SAN ANTONIO WATER SYSTEM
CIBOLO CREEK SEWERSHED FLOW DIVERSION PROJECT
SAWS PROJECT NO. 11-2511
SOLICITATION NO. CO-00004
ADDENDUM NO. 1

July 13, 2015

This addendum, applicable to work designated above, is an amendment to the proposal and specification documents and as such shall be a part of and included in the Contract. Acknowledge receipt of this addendum by entering the addendum number and issue date in the spaces provided on all submitted copies of the proposal.

1.0 Addenda Purpose

The purpose of this addendum is to issue a revision to the Contract Documents, plans and specifications for Cibolo Creek Sewershed Flow Diversion Project (SAWS Job No. 11-2511).

2.0 Mandatory Pre-Proposal – Firms in Attendance

Invitation for Competitive Sealed Proposals – Proposals will not be accepted from any company not represented at the mandatory pre-proposal meeting held on July 8, 2015 at 9:00 a.m. The following list is a record of represented firms:

Firm Name
- Archer Western
- Rain for Rent
- Laughlin Thyssen
- Pronto Sandblasting Oil Field Services
- PPG Industries
- Pesado Construction
- Spiess Construction Company
- Glenmount Global Solutions

Firm Name
- Webber
- Shannon-Monk, Inc.
- DC Civil Construction
- Xylem Flygt Products
- Gajeske Inc.
- Alterman
- KLP Commercial

3.0 Modifications to Part I – CONTRACT DOCUMENTS

A. PRICE PROPOSAL – DELETE the Price Proposal in its entirety and REPLACE with the Price Proposal provided in Addendum No. 1.

B. SUPPLEMENTAL CONDITION, Article V. – Contract Responsibilities, Section 5.13.7., ADD the following at the end of this paragraph:

- "Acceptance of any schedule update and/or revision does not indicate any approval of the Contractor's proposed sequences and duration."

4.0 Modifications to Part II – TECHNICAL SPECIFICATIONS

A. SECTION 01120 – PART 3.01(A). DELETE and REPLACE with the following:

"1. Construct Force Main B and Lift Station B. Perform required testing and obtain SAWS approval for Force Main B.

2. Construct Gravity Main C, including the connection to the existing downstream gravity main. Perform required testing and obtain SAWS approval for Gravity Main C and Lift Station B.

3. Construct Force Main A and Lift Station A. Perform required testing and obtain SAWS approval for Force Main A and Lift Station A.

4. Construct all of Gravity Main B-2 except the connection to the existing upstream gravity main. Perform required testing and obtain SAWS approval for Gravity Main B-2. Make connection to the existing upstream gravity main.

5. Construct Gravity Main B-1. Perform required testing and obtain SAWS approval for Gravity Main B-1 before making connections to existing gravity mains.

6. Construct Gravity Main A except the connection to the existing upstream gravity main. Perform required testing and obtain SAWS approval for Gravity Main A. Make connection to the exiting upstream gravity main.

7. Abandon all existing mains as identified in the Plans."

B. SECTION 09900 – PART 2.01(A). DELETE the last sentence and REPLACE with the following:

- "Other acceptable manufacturers include Tnemec Co., Carboline Co., and PPG Industries."

C. SECTION 16921 APPENDIX B RADIO PATH REPORT – ADD the attached report after Specification 16921-Appendix A PLC I/O List.

5.0 Modifications to Part III – PLANS FOR CONSTRUCTION

A. SHEET E.6A – MISCELLANEOUS DETAILS #1 – REVISE Detail A-SCADA Antenna Sections note 3. with the following:

- "3. Estimated signal strength to Kings Mountain with an antenna of 50' for Lift Station A is -63dB and Lift Station B is -58dB."

6.0 Questions and Answers

Q1: Please tell me how Glenmount Global Solutions can get on the SAWS list of approved Process Control Systems Integrator (PCSI).

Response: If the qualification requirements of Technical Specification 16921, Part 1.1(B) are satisfied, then the Contractor (or Subcontractor) would be deemed an approved equal as defined in Part 2.02(D)(5).

Q2: PPG Industries is not listed as acceptable manufacturer in the 09900 Part 2 Products 2.01 Painting Section, however we are listed in the tanks coating specs like the Anderson Storage tank with the same products. What would be the process to be included in this coating specs?

Response: The list of acceptable manufacturers in Technical Specification 09900 has been updated. Refer to Part 4.0 of this Addendum.

Q3: Specification 16921 1.2 SUBMITTALS, A. Pre-submittal Conference, 1. Prior to the Submittal Process, the Application Services Provider (ASP) shall hold "workshops", in which the Engineer and Owner may "observe" the displays and control strategies prior to submitting database, trends, graphics, reports, and control strategies.

How many workshops are expected and please define the intent of the term "observe", i.e., provide more detail of what the Engineer and Owner is expecting to see/discuss, and how it will be accomplished, bearing in mind that the workshop(s) is/are to occur prior to the submittals.

Response: There will be one (1) workshop at SAWS Headquarters. The intent for this workshop is to present preliminary programming strategies and to discuss any issues with the Owner and Engineer prior to submittals. The PCSI will also present preliminary programming strategies, planned hardware and discuss any issues with the Owner and Engineer at this same workshop.

Q4: Specification 16921 3.01 COORDINATION MEETING, A. The ASP shall be responsible to coordinate the work with the PCSI and/or the Contractor. The ASP shall schedule and administer a minimum of two mandatory control system coordination meetings "as described herein." The ASP shall make arrangements for meetings and prepare/distribute an agenda a minimum of one week before the scheduled meeting date.

We are unable to find any descriptions of the meetings, please provide descriptions of the meetings.

Response: There will be one (1) meeting at SAWS Headquarters. The intent for this meeting is to present final programming strategies and to discuss any issues with the Owner and Engineer after submittals. The PCSI will also present

final programming strategies, final hardware and discuss any issues with the Owner and Engineer at this same meeting. Up to two (2) phone conference meetings should also be included. In addition, one (1) additional meeting at SAWS Headquarters could be scheduled.

Q5: Specification 16921 3.06 TOP END TRAINING, A. Manufacturer's Training: Describes training requirements for the SAWS existing HMI/SCADA system by the ASP subcontractor.

B. Programmable Logic Controller (PLC) Hardware and Software: Describes training requirements for the PLC by the PICS subcontractor.

C. Human Machine Interface (HMI): What is the intent of this training? It appears to be training for a new HMI system being provided rather than training for the existing SAWS HMI system (A. Manufacturer's Training above). Please clarify.

Response: The training will be for the existing SAWS HMI System.

