

# AMATEUR RADIO TOWER PROPOSAL

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Rho Epsilon Amateur Radio Club

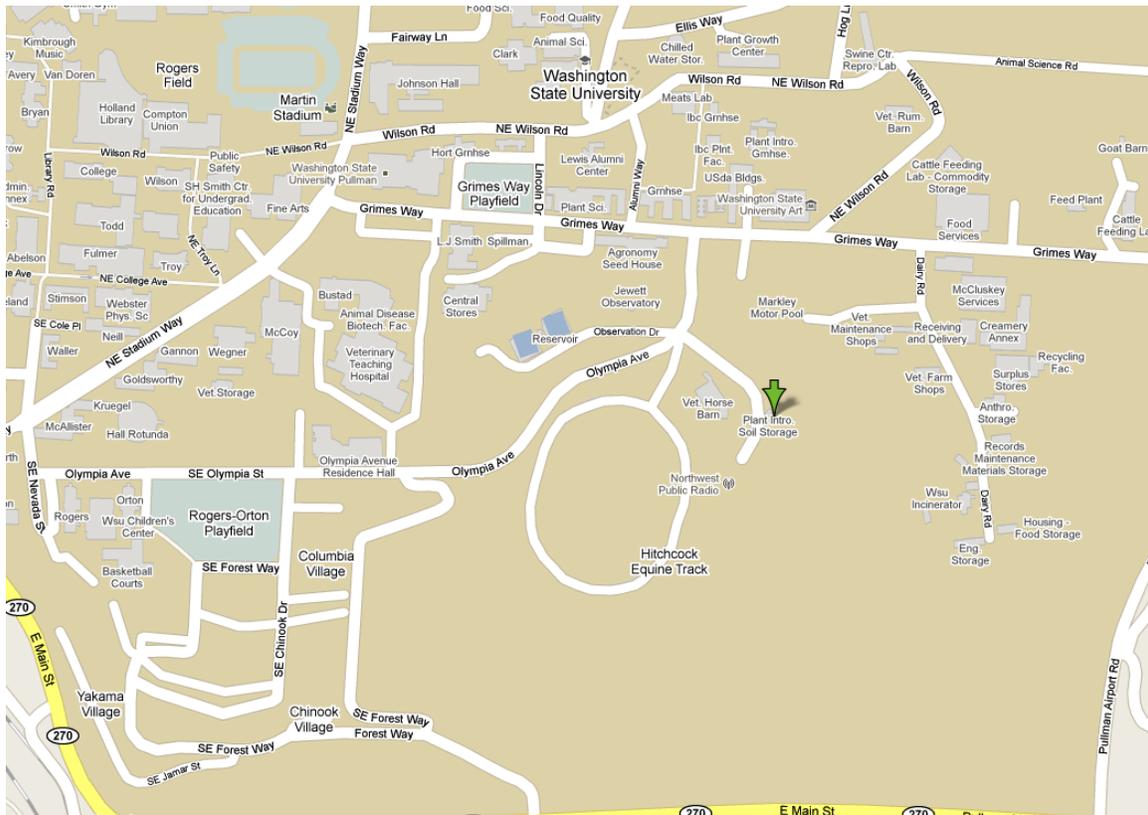
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December 14, 2010

# 1 Executive Summary

This proposal requests the allocation of land and approval to build an amateur (ham) radio station. The proposed location<sup>1</sup> is pictured below in Figure 1. This location is between the USDA building and fields on the hill behind the new steam plant. The station will consist of a tower, antennas, and small box or building for radio and remote control equipment. The station will be owned by the School of Electrical Engineering and Computer Science and operated by the W7YH Amateur Radio club. The goal of the amateur radio station is to further education in radio frequency (RF) engineering and propagation by providing an operational lab for experimenting with HF and VHF radio.



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Figure 1: Map Depicting Proposed Location

<sup>1</sup>The proposed location is: 46° 43' 33.78" N 117° 9' 2.65" W

## 2 Statement of Problem and Goals

RF engineering is an important field in the 21st century. Your mobile phone, WiFi, cable internet, and satellite TV receiver were all designed by RF engineers. RF engineering is thought of by some as a “dark art” – it requires years of study and experience to become proficient. Washington State University currently offers some opportunity for study in the field of RF engineering, but little opportunity for experimentation. Furthermore, the antennas required for HF and VHF radio (RF) are large and infeasible for most student renters to install at home.

