[Many of the links in my original comments are broken. In this version I have updated the links and/or added links to the local copies I kept. JM]

Analysis of Tom Taormina's Antenna Documents

Jed Margolin
Virginia City Highlands

The documents were downloaded from http://vch-nv.us/VCHtowers.html.

vch-nv.us is a domain registered to Jim Poston, the VCH Webmaster and moderator of the Yahoo discussion group. The files are no longer there so I have changed the links to the copies that I saved.]

First, here are direct links to the documents:

Documentation on towers in the Virginia City Highlands

Information provided by Tom Taormina

Cover Letter for Building Permit Application
dated August 13, 2008 (2 pgs)
(from Fred Hopengarten, attorney, to Dean Haymore, Storey County Building Director)

Supplemental Information for an Amateur Radio Facility Accompanying Applications for Building Permits
dated August 12, 2008 (80 pgs)
(prepared by Brian M. McMahon, attorney)

Needs Analysis for Height of Amateur Radio Antenna Support Structures
undated (38 pgs)
(prepared by R. Dean Straw, former Senior Assistant Technical Editor, American Radio Relay League)

Attachment to Building Permit Application, Amateur Radio Antenna Support Structures
dated August 13, 2008 (17 pgs)
(submitted by Tom Taormina, Applicant)

For more information, contact: Tom Taormina

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1. The above documents are in a PDF format that allows you to cut and paste text if you need to quote from them.

2. I suggest you download the documents for local reference.

My Comments

1. Very, very few hams have an antenna farm as large as Tom's. Most hams would be very happy if they had a single 45' tower.

2. In Mr. Straw's ***Needs Analysis for Height of Amateur Radio Antenna Support Structures*** he justifies the need for the towers based on providing reliable communications with Asia and Europe. The ARRL publication ***Antenna Height and Communications Effectiveness*** that he mentions (and which he co-wrote) is available at: http://www2.arrl.org/FandES/field/regulations/local/antplnr.pdf

[Now at: http://www.arrl.org/files/file/antplnr.pdf For a local copy click here.]

Not surprisingly, it says that higher is better. (But it doesn't say that more towers are better.)

From page 3:

> This report considers amateur radio antenna systems on proposed supporting structures that have already received permits but which are presently under a stop-work order. The studies presented consider antenna heights to compute standard reliability criteria for communications on the 80 and 40-meter Amateur Radio bands for:
>
> 1. A height of 195 feet for the 80-meter band (3.5 to 4.0 MHz) to Asia and Europe
> 2. A height of 45 feet, for the 80-meter band (3.5 to 4.0 MHz) to Asia and Europe
> 3. A height of 140 feet for the 40-meter band (7.0 to 7.3 MHz) to Asia and Europe
> 4. A height of 45 feet for the 40-meter band (7.0 to 7.3 MHz) to Asia and Europe
>
> Mr. Taormina has specified that the purpose of High Frequency (1.8 to 30 MHz) antenna systems is intended to serve to provide effective communications with Europe, Asia and North America. These three geographic areas are the most highly populated areas for Amateur Radio operators. North America, basically Canada, the USA and Mexico, is located relatively close to Nevada, while Asia and Europe are far more distant, requiring higher antennas for reliable communications.

and from page 10:

> 80 METERS (3.7 MHZ) TO ASIA
>
> What then are the actual effects of using these antennas, in terms of the reliability of signal coverage into Asia?
>
> Fig 3 shows the REL (reliability) contours generated by VOAAREA using the high 195 and 70-foot pair of 3-element Yagis pointed towards Asia at 1000 UTC in November. The 57% reliability contour just manages to cover all of Japan plus Korea. Again, this means that on four days out of seven communications are possible with the eastern part of Asia from Reno, NV, using a large antenna array. Coverage further west into mainland China with Beijing or Hong Kong is just out of range.

What possible kind of emergency could Storey County have that would require direct communications between the County and either Europe or Asia?