Date

Signature

Kimley-Horn and Associates, Inc.
Texas Registered Engineering Firm F-928
601 NW Loop 410, Ste. 350
San Antonio, TX 78216

Cibolo Creek Sewershed Flow Diversion Project
Job No. 11-2511
Solicitation No. CO-00004

PRICE PROPOSAL

PROPOSAL OF _____, a corporation

a partnership consisting of _____

an individual doing business as _____

THE SAN ANTONIO WATER SYSTEM
Pursuant to Instructions and Invitations for Competitive Sealed Proposals, the undersigned proposes to furnish all labor, materials, equipment and supervision as specified and perform the work required for the following: The installation of two sanitary sewer lift stations (Lift Station A = 1.56 MGD) capacity and Lift Station B = 2.65 MGD capacity), including site work, wet wells, pumps, piping, valves, electrical and controls, SCADA including required programming for a turnkey system, antenna tower, and miscellaneous appurtenances. The installation of approximately 4,400 linear feet of 12-inch force main and 10,300 linear feet of 16-inch force main. The installation of approximately 9,600 linear feet of gravity sanitary sewer main ranging in diameter from 8-inches to 18-inches; San Antonio Water System Job No. 11-2511 in accordance with the Plans and Specifications for the following prices to wit:

BASE UNIT PRICES:

ITEM NO.	ITEM DESCRIPTION (Unit price to be written in words)	QTY.	UNIT	UNIT PRICE (Figures)	TOTAL (Figures)
A	**BASE BID ITEMS**				
202.1	Prime Coat (0.2 GAL / SY) _____Dollars and _____Cents Per Gallon	1,680	GAL		
203.1	Tack Coat (0.1 GAL / SY) _____Dollars and _____Cents Per Gallon	840	GAL		
205.4	2” Hot Mix Asphaltic Concrete Pavement “D” _____Dollars and _____Cents Per Square Yard	8,397	SY		
208.1	Salvaging, Hauling and Stockpiling Reclaimable Asphaltic Pavement (2” Depth) _____Dollars and _____Cents Per Square Yard	8,397	SY		
413.1	Flowable Fill (Low Strength) _____Dollars and _____Cents Per Cubic Yard	1,357	CY		
502.1	Concrete Sidewalks _____Dollars and _____Cents Per Square Yard	4	SY		

508	Chain Link Wire Fence _____Dollars and _____Cents Per Linear Foot	530	LF		
508	Relocating Wire Fence _____Dollars and _____Cents Per Linear Foot	1,222	LF		
511.3	Replacing with Hot Mix Asphaltic Concrete Pavement (2” Type D and 10” Type B) _____Dollars and _____Cents Per Square Yard	815	SY		
515.1	Topsoil _____Dollars and _____Cents Per Cubic Yard	9,091	CY		
520.1	Hydromulching (Residential or Commercial) _____Dollars and _____Cents Per Square Yard	81,777	SY		
530.1	Barricades, Signs, and Traffic Handling _____Dollars and _____Cents	1	LS	XXXX	
550.1	Trench Excavation Safety Protection _____Dollars and _____Cents Per Linear Foot	17,536	LF		
553.1	Erosion/Sedimentation Control _____Dollars and _____Cents	1	LS	XXXX	
828	12-Inch Plug Valve _____Dollars and _____Cents Per Item	4	EA		

828	16-Inch Plug Valve _____Dollars and _____Cents Per Item	8	EA		
841	Hydrostatic Pressure Test _____Dollars and _____Cents Per Item	3	EA		
846	Air Release Assembly _____Dollars and _____Cents Per Item	2	EA		
846	Dual Air Release Assembly _____Dollars and _____Cents	4	EA		
848	8-Inch SDR-26 (ASTM D-3034) PVC Sanitary Sewer Line (0’ to 6’) _____Dollars and _____Cents Per Linear Foot	143	LF		
848	8-Inch SDR-26 (ASTM D-3034) PVC Sanitary Sewer Line (6’ to 10’) _____Dollars and _____Cents Per Linear Foot	169	LF		
848	8-Inch SDR-26 (ASTM D-3034) PVC Sanitary Sewer Line (10’ to 14’) _____Dollars and _____Cents Per Linear Foot	452	LF		
848	8-Inch SDR-26 (ASTM D-3034) PVC Sanitary Sewer Line (14’ to 18’) _____Dollars and _____Cents Per Linear Foot	327	LF		
848	8-Inch SDR-26 (ASTM D-3034) PVC Sanitary Sewer Line (18’ to 22’) _____Dollars and _____Cents Per Linear Foot	643	LF		

848	8-Inch SDR-26 (ASTM D-3034) PVC Sanitary Sewer Line (22’ to 25’) _____Dollars and _____Cents Per Linear Foot	174	LF		
848	8-Inch SDR-26 (ASTM D-3034) PVC Sanitary Sewer Line (25’ to 30’) _____Dollars and _____Cents Per Linear Foot	639	LF		
848	15-Inch SDR-26 (ASTM D-3034) PVC Sanitary Sewer Line (0’ to 6’) _____Dollars and _____Cents Per Linear Foot	215	LF		
848	15-Inch SDR-26 (ASTM D-3034) PVC Sanitary Sewer Line (6’ to 10’) _____Dollars and _____Cents Per Linear Foot	2,455	LF		
848	15-Inch SDR-26 (ASTM D-3034) PVC Sanitary Sewer Line (10’ to 14’) _____Dollars and _____Cents Per Linear Foot	898	LF		
848	15-Inch SDR-26 (ASTM D-3034) PVC Sanitary Sewer Line (14’ to 18’) _____Dollars and _____Cents Per Linear Foot	302	LF		
848	15-Inch SDR-26 (ASTM D-3034) PVC Sanitary Sewer Line (18’ to 22’) _____Dollars and _____Cents Per Linear Foot	138	LF		
848	15-Inch SDR-26 (ASTM D-3034) PVC Sanitary Sewer Line (22’ to 25’) _____Dollars and _____Cents Per Linear Foot	86	LF		
848	18-Inch PS-115 (ASTM F-679) PVC Sanitary Sewer Line (6’ to 10’) _____Dollars and _____Cents Per Linear Foot	129	LF		

848	18-Inch PS-115 (ASTM F-679) PVC Sanitary Sewer Line (10’ to 14’) _____Dollars and _____Cents Per Linear Foot	198	LF		
848	18-Inch SDR-26 (ASTM D-3034) PVC Sanitary Sewer Line (14’ to 18’) _____Dollars and _____Cents Per Linear Foot	192	LF		
848	16-Inch DR-25 (AWWA C-905) PVC Sanitary Sewer Line (0’ to 6’) _____Dollars and _____Cents Per Linear Foot	82	LF		
848	16-Inch DR-25 (AWWA C-905) PVC Sanitary Sewer Line (6’ to 10’) _____Dollars and _____Cents Per Linear Foot	1,263	LF		
848	16-Inch DR-25 (AWWA C-905) PVC Sanitary Sewer Line (10’ to 14’) _____Dollars and _____Cents Per Linear Foot	43	LF		
848	16-Inch DR-25 (AWWA C-905) PVC Sanitary Sewer Line (14’ to 18’) _____Dollars and _____Cents Per Linear Foot	73	LF		
848	18-Inch DR-25 (AWWA C-905) PVC Sanitary Sewer Line (10’ to 14’) _____Dollars and _____Cents Per Linear Foot	12	LF		
848	18-Inch DR-25 (AWWA C-905) PVC Sanitary Sewer Line (14’ to 18’) _____Dollars and _____Cents Per Linear Foot	21	LF		

