CITY OF
SUMNER
WASHINGTON

REQUEST FOR QUALIFICATIONS FOR PROFESSIONAL SERVICES

FOR

WATER MAST RADIO TOWER

JULY 16, 2025

CITY OF SUMNER
REQUEST FOR PROPOSALS FOR PROFESSIONAL SERVICES
FOR MAST RADIO TOWER DESIGN SERVICES

The City of Sumner solicits interest from consulting firms with expertise in engineering design services related to the mast radio tower. Services are anticipated to be completed within the 2025 and 2026 calendar years.

The City of Sumner reserves the right to retain the services of responsive firm(s) for subsequent phases associated with this work.

The City of Sumner reserves the right to amend the terms of this "Request for Proposal" (RFP), to circulate various addenda, or to withdraw the RFP at any time, regardless of how much time and effort consultants have spent on their responses.

Prospective consultants will be held to Federal EEO requirements for federally funded projects and to the ADA and Civil Rights language adopted by the City of Sumner.

Project Description

The City of Sumner invites proposals from qualified firms to provide design services for a new radio communication tower at the Central Well site, located at 1729 Steele Ave, Sumner, WA 98390. The project aims to enhance and ensure reliable communication across all municipal water and sewer system sites.

The scope of work includes, but is not limited to:

1. Develop a complete design for a radio tower that will support communication across all water facilities operated by the City.
2. The design must align with all applicable standards and support the technical specifications outlined in **Exhibit A – Radio Study**. The tower must be structurally and technologically capable of achieving clear and dependable connectivity among all water and sewer sites.
3. Ensure the radio tower is fully designed and permitted for construction in accordance with City requirements and standards.

Evaluation Criteria

Submittals will be evaluated and ranked based on the following criteria:

1) Qualification of the proposed project manager and key staff members.
2) Qualifications/expertise of the firm with Radio Tower infrastructure; experience with projects of similar complexity and function.
3) Consultant's approach to the City's project as demonstrated in a description of their approach to the work.
4) Familiarity with City standards, relevant codes, and City planning requirements;
5) Demonstrated ability of the Consultant to perform high quality work, control costs, meet schedules, prepare documentation, and ensure project commitments are met; and
6) Relevant and demonstrated experience on similar projects.

Selection Procedure

After the deadline for acceptance of proposals, the Submittal's will be reviewed and evaluated by an Evaluation Committee comprised of, but not limited to, City staff, appointed or elected officials, and individuals chosen by Public Works staff to participate. The Evaluation Committee will rate written proposals based on the evaluation criteria listed above.

The City may choose to interview the top firms as ranked by the Evaluation Committee. Information from the interviews along with feedback from references will be incorporated into the final rankings.

If a contract cannot be negotiated with the top ranked firm, the City will contact the next firm in line and attempt to negotiate with that firm. The process will be repeated until an agreement is reached.

Format

The Proposal should describe the composition of the proposed team, the qualifications of the key individuals identified on that team, and the relevant experience of the team on similar projects. Respondents may include subconsultants within their project team.

The Consultant's Proposal should include the following information:

a) The proposal should be accompanied by a brief introductory letter stating your firm's interest in the project.
b) Provide resumes of no more than three (3) key members of the proposed project team inclusive of key subconsultant who will work on this project.
c) List projects of similar complexity and magnitude undertaken and completed in the past ten (10) years and provide references and a phone number for each reference.
d) Reference projects should list the involvement of proposed project team members for whom resumes have been submitted.
e) Please include a statement of assurance that listed team members, including those of subconsultants, will not be replaced without prior approval of the City.
f) A detailed breakdown of the proposed fee for design.

The Proposal should consist of no more than ten (10) pages. The cover letter, front and back covers, and section dividers will not be counted in the ten (10) page limit.

Submittal Deadline:

Please submit an electronic version of your Statement of Qualifications in a single .pdf document by email or other electronic means drewm@sumnerwa.gov no later than no later than **1:00 p.m. on August 14th, 2025**. Hard copy submittals are not required. Any proposal received after the specified date and time may be rejected and may not receive any further consideration by the

City. Postmarks will not be accepted. All questions regarding this solicitation should be directed to Drew McCarty, Assistant Engineering Manager at (253) 299-5719 or drewm@sumnerwa.gov.

Americans with Disabilities Act (ADA) Information

The City of Sumner in accordance with Section 504 of the Rehabilitation Act (Section 504) and the Americans with Disabilities Act (ADA), commits to nondiscrimination on the basis of disability, in all of its programs and activities. This material can be made available in an alternate format by emailing the Contact person or by calling collect 253-299-5700.

Title VI Statement

The City of Sumner in accordance with Title VI of the Civil Rights Act of 1964, 78 Stat. 252, 42 U.S.C. 2000d to 2000d-4 and Title 49, Code of Federal Regulations, Department of Transportation, subtitle A, Office of the Secretary, Part 21, nondiscrimination in federally assisted programs of the Department of Transportation issued pursuant to such Act, hereby notifies all bidders that it will affirmatively ensure that in any contract entered into pursuant to this advertisement, disadvantaged business enterprises as defined at 49 CFR Part 26 will be afforded full opportunity to submit bids in response to this invitation and will not be discriminated against on the grounds of race, color, national origin, or sex in consideration for an award.

Federal Emergency Management Agency Assurances

Agencies shall read and document that they will comply with the assurances and certifications contained in FEMA Form 20-16A, Assurances – Non-construction Programs; FEMA Form 2016B, Assurances-Construction Programs; FEMA Form 20-16C, Certifications Regarding Lobbying; Debarment, Suspension, and Other Responsibility Matters; and Drug-Free Workplace Requirements; SF LLL, Disclosure of Lobbying Activities (If applicable). Agencies shall further agree that they will include the clause title "Certification Regarding Debarment, Suspension, Ineligibility and Voluntary Exclusion-Lower Tier Covered Transaction," provided by the FEMA Regional Office, without modification, in all lower tier covered transactions and in all solicitations for lower tier covered transactions. (Refer to 44 CFR Part 17.)

Dates of Publication:
Courier Herald: July 16th, 2025
Seattle Daily Journal of Commerce: July 16th, 2025

EXHIBIT A

Central Well

Old Shop

West Well

New Shop Facility

Derringer Well

North Tank

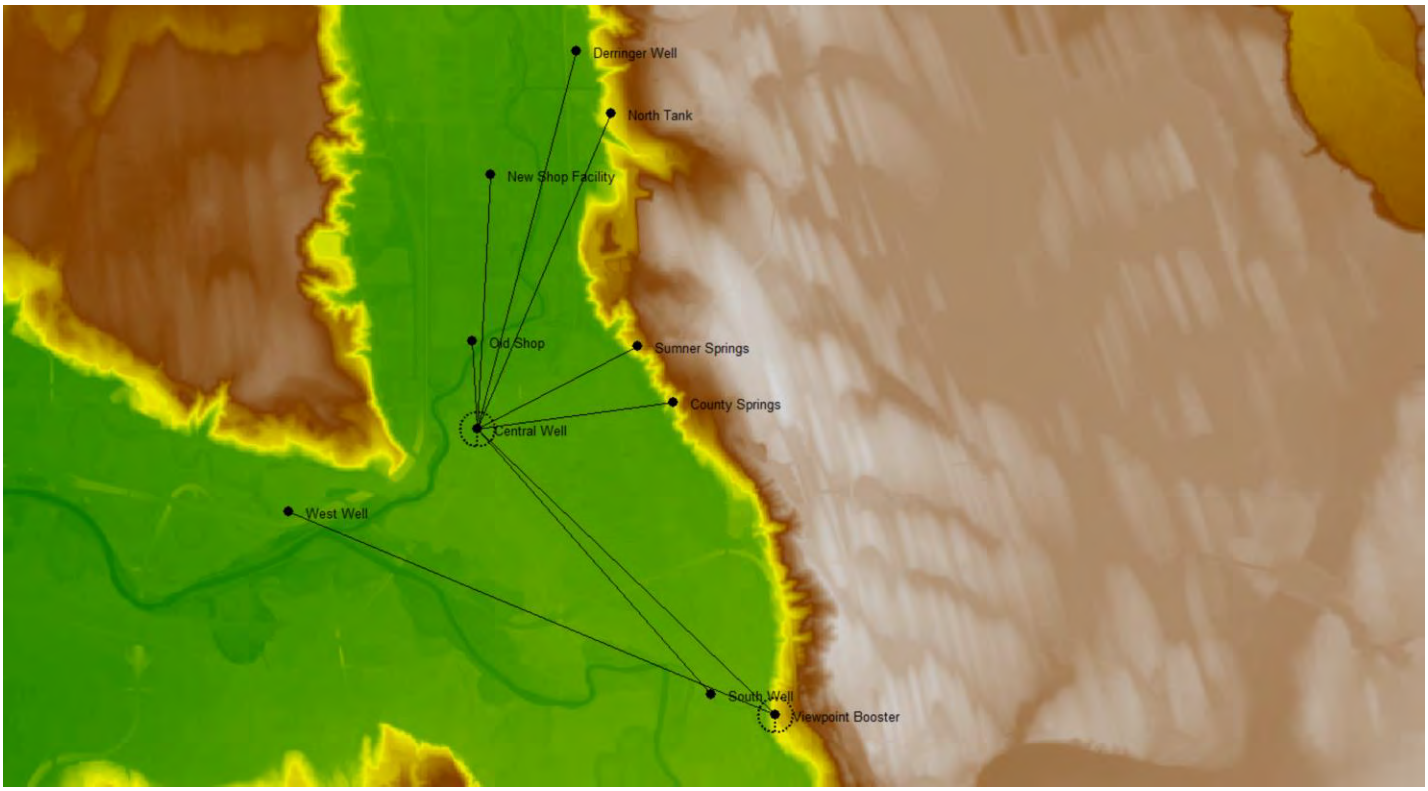
County Springs

Viewpoint Booster

South Well

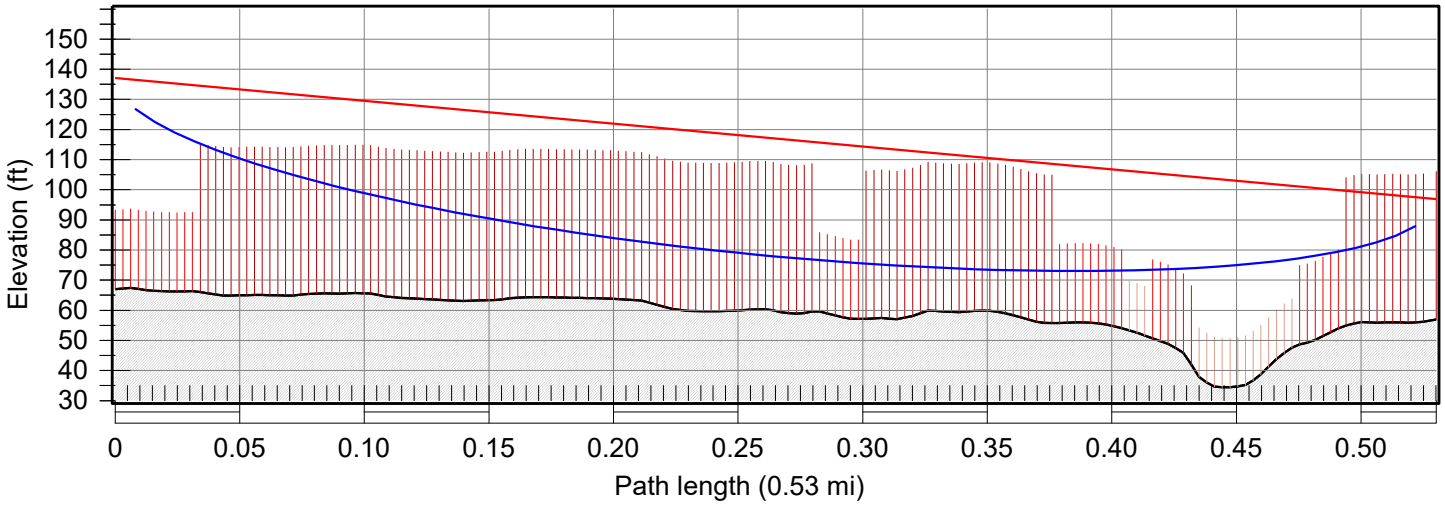
Sumner Springs

Radio Planning Report
City Of Summer



Disclaimer

Propagation models are statistically derived for customer-supplied locations. GE MDS makes no claims of location accuracy. Coverage areas contain unpredictable elements that can negatively affect predicted signal levels including buildings, vegetation, interference, and weather effects. Predictions must be verified by on-site surveys. Customer assumes all performance risks if radios are installed based only on feasibility studies. GE MDS reserves the right to change product specifications or study assumptions without notice or obligation."