The assumptions underlying this need are:

1. Communications with the rest of North America is no longer possible.

2. There has been a catastrophe, everyone else is dead, and there is no one to operate the satellite networks or the undersea fiberoptic cables linking the continents.

3. Europe and Asia have escaped the catastrophe that has befallen all of North America (except for Storey County).

What kind of emergency aid does Tom think Europe and Asia will be able and willing to provide to Storey County?

The only emergency I can think of is that Tom and his friends need to contact more stations in Europe and Asia so they can win the Contests they are so passionate about participating in.

3. In Mr. Straw's ***Needs Analysis for Height of Amateur Radio Antenna Support Structures*** he lists his qualifications. They are, indeed, impressive. See Page 4: Resume of the Author.

However, he also says:

> Straw retired in March 2008, and has been devoting his time primarily to the technical analysis of propagation and antenna phenomena, while indulging also in his passion for traveling and operating ham-radio contests around the world. He has been licensed as a Radio Amateur for 49 years, holding an Amateur Extra, the highest class, license since 1969.

{Emphasis added}

Also, from Mr. Straw's resume, from page 4 is:

> Straw also edited a number of books in his 15-year tenure at ARRL, including:
>
> 1. Three editions of The ARRL Handbook
> 2. Four volumes of The ARRL Antenna Compendium series
> 3. ON4UN's Low-Band DXing (two editions)
> 4. Low-Profile Amateur Radio
> **5. The ARRL DXCC Handbook**
> 6. Antenna Zoning
> 7. DXing on the Edge—the Thrill of 160 Meters
> 8. Basic Radio
> 9. Basic Antennas
> 10. He was co-author of Simple and Fun Antennas for Hams.
> 11. He has authored dozens of technical articles for the ARRL monthly magazine, QST.

{Emphasis added}

From the ARRL page for the DXCC Handbook http://www.arrl.org/catalog/?item=9884
[Now at http://www.arrl.org/shop/The-ARRL-DXCC-Handbook]

> **The ARRL DXCC Handbook**
> -- --by Jim Kearman, KR1S
> **The Thrill of Working DX!**
>
> **DX** in ham radio shorthand means ***distance***, literally talking to people in distant lands. Many radio amateurs enjoy the lure of DXing--seeing how far away we can communicate with other Amateur Radio operators. It's a way of determining how well our stations -- and we, the operators -- perform. DXing is a full-time goal for some hams and a just-for-fun challenge for others. The pinnacle of DXing success is the **ARRL DX Century Club**, or DXCC award.
>
> Author Jim Kearman, KR1S, discovered the thrill of DXing shortly after receiving his General Class ham radio license in 1963. After more than 40 years, the fluttery sounds of radio signals from faraway places still thrill him. In short, he still chases DX because it's great fun!
>
> We hope this book will inspire you to try DXing, and that you'll use it as a guide to beginning your own DX journey.

And, finally, Mr. Straw is hardly an objective expert. He is a past Director (2007-2008) of the Northern California Contest Club. Tom is a current director of that club (2008-2009). See http://www.nccc.cc/officers.html [For a local copy from 2008 click here.]

Perhaps Mr. Straw's passion for contests and DXing (and his association with Tom) has influenced his interpretation of the data regarding the need for Tom's antenna heights.

If this were to go to trial, Mr. Straw would not be allowed to testify as an expert witness due, at least, to his association with Tom.

4. There are a number of charts in Needs Analysis for Height of Amateur Radio Antenna Support Structures that are used to show the need for high towers. These charts were produced using the computer program VOAAREA which is used by the Voice of American to plan their shortwave facilities. http://www.voacap.com/

The Voice of America is a ***Broadcaster***. From: http://www.voanews.com/english/About/

> The Voice of America, which first went on the air in 1942, is a multimedia international broadcasting service funded by the U.S. Government through the Broadcasting Board of Governors. VOA broadcasts more than 1,250 hours of news, information, educational, and cultural programming every week to an estimated worldwide audience of 134 million people.