The W7YH Amateur Radio Club would like to install a tower and antennas for use by students, faculty, and staff of the university. A very high quality tower and set of antennas was donated to the club January 2010, but the club needs a location and approval to install them. Approval of this project would be consistent with the university’s mission by providing hands-on opportunities for students to learn about radio.

Amateur (ham) radio is well-known for providing communication in times of emergency. HF radio will be a vital communication tool if a disaster damages the communication lines into the region. There is currently no public facility in Whitman County with HF radio capability and high-gain directional antennas. The W7YH Amateur Radio Club plans to offer the capabilities of the tower facility in the event of an emergency, and has received support from Whitman County Emergency Management and WSU Emergency Management to this regard.

The final goal of this project will be to further the heritage of the nation’s oldest collegiate amateur radio club. W7YH Rho Epsilon of Washington State University was the first collegiate amateur radio club, established in 1911 by H.V. Carpenter, Homer Dana and Royal Sloan. Previously, our club had a tower and directional antennas installed on the roof of the CUB. These assets were lost or stolen during the CUB remodel project.

To meet these goals, the W7YH Amateur Radio club requests approval to install our tower, antennas, and radio equipment at a remote site on the WSU Pullman campus. This equipment would be remotely controlled from our office in the EME building.

## 3 Location Requirements

There are several requirements that need to be taken into consideration when selecting a site for an amateur radio tower. Our greatest concern is RF noise. This is the key reason our current location in the EME building is not workable for our HF amateur radio station. Due to the large number of noise sources in the building (which consist mostly of computers, HVAC motors, and florescent lighting) we are not able to hear stations attempting to communicate with us. In order to avoid RF noise, the tower will need to be located in a remote part of campus, away from noise sources. Another consideration is elevation. In order to effectively radiate a signal the tower will need to be in a location above the average terrain height. The final primary consideration is the ability to remotely control the system from our office in EME. Because our other requirements necessitate a location in a remote part of campus it will be difficult for students to travel to the tower. Current simulations show it to be possible to achieve a remote control link to the proposed site. We will be conducting tests early in the spring semester to verify these simulations. Other concerns and considerations include power availability, ease of access (for a construction crane), and FAA approval. Once the site is approved by the university, the site will need to be approved by the FAA.

## 4 Visual Impact



Figure 2: C-31XR 3-band Yagi Antenna

As with any radio tower, the aesthetic impact will be a serious limitation in selecting the feasible locations for its installation. Our tower is a telescoping with a height varying from 21 to 54 feet above ground level. With mast and lightning protection the highest point on the tower will likely be 60 feet above ground level. The engineering drawing in Figure 4 depicts the tower in its fully extended state. The largest antenna on the tower, pictured in Figure 2, will be a 31 foot beam antenna with 14 elements. We also plan to install a 24 foot two element beam, which will fit within the visual footprint of the the larger antenna. There will also be approximately 3 significantly smaller antennas; however these will easily blend in with the tower from a distance. Our antennas will be on an antenna rotor to allow them to be remotely turned for maximal performance. Some may call this installation an eyesore. We will do our best to minimize the visual impact on the WSU campus. Do keep in mind there was previously a similar installation on the roof of the CUB as well as an existing installation on the steam plant at the University of Idaho.

## 5 Site Plan

Our current site plan is pictured in Figure 3. This is a very preliminary plan, and is subject to change as required by the university and building codes. We intend to fence in a 12ft by 12ft area around the tower with one side of the fence running near the existing building. This will provide a 6 ft radius Controlled Area in which the general public will not have access due to risk of RF exposure. We will take measurements to ensure we are not creating an unsafe environment outside of this fenced area. (More details are given in the next section.) The fenced area will be covered with gravel to minimize maintenance requirements. In the center of the fenced area will be a 3 ft 6 in by 3 ft 6 in foundation for the tower. In a previous installation of this tower the foundation was a 7 ft deep rebar reenforced concrete block. Next to the tower there will be an approximately 2 ft 6 in by 2 ft 6 in cement foundation for an equipment shelter. A conduit will be installed from the

USDA building to provide power for the equipment. Appropriate FCC identification signs and RF warning signs will be installed on the fence and tower.