Central Well	
Latitude	47 12 31.35 N
Longitude	122 14 23.43 W
Azimuth	356.76°
Elevation	67 ft ASL
Antenna CL	70.0 ft AGL

Frequency (MHz) = 450.0
K = 1.33
%F1 = 100.00

Old Shop	
Latitude	47 12 58.93 N
Longitude	122 14 25.72 W
Azimuth	176.76°
Elevation	57 ft ASL
Antenna CL	40.0 ft AGL

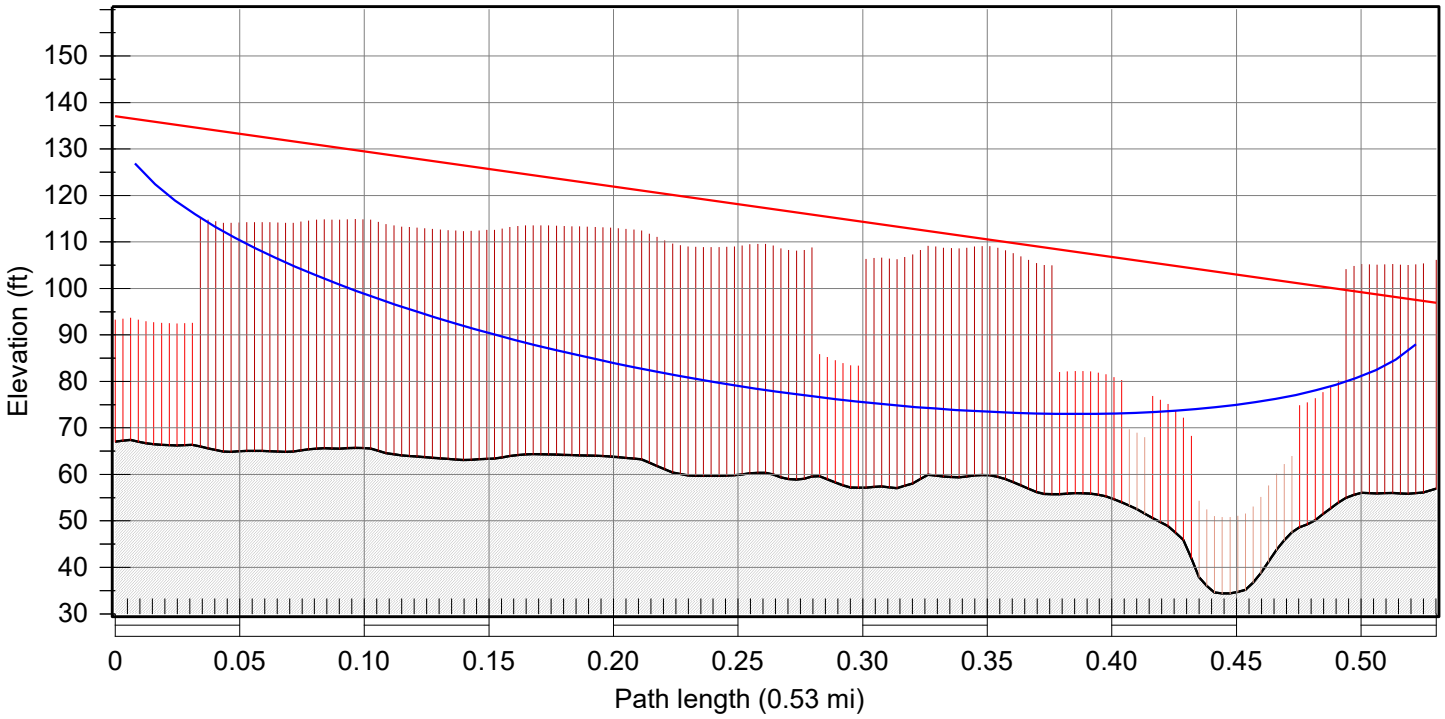
Transmission details (Central Well-Old Shop.pl5)

	Central Well	Old Shop
Latitude	47 12 31.35 N	47 12 58.93 N
Longitude	122 14 23.43 W	122 14 25.72 W
True azimuth (°)	356.76	176.76
Vertical angle (°)	-0.82	0.82
Elevation (ft)	66.99	56.89
Antenna model	Omni (TR)	Yagi (TR)
Antenna gain (dBi)	7.15	12.15
Antenna height (ft)	70.00	40.00
Antenna azimuth (°)	0.00	
TX line model	LDF4-50A	LDF4-50A
TX line unit loss (dB/100 ft)	1.51	1.51
TX line length (ft)	80.00	60.00
TX line loss (dB)	1.21	0.91
Connector loss (dB)	0.50	0.50
Frequency (MHz)	450.00	
Polarization	Vertical	
Path length (mi)	0.53	
Free space loss (dB)	84.15	
Atmospheric absorption loss (dB)	0.00	
Diffraction loss	16.82	
Net path loss (dB)	84.80	84.80
Radio model	LN4-25KHz	LN4-25KHz
Radio file name	ln4_25khz	ln4_25khz
TX power (dBm)	34.00	34.00
ERP (dbm)	37.29	42.59
ERP (watts)	5.36	18.17
RX threshold criteria	10-6 BER	10-6 BER
RX threshold level (dBm)	-114.00	-114.00
Receive signal (dBm)	-50.80	-50.80
Thermal fade margin (dB)	63.20	63.20
Dispersive fade margin (dB)	104.00	104.00
Dispersive fade occurrence factor	1.00	
Effective fade margin (dB)	63.20	63.20
Climatic factor	1.00	
Terrain roughness (ft)	20.00	

	Central Well	Old Shop
C factor	3.29	
Average annual temperature (°F)	43.52	
Fade occurrence factor (Po)	5.517E-007	
Worst month multipath availability (%)	100.00000	100.00000
Worst month multipath unavailability (sec)	0.00	0.00
Annual multipath availability (%)	100.00000	100.00000
Annual multipath unavailability (sec)	0.00	0.00
Annual 2 way multipath availability (%)	100.00000	
Annual 2 way multipath unavailability (sec)	0.00	
Polarization	Vertical	
Rain region	Tacoma, Washington	

Multipath fading method - Vigants - Barnett
Rain fading method - Crane

Transmission summary (Central Well-Old Shop.pl5)

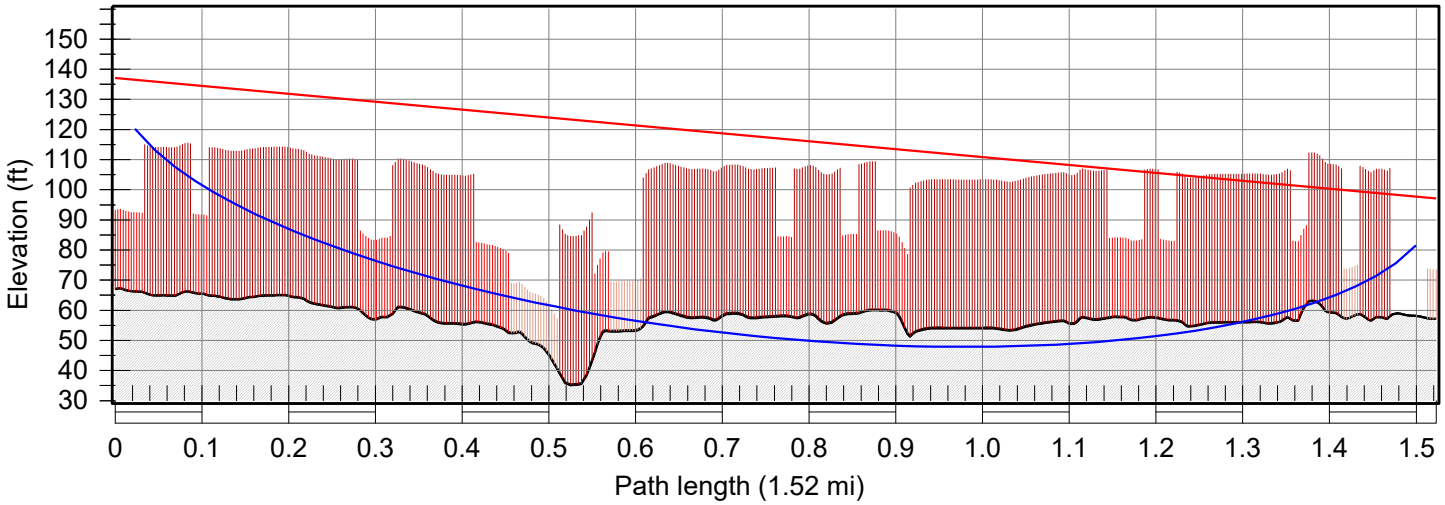


F = 450.00 MHz K = 1.33 %F1 = 100.0, 60.0

	Central Well	Old Shop
Latitude	47 12 31.35 N	47 12 58.93 N
Longitude	122 14 23.43 W	122 14 25.72 W
True azimuth (°)	356.76	176.76
Vertical angle (°)	-0.82	0.82
Elevation (ft)	66.99	56.89
Antenna model	Omni (TR)	Yagi (TR)
Antenna gain (dBi)	7.15	12.15
Antenna height (ft)	70.00	40.00
TX line model	LDF4-50A	LDF4-50A
TX line length (ft)	80.00	60.00
TX loss (dB)	1.71	1.41
RX loss (dB)	1.71	1.41
Diffraction loss	16.82	
Radio model	LN4-25KHz	LN4-25KHz
TX power (dBm)	34.00	34.00
ERP (dbm)	37.29	42.59
ERP (watts)	5.36	18.17

	Central Well	Old Shop
Receive signal (dBm)	-50.80	-50.80
Thermal fade margin (dB)	63.20	63.20
Effective fade margin (dB)	63.20	63.20
Annual 2 way multipath availability (%)	100.00000	
Annual 2 way multipath unavailability (sec)	0.00	

Multipath fading method - Vigants - Barnett
Rain fading method - Crane



Central Well	
Latitude	47 12 31.35 N
Longitude	122 14 23.43 W
Azimuth	2.98°
Elevation	67 ft ASL
Antenna CL	70.0 ft AGL

Frequency (MHz) = 450.0
K = 1.33
%F1 = 100.00

New Shop Facility	
Latitude	47 13 50.60 N
Longitude	122 14 17.37 W
Azimuth	182.98°
Elevation	57 ft ASL
Antenna CL	40.0 ft AGL

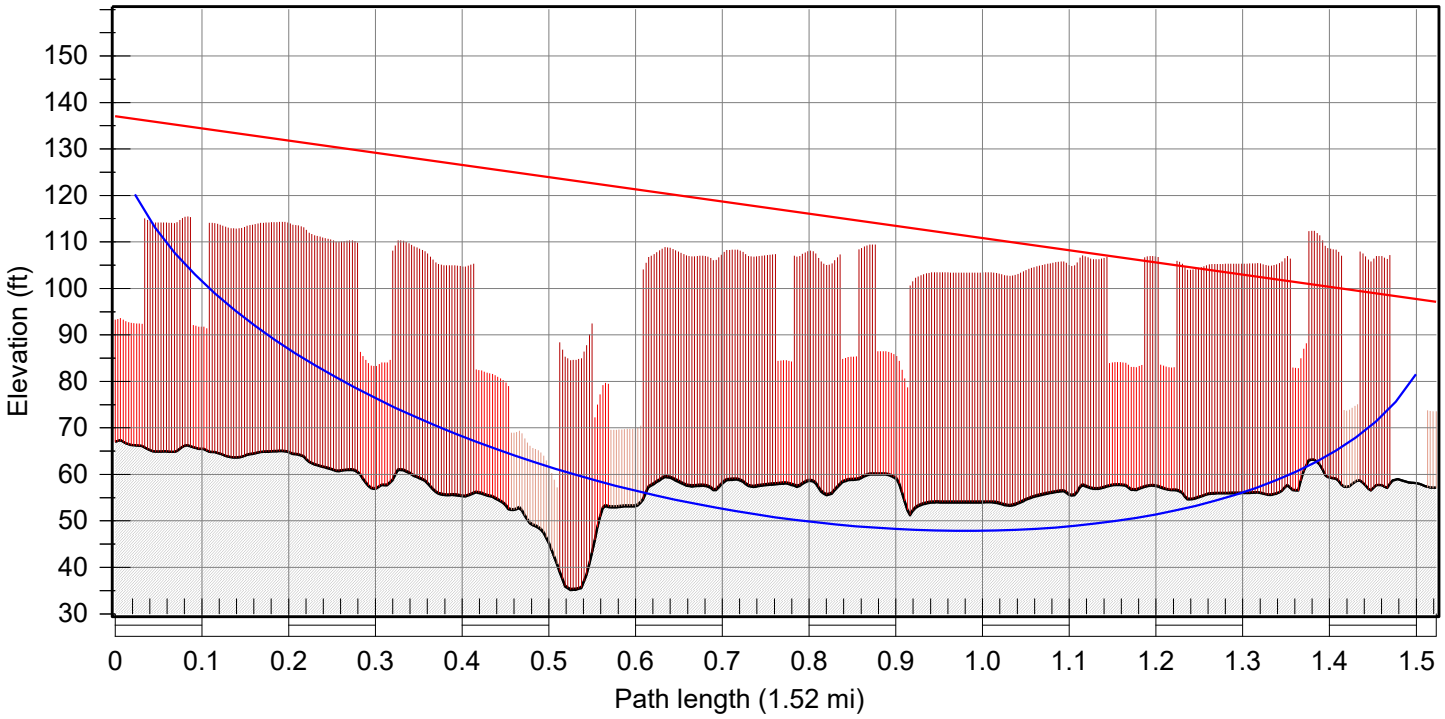
Transmission details (Central Well-New Shop Facility.pl5)