Although they now also use satellite radio and the Internet, they still also use short wave:
http://www.voanews.com/english/About/Frequenciesatoz_a.cfm

[Try this instead:
http://www.insidevoa.com/search/?btnG.y=0&btnG.x=0&keywords=shortwave&btnG=Search]

1. When you are listening to a broadcast and you miss something, you cannot ask them to repeat it. When you are using person-to-person communications (as with ham radio) you can.

2. Asserting that emergency communications requires the same high quality signal as a Broadcaster (even a short wave Broadcaster) is ludicrous. It's like saying that your cell phone quality must be as good as what you hear on broadcast FM.

On page 6 on the Needs Analysis Mr. Straw states:

> 2. The MAL (Minimum Acceptable Level) is expressed as a percentage of time that communications are available at a specified Signal-to-Noise Ratio (SNR). The SNR value of 40 dB is commonly used in Amateur Radio. It is the minimum required SNR for a Single Sideband (voice) transmission. Single sideband transmissions sometimes require an SNR of up to 50 dB or more, which would further lower the results presented here (ie, this would require a larger/taller antenna system). In other words, in presenting the results here, the assumptions about required Reliability are very modest indeed.

I would like Mr. Straw to cite a reference to back up his statement that the SNR value of 40 dB is commonly used in Amateur Radio.

I have seen references (somewhere) that 40 dB is the SNR for Plain Old Telephone Service (POTS) and, according to the following reference, 20 dB is considered acceptable for communications.

From:
http://publib.boulder.ibm.com/infocenter/tivihelp/v8r1/index.jsp?topic=/com.ibm.netcool_wireless.doc/xF1122641919096.html
In Table 22 of the document: ***Netcool for Wireless User Quality, Version 2.0*** (it appears to be a product sold by IBM for evaluating communications networks) in the section ***Voice Monitor Measurements***, there as an entry:

Minimum signal to noise ratio	The minimum Signal to Noise Ratio (SNR). SNR measures the speech stream's signal strength relative to background noise. The higher the signal to noise ratio, the better the possible listening quality. SNR is measured in decibels (dB). An SNR value of 20 dB can begin to impair conversational quality.

They are saying that conversational quality can begin to be impaired when the SNR drops below 20 dB.

It can also be found in Table 22 of the PDF version of the document [PDF page 94] at:
http://publib.boulder.ibm.com/infocenter/tivihelp/v8r1/topic/com.ibm.netcool_wireless.doc/WUQ_2.0_Monitoring_Guide.pdf

[For a local copy click here.]

The Signal-to-Noise Ratio (SNR) is given in dB, which stands for deci-Bell (1/10 of a Bell). The Bell is a logarithmic unit named in honor of Alexander Graham Bell. For comparing power levels the actual math is dB = 10 * log(p2/p1) . Because this is a logarithmic unit dBs are added (or subtracted) instead of being multiplied (or divided).

Let's give some examples.

Example 1: A 3 dB difference in power is a factor of 2, a 6 dB difference in power is a factor of 4, a 9 dB difference in power is a factor of 8, a 10 dB difference in power is a factor of 10, a 20 dB difference in power is a factor of 100, a 40 dB difference in power is a factor of 10,000.

Example 2: The difference in power between a 100 Watt transmitter and 200 Watt transmitter (twice the power)

is 3 dB. The difference in power between a 200 Watt transmitter and a 400 Watt transmitter (also twice the power) is also 3 dB so that the difference in power between a 100 Watt Transmitter and a 400 Watt transmitter (4 times the power) is 6 dB. The difference in power between a 100 Watt transmitter and a 1000 Watt transmitter (10 times the power) is 10 dB. The difference in power between a 100 Watt transmitter and a 10,000 Watt transmitter (100 times the power) is 20 dB. The difference in power between a 100 Watt transmitter and a 1,000,000 Watt transmitter (10,000 times the power) is 40 dB.