848	12-Inch DR-11 HDPE Force Main _____Dollars and _____Cents Per Linear Foot	3,749	LF		
848	16-Inch PE 3408 DR-11 HDPE Force Main _____Dollars and _____Cents Per Linear Foot	10,283	LF		
852	Sanitary Sewer Manhole (4’ Dia.) (0’ – 6’) _____Dollars and _____Cents Per Item	8	EA		
852	Sanitary Sewer Manhole (5’ Dia.) (0’ – 6’) _____Dollars and _____Cents Per Item	27	EA		
852	Sanitary Sewer Drop Manhole (5’ Dia.) (0’ – 6’) _____Dollars and _____Cents Per Item	4	EA		
852	Sanitary Sewer Manhole (6’ Dia.) (0’ – 6’) _____Dollars and _____Cents Per Item	3	EA		
852	Sanitary Sewer Drop Manhole (6’ Dia.) (0’ – 6’) _____Dollars and _____Cents Per Item	1	EA		
852	Lift Station Site Manhole (0’ – 6’) _____Dollars and _____Cents Per Item	1	EA		
850	Extra Depth Manhole (4’ Dia.) (>6’) _____Dollars and _____Cents Per Vertical Foot	96	VF		
851	Extra Depth Manhole (5’ Dia.) (>6’) _____Dollars and _____Cents Per Vertical Foot	197	VF		

852	Extra Depth Manhole (6’ Dia.) (>6’) _____Dollars and _____Cents Per Vertical Foot	57	VF		
856	Jacking, Boring, or Tunneling – 24” _____Dollars and _____Cents Per Linear Foot	560	LF		
856	Jacking, Boring, or Tunneling – 30” _____Dollars and _____Cents Per Linear Foot	620	LF		
856	Jacking, Boring, or Tunneling – 36” _____Dollars and _____Cents Per Linear Foot	300	LF		
856	12” Carrier Pipe for Jacking, Boring, Tunneling _____Dollars and _____Cents Per Linear Foot	560	LF		
856	16” Carrier Pipe for Jacking, Boring, Tunneling _____Dollars and _____Cents Per Linear Foot	620	LF		
856	18” Carrier Pipe for Jacking, Boring, Tunneling _____Dollars and _____Cents Per Linear Foot	300	LF		
856	Casing or Liner – 24” _____Dollars and _____Cents Per Linear Foot	560	LF		
856	Casing or Liner – 30” _____Dollars and _____Cents Per Linear Foot	620	LF		

856	Casing or Liner – 36” _____Dollars and _____Cents Per Linear Foot	300	LF		
858	Concrete Encasement, Cradles, Saddles and Collars _____Dollars and _____Cents Per Cubic Yard	126	CY		
862	Abandonment of Existing Manhole _____Dollars and _____Cents Per Item	11	EA		
862	Abandonment of Existing Sewer Main (8”) _____Dollars and _____Cents Per Linear Foot	123	LF		
862	Abandonment of Existing Sewer Manhole (15”) _____Dollars and _____Cents Per Linear Foot	2,938	LF		
862	Removal of Existing Sewer Main (12”) _____Dollars and _____Cents Per Linear Foot	180	LF		
864	Bypass Pumping _____Dollars and _____Cents	1	LS	XXXX	
866A	Sewer Main Television Inspection (8“ – 15”) _____Dollars and _____Cents Per Linear Foot	8716	LF		
866B	Sewer Main Television Inspection (18“ – 24”) _____Dollars and _____Cents Per Linear Foot	850	LF		
01270	Tree Mitigation / Protection _____Dollars and _____Cents	1	LS	XXXX	

3000	AC Plan Submittal and Removal _____Dollars and _____Cents	1	LS	XXXX	
01270	Lift Station A – Furnish all labor, materials, equipment, and superintendence required to construct the lift station as identified in these Contract Documents (defined further in Technical Specification 01270), complete in place. _____Dollars and _____Cents	1	LS	XXXX	
01270	Lift Station B – Furnish all labor, materials, equipment, and superintendence required to construct the lift station as identified in these Contract Documents (defined further in Technical Specification 01270), complete in place. _____Dollars and _____Cents	1	LS	XXXX	
01270	SCADA Programming – Work required for the integration of the lift stations' programming based on upgraded equipment and instrumentation components into SAWS existing SCADA System in accordance with the Contract Documents (defined further in Technical Specification 01270), complete in place. _____Dollars and _____Cents	1	LS	XXXX	
BID SUMMARY LINE ITEM "A" **SUBTOTAL BASE BID**				**$**_____	
01270	**Permitting Allowance** – Allowance for the permitting fees associated with the Project. This shall include furnishing all labor, materials, tools, equipment and incidentals required to obtain all necessary permits in accordance with the Contract Documents (defined further in Technical Specification 01270), complete in place. Contractor to pay and be reimbursed actual amount by SAWS. _____Dollars and _____Cents	1	LS	$10,000.00	

01270	**CPS Energy Allowance** – Allowance for any fees from CPS Energy associated with electrical improvements for the Project. Contractor to pay and be reimbursed actual amount by SAWS. _____Dollars and _____Cents	1	LS	$10,000.00	
01270	**Start-up/Commissioning Allowance** – Allowance for unforeseen construction-related items (not included in the Project scope) associated with the pre-start up, start-up, and commissioning services for the Project. This shall include furnishing all labor, materials, tools, equipment and incidentals required to construct these project-related items at SAWS request. Work under this pay item will be negotiated on an individual basis for each out-of-scope item requested by the Owner. _____Dollars and _____Cents	1	LS	$50,000.00	
01270	**Subsurface Utility Exploration Allowance** – Allowance the exploration and location of existing utilities, by a means of hydro-excavation or conventional excavation, within the project limits that may parallel or cross the proposed alignment and require exposure beyond what is considered normal excavation and exposure for utility location. This item shall include the furnishing of labor, materials, tools, equipment and incidentals required to expose and determine the location of existing utilities. _____Dollars and _____Cents	1	LS	$10,000.00	
100	Mobilization and Demobilization: This item includes project move-in and move-out of personnel and equipment, for work shall include furnishing all labor, materials, tools, equipment, and incidentals required to mobilize, demobilize, bond and insure the Work for the *CIBOLO CREEK SEWERSHED FLOW DIVERSION PROJECT*, in accordance with the contract documents, complete in place. Percent of the Line Item "A", Subtotal Base Bid written in words _____Percent (Maximum of 10% Line Item "A" Subtotal Base Bid Amount) _____Dollars and _____Cents	1	LS	XXXX	

101	Preparation of ROW: This item includes removing and disposing of all obstructions from the right-of-way and from designated easements where removal of such obstructions is not otherwise provided in the Drawings and Specifications. Work shall include furnishing all labor, materials, tools, equipment, incidentals required, complete in place. Percent of the Line Item "A", Subtotal Base Bid written in words _____Percent (Maximum of 5% Line Item "A" Subtotal Base Bid Amount) _____Dollars and _____Cents	1	LS	XXXX	

Mobilization and Demobilization lump sum bid shall be limited to a maximum 10% of the Line Item "A" Sub-total Base Bid amount. Preparation of ROW lump sum bid shall be limited to a maximum of 5% of the Line Item "A" Sub-total Base Bid amount. The Line Item "A" Sub-total Base Bid is defined as all bid items **EXCLUDING** Item 100, Mobilization and Demobilization, Item 101, Preparation of ROW, and Allowances. **In the event of a discrepancy between percentage and dollar amount shown for Mobilization and Demobilization and Preparation of ROW bid items the written percentage will govern. If the percentage written exceeds the allowable maximum stated for mobilization and or preparation of ROW, SAWS reserves the right to cap the amount at the percentages shown and adjust the extensions of the bid items accordingly.**

TOTAL BID AMOUNT (LINE ITEM "A", MOBILIZATION, DEMOBILIZATION, PREPARATION OF ROW & ALLOWANCES)

$_____Dollars and

_____Cents

RESPONDENT'S SIGNATURE & TITLE

FIRM'S NAME (TYPE OR PRINT)

FIRM'S ADDRESS

FIRM'S PHONE NO./FAX NO.