	Central Well	New Shop Facility
Latitude	47 12 31.35 N	47 13 50.60 N
Longitude	122 14 23.43 W	122 14 17.37 W
True azimuth (°)	2.98	182.98
Vertical angle (°)	-0.29	0.28
Elevation (ft)	66.99	57.12
Antenna model	Omni (TR)	Yagi (TR)
Antenna gain (dBi)	7.15	12.15
Antenna height (ft)	70.00	40.00
Antenna azimuth (°)	0.00	
TX line model	LDF4-50A	LDF4-50A
TX line unit loss (dB/100 ft)	1.51	1.51
TX line length (ft)	80.00	60.00
TX line loss (dB)	1.21	0.91
Connector loss (dB)	0.50	0.50
Frequency (MHz)	450.00	
Polarization	Vertical	
Path length (mi)	1.52	
Free space loss (dB)	93.32	
Atmospheric absorption loss (dB)	0.01	
Diffraction loss	16.12	
Net path loss (dB)	93.26	93.26
Radio model	LN4-25KHz	LN4-25KHz
Radio file name	ln4_25khz	ln4_25khz
TX power (dBm)	34.00	34.00
ERP (dbm)	37.29	42.59
ERP (watts)	5.36	18.17
RX threshold criteria	10-6 BER	10-6 BER
RX threshold level (dBm)	-114.00	-114.00
Receive signal (dBm)	-59.26	-59.26
Thermal fade margin (dB)	54.74	54.74
Dispersive fade margin (dB)	104.00	104.00
Dispersive fade occurrence factor	1.00	
Effective fade margin (dB)	54.74	54.74
Climatic factor	1.00	
Terrain roughness (ft)	20.00	

	Central Well	New Shop Facility
C factor	3.29	
Average annual temperature (°F)	43.52	
Fade occurrence factor (Po)	1.308E-005	
Worst month multipath availability (%)	100.00000	100.00000
Worst month multipath unavailability (sec)	0.00	0.00
Annual multipath availability (%)	100.00000	100.00000
Annual multipath unavailability (sec)	0.00	0.00
Annual 2 way multipath availability (%)	100.00000	
Annual 2 way multipath unavailability (sec)	0.00	
Polarization	Vertical	
Rain region	Tacoma, Washington	

Multipath fading method - Vigants - Barnett
Rain fading method - Crane

Transmission summary (Central Well-New Shop Facility.pl5)

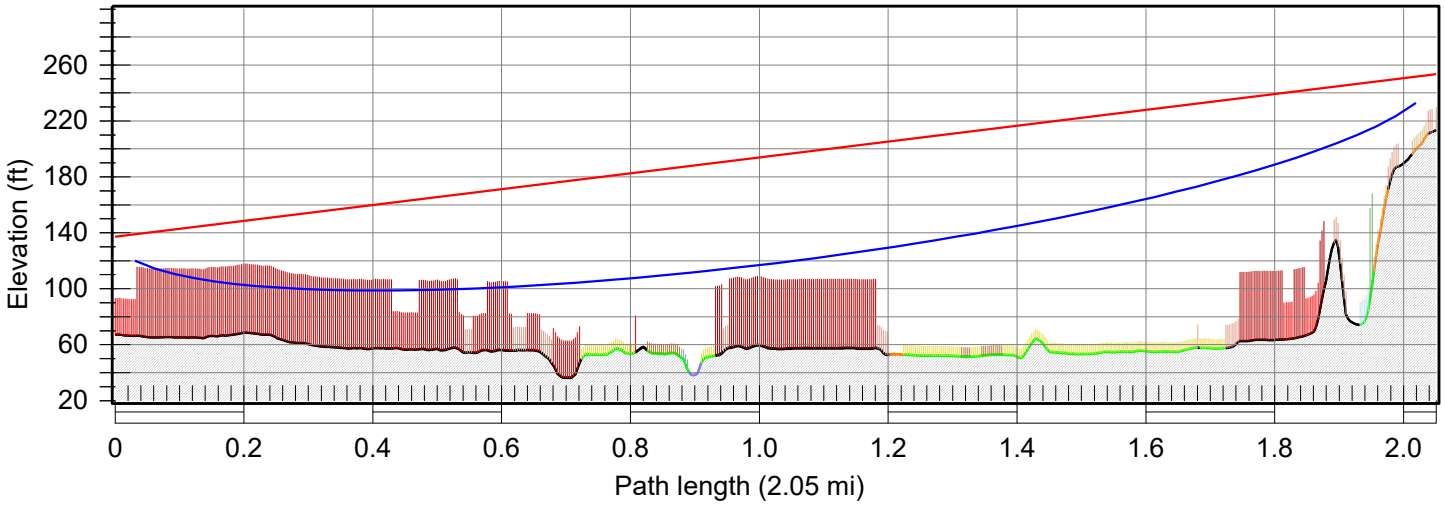


F = 450.00 MHz K = 1.33 %F1 = 100.0, 60.0

	Central Well	New Shop Facility
Latitude	47 12 31.35 N	47 13 50.60 N
Longitude	122 14 23.43 W	122 14 17.37 W
True azimuth (°)	2.98	182.98
Vertical angle (°)	-0.29	0.28
Elevation (ft)	66.99	57.12
Antenna model	Omni (TR)	Yagi (TR)
Antenna gain (dBi)	7.15	12.15
Antenna height (ft)	70.00	40.00
TX line model	LDF4-50A	LDF4-50A
TX line length (ft)	80.00	60.00
TX loss (dB)	1.71	1.41
RX loss (dB)	1.71	1.41
Diffraction loss	16.12	
Radio model	LN4-25KHz	LN4-25KHz
TX power (dBm)	34.00	34.00
ERP (dbm)	37.29	42.59
ERP (watts)	5.36	18.17

	Central Well	New Shop Facility
Receive signal (dBm)	-59.26	-59.26
Thermal fade margin (dB)	54.74	54.74
Effective fade margin (dB)	54.74	54.74
Annual 2 way multipath availability (%)	100.00000	
Annual 2 way multipath unavailability (sec)	0.00	

Multipath fading method - Vigants - Barnett
Rain fading method - Crane



Central Well	
Latitude	47 12 31.35 N
Longitude	122 14 23.43 W
Azimuth	23.03°
Elevation	67 ft ASL
Antenna CL	70.0 ft AGL

Frequency (MHz) = 450.0
K = 1.33
%F1 = 100.00

North Tank	
Latitude	47 14 09.68 N
Longitude	122 13 22.05 W
Azimuth	203.04°
Elevation	213 ft ASL
Antenna CL	40.0 ft AGL

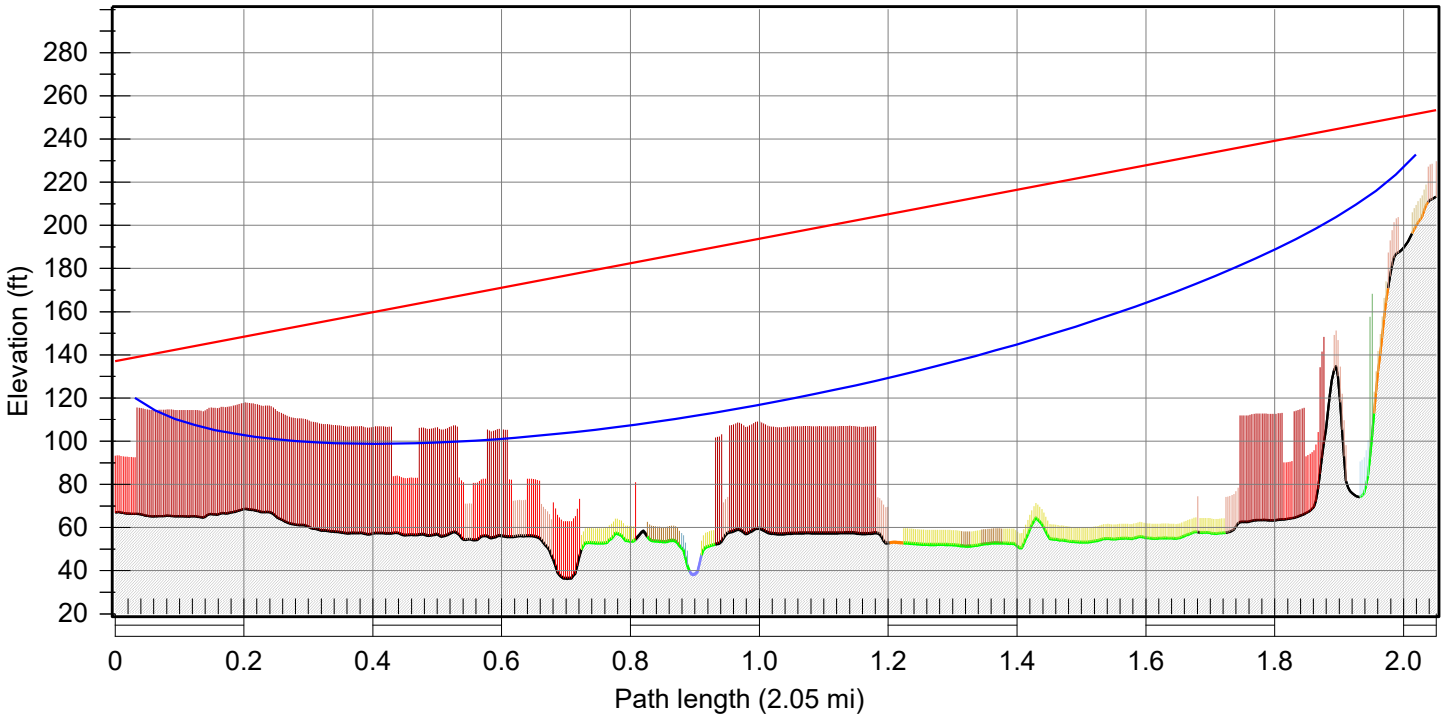
Transmission details (Central Well-North Tank.pl5)

	Central Well	North Tank
Latitude	47 12 31.35 N	47 14 09.68 N
Longitude	122 14 23.43 W	122 13 22.05 W
True azimuth (°)	23.03	203.04
Vertical angle (°)	0.60	-0.63
Elevation (ft)	66.99	213.28
Antenna model	Omni (TR)	Yagi (TR)
Antenna gain (dBi)	7.15	12.15
Antenna height (ft)	70.00	40.00
Antenna azimuth (°)	0.00	
TX line model	LDF4-50A	LDF4-50A
TX line unit loss (dB/100 ft)	1.51	1.51
TX line length (ft)	80.00	60.00
TX line loss (dB)	1.21	0.91
Connector loss (dB)	0.50	0.50
Frequency (MHz)	450.00	
Polarization	Vertical	
Path length (mi)	2.05	
Free space loss (dB)	95.90	
Atmospheric absorption loss (dB)	0.01	
Net path loss (dB)	79.73	79.73
Radio model	LN4-25KHz	LN4-25KHz
Radio file name	ln4_25khz	ln4_25khz
TX power (dBm)	34.00	34.00
ERP (dbm)	37.29	42.59
ERP (watts)	5.36	18.17
RX threshold criteria	10-6 BER	10-6 BER
RX threshold level (dBm)	-114.00	-114.00
Receive signal (dBm)	-45.73	-45.73
Thermal fade margin (dB)	68.27	68.27
Dispersive fade margin (dB)	104.00	104.00
Dispersive fade occurrence factor	1.00	
Effective fade margin (dB)	68.27	68.27
Climatic factor	1.00	
Terrain roughness (ft)	20.00	