Example 3: The same relationships hold for receiving signals from an antenna even though the power levels of a received signal are very very small. A signal-to-noise ratio of 20 dB requires that the received signal be 100 times stronger than the noise. A signal-to-noise ratio of 40 dB requires that the signal be 10,000 times stronger than the noise. Thus, the difference between a signal-to-noise ratio of 40 dB and a signal-to-noise ratio of 20 dB is 20 dB, which means that a signal-to-noise ratio of 40 dB requires a signal that is 100 times the strength as a signal-to-noise ratio of 20 dB.

Thus, Mr. Straw has exaggerated the amount of signal needed to be received by the antennas (in order to provide reliable communications with Europe and Asia) by a factor of 100.

Even if we say we need a signal-to-noise ratio of 30 dB the amount of signal needed is 1/10 (10 dB lower than) the amount of signal needed for a signal-to-noise of 40 dB.

Example 4: To make dBs more meaningful we will use a stereo system with an amplifier and speakers as an example. The minimum difference in acoustic power that the human ear can discern is 1 dB. (An amplifier producing 10 Watts would have to be cranked up to 12.6 Watts to increase the power by 1 dB.) A 3 dB difference will be noticeable but will not sound twice as loud even though the amplifier has been cranked up to 20 Watts. In order for the human ear to perceive that one sound is twice as loud as another sound it must be approximately 10 dB louder so the amplifier must be cranked up to 100 Watts.

There is also the matter that signal-to-noise ratio is not the only method used to determine the intelligibility of speech. There is the Articulation Index and the newer Speech Intelligibility Index which break the audio spectrum into frequency bands and assign a weighting number to the SNR in each band. See: http://scitation.aip.org/getabs/servlet/GetabsServlet?prog=normal&id=JASMAN000119000005003326000004&idtype=cvips&gifs=yes

And, finally, in stating the signal-to-noise requirements for Tom's communications on "Needs Analysis" on page 12:

> Noise
> The term “Signal-to-Noise Ratio” suggests that there are two quantities compared to each other - a (desired) voice signal and some sort of (undesired) noise. VOAAREA calculates the average noise mainly due to seasonal thunderstorms (whether the lightning crashes are coming from nearby or distant storms, propagating through the ionosphere). VOAAREA adds to that the average level of noise coming from the local environment — perhaps noise pulses coming from arcing high-voltageinsulators, electric fences or an electric trolley running in the street near your receiving antenna.

Instead of a 195' tower perhaps Tom could fix his arcing high-voltage insulators and electric fences, and turn off his electric trolly during emergencies.

5. In Tom's Supplemental Information for an Amateur Radio Facility Accompanying Applications for Building Permit, starting on page 13 **"Height Above Grade Level" Must Be Defined**, he says that since **height above**

grade has not been defined he will, instead, use the FCC's Height Above Average Terrain (HAAT) which admits (on page 15):

> The FCC and FAA have been dealing with the "height above ground" issue for many years. The FCC because they need to determine effective height of FM, VHF-TV or UHF-TV broadcast stations to determine potential interference with stations nearby. The FAA cares about flight safety. Their term for height is "Height Above Average Terrain" (or HAAT). The FCC web site has a calculator used to determine these numbers[8]. Average HAAT (measured at the top of the antenna structure) is an average of the height above mean sea level (AMSL) for 360 degrees of terrain about the precise latitude and longitude of the subject structure, when calculated over a **ten-mile radius of the structure**.

The FCC's use of HAAT is to predict the coverage of **FM and TV broadcast stations** in order to prevent interference to other broadcast stations. The FCC calculator (http://www.fcc.gov/mb/audio/bickel/haat_calculator.html) is not used for AM or Short Wave prediction.

Tom is not a **broadcaster**, and the use of FCC HAAT calculations is not only inappropriate, it is specious.

6. In the Antenna Application (Supplemental Information for an Amateur Radio Facility Accompanying Applications for Building Permits)) on page 8:

> ALL STRUCTURES COMPLY WITH THE STOREY COUNTY CODE
>
> THE PROPOSED ANTENNA SYSTEM MAY BE PERMITTED AS A MATTER OF RIGHT
>
> Amateur radio is a permitted use in all districts of the County because amateur radio cannot be forbidden. "State and local regulation of a station antenna structure must not preclude amateur service communications." 47 C.F.R. §97.15(b). "A governing body shall not adopt an ordinance, regulation or plan or take any other action that precludes amateur service communications . . . " NRS 278.02085.1.