FIRM'S E-MAIL ADDRESS

The Contractor herein acknowledges receipt of the following Addendum Nos. _____
OWNER RESERVES THE RIGHT TO ACCEPT THE OVERALL MOST RESPONSIBLE PRICE PROPOSAL.

1. The Offeror offers to construct the Project in accordance with the Contract Documents for the contract price and to complete the project within **390 calendar days** after the start date, as set forth in the Authorization to Proceed. The Offeror understands and accepts the provisions of the Contract Documents relating to liquidated damages of the Project if not completed on time.

2. The Undersigned agrees to commence work on a date to be specified in a written "Authorization to Proceed", and to substantially complete the work in **360 calendar days** and complete all the work in **390 calendar days** from that date.

Specification 16921
Appendix B
Radio Path Report

GRUBB ENGINEERING, INC.
ELECTRICAL POWER SYSTEMS
DESIGN AND TESTING

TBPE #3904

July 09, 2015

Mr. Ryan Sowa
Kimley-Horn and Associates Inc.
601 NW Loop 410, Suite 350
San Antonio, TX 78216

Ref: Radio Path Study for Cibolo Creek Sewershed Flow Diversion Project Lift Stations A & B

Mr. Sowa,

A radio path study report is vital when constructing a wireless telecommunication system. A clear line-of-sight does not guarantee a dependable communication link. Radio attenuation can influence the reliability and quality of the radio wave. Radio attenuation can arise from a variety of effects such as free-space loss, refraction, reflection, absorption and/or atmospheric loss. Free-space path loss is the loss that is encountered from an unobstructed clear line-of-sight, over a given distance. Signal refraction occurs when a radio wave crosses from one medium to another. Signal reflection occurs when the radio wave bounces off of obstacles. A radio path study report can ensure that a reliable communication link can be established over a given area.

There are two procedures for generating a radio path study report. The first step involves implementing computer software to generate a path profile. With the use of topographical values, the software then approximates the expected path attenuation. The results from the software-based study do not represent attenuation caused by clutter, absorption and/or atmospheric loss. When the results of the computer based radio path showed a clear line of sight and strong received signal between the two antennas then we proceed to the second step. The second step involves implementing radios to establish a link from the base or repeater site to the designated point. The physical study values are then documented to confirm the results of the computer-based study.

Grubb Engineering conducted computer-based studies for Lift Stations A and B to the following repeater sites:

1. North East Service Center (NESC, planned installation at Naco Pump Station)
2. Echo Mountain
3. Foster Tower
4. Wayland Tank
5. Hildebrand Tank
6. Northridge Tank
7. Cibolo Tank
8. New World Tank.

2727 N. St. Mary's St. * San Antonio, Texas 78212 * Phone: (210) 658-7250 * Fax (210) 658-9805

Ref: Radio Path Study for Cibolo Creek Sewershed Flow Diversion Project
Lift Stations A & B

These repeater sites were chosen since they utilize the Trio radio. None of these paths yielded a viable signal strength.Therefore, we would not recommend performing a physical study to verify any of these links.

Based on these results Kings Mountain (Stahl Road) Repeater is again proposed as the repeater for Lift Stations A & B. As Kings Mountain Repeater is currently equipped with a TransNET serial- type radio, the proposed radios for the lift stations are TransNET serial-type radios. The physical studies completed in 2011 and 2015 utilized Kings Mountain with viable signal strengths at antenna heights of 30 feet, 40 feet and 50 feet. SAWS preference for a 50 foot antenna mast at both sites will work with a signal strength of -63dB at Lift Station A and -58dB at Lift Station B.

Bridgett De Leon
Graduate Engineer
Grubb Engineer, Inc.