	Central Well	North Tank
C factor	3.29	
Average annual temperature (°F)	43.46	
Fade occurrence factor (Po)	3.192E-005	
Worst month multipath availability (%)	100.00000	100.00000
Worst month multipath unavailability (sec)	0.00	0.00
Annual multipath availability (%)	100.00000	100.00000
Annual multipath unavailability (sec)	0.00	0.00
Annual 2 way multipath availability (%)	100.00000	
Annual 2 way multipath unavailability (sec)	0.00	
Polarization	Vertical	
Rain region	Tacoma, Washington	

Multipath fading method - Vigants - Barnett
Rain fading method - Crane

Transmission summary (Central Well-North Tank.pl5)

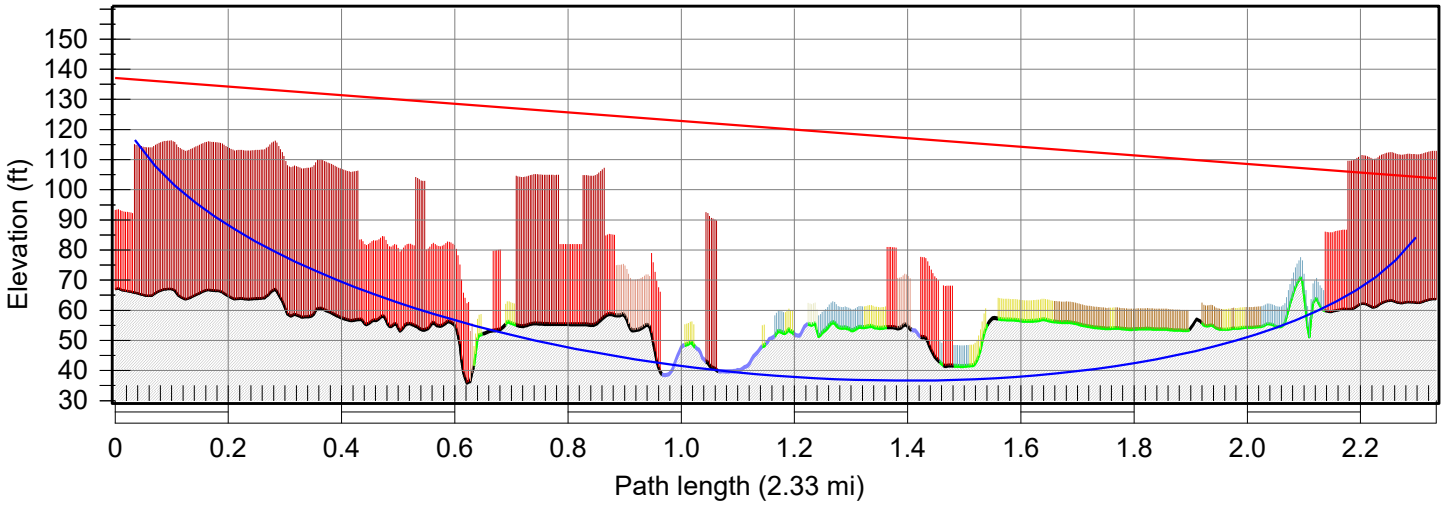


F = 450.00 MHz K = 1.33 %F1 = 100.0, 60.0

	Central Well	North Tank
Latitude	47 12 31.35 N	47 14 09.68 N
Longitude	122 14 23.43 W	122 13 22.05 W
True azimuth (°)	23.03	203.04
Vertical angle (°)	0.60	-0.63
Elevation (ft)	66.99	213.28
Antenna model	Omni (TR)	Yagi (TR)
Antenna gain (dBi)	7.15	12.15
Antenna height (ft)	70.00	40.00
TX line model	LDF4-50A	LDF4-50A
TX line length (ft)	80.00	60.00
TX loss (dB)	1.71	1.41
RX loss (dB)	1.71	1.41
Radio model	LN4-25KHz	LN4-25KHz
TX power (dBm)	34.00	34.00
ERP (dbm)	37.29	42.59
ERP (watts)	5.36	18.17
Receive signal (dBm)	-45.73	-45.73

	Central Well	North Tank
Thermal fade margin (dB)	68.27	68.27
Effective fade margin (dB)	68.27	68.27
Annual 2 way multipath availability (%)	100.00000	
Annual 2 way multipath unavailability (sec)	0.00	

Multipath fading method - Vigants - Barnett
Rain fading method - Crane



Central Well	
Latitude	47 12 31.35 N
Longitude	122 14 23.43 W
Azimuth	14.69°
Elevation	67 ft ASL
Antenna CL	70.0 ft AGL

Frequency (MHz) = 450.0
K = 1.33
%F1 = 100.00

Derringer Well	
Latitude	47 14 28.97 N
Longitude	122 13 38.15 W
Azimuth	194.70°
Elevation	64 ft ASL
Antenna CL	40.0 ft AGL

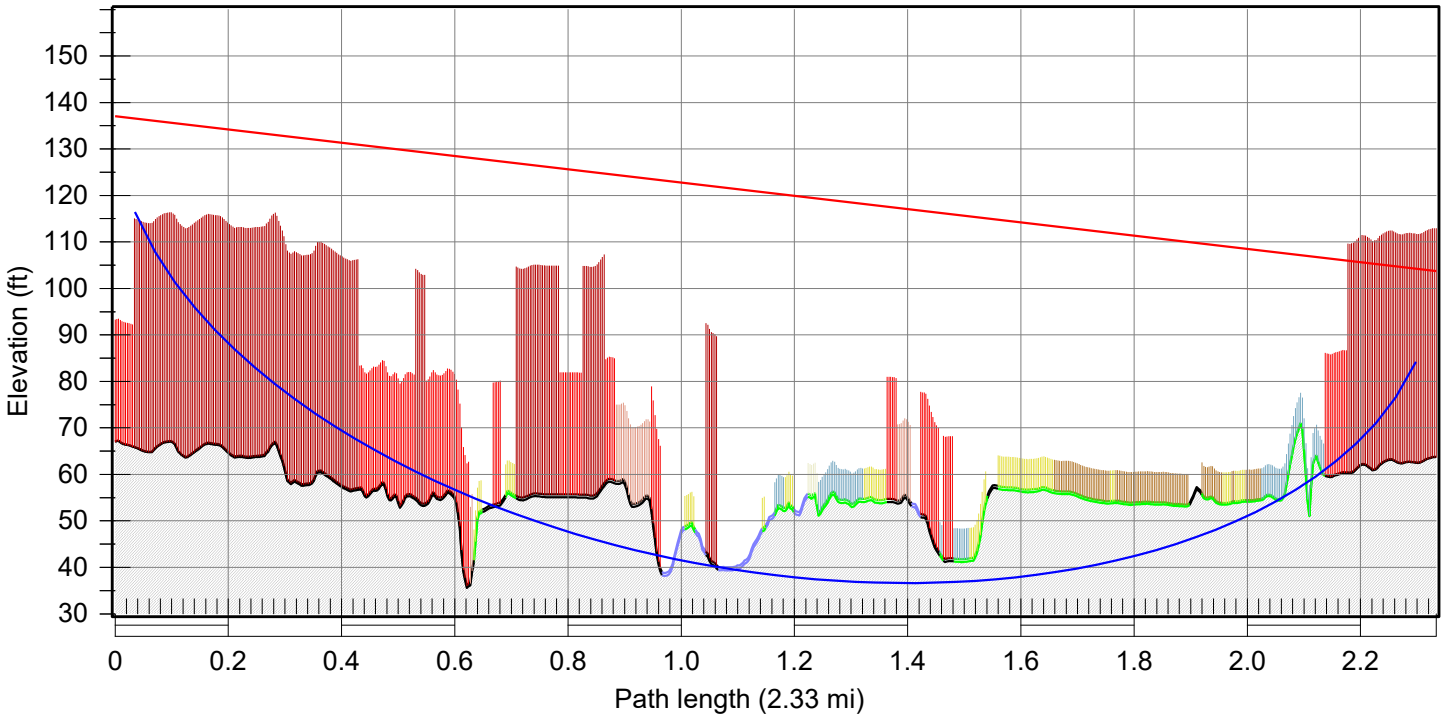
Transmission details (Central Well-Derringer Well.pl5)

	Central Well	Derringer Well
Latitude	47 12 31.35 N	47 14 28.97 N
Longitude	122 14 23.43 W	122 13 38.15 W
True azimuth (°)	14.69	194.70
Vertical angle (°)	-0.17	0.14
Elevation (ft)	66.99	63.70
Antenna model	Omni (TR)	Yagi (TR)
Antenna gain (dBi)	7.15	12.15
Antenna height (ft)	70.00	40.00
Antenna azimuth (°)	0.00	
TX line model	LDF4-50A	LDF4-50A
TX line unit loss (dB/100 ft)	1.51	1.51
TX line length (ft)	80.00	60.00
TX line loss (dB)	1.21	0.91
Connector loss (dB)	0.50	0.50
Frequency (MHz)	450.00	
Polarization	Vertical	
Path length (mi)	2.33	
Free space loss (dB)	97.02	
Atmospheric absorption loss (dB)	0.01	
Diffraction loss	19.66	
Net path loss (dB)	100.51	100.51
Radio model	LN4-25KHz	LN4-25KHz
Radio file name	ln4_25khz	ln4_25khz
TX power (dBm)	34.00	34.00
ERP (dbm)	37.29	42.59
ERP (watts)	5.36	18.17
RX threshold criteria	10-6 BER	10-6 BER
RX threshold level (dBm)	-114.00	-114.00
Receive signal (dBm)	-66.51	-66.51
Thermal fade margin (dB)	47.49	47.49
Dispersive fade margin (dB)	104.00	104.00
Dispersive fade occurrence factor	1.00	
Effective fade margin (dB)	47.49	47.49
Climatic factor	1.00	
Terrain roughness (ft)	20.00	

	Central Well	Derringer Well
C factor	3.29	
Average annual temperature (°F)	43.48	
Fade occurrence factor (Po)	4.704E-005	
Worst month multipath availability (%)	100.00000	100.00000
Worst month multipath unavailability (sec)	0.00	0.00
Annual multipath availability (%)	100.00000	100.00000
Annual multipath unavailability (sec)	0.01	0.01
Annual 2 way multipath availability (%)	100.00000	
Annual 2 way multipath unavailability (sec)	0.01	
Polarization	Vertical	
Rain region	Tacoma, Washington	

Multipath fading method - Vigants - Barnett
Rain fading method - Crane

Transmission summary (Central Well-Derringer Well.pl5)

