Sky Valley Wireless Communication Facility
ATTACHMENT A

Telecommunications Engineering Supplemental Information for construction of Wireless Communications Facility (WCF) at new Sky Valley Switching Station.

This document discusses SNOPUD Sky Valley Radio Site's; 1) Need for additional radio site and why the proposed utility switching station location fits the District's radio requirements and; 2) Justification for requesting a CUP for 20' over the allowed monopole height of 100'; and 3) Why commercial towers in the area were not chosen for a solution by the District.

The radio frequency propagation plots included are produced using the EDX radio propagation tool utilizing high-resolution terrain and clutter data with tuned radio propagation prediction models. The predictions have an 8dB standard deviation. The interpretations of the plots and data show the need for a radio site and how the location at Sky Valley Switching station will fill the District's requirements.

I will be happy to answer any questions as needed.

Scott Cashmore
Snohomish PUD #1
Telecom Engineer
swcashmore@snopud.com
1) **District Radio Coverage Requirements and Sky Valley Solution**

SNOPUD (Snohomish PUD #1) wishes to improve the Districts radio coverage in Monroe. The District crews use VHF and 900 MHz radio systems for critical utility job functions and electrical grid switching instructions with the Districts Control Center. The depicted area of improvement is well known to the District Telecom department as a weak coverage location for our radio systems, with the construction of the Sky Valley substation in Monroe the District has the perfect opportunity to remedy the radio coverage gap.

**Sky Valley Radio Coverage Requirements**

Plot 1 shows the District 900 MHz radio coverage in the Monroe area from the neighbor sites of TLH (north), CLV (west), IND and PHS (east). The plot depicts the service level of a mobile/radio in the field as it would be from the future 900 MHz network. The District current 900 MHz system does not include PHS or IND; however, these plots show coverage predictions of a system planned for 2024, in addition to the current VHF radio network, the current 900 MHz coverage is actually worse than shown. Both VHF and 900 MHz will be deployed at the Sky Valley. The white-circled area is underserved without the future Sky Valley Radio Site. A significant area in this circle (most of the town of Monroe) shows a radio signal strength of less than -105 dBm which is not strong enough to provide reliable two-way radio service to the District crews. Highway 2 east of Monroe is marginal (see PLOT 2) and the radio
connection is to our (future 900 MHz) site at Index (Deer Valley Flats), which is 18.7 miles away and not a good server for this part of Highway 2.

PLOT 2 - This is a zoomed-in plot showing the unserved area of Moroe and Highway 2 in more detail.
PLOT 3 – Monroe area RF coverage after Sky Valley Radio Site

Sky Valley Location
Plot 3 depicts the area coverage predictions after the construction of Sky Valley WCF. The location is nicely situated in the central area of the coverage objective. It is shielded to the north where less coverage from this location is desired and provides a strong radio signal is the objective area. The coverage attained from this location will resolve the poor signal strength gap and provide a “dominant” server to optimize the District’s radio systems in the Monroe area.

Radio Serving Site Requirement
PLOT 4 is a "Radio Site Server" depiction showing the radio sites that provide coverage to the Monroe area without the Sky Valley Site. The issue here too many radio sites reach the area with similar yet low signal strength. This condition causes the subscriber units constantly switch between radio sites, reducing the performance and quality of the call/reception. Additionally, the future radio network technology (digital simulcast) will be even less tolerate areas with too many servers, too far away, and poor signal levels such as this. The condition will cause low-quality reception, drops in calls, and user dissatisfaction. This lack of strong servier problem is resolved with the proposed Sky Valley radio site.
2) **Sky Valley Radio Coverage per Antenna Height (115', 95', 80', 55') - Request for CUP of 20' exception**

PLOTS 5-8 show radio coverage prediction of the Sky Valley location's service area at four height levels. The plots can be interpreted as "maximize the red/yellow/green and minimize the blue and grey areas." The primary areas of concern are the core portions of Monroe and Highway 2.

PLOT 5 is at 115’ antenna centerline. I have chosen this height because it is the highest possible antenna center with a 120' tower approved (via CUP).

PLOT 6 is at 95’ and is the antenna centerline if a 100’ tower is constructed (allowed for a tower built for colocation).

PLOT 7 is at 80 antenna centerline which depicts the coverage from a 85’ tower (allowed in this zone).

PLOT 8 is at 55’ centerline to show radio coverage from a 60' tower (no FAA needed).

**Tower Height of 120 foot**
A review of plots five and six for 115' and 95' antenna heights show no noticeable change to coverage. Since there is no interesting coverage expansion past the 95' antenna centerline, this is the maximum height required for strictly coverage. The District’s request for a 120' tower is driven by the maximum height needed of 95' for coverage translating to the physical placement of the antennas required.
The District has two radio systems, VHF and 900 MHz; the more critical 900 MHz system is for utility power switching communications with the control center and the VHF system is for crew fieldwork. Both systems will be in use at the new Sky Valley radio site. As planned, the antenna systems require space from 85' to 120' (35') for the two radio systems because both systems use separate receive and transmit antennas, on separate levels, with the receive antenna placed higher, and the transmit antenna placed lower on the structure. VHF antennas are up to 20' long, 900 MHz antennas are about 10' long. Thus, to achieve the expected coverage for both systems, the VHF transmit antenna which is below the receive antenna, should be mounted at 85' (centerline 95'). The receive antenna should be mounted at 105' (115' centerline) because the VHF antennas require mid-length support at 115". A 10' lightning rod is used at the tower top, which should reach at least 5' above the VHF antenna tip (125'); thus, a tower of 120' is requested. The 900 MHz system 10' foot antennas have mounting heights of 115' for Rx and 100' for Tx, which will fit in with the VHF height requirement for the tower of 120'.