TABLE OF CONTENTS

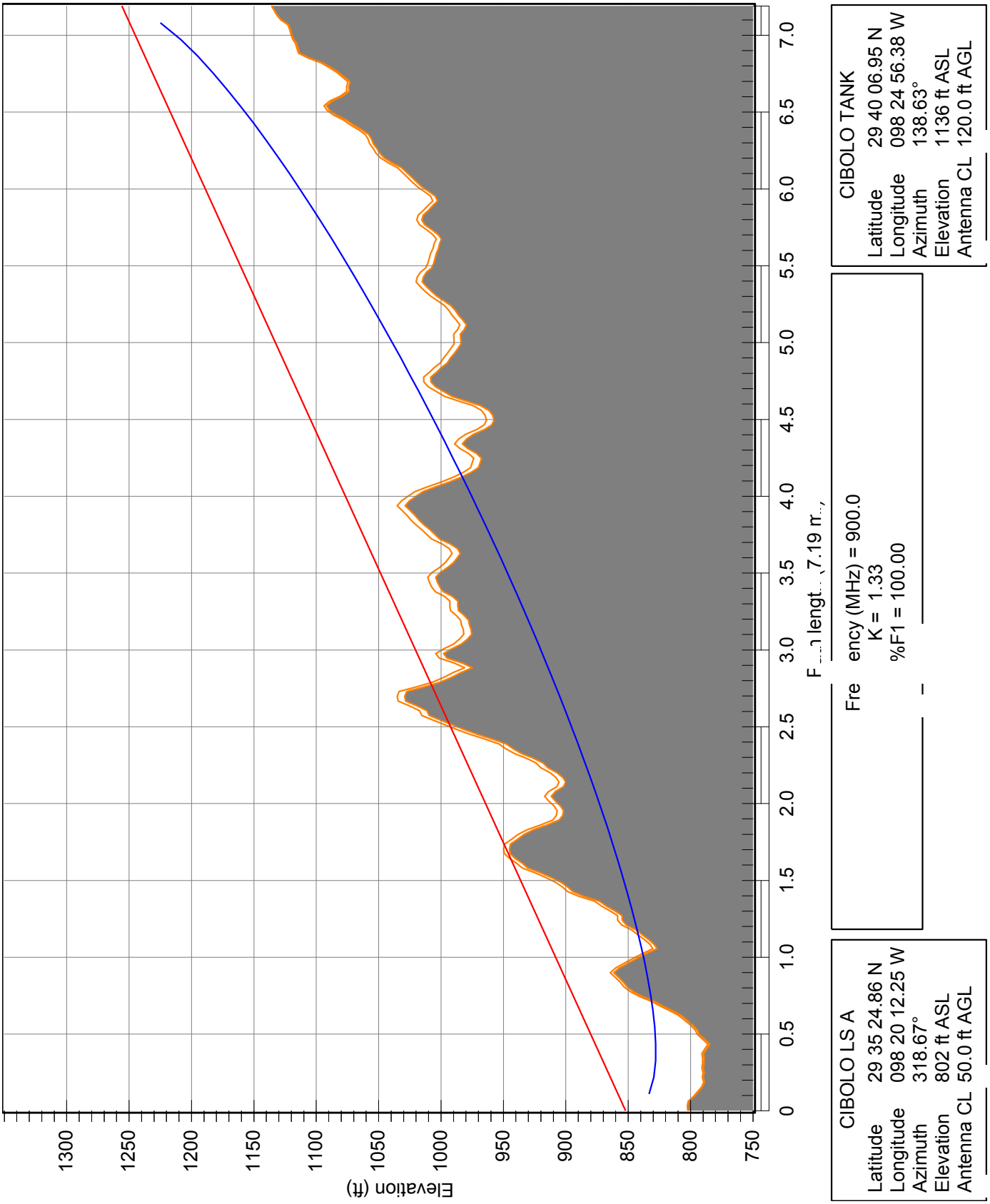
Background for Radio Path Studies

A radio path survey report is vital when constructing a wireless communication system. A clear line-of-sight does not always guarantee a dependable communication link. Radio attenuation can influence the reliability and quality of the radio wave. Radio attenuation can arise from a variety of effects such as free-space loss, refraction, reflection, absorption and/or atmospheric loss. Depending on the power and the transmit and receive frequencies of the radio, Free-space loss is signal attenuation that occurs over an unobstructed distance. Signal refraction is attenuation that occurs when the radio wave crosses from one medium to another. Signal reflection occurs when the radio wave bounces off of obstacles. Signal absorption occurs when the radio wave becomes entrapped in a medium.

A radio path survey report can ensure that a reliable communication link can be established over a given area. There are two procedures required for generating a radio path survey report. The first step involves implementing computer-based software to simulate a path profile. With the help of topographical values, the software approximates the expected path attenuation. Because the software can only estimate path attenuation a second step must be implemented. The second step involves applying live radios to establish a link from the proposed site to the designated point. The physical study values are then documented to confirm the results of the computer-based study.

APPENDIX A

LIFT STATION A
COMPUTER-BASE
RADIO PATH STUDY
AND ELEVATION PLOTS


Elevation (ft)
1300
1250
1200
1150
1100
1050
1000
950
900
850
800
750
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
F ...1 lengt...\7.19 m...
Fre ency (MHz) = 900.0
K = 1.33
%F1 = 100.00
CIBOLO LS A
Latitude 29 35 24.86 N
Longitude 098 20 12.25 W
Azimuth 318.67°
Elevation 802 ft ASL
Antenna CL 50.0 ft AGL
CIBOLO TANK
Latitude 29 40 06.95 N
Longitude 098 24 56.38 W
Azimuth 138.63°
Elevation 1136 ft ASL
Antenna CL 120.0 ft AGL

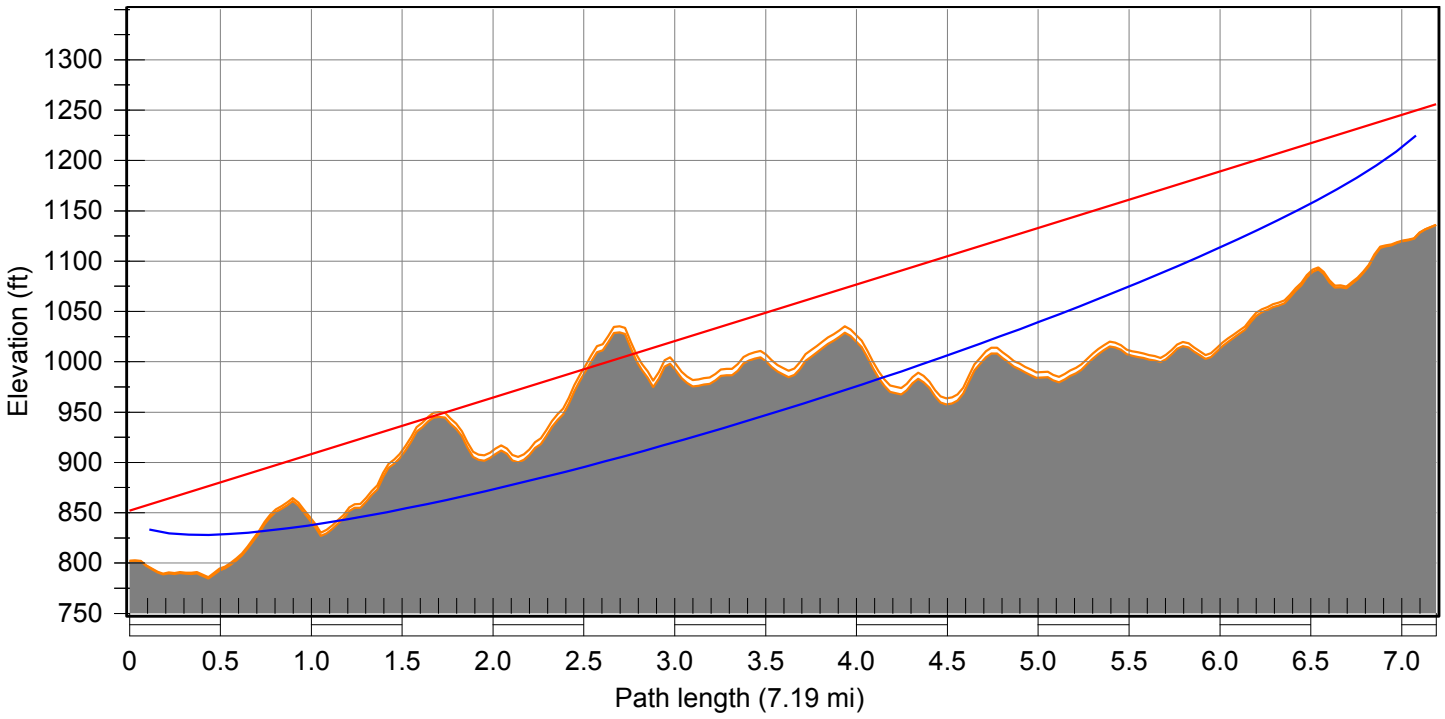
Transmission details (CIBOLO LS A-CIBOLO TANK.pl5)

	CIBOLO LS A	CIBOLO TANK
Latitude	29 35 24.86 N	29 40 06.95 N
Longitude	098 20 12.25 W	098 24 56.38 W
True azimuth (°)	318.67	138.63
Vertical angle (°)	0.70	-0.57
Elevation (ft)	802.00	1135.72
Antenna model	TY-900 (TR)	OGB900 (TR)
Antenna gain (dBi)	12.00	11.00
Antenna height (ft)	50.00	120.00
TX line model	LMR 600	LMR 900
TX line unit loss (dB/100 ft)	7.30	4.90
TX line length (ft)	75.00	150.00
TX line loss (dB)	5.48	7.35
Connector loss (dB)	0.25	0.25
Frequency (MHz)	900.00	
Polarization	Vertical	
Path length (mi)	7.19	
Free space loss (dB)	112.82	
Atmospheric absorption loss (dB)	0.06	
Diffraction loss	12.47	
Net path loss (dB)	115.67	115.67
Radio model	Trio J-Series	Trio J-Series
TX power (dBm)	30.00	30.00
Emission designator	36 dBm	36 dBm
EIRP (dBm)	36.27	33.40
RX threshold criteria	5.62	5.62
RX threshold level (dBm)	-92.00	-92.00
Receive signal (dBm)	-85.67	-85.67
Thermal fade margin (dB)	6.33	6.33
Dispersive fade occurrence factor	1.00	
Effective fade margin (dB)	6.33	6.33
Climatic factor	1.00	
Terrain roughness (ft)	32.71	
C factor	1.74	
Average annual temperature (°F)	67.83	
Fade occurrence factor (Po)	1.452E-003	