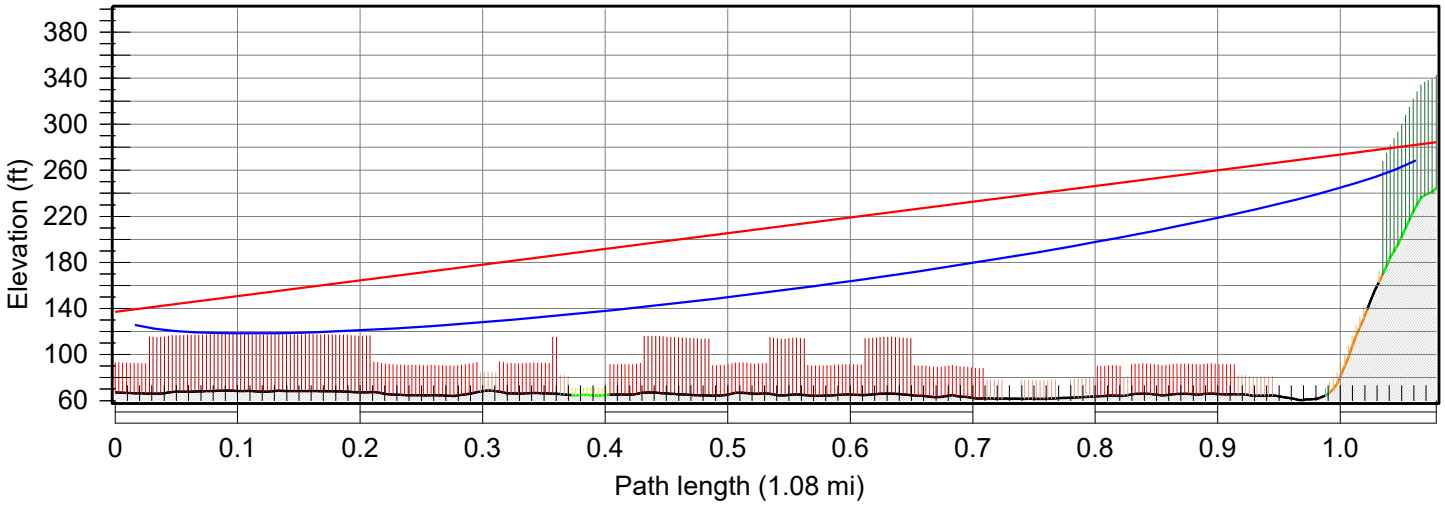


F = 450.00 MHz K = 1.33 %F1 = 100.0, 60.0

	Central Well	Derringer Well
Latitude	47 12 31.35 N	47 14 28.97 N
Longitude	122 14 23.43 W	122 13 38.15 W
True azimuth (°)	14.69	194.70
Vertical angle (°)	-0.17	0.14
Elevation (ft)	66.99	63.70
Antenna model	Omni (TR)	Yagi (TR)
Antenna gain (dBi)	7.15	12.15
Antenna height (ft)	70.00	40.00
TX line model	LDF4-50A	LDF4-50A
TX line length (ft)	80.00	60.00
TX loss (dB)	1.71	1.41
RX loss (dB)	1.71	1.41
Diffraction loss	19.66	
Radio model	LN4-25KHz	LN4-25KHz
TX power (dBm)	34.00	34.00
ERP (dbm)	37.29	42.59
ERP (watts)	5.36	18.17

	Central Well	Derringer Well
Receive signal (dBm)	-66.51	-66.51
Thermal fade margin (dB)	47.49	47.49
Effective fade margin (dB)	47.49	47.49
Annual 2 way multipath availability (%)	100.00000	
Annual 2 way multipath unavailability (sec)	0.01	

Multipath fading method - Vigants - Barnett
Rain fading method - Crane



Central Well	
Latitude	47 12 31.35 N
Longitude	122 14 23.43 W
Azimuth	62.66°
Elevation	67 ft ASL
Antenna CL	70.0 ft AGL

Frequency (MHz) = 450.0
K = 1.33
%F1 = 100.00

Sumner Springs	
Latitude	47 12 57.15 N
Longitude	122 13 10.18 W
Azimuth	242.67°
Elevation	244 ft ASL
Antenna CL	40.0 ft AGL

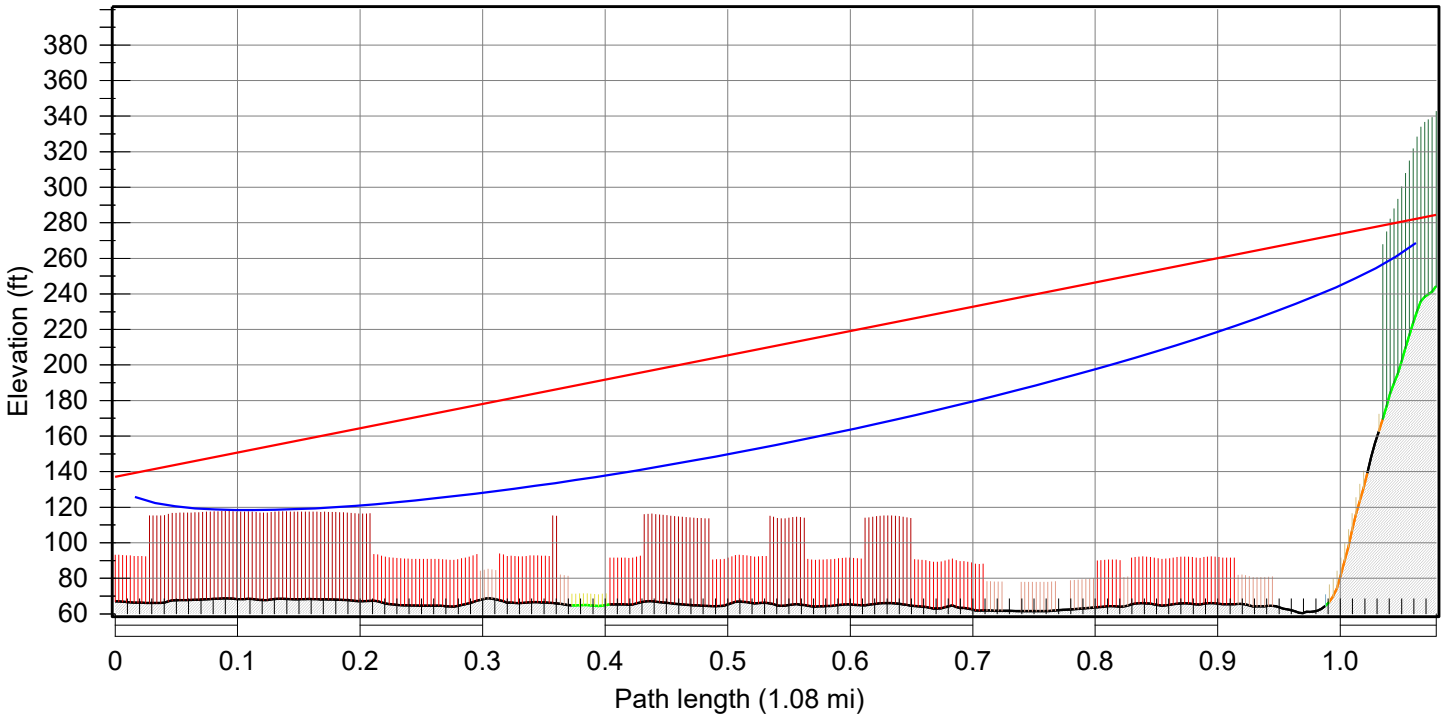
Transmission details (Central Well-Sumner Springs.pl5)

	Central Well	Sumner Springs
Latitude	47 12 31.35 N	47 12 57.15 N
Longitude	122 14 23.43 W	122 13 10.18 W
True azimuth (°)	62.66	242.67
Vertical angle (°)	1.48	-1.49
Elevation (ft)	66.99	244.34
Antenna model	Omni (TR)	Yagi (TR)
Antenna gain (dBi)	7.15	12.15
Antenna height (ft)	70.00	40.00
Antenna azimuth (°)	0.00	
TX line model	LDF4-50A	LDF4-50A
TX line unit loss (dB/100 ft)	1.51	1.51
TX line length (ft)	80.00	60.00
TX line loss (dB)	1.21	0.91
Connector loss (dB)	0.50	0.50
Frequency (MHz)	450.00	
Polarization	Vertical	
Path length (mi)	1.08	
Free space loss (dB)	90.32	
Atmospheric absorption loss (dB)	0.01	
Diffraction loss	30.39	
Net path loss (dB)	104.53	104.53
Radio model	LN4-25KHz	LN4-25KHz
Radio file name	ln4_25khz	ln4_25khz
TX power (dBm)	34.00	34.00
ERP (dbm)	37.29	42.59
ERP (watts)	5.36	18.17
RX threshold criteria	10-6 BER	10-6 BER
RX threshold level (dBm)	-114.00	-114.00
Receive signal (dBm)	-70.53	-70.53
Thermal fade margin (dB)	43.47	43.47
Dispersive fade margin (dB)	104.00	104.00
Dispersive fade occurrence factor	1.00	
Effective fade margin (dB)	43.47	43.47
Climatic factor	1.00	
Terrain roughness (ft)	20.00	

	Central Well	Sumner Springs
C factor	3.29	
Average annual temperature (°F)	43.45	
Fade occurrence factor (Po)	4.645E-006	
Worst month multipath availability (%)	100.00000	100.00000
Worst month multipath unavailability (sec)	0.00	0.00
Annual multipath availability (%)	100.00000	100.00000
Annual multipath unavailability (sec)	0.00	0.00
Annual 2 way multipath availability (%)	100.00000	
Annual 2 way multipath unavailability (sec)	0.00	
Polarization	Vertical	
Rain region	Tacoma, Washington	

Multipath fading method - Vigants - Barnett
Rain fading method - Crane

Transmission summary (Central Well-Sumner Springs.pl5)

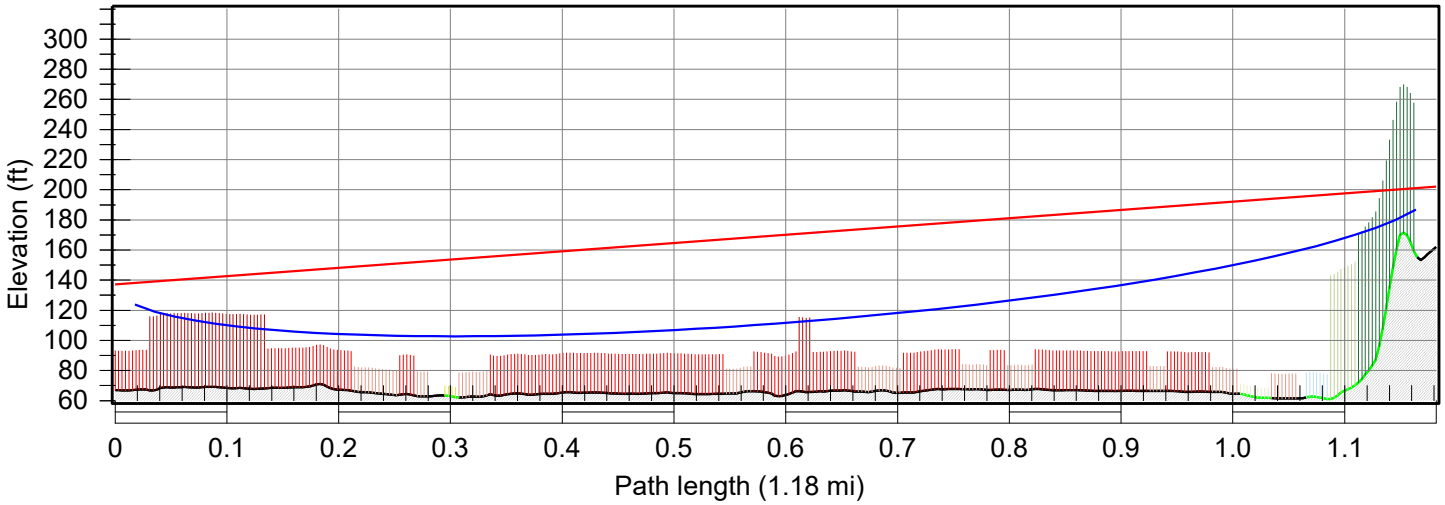


F = 450.00 MHz K = 1.33 %F1 = 100.0, 60.0

	Central Well	Sumner Springs
Latitude	47 12 31.35 N	47 12 57.15 N
Longitude	122 14 23.43 W	122 13 10.18 W
True azimuth (°)	62.66	242.67
Vertical angle (°)	1.48	-1.49
Elevation (ft)	66.99	244.34
Antenna model	Omni (TR)	Yagi (TR)
Antenna gain (dBi)	7.15	12.15
Antenna height (ft)	70.00	40.00
TX line model	LDF4-50A	LDF4-50A
TX line length (ft)	80.00	60.00
TX loss (dB)	1.71	1.41
RX loss (dB)	1.71	1.41
Diffraction loss	30.39	
Radio model	LN4-25KHz	LN4-25KHz
TX power (dBm)	34.00	34.00
ERP (dbm)	37.29	42.59
ERP (watts)	5.36	18.17

	Central Well	Sumner Springs
Receive signal (dBm)	-70.53	-70.53
Thermal fade margin (dB)	43.47	43.47
Effective fade margin (dB)	43.47	43.47
Annual 2 way multipath availability (%)	100.00000	
Annual 2 way multipath unavailability (sec)	0.00	

