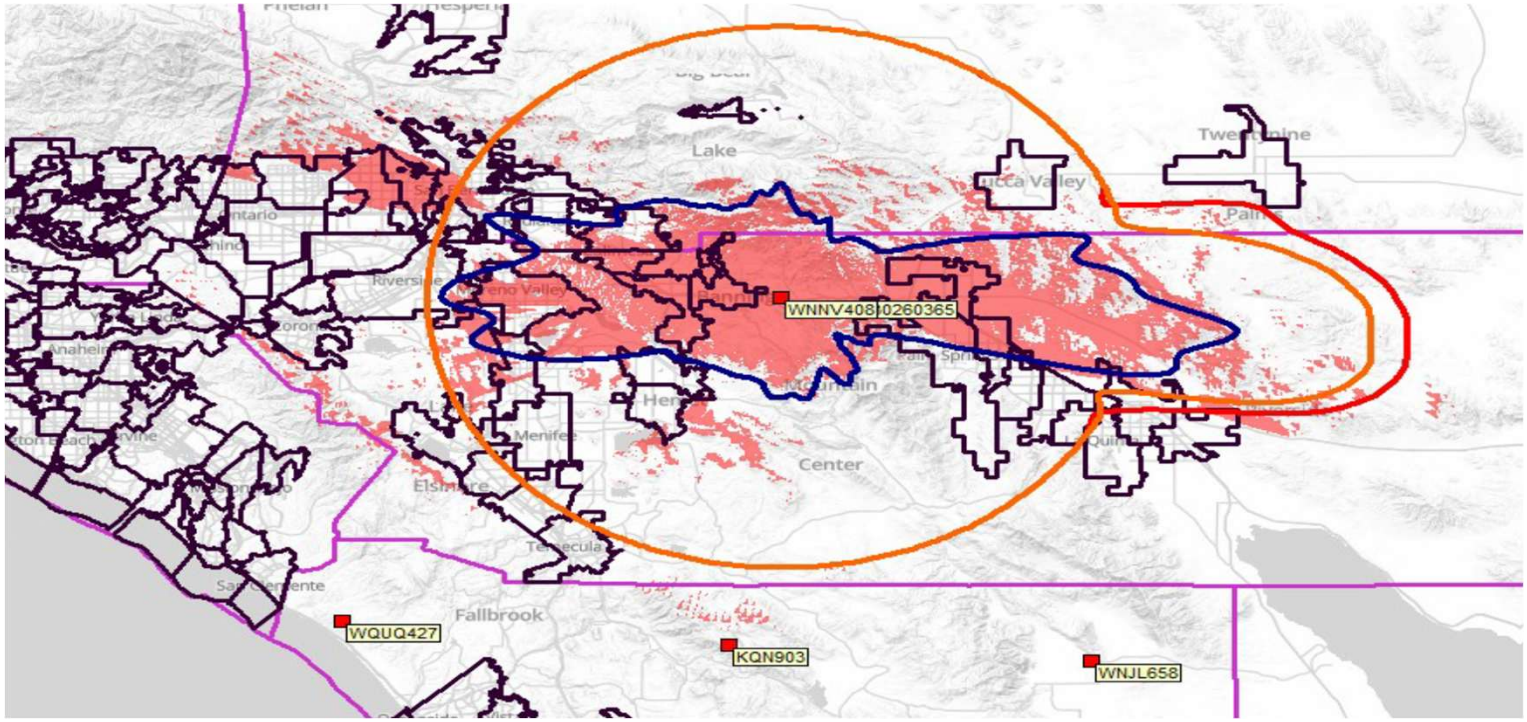


Impact of negative HAAT

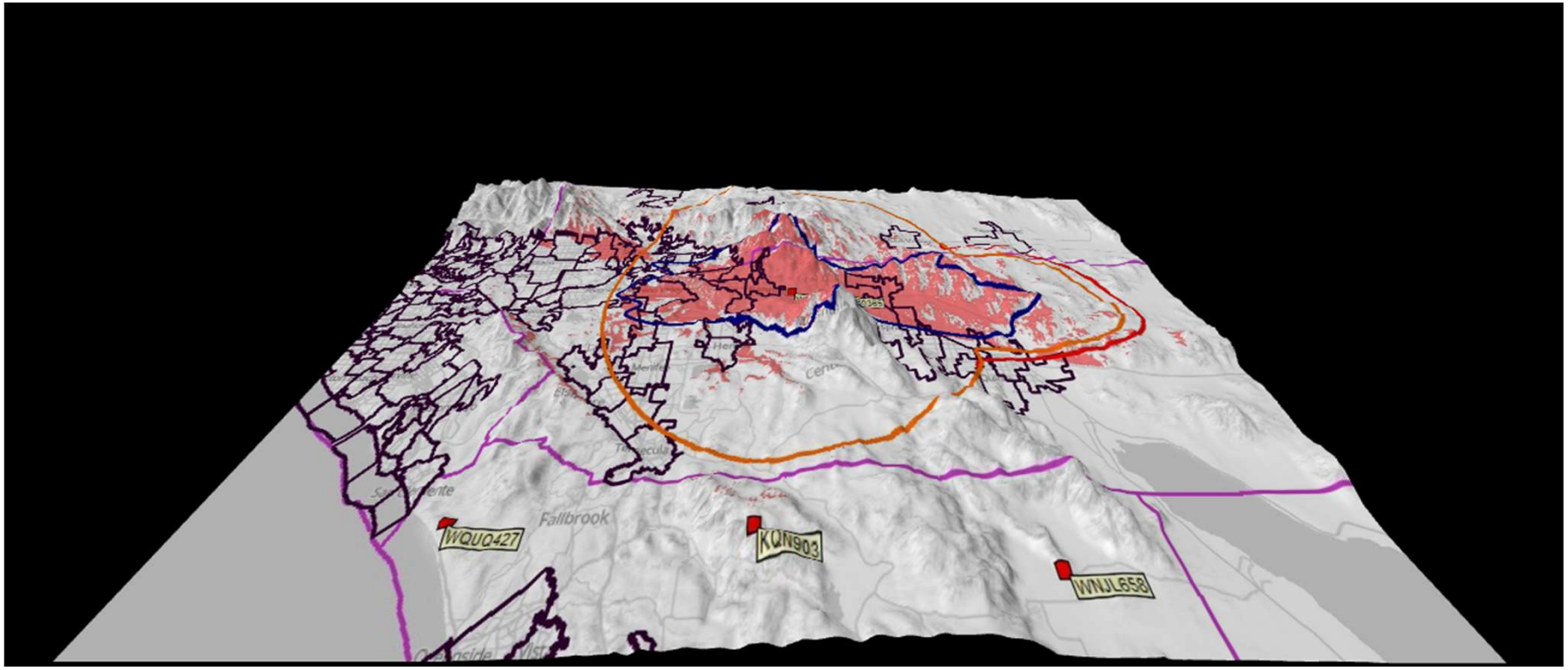


These contours show what happens when negative HAAT is changed to 30 meters for calculation. Both locations are within 1 second of each other. The red contour has antenna height of 102 M and the orange contour is 40M both have a negative HAAT