## 6 RF Safety

We will be operating on numerous frequencies at relatively high power levels. However, we do not anticipate the system causing any interference with existing equipment. All transmissions will be made by or under the supervision of FCC licensed operators.

We have also conducted a safety study. Below is a table of the frequencies we are likely to use with probable antenna gain and the projected maximum safe power level with that antenna. In practice, we will likely use around 100W for most transmissions below 900Mhz and 1W for transmissions above.

Frequency (MIN)	Frequency (MAX)	Antenna Gain	Transmitter Power (MAX)
3.5 Mhz	4 Mhz	11.4dBi	1500W
7 Mhz	7.3 Mhz	12.2dBi	1500W
14 Mhz	14.35 Mhz	14.0dBi	900W
21 Mhz	21.45 Mhz	14.3dBi	380W
28 Mhz	29.7 Mhz	15.6dBi	150W
50 Mhz	54 Mhz	18.5dBi	75W
50 Mhz	54 Mhz	9dBi	600W
144 Mhz	148 Mhz	22.1dBi	30W
144 Mhz	148 Mhz	9dBi	600W
219 Mhz	225 Mhz	9dBi	600W
420 Mhz	450 Mhz	9dBi	900W
902 Mhz	928 Mhz	12.5dBi	900W
2390 Mhz	2450 Mhz	24dBi	100W
5650 Mhz	5925 Mhz	24dBi	100W

## 7 Conclusion

Having the Rho Epsilon amateur radio club tower on campus will have a positive impact on Washington State University. We appreciate your consideration of our proposal and are available to answer any of your questions via email at [hamradio@wsu.edu](mailto:hamradio@wsu.edu). Additional details, including engineering drawings of the tower and audio samples demonstrating the RF noise in our current operating location are posted on our website at <http://hamradio.wsu.edu/projects/tower>.