Multipath fading method - Vigants - Barnett
Rain fading method - Crane



Central Well	
Latitude	47 12 31.35 N
Longitude	122 14 23.43 W
Azimuth	82.10°
Elevation	67 ft ASL
Antenna CL	70.0 ft AGL

Frequency (MHz) = 450.0
K = 1.33
%F1 = 100.00

County Springs	
Latitude	47 12 39.81 N
Longitude	122 12 53.91 W
Azimuth	262.11°
Elevation	162 ft ASL
Antenna CL	40.0 ft AGL

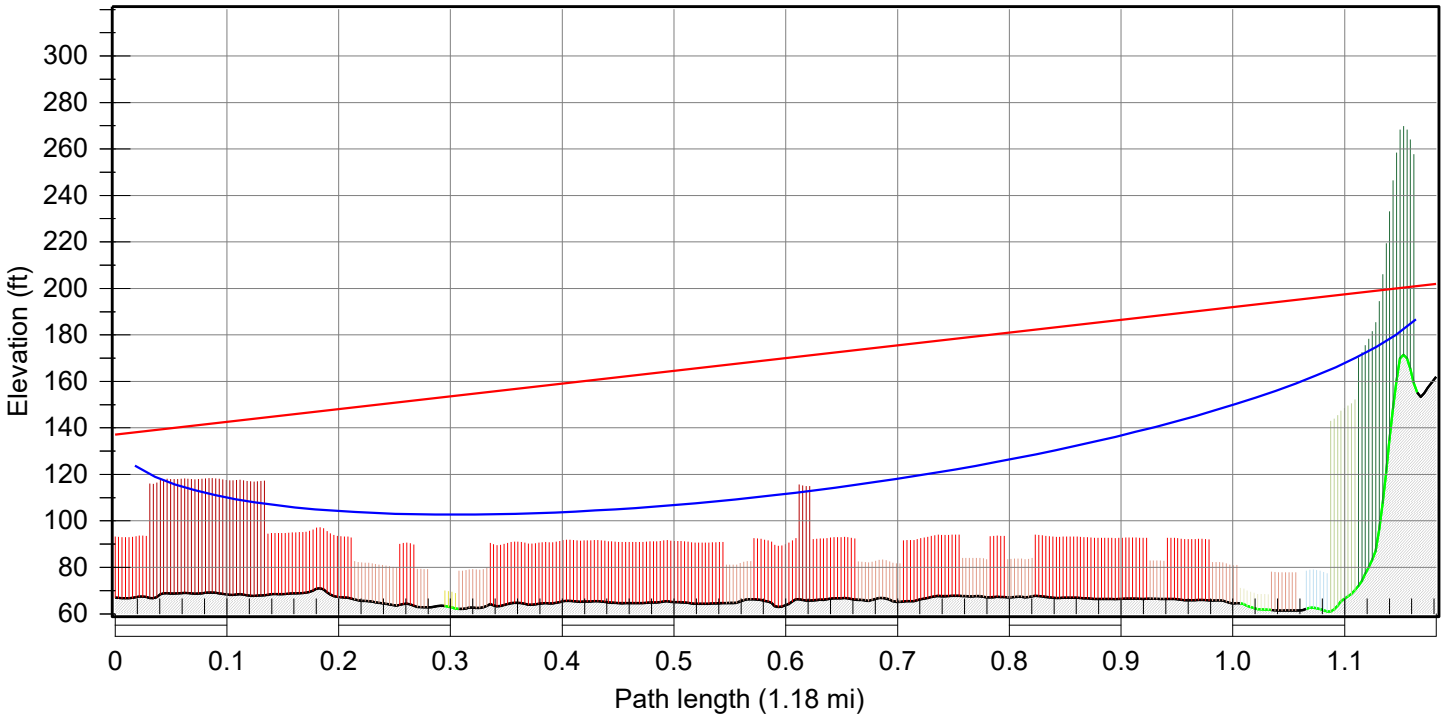
Transmission details (Central Well-County Springs.pl5)

	Central Well	County Springs
Latitude	47 12 31.35 N	47 12 39.81 N
Longitude	122 14 23.43 W	122 12 53.91 W
True azimuth (°)	82.10	262.11
Vertical angle (°)	0.59	-0.60
Elevation (ft)	66.99	161.91
Antenna model	Omni (TR)	Yagi (TR)
Antenna gain (dBi)	7.15	12.15
Antenna height (ft)	70.00	40.00
Antenna azimuth (°)	0.00	
TX line model	LDF4-50A	LDF4-50A
TX line unit loss (dB/100 ft)	1.51	1.51
TX line length (ft)	80.00	60.00
TX line loss (dB)	1.21	0.91
Connector loss (dB)	0.50	0.50
Frequency (MHz)	450.00	
Polarization	Vertical	
Path length (mi)	1.18	
Free space loss (dB)	91.12	
Atmospheric absorption loss (dB)	0.01	
Diffraction loss	27.14	
Net path loss (dB)	102.08	102.08
Radio model	LN4-25KHz	LN4-25KHz
Radio file name	ln4_25khz	ln4_25khz
TX power (dBm)	34.00	34.00
ERP (dbm)	37.29	42.59
ERP (watts)	5.36	18.17
RX threshold criteria	10-6 BER	10-6 BER
RX threshold level (dBm)	-114.00	-114.00
Receive signal (dBm)	-68.08	-68.08
Thermal fade margin (dB)	45.92	45.92
Dispersive fade margin (dB)	104.00	104.00
Dispersive fade occurrence factor	1.00	
Effective fade margin (dB)	45.92	45.92
Climatic factor	1.00	
Terrain roughness (ft)	20.00	

	Central Well	County Springs
C factor	3.29	
Average annual temperature (°F)	43.43	
Fade occurrence factor (Po)	6.112E-006	
Worst month multipath availability (%)	100.00000	100.00000
Worst month multipath unavailability (sec)	0.00	0.00
Annual multipath availability (%)	100.00000	100.00000
Annual multipath unavailability (sec)	0.00	0.00
Annual 2 way multipath availability (%)	100.00000	
Annual 2 way multipath unavailability (sec)	0.00	
Polarization	Vertical	
Rain region	Tacoma, Washington	

Multipath fading method - Vigants - Barnett
Rain fading method - Crane

Transmission summary (Central Well-County Springs.pl5)

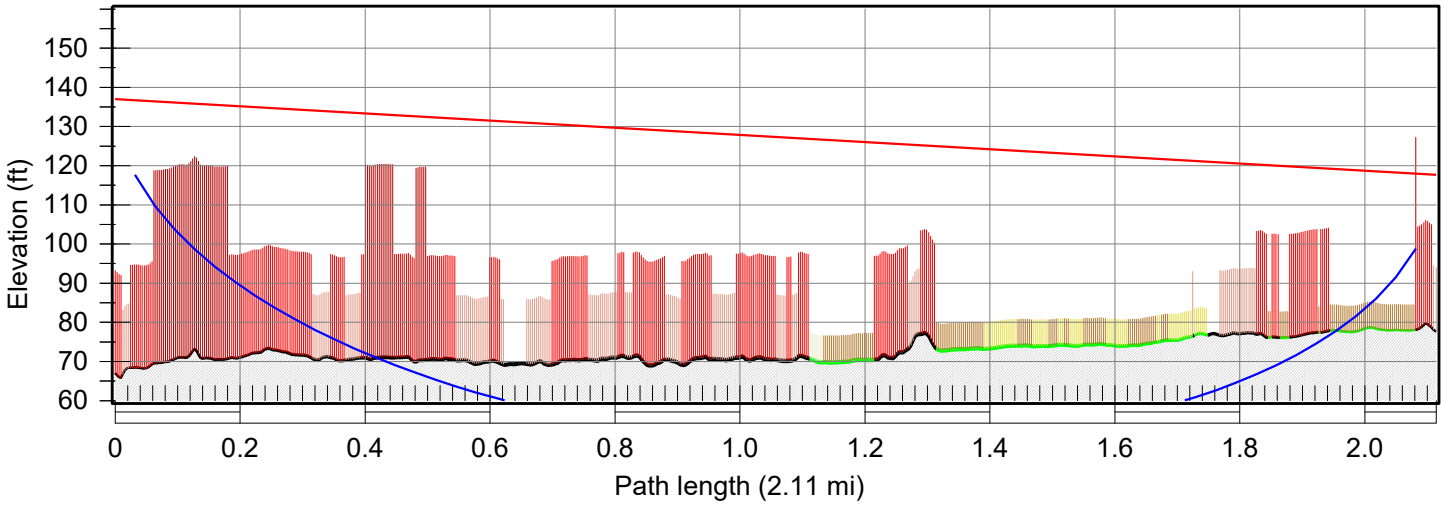


F = 450.00 MHz K = 1.33 %F1 = 100.0, 60.0

	Central Well	County Springs
Latitude	47 12 31.35 N	47 12 39.81 N
Longitude	122 14 23.43 W	122 12 53.91 W
True azimuth (°)	82.10	262.11
Vertical angle (°)	0.59	-0.60
Elevation (ft)	66.99	161.91
Antenna model	Omni (TR)	Yagi (TR)
Antenna gain (dBi)	7.15	12.15
Antenna height (ft)	70.00	40.00
TX line model	LDF4-50A	LDF4-50A
TX line length (ft)	80.00	60.00
TX loss (dB)	1.71	1.41
RX loss (dB)	1.71	1.41
Diffraction loss	27.14	
Radio model	LN4-25KHz	LN4-25KHz
TX power (dBm)	34.00	34.00
ERP (dbm)	37.29	42.59
ERP (watts)	5.36	18.17

	Central Well	County Springs
Receive signal (dBm)	-68.08	-68.08
Thermal fade margin (dB)	45.92	45.92
Effective fade margin (dB)	45.92	45.92
Annual 2 way multipath availability (%)	100.00000	
Annual 2 way multipath unavailability (sec)	0.00	

Multipath fading method - Vigants - Barnett
Rain fading method - Crane



Central Well	
Latitude	47 12 31.35 N
Longitude	122 14 23.43 W
Azimuth	138.59°
Elevation	67 ft ASL
Antenna CL	70.0 ft AGL

Frequency (MHz) = 450.0
K = 1.33
%F1 = 100.00

South Well	
Latitude	47 11 08.71 N
Longitude	122 12 36.55 W
Azimuth	318.61°
Elevation	78 ft ASL
Antenna CL	40.0 ft AGL

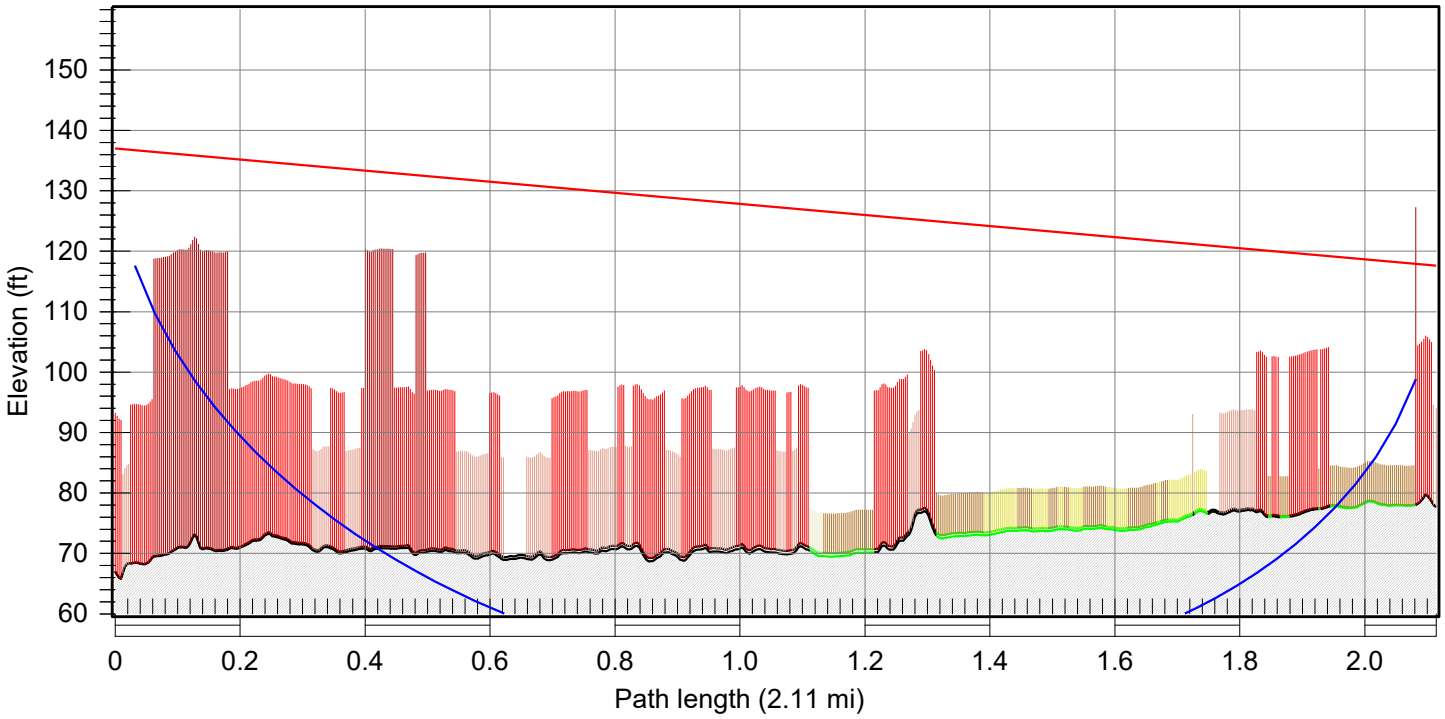
Transmission details (Central Well-South Well.pl5)