	CIBOLO LS A	CIBOLO TANK
Worst month multipath availability (%)	99.96617	99.96617
Worst month multipath unavailability (sec)	889.13	889.13
Annual multipath availability (%)	99.98853	99.98853
Annual multipath unavailability (sec)	3618.74	3618.74
Annual 2 way multipath availability (%)	99.97705	
Annual 2 way multipath unavailability (sec)	7237.48	

Multipath fading method - Vigants - Barnett

Transmission summary (CIBOLO LS A-CIBOLO TANK.pl5)

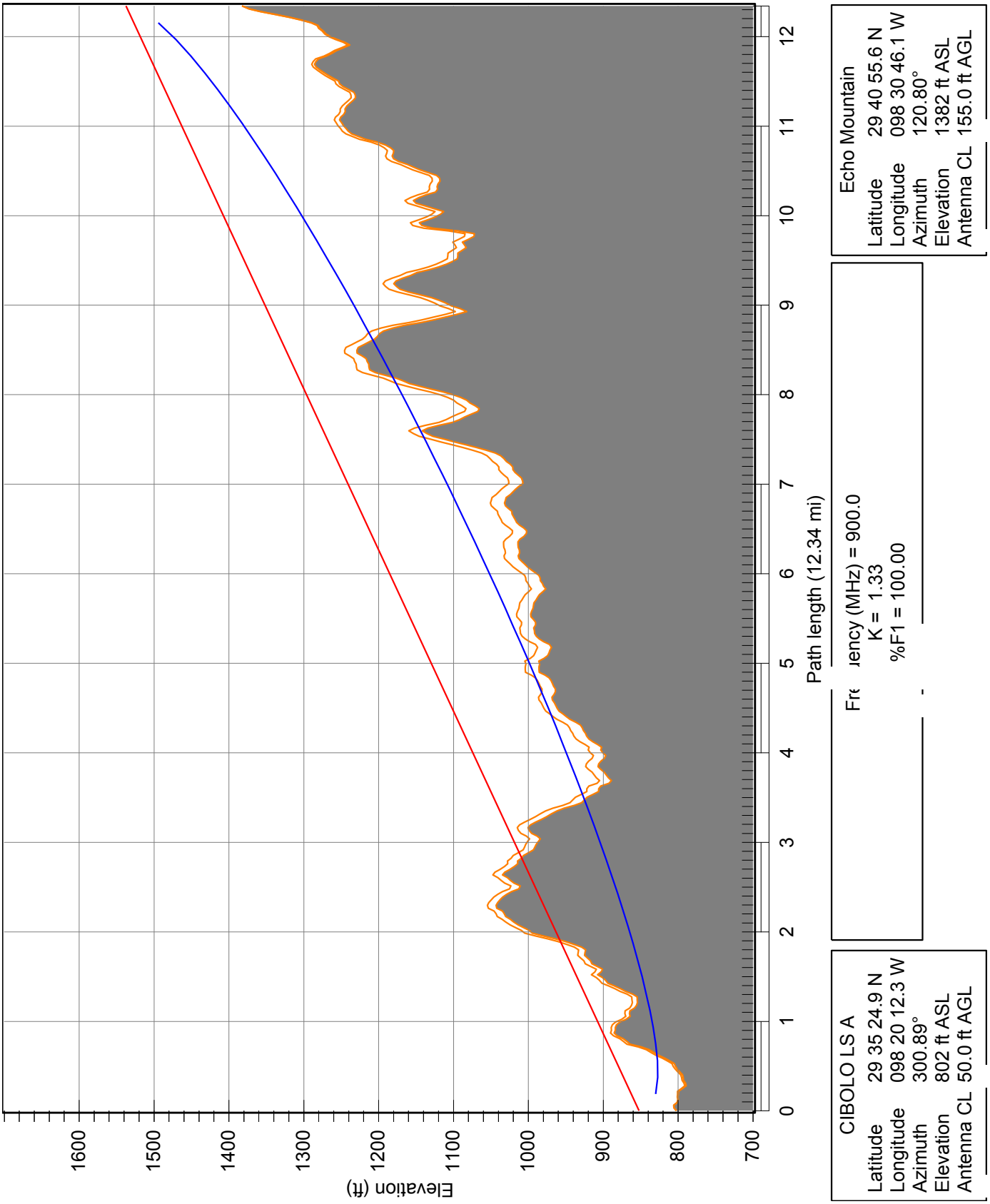


F = 900.00 MHz K = 1.33 %F1 = 100.0, 60.0

	CIBOLO LS A	CIBOLO TANK
Latitude	29 35 24.86 N	29 40 06.95 N
Longitude	098 20 12.25 W	098 24 56.38 W
True azimuth (°)	318.67	138.63
Vertical angle (°)	0.70	-0.57
Elevation (ft)	802.00	1135.72
Antenna model	TY-900 (TR)	OGB900 (TR)
Antenna gain (dBi)	12.00	11.00
Antenna height (ft)	50.00	120.00
TX line model	LMR 600	LMR 900
TX line length (ft)	75.00	150.00
Diffraction loss	12.47	
Radio model	Trio J-Series	Trio J-Series
TX power (dBm)	30.00	30.00
EIRP (dBm)	36.27	33.40
Receive signal (dBm)	-85.67	-85.67
Thermal fade margin (dB)	6.33	6.33
Effective fade margin (dB)	6.33	6.33

	CIBOLO LS A	CIBOLO TANK
Annual 2 way multipath availability (%)	99.97705	
Annual 2 way multipath unavailability (sec)	7237.48	

Multipath fading method - Vigants - Barnett


Elevation (ft)
1600
1500
1400
1300
1200
1100
1000
900
800
700
0 1 2 3 4 5 6 7 8 9 10 11 12
Path length (12.34 mi)
CIBOLO LS A
Latitude 29 35 24.9 N
Longitude 098 20 12.3 W
Azimuth 300.89°
Elevation 802 ft ASL
Antenna CL 50.0 ft AGL
Frequency (MHz) = 900.0
K = 1.33
%F1 = 100.00
Echo Mountain
Latitude 29 40 55.6 N
Longitude 098 30 46.1 W
Azimuth 120.80°
Elevation 1382 ft ASL
Antenna CL 155.0 ft AGL