Plot seven, the 80' coverage plot, shows the point where service levels from Sky Valley will begin to drop as antenna heights are lowered. The first areas that will be affected are east Highway 2 and the Highway 2 corridor in Monroe. These are both critical areas as our crew travel Highway 2 frequently to reach work locations, and there is a crew office in east Monroe near Highway 2. A tower constructed at 100' (the allowed height in this zone) will place transmitter antenna for VHF at 75' CL (centerline) which is below the height where service levels begin to be affected so the District wishes to construct the 120' as proposed. It should also be noted that a 120' tower with the District equipment from 85' to 120' will provide usable space for future radio service collocations the maximum flexibility to utilize the coverage available from the Sky Valley location.

Plot eight is at 55' antenna centerline. This plot shows that at 55’ the service levels in Monroe and Highway 2 (the VHF transmit antenna CL would be 35') are noticeably reduced due to terrain and obstructions. Also, there is no space for other carriers to use on the tower. The main reason for showing this plot is to note how tower heights affect coverage; However, it is also included because this is about the height that does not need FAA registration. Above this, the proximity of the airport requires the proposed tower to be "marked." Currently, the District is awaiting the FAA Airspace Study to let us know what the markings will be. Most likely it is a form of red or white light common on radio towers and other structures.
PLOT 5 – Sky Valley Radio Coverage at 115’ antenna centerline
PLOT 6 – Sky Valley Radio Coverage at 95’ antenna centerline
PLOT 7 – Sky Valley Radio Coverage at 80’ antenna centerline
PLOT 8 – Sky Valley Radio Coverage at 55’ antenna centerline
3) **Collocation at Existing Radio Sites**

SNOPUD Telecom Department has reviewed locating at the four commercial towers which are currently existing in the Monroe area. All are cellular carrier towers with common issues regarding why the District is not in favor of collocating at these locations. The red circle is the ¼ mile tower radius for excluding new towers.

- **Monroe Crown Tower** - Near the football field at Monroe High School 177th Ave SE.
- **Sprint Tower** - East end of town at 117 S. Ann Street.
- **Monroe Verizon Tower** - North of town at 13224 191st Street.
- **Monroe Cingular (ATT) Tower** - North of town at 13310 191st Street.

The four commercial site locations appear not to have sufficient ground space for the District’s radio equipment shelter. Most commercial radio locations are full and only have space available for outdoor equipment enclosures. The type of radio equipment the District uses is designed for rack mounting inside radio equipment shelters. The shelters also support the system’s DC power and batteries, plus the District’s fiber network terminals for communications used through the electrical grid.

The commercial tower space is cluttered and limited. These tower locations are loaded and best utilized for commercial cellular types of radio service. It is a radio engineering best practice to not mix the type
of antenna equipment the District uses (omnidirectional whip style) on tower elevations mainly used for commercial cellular applications. District radio systems' best practice is to utilize separate tower elevations for the Tx and Rx of the separate services, meaning multiple tower elevations are required. Even though far less equipment (usually just a few antenna) are put on the tower the practice uses up more tower space thus requiring District antennas be located low on existing towers and wasting tower elevations best utilized for cellular types of applications, while substantially increasing the Districts tower lease cost due to the space required.

From a strictly coverage perspective, it might be possible for some commercial locations to fit the primary coverage objectives of the proposed Sky Valley radio site. However, none of the locations are better in any way, especially when considering the antenna heights available to the District.

The Sprint Tower is shorter and loaded, so the available antenna height is low. It has less coverage area, especially in the west end of the objective area.

The Crown Tower is far on the southwest side of the objective area, making the coverage issue along Highway 2 east of town unlikely to be helped or even made worse by providing another server that is not very useful. In other areas, the coverage overlap will be excessive.

The Verizon and ATT towers are at approximately the same location. The Verizon tower appears to have more ground and tower space so it will be addressed. Of the commercial towers, this is the best choice. The primary coverage issue here is too much coverage overlap to the north and west. For new digital simulcast radio systems, excessive coverage overlap is detrimental to the radio network's quality. In some cases, this issue can be mitigated by using sector designs and fine-tuning of the antenna pattern however, this increases the cost and complexity of the radio site by at least a factor of three over the Districts typical radio installation cost while only providing the same usable service area as the Sky Valley location can provide. Thus, the Verizon location is not a practical option for the Sky Valley coverage objective.

Additionally, the Sky Valley location is far more economically viable to the District verses any commercial location. The District is developing the Sky Valley location for a utility switching substation, which means adding a radio tower to the project is very cost-effective. There is very little additional site preparation or development cost when rolled into the utility project. The other radio site cost is primarily building and tower. Also, the district site rent at a commercial tower is currently at least $60,000 per year and rises incrementally (this is what the District is currently paying at similar commercial locations). This is a direct expense item to the District. Locating a needed new radio site at an available District location is prudent management of our ratepayers investments.

Summary
This “Appendix A” engineering evaluation documents the District needs radio coverage improvement for the Monroe area due to low signal levels and lack of a dominant radio server. The proposed project of building a 120' Wireless Communications Facility at the new Sky Valley switching station is shown to resolve the radio service level issues. The evaluation addresses the need for no taller than 120' tower structure and shows that less than 120' tower structure will negatively impact the new radio site coverage and ability to be used for collocation by other radio carriers. Lastly, sufficient radio service-
affecting, and economic, reasons are discussed for not using the existing three commercial tower locations in the area.

It is hoped that this “Appendix A”, along with the comments provided in “Monroe Zoning Chapter 22.62 Large Wireless Communication Facilities Review” document, are sufficient to justify approval of the Sky Valley WCF and 20’ tower height exception CUP.

Sincerely,
Scott Cashmore
Snohomish PUD #1
Telecom Engineer"