{Emphasis added}

He selectively quoted NRS 278.02085. Here is what it really says (http://www.leg.state.nv.us/Nrs/NRS-278.html)

NRS 278.02085 Amateur radio: Limitations on restrictions on amateur service communications; limitations on regulation of station antenna structures; exception.

> 1. A governing body shall not adopt an ordinance, regulation or plan or take any other action that precludes amateur service communications or that in any other manner does not conform to the provisions of 47 C.F.R. § 97.15 and the limited preemption entitled "Amateur Radio Preemption, 101 F.C.C. 2d 952 (1985)" as issued by the Federal Communications Commission.
>
> 2. If a governing body adopts an ordinance, regulation or plan or takes any other action that regulates the placement, screening or height of a station antenna structure based on health, safety or aesthetic considerations, the ordinance, regulation, plan or action must:
>
> (a) Reasonably accommodate amateur service communications; and
>
> (b) Constitute the minimum level of regulation practicable to carry out the legitimate purpose of the governing body.

3. The provisions of this section do not apply to any district organized pursuant to federal, state or local law for the purpose of historic or architectural preservation.

4. Any ordinance, regulation or plan adopted by or other action taken by a governing body in violation of the provisions of this section is void.

5. As used in this section:
(a) “Amateur radio services” has the meaning ascribed to it in 47 C.F.R. § 97.3.
(b) “Amateur service communications” means communications carried out by one or more of the amateur radio services.
(c) “Amateur station” has the meaning ascribed to it in 47 C.F.R. § 97.3.
(d) “Station antenna structure” means the antenna that serves an amateur station, including such appurtenances and other structures as may be necessary to support, stabilize, raise, lower or otherwise adjust the antenna.

(Added to NRS by 2001, 596)

{Emphasis added}

Here is what 47 C.F.R. § 97.15 says (http://edocket.access.gpo.gov/cfr_2002/octqtr/47cfr97.15.htm):

[Code of Federal Regulations]
[Title 47, Volume 5]
[Revised as of October 1, 2002]
From the U.S. Government Printing Office via GPO Access
[CITE: 47CFR97.15]

[Page 568-569]

TITLE 47--TELECOMMUNICATION

COMMISSION (CONTINUED)

PART 97--AMATEUR RADIO SERVICE--Table of Contents

Subpart A--General Provisions

Sec. 97.15 Station antenna structures.

(a) Owners of certain antenna structures more than 60.96 meters (200 feet) above ground level at the site or located near or at a public use airport must notify the Federal Aviation Administration and register with the Commission as required by part 17 of this chapter.

(b) Except as otherwise provided herein, a station antenna structure may be erected at heights and dimensions sufficient to accommodate amateur service communications. (State and local regulation of a station antenna structure must not preclude amateur service communications. Rather, it must reasonably accommodate such communications and must constitute the minimum practicable regulation to accomplish the state or local authority's legitimate purpose.

[[Page 569]]

See PRB-1, 101 FCC 2d 952 (1985) for details.)

[64 FR 53242, Oct. 1, 1999]

{Emphasis added}

Here is the "Amateur Radio Preemption, 101 F.C.C. 2d 952 (1985)" as issued by the Federal Communications Commission. http://www2.arrl.org/FandES/field/regulations/local/prb-1.html

[Now at http://www.arrl.org/prb-1 . For a local copy of 101 F.C.C. 2d 952 (1985) click here.]