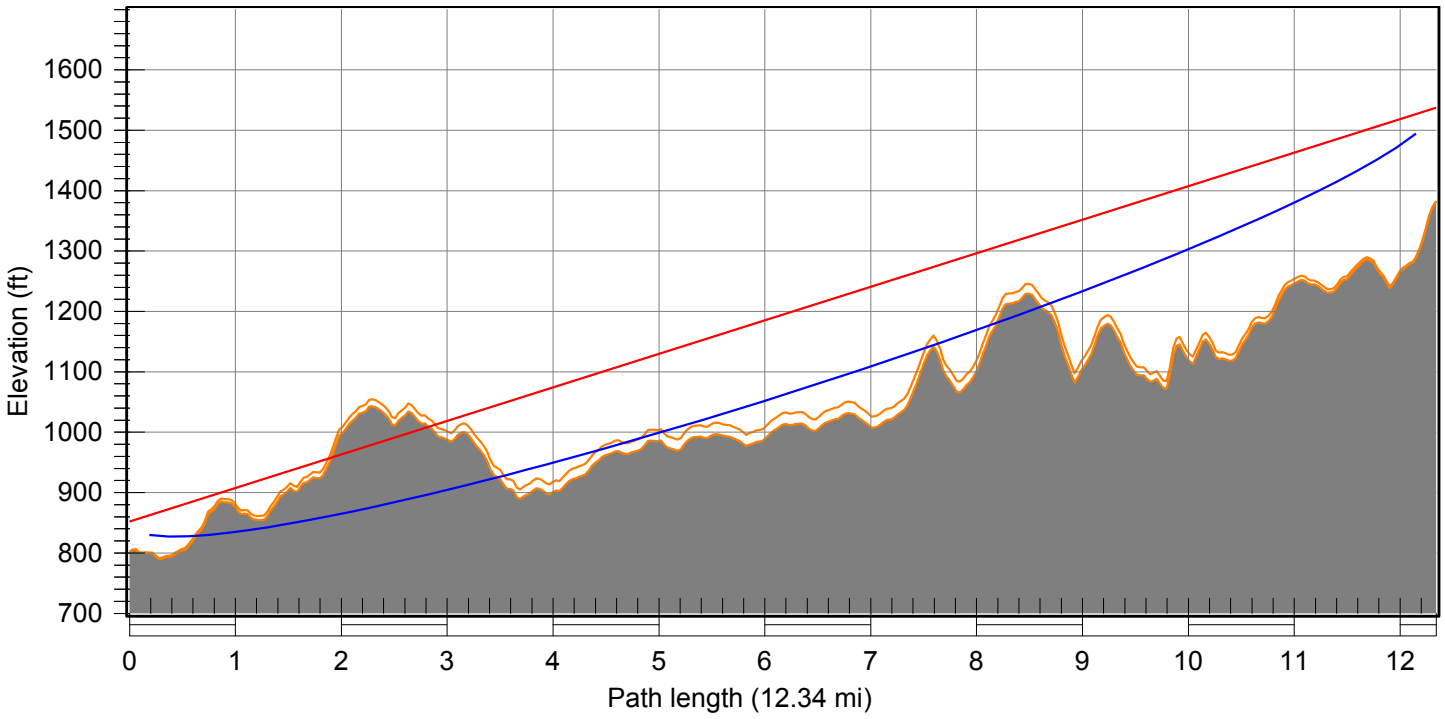
Transmission details (CIBOLO LS A-Echo Mountain.pl5)

	CIBOLO LS A	Echo Mountain
Latitude	29 35 24.86 N	29 40 55.56 N
Longitude	098 20 12.25 W	098 30 46.08 W
True azimuth (°)	300.89	120.80
Vertical angle (°)	0.90	-0.59
Elevation (ft)	802.00	1382.19
Antenna model	TY-900 (TR)	OGB900 (TR)
Antenna gain (dBi)	12.00	11.00
Antenna height (ft)	50.00	155.00
TX line model	LMR-600	LMR-900
TX line unit loss (dB/100 ft)	7.30	4.90
TX line length (ft)	50.00	50.00
TX line loss (dB)	3.65	2.45
Connector loss (dB)	0.25	0.25
Frequency (MHz)	900.00	
Polarization	Vertical	
Path length (mi)	12.34	
Free space loss (dB)	117.51	
Atmospheric absorption loss (dB)	0.10	
Diffraction loss	17.44	
Net path loss (dB)	118.65	118.65
Radio model	Trio J-Series	Trio J-Series
TX power (dBm)	30.00	30.00
Emission designator	36 dBm	36 dBm
EIRP (dBm)	38.10	38.30
RX threshold criteria	5.62	5.62
RX threshold level (dBm)	-92.00	-92.00
Receive signal (dBm)	-88.65	-88.65
Thermal fade margin (dB)	3.35	3.35
Dispersive fade occurrence factor	1.00	
Effective fade margin (dB)	3.35	3.35
Climatic factor	1.00	
Terrain roughness (ft)	52.87	
C factor	0.93	
Average annual temperature (°F)	67.76	
Fade occurrence factor (Po)	3.933E-003	

	CIBOLO LS A	Echo Mountain
Worst month multipath availability (%)	99.81809	99.81809
Worst month multipath unavailability (sec)	4780.56	4780.56
Annual multipath availability (%)	99.93837	99.93837
Annual multipath unavailability (sec)	19436.56	19436.56
Annual 2 way multipath availability (%)	99.87673	
Annual 2 way multipath unavailability (sec)	38873.13	

Multipath fading method - Vigants - Barnett

Transmission summary (CIBOLO LS A-Echo Mountain.pl5)