	Central Well	South Well
Latitude	47 12 31.35 N	47 11 08.71 N
Longitude	122 14 23.43 W	122 12 36.55 W
True azimuth (°)	138.59	318.61
Vertical angle (°)	-0.11	0.09
Elevation (ft)	66.99	77.61
Antenna model	Omni (TR)	Yagi (TR)
Antenna gain (dBi)	7.15	12.15
Antenna height (ft)	70.00	40.00
Antenna azimuth (°)	0.00	
TX line model	LDF4-50A	LDF4-50A
TX line unit loss (dB/100 ft)	1.51	1.51
TX line length (ft)	80.00	60.00
TX line loss (dB)	1.21	0.91
Connector loss (dB)	0.50	0.50
Frequency (MHz)	450.00	
Polarization	Vertical	
Path length (mi)	2.11	
Free space loss (dB)	96.17	
Atmospheric absorption loss (dB)	0.01	
Diffraction loss	11.69	
Net path loss (dB)	91.68	91.68
Radio model	LN4-25KHz	LN4-25KHz
Radio file name	ln4_25khz	ln4_25khz
TX power (dBm)	34.00	34.00
ERP (dbm)	37.29	42.59
ERP (watts)	5.36	18.17
RX threshold criteria	10-6 BER	10-6 BER
RX threshold level (dBm)	-114.00	-114.00
Receive signal (dBm)	-57.68	-57.68
Thermal fade margin (dB)	56.32	56.32
Dispersive fade margin (dB)	104.00	104.00
Dispersive fade occurrence factor	1.00	
Effective fade margin (dB)	56.32	56.32
Climatic factor	1.00	
Terrain roughness (ft)	20.00	

	Central Well	South Well
C factor	3.29	
Average annual temperature (°F)	43.41	
Fade occurrence factor (Po)	3.498E-005	
Worst month multipath availability (%)	100.00000	100.00000
Worst month multipath unavailability (sec)	0.00	0.00
Annual multipath availability (%)	100.00000	100.00000
Annual multipath unavailability (sec)	0.00	0.00
Annual 2 way multipath availability (%)	100.00000	
Annual 2 way multipath unavailability (sec)	0.00	
Polarization	Vertical	
Rain region	Tacoma, Washington	

Multipath fading method - Vigants - Barnett
Rain fading method - Crane

Transmission summary (Central Well-South Well.pl5)

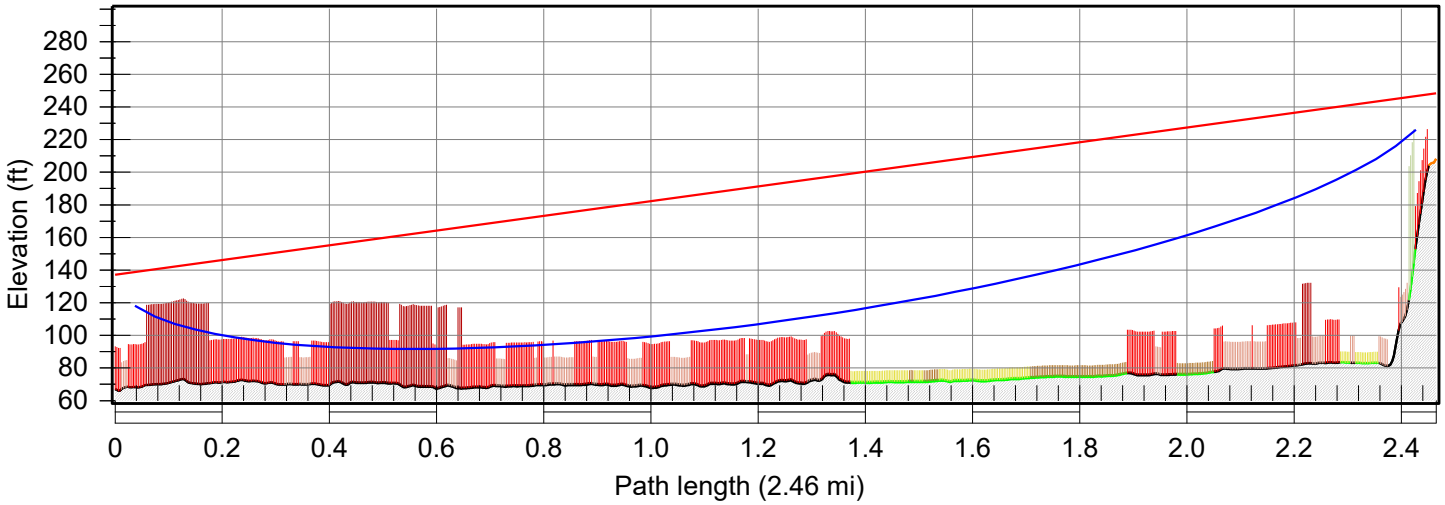


F = 450.00 MHz K = 1.33 %F1 = 100.0, 60.0

	Central Well	South Well
Latitude	47 12 31.35 N	47 11 08.71 N
Longitude	122 14 23.43 W	122 12 36.55 W
True azimuth (°)	138.59	318.61
Vertical angle (°)	-0.11	0.09
Elevation (ft)	66.99	77.61
Antenna model	Omni (TR)	Yagi (TR)
Antenna gain (dBi)	7.15	12.15
Antenna height (ft)	70.00	40.00
TX line model	LDF4-50A	LDF4-50A
TX line length (ft)	80.00	60.00
TX loss (dB)	1.71	1.41
RX loss (dB)	1.71	1.41
Diffraction loss	11.69	
Radio model	LN4-25KHz	LN4-25KHz
TX power (dBm)	34.00	34.00
ERP (dbm)	37.29	42.59

	Central Well	South Well
ERP (watts)	5.36	18.17
Receive signal (dBm)	-57.68	-57.68
Thermal fade margin (dB)	56.32	56.32
Effective fade margin (dB)	56.32	56.32
Annual 2 way multipath availability (%)	100.00000	
Annual 2 way multipath unavailability (sec)	0.00	

Multipath fading method - Vigants - Barnett
Rain fading method - Crane



Central Well	
Latitude	47 12 31.35 N
Longitude	122 14 23.43 W
Azimuth	133.73°
Elevation	67 ft ASL
Antenna CL	70.0 ft AGL

Frequency (MHz) = 450.0
K = 1.33
%F1 = 100.00

Viewpoint Booster	
Latitude	47 11 02.54 N
Longitude	122 12 07.29 W
Azimuth	313.76°
Elevation	208 ft ASL
Antenna CL	40.0 ft AGL

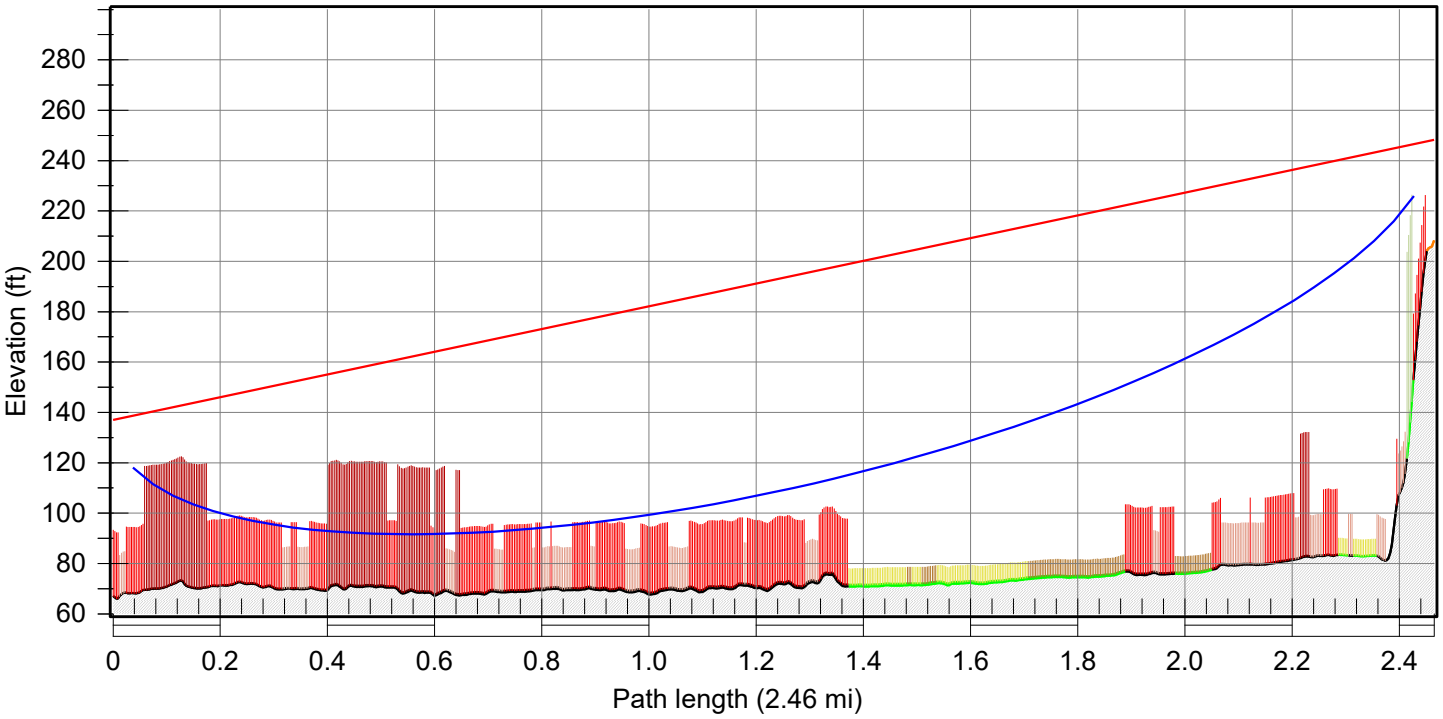
Transmission details (Central Well-Viewpoint Booster.pl5)

	Central Well	Viewpoint Booster
Latitude	47 12 31.35 N	47 11 02.54 N
Longitude	122 14 23.43 W	122 12 07.29 W
True azimuth (°)	133.73	313.76
Vertical angle (°)	0.48	-0.50
Elevation (ft)	66.99	208.17
Antenna model	Omni (TR)	Yagi (TR)
Antenna gain (dBi)	7.15	12.15
Antenna height (ft)	70.00	40.00
Antenna azimuth (°)	0.00	
TX line model	LDF4-50A	LDF4-50A
TX line unit loss (dB/100 ft)	1.51	1.51
TX line length (ft)	80.00	60.00
TX line loss (dB)	1.21	0.91
Connector loss (dB)	0.50	0.50
Frequency (MHz)	450.00	
Polarization	Vertical	
Path length (mi)	2.46	
Free space loss (dB)	97.50	
Atmospheric absorption loss (dB)	0.01	
Diffraction loss	0.10	
Net path loss (dB)	81.42	81.42
Radio model	LN4-25KHz	LN4-25KHz
Radio file name	ln4_25khz	ln4_25khz
TX power (dBm)	34.00	34.00
ERP (dbm)	37.29	42.59
ERP (watts)	5.36	18.17
RX threshold criteria	10-6 BER	10-6 BER
RX threshold level (dBm)	-114.00	-114.00
Receive signal (dBm)	-47.42	-47.42
Thermal fade margin (dB)	66.58	66.58
Dispersive fade margin (dB)	104.00	104.00
Dispersive fade occurrence factor	1.00	
Effective fade margin (dB)	66.58	66.58
Climatic factor	1.00	
Terrain roughness (ft)	20.00	