This is the important part:

> 25. Because amateur station communications are only as effective as the antennas employed, antenna height restrictions directly affect the effectiveness of amateur communications. Some amateur antenna configurations require more substantial installations than others if they are to provide the amateur operator with the communications that he/she desires to engage in. For example, an antenna array for international amateur communications will differ from an antenna used to contact other amateur operators at shorter distances. We will not, however, specify any particular height limitation below which a local government may not regulate, nor will we suggest the precise language that must be contained in local ordinances, such as mechanisms for special exceptions, variances, or conditional use permits. Nevertheless, local regulations which involve placement, screening, or height of antennas based on health, safety, or aesthetic considerations must be crafted to accommodate reasonably amateur communications, and to represent the minimum practicable regulation to accomplish the local authority's legitimate purpose. \fn 6/

It doesn't say that Tom can do whatever he wants. It does say that local regulations cannot prohibit ham antennas but that local regulations are permissible which involve placement, screening, or height of antennas based on health, safety, or aesthetic considerations as long as they are crafted to accommodate reasonably amateur communications, and to represent the minimum practicable regulation to accomplish the local authority's legitimate purpose.

It will come down to, "What is the local authority's legitimate interest?"

Is it aesthetics? How many towers can you have (and how high do they have to be) before they become an outright eyesore?

Is it safety? If a tower falls down totally intact, will it (or the guy wires, if it is guyed) cross the property line?

The theory is, "If you want to kill yourself, ok, but you can't take your neighbor with you." Note that towers don't generally fall down intact. They can collapse into a relatively small area or they can probably separate into pieces that can be thrown a good distance. (I do not have a reference for the various ways towers can collapse.) When guy wires snap they can go anywhere.

I'm not sure "health" would be a good argument since the RF levels are probably too low to exceed the standards for such things. Indeed, for directional antennas such as horizontally polarized Yagis, the higher they are the less RF energy reaches the ground.

Is it when the neighbors get together and sign a petition?

Storey County has always been a place where people can mostly do as they please, but Tom crossed a threshold when he started putting up a 200' tower despite County Code 17.12.044 which states:

> Radio, television and other communication masts may extend not more than forty-five feet above grade level, provided that the same may be safely erected and maintained at such height in view of surrounding conditions and circumstances. (Ord. 159 § 2(part), 1999)

See Appendix A.

Contesting is a legitimate ham activity but there is the issue that Tom has attempted to mislead the County as to the real purpose of his antennas, and has failed to disclose his relationship with his Expert Witness, Mr. Straw. It's called Inequitable Conduct. That would be enough to shut Tom down completely if the County wanted to do so. (I am not an attorney and this is just my opinion.)

There is also the issue that Mr. Straw has exaggerated the signal-to-noise requirement for emergency communications systems by at least 10 dB (a power of 10) and probably 20 dB (a power of 100).

Here is the advice that the ARRL gives to hams: http://www2.arrl.org/FandES/field/regulations/PRB-1_Pkg/ [Now at http://www.arrl.org/prb-1.]

There may be something useful in it but I have not had the time to go through it.

And, for the record:

1. I have been a licensed ham for 46 years. For the last 30 years I have had an Amateur Extra Class License, the same license held by Tom and Mr. Straw.

2. One of the reasons I moved here was because the house I almost bought (in Sparks) came with CC&Rs that prohibited outdoor antennas of any kind. (see http://www.skyranchnhoa.org)

3. Although I have no plans at all to put up a tower, if I did I would want the option of putting up a 75' tower in order to make sure the antenna clears the trees, but I could live with 45'.

This is WA2VEW (Jed on Empire) signing off for now.
August 21, 2008 [Links revised 2/19/2011]

Appendix A - Storey County code 17.12.044

(http://www.storeycounty.org/CountyCode/detail.asp?id=17.12.044)

Chapter 17.12 GENERAL PROVISIONS

SectionNo(17.12.044)

Height of buildings.

In the R-1, R-2, E, A, PUD, and F zones, no building, manufactured building or manufactured home shall exceed a height of three stories or thirty-five feet, whichever is higher, except as may be allowed by special use permit. The requirements of this section shall not apply to church spires, belfries, cupolas, domes, chimneys or flagpoles. Radio, television and other communication masts may extend not more than forty-five feet above grade level, provided that the same may be safely erected and maintained at such height in view of surrounding conditions and circumstances. (Ord. 159 § 2(part), 1999)

{Emphasis added}

.end