Riverside County contours and L/R matrix+cov-to-con

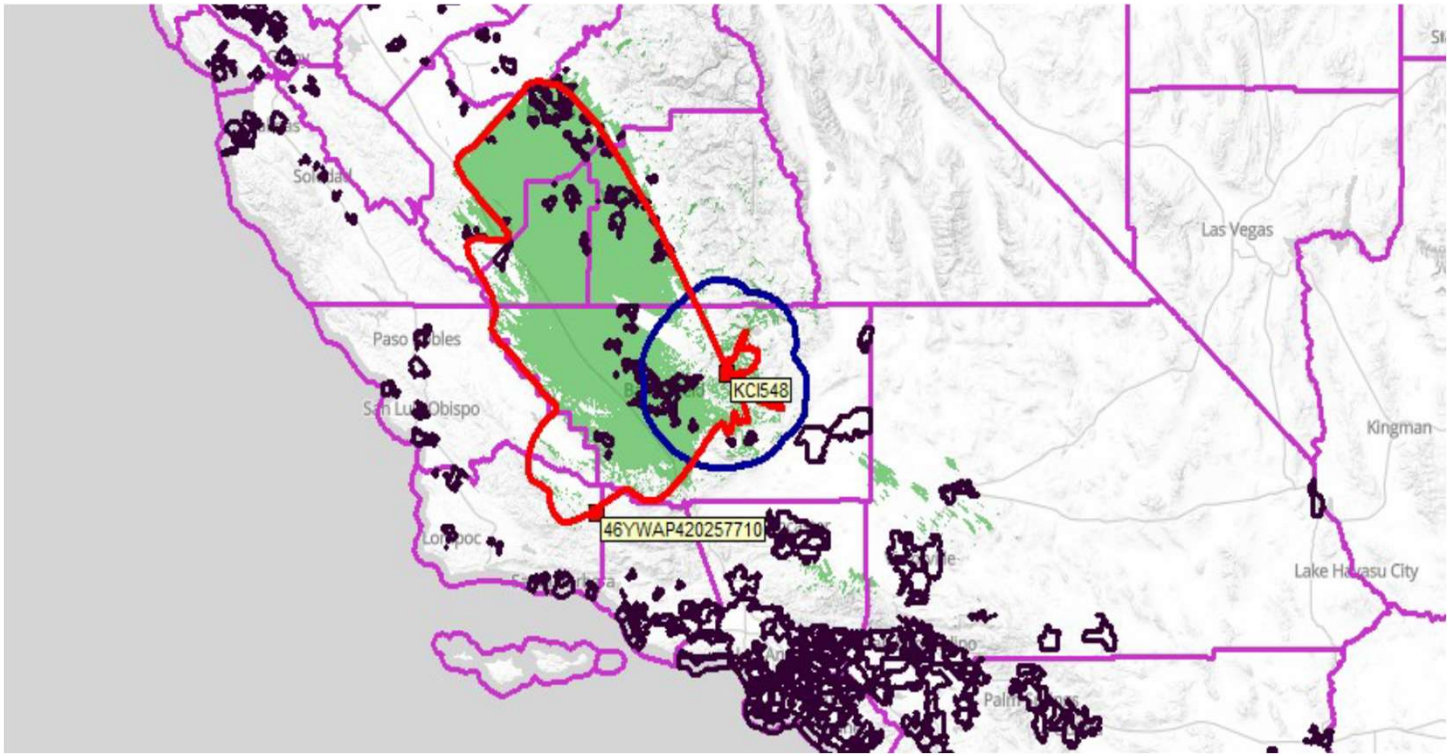


Riverside County 3D view

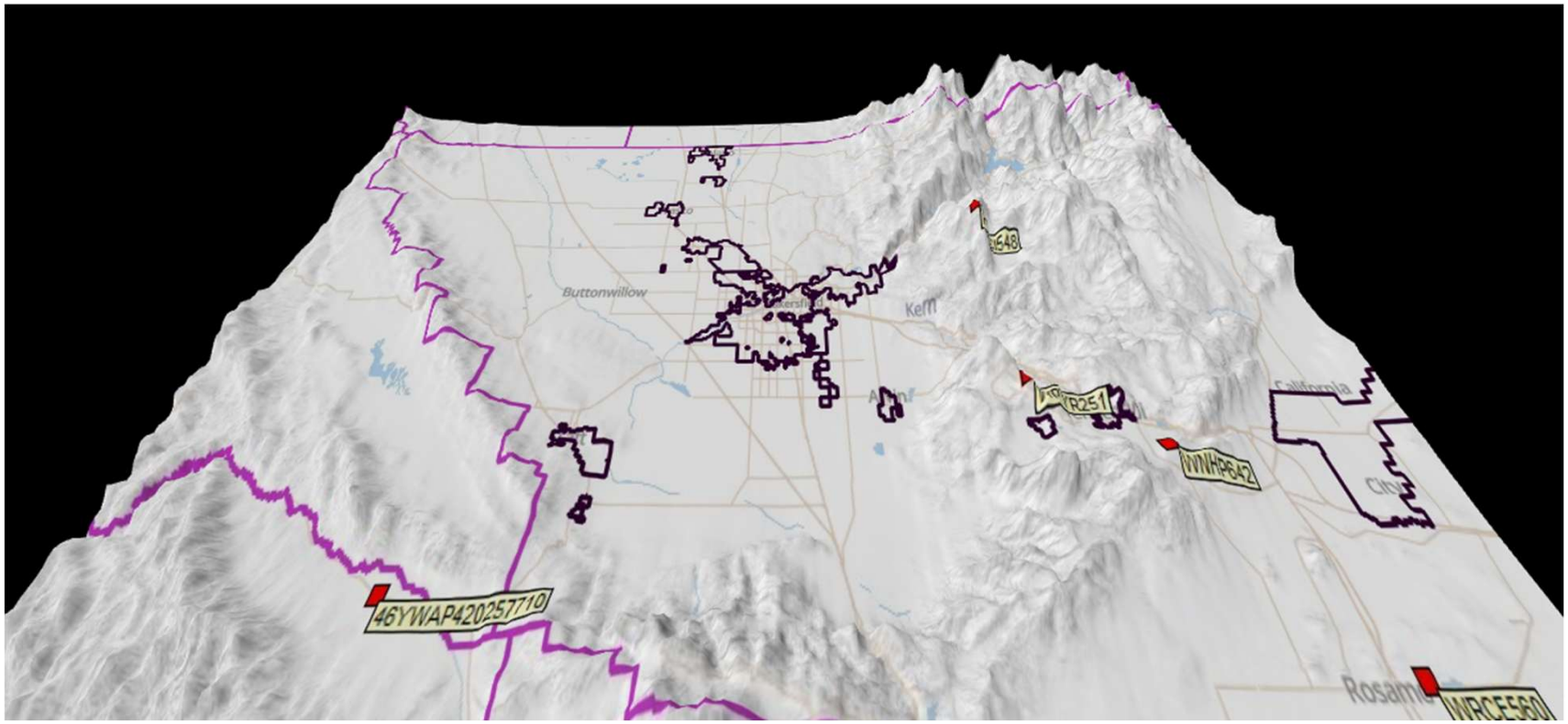


Case where contours fail to show interference

Blue is the coverage contour and Red shows the coverage to contour fit



3D Map view



Different Coordination Cases

- FB8 –Centralized Trunking VHF and UHF
  - There cannot be any Contour overlap or touching of contours. See 90.187
- 800 MHz – Interstitial Channels – Complex derating contours apply. Under Subpart S – 90.621 (B)(5) is LOC requirements – 90.621 (d) s 12.5 adjacent channel derating
  - Co-channel short spacing uses DHAAT table down to 88 km

Different Coordination Cases

- 800 DHAAT incumbent changing and there is a DHAAT short spaced licensee
- 47 CFR 90.621(b)(6)
- A station located closer than the distances provided in this section to a co-channel station that was authorized as short-spaced under paragraph (b)(4) of this section shall be permitted to modify its facilities as long as the station does not extend its 22 dBu contour beyond its maximum 22 dBu contour (i.e., the 22 dBu contour calculated using the station's maximum power and antenna height at its original location) in the direction of the short-spaced station.