	Central Well	Viewpoint Booster
C factor	3.29	
Average annual temperature (°F)	43.38	
Fade occurrence factor (Po)	5.545E-005	
Worst month multipath availability (%)	100.00000	100.00000
Worst month multipath unavailability (sec)	0.00	0.00
Annual multipath availability (%)	100.00000	100.00000
Annual multipath unavailability (sec)	0.00	0.00
Annual 2 way multipath availability (%)	100.00000	
Annual 2 way multipath unavailability (sec)	0.00	
Polarization	Vertical	
Rain region	Tacoma, Washington	

Multipath fading method - Vigants - Barnett
Rain fading method - Crane

Transmission summary (Central Well-Viewpoint Booster.pl5)

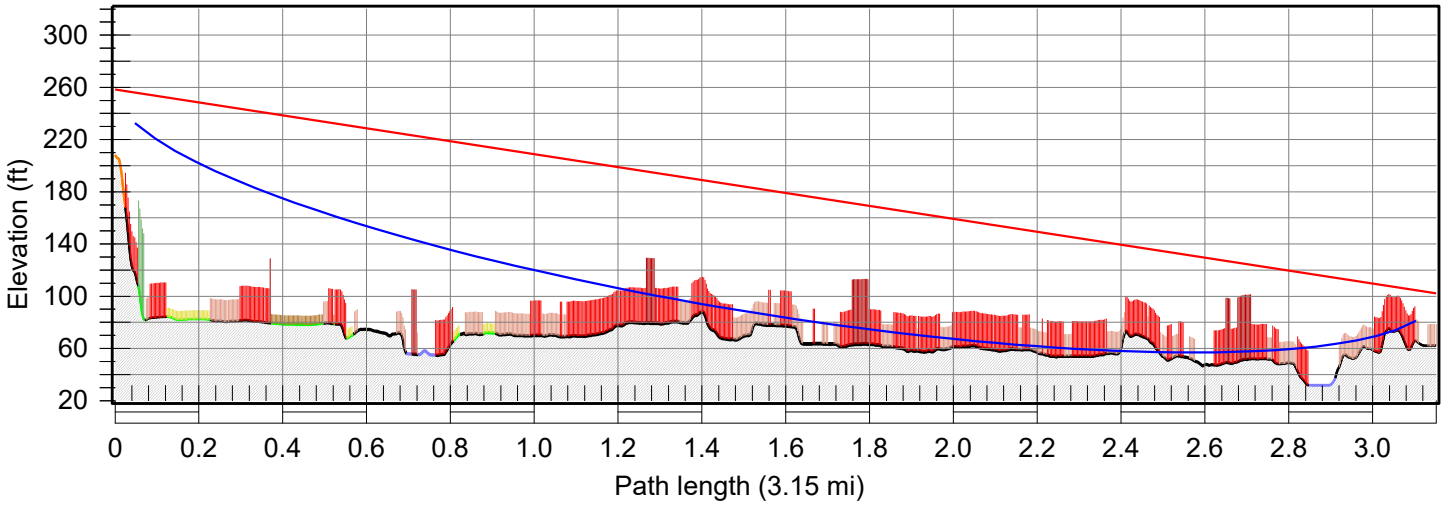


F = 450.00 MHz K = 1.33 %F1 = 100.0, 60.0

	Central Well	Viewpoint Booster
Latitude	47 12 31.35 N	47 11 02.54 N
Longitude	122 14 23.43 W	122 12 07.29 W
True azimuth (°)	133.73	313.76
Vertical angle (°)	0.48	-0.50
Elevation (ft)	66.99	208.17
Antenna model	Omni (TR)	Yagi (TR)
Antenna gain (dBi)	7.15	12.15
Antenna height (ft)	70.00	40.00
TX line model	LDF4-50A	LDF4-50A
TX line length (ft)	80.00	60.00
TX loss (dB)	1.71	1.41
RX loss (dB)	1.71	1.41
Diffraction loss	0.10	
Radio model	LN4-25KHz	LN4-25KHz
TX power (dBm)	34.00	34.00
ERP (dbm)	37.29	42.59

	Central Well	Viewpoint Booster
ERP (watts)	5.36	18.17
Receive signal (dBm)	-47.42	-47.42
Thermal fade margin (dB)	66.58	66.58
Effective fade margin (dB)	66.58	66.58
Annual 2 way multipath availability (%)	100.00000	
Annual 2 way multipath unavailability (sec)	0.00	

Multipath fading method - Vigants - Barnett
Rain fading method - Crane



Viewpoint Booster	
Latitude	47 11 02.54 N
Longitude	122 12 07.29 W
Azimuth	292.68°
Elevation	208 ft ASL
Antenna CL	50.0 ft AGL

Frequency (MHz) = 450.0
K = 1.33
%F1 = 100.00

West Well	
Latitude	47 12 05.81 N
Longitude	122 15 49.62 W
Azimuth	112.64°
Elevation	62 ft ASL
Antenna CL	40.0 ft AGL

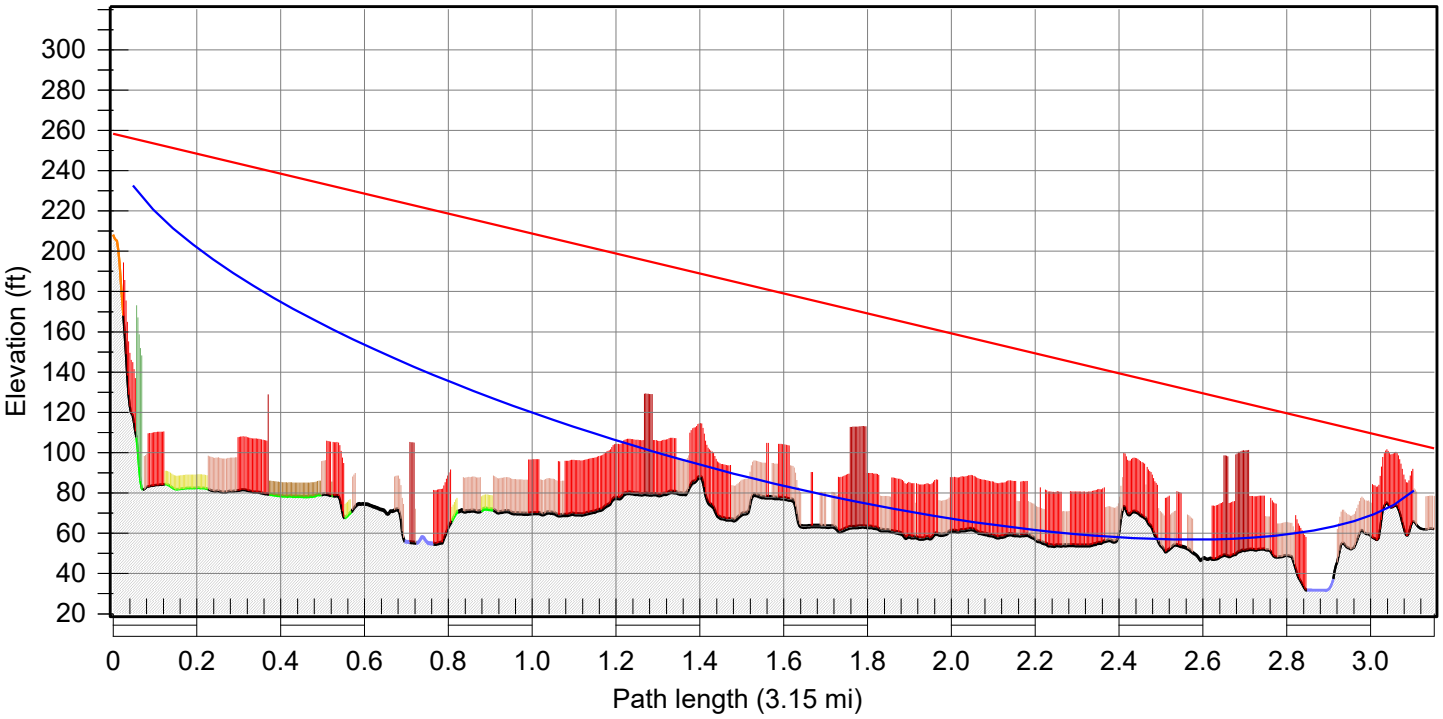
Transmission details (Viewpoint Booster-West Well.pl5)

	Viewpoint Booster	West Well
Latitude	47 11 02.54 N	47 12 05.81 N
Longitude	122 12 07.29 W	122 15 49.62 W
True azimuth (°)	292.68	112.64
Vertical angle (°)	-0.55	0.52
Elevation (ft)	208.17	61.99
Antenna model	Omni (TR)	Yagi (TR)
Antenna gain (dBi)	7.15	12.15
Antenna height (ft)	50.00	40.00
Antenna azimuth (°)	0.00	
TX line model	LDF4-50A	LDF4-50A
TX line unit loss (dB/100 ft)	1.51	1.51
TX line length (ft)	80.00	60.00
TX line loss (dB)	1.21	0.91
Connector loss (dB)	0.50	0.50
Frequency (MHz)	450.00	
Polarization	Vertical	
Path length (mi)	3.15	
Free space loss (dB)	99.63	
Atmospheric absorption loss (dB)	0.01	
Diffraction loss	3.95	
Net path loss (dB)	87.42	87.42
Radio model	LN4-25KHz	LN4-25KHz
Radio file name	ln4_25khz	ln4_25khz
TX power (dBm)	34.00	34.00
ERP (dbm)	37.29	42.59
ERP (watts)	5.36	18.17
RX threshold criteria	10-6 BER	10-6 BER
RX threshold level (dBm)	-114.00	-114.00
Receive signal (dBm)	-53.42	-53.42
Thermal fade margin (dB)	60.58	60.58
Dispersive fade margin (dB)	104.00	104.00
Dispersive fade occurrence factor	1.00	
Effective fade margin (dB)	60.58	60.58
Climatic factor	1.00	

	Viewpoint Booster	West Well
Terrain roughness (ft)	20.00	
C factor	3.29	
Average annual temperature (°F)	43.46	
Fade occurrence factor (Po)	1.159E-004	
Worst month multipath availability (%)	100.00000	100.00000
Worst month multipath unavailability (sec)	0.00	0.00
Annual multipath availability (%)	100.00000	100.00000
Annual multipath unavailability (sec)	0.00	0.00
Annual 2 way multipath availability (%)	100.00000	
Annual 2 way multipath unavailability (sec)	0.00	
Polarization	Vertical	
Rain region	Tacoma, Washington	

Multipath fading method - Vigants - Barnett
Rain fading method - Crane

Transmission summary (Viewpoint Booster-West Well.pl5)



F = 450.00 MHz K = 1.33 %F1 = 100.0, 60.0

	Viewpoint Booster	West Well
Latitude	47 11 02.54 N	47 12 05.81 N
Longitude	122 12 07.29 W	122 15 49.62 W
True azimuth (°)	292.68	112.64
Vertical angle (°)	-0.55	0.52
Elevation (ft)	208.17	61.99
Antenna model	Omni (TR)	Yagi (TR)
Antenna gain (dBi)	7.15	12.15
Antenna height (ft)	50.00	40.00
TX line model	LDF4-50A	LDF4-50A
TX line length (ft)	80.00	60.00
TX loss (dB)	1.71	1.41
RX loss (dB)	1.71	1.41
Diffraction loss	3.95	
Radio model	LN4-25KHz	LN4-25KHz
TX power (dBm)	34.00	34.00
ERP (dbm)	37.29	42.59
ERP (watts)	5.36	18.17

	Viewpoint Booster	West Well
Receive signal (dBm)	-53.42	-53.42
Thermal fade margin (dB)	60.58	60.58
Effective fade margin (dB)	60.58	60.58
Annual 2 way multipath availability (%)	100.00000	
Annual 2 way multipath unavailability (sec)	0.00	

Multipath fading method - Vigants - Barnett
Rain fading method - Crane