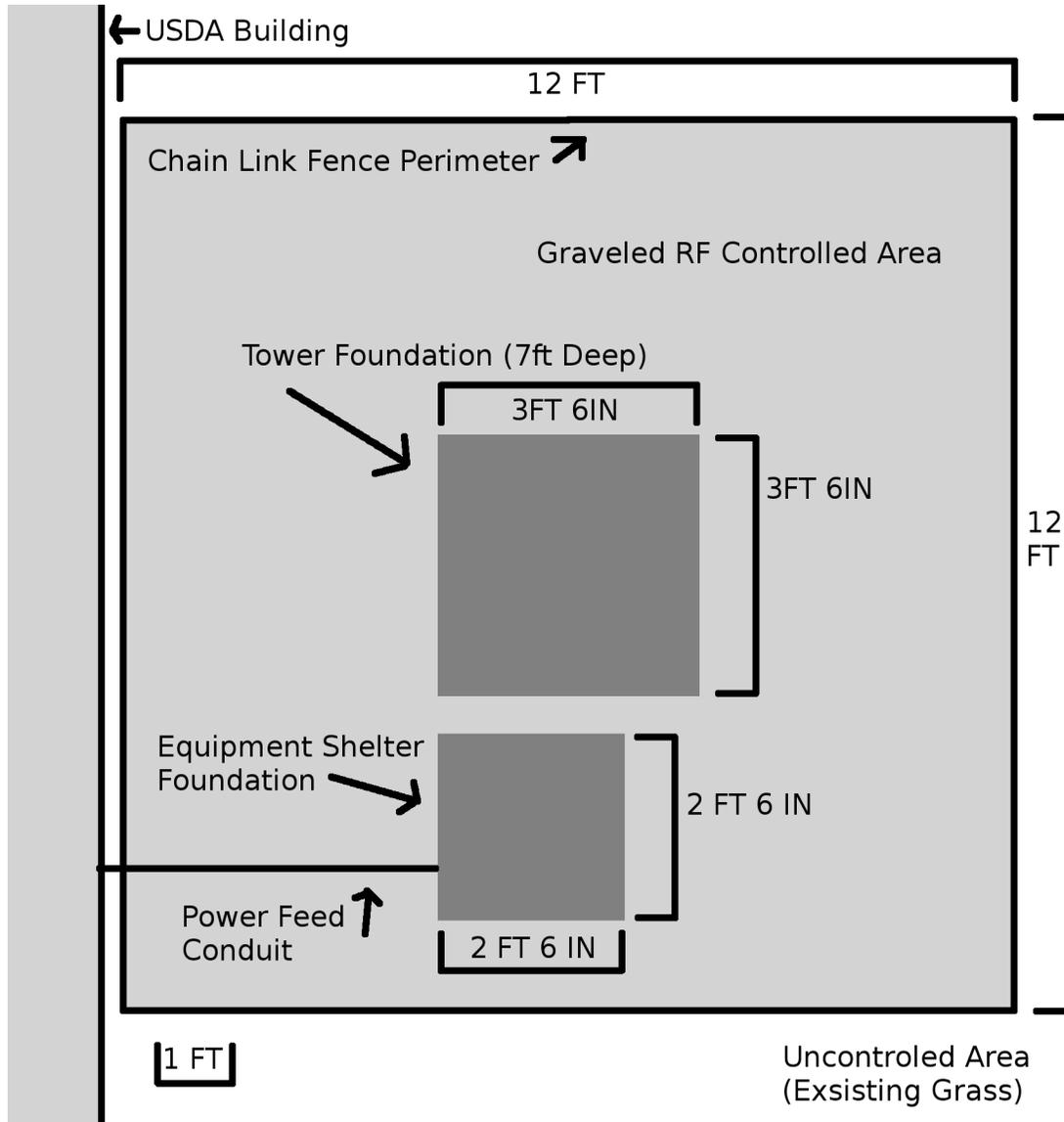


Figure 3: Proposed Site Plan

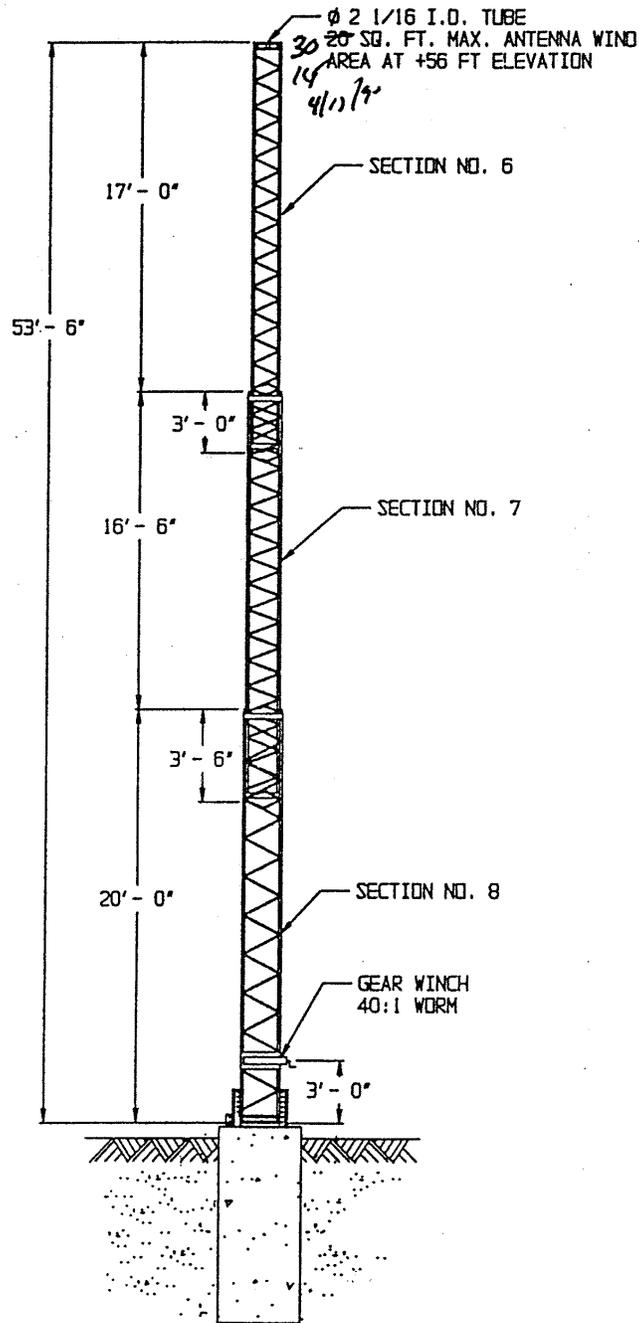


Figure 4: Tower Engineering Drawing