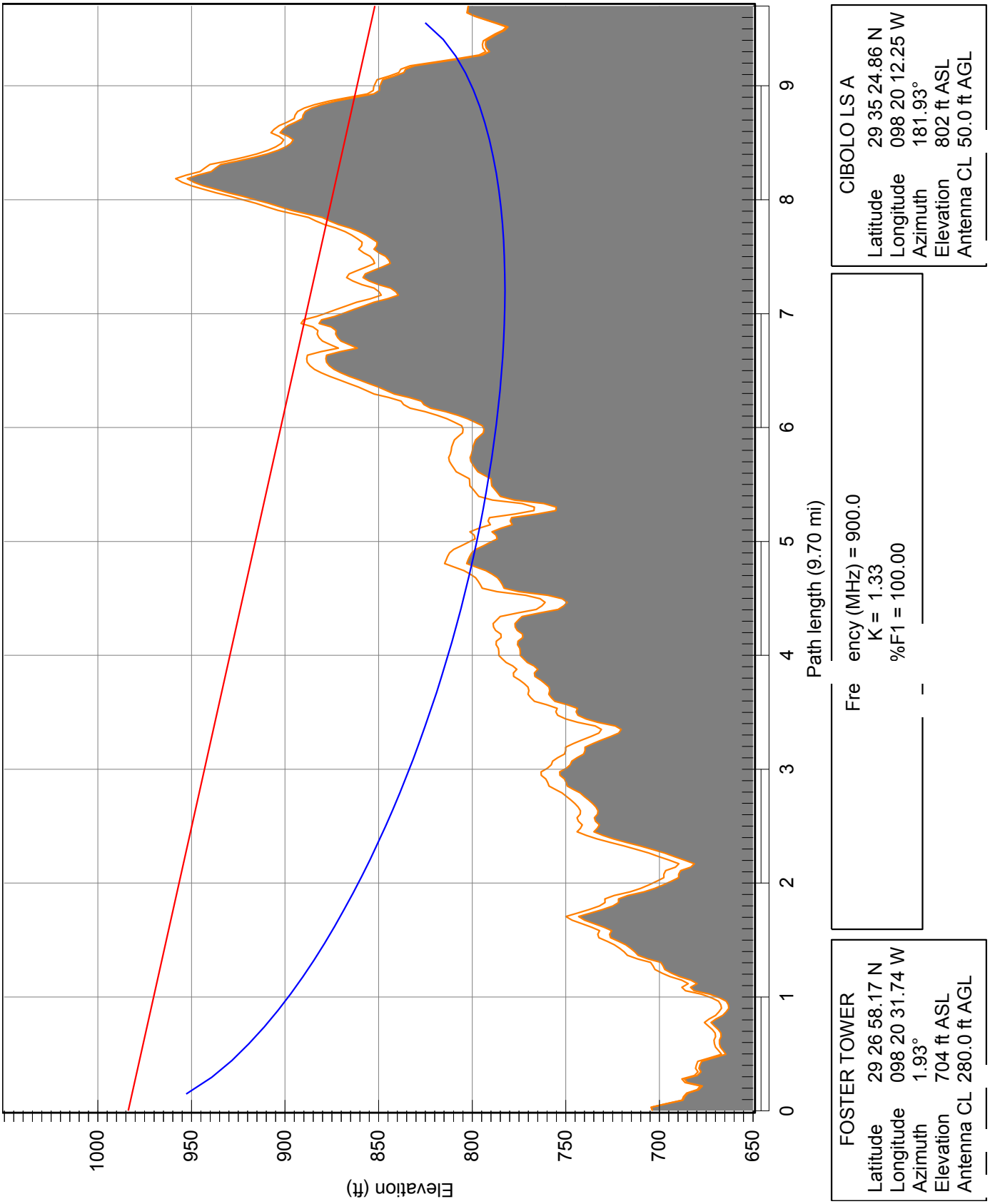


F = 900.00 MHz K = 1.33 %F1 = 100.0, 60.0

	CIBOLO LS A	Echo Mountain
Latitude	29 35 24.86 N	29 40 55.56 N
Longitude	098 20 12.25 W	098 30 46.08 W
True azimuth (°)	300.89	120.80
Vertical angle (°)	0.90	-0.59
Elevation (ft)	802.00	1382.19
Antenna model	TY-900 (TR)	OGB900 (TR)
Antenna gain (dBi)	12.00	11.00
Antenna height (ft)	50.00	155.00
TX line model	LMR-600	LMR-900
TX line length (ft)	50.00	50.00
Diffraction loss	17.44	
Radio model	Trio J-Series	Trio J-Series
TX power (dBm)	30.00	30.00
EIRP (dBm)	38.10	38.30
Receive signal (dBm)	-88.65	-88.65
Thermal fade margin (dB)	3.35	3.35
Effective fade margin (dB)	3.35	3.35

	CIBOLO LS A	Echo Mountain
Annual 2 way multipath availability (%)	99.87673	
Annual 2 way multipath unavailability (sec)	38873.13	

Multipath fading method - Vigants - Barnett

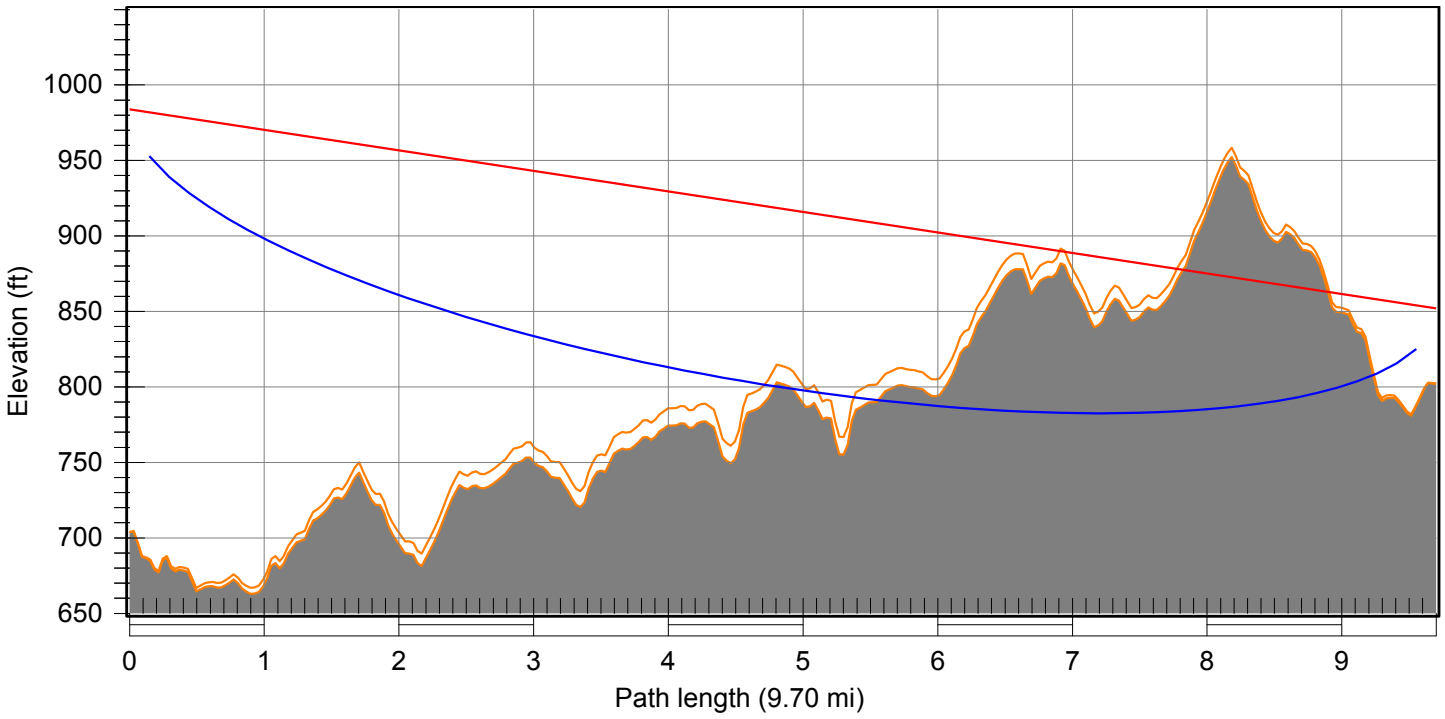

Elevation (ft)
1000
950
900
850
800
750
700
650
0
1
2
3
4
5
6
7
8
9
Path length (9.70 mi)
Fre ency (MHz) = 900.0
K = 1.33
%F1 = 100.00
FOSTER TOWER
Latitude 29 26 58.17 N
Longitude 098 20 31.74 W
Azimuth 1.93°
Elevation 704 ft ASL
Antenna CL 280.0 ft AGL
CIBOLO LS A
Latitude 29 35 24.86 N
Longitude 098 20 12.25 W
Azimuth 181.93°
Elevation 802 ft ASL
Antenna CL 50.0 ft AGL

Transmission details (FOSTER TOWER-CIBOLO LS A.pl5)

	FOSTER TOWER	CIBOLO LS A
Latitude	29 26 58.17 N	29 35 24.86 N
Longitude	098 20 31.74 W	098 20 12.25 W
True azimuth (°)	1.93	181.93
Vertical angle (°)	-0.09	0.71
Elevation (ft)	703.69	802.00
Antenna model	OGB9-915N (TR)	TY-900 (TR)
Antenna file name	ogb9-915n_0902-mhz_vpol	ty-900_0925-mhz_hpol
Antenna gain (dBi)	11.15	12.15
Antenna height (ft)	280.00	50.00
TX line model	LMR-900	LMR-600
TX line unit loss (dB/100 ft)	4.90	7.30
TX line length (ft)	300.00	75.00
TX line loss (dB)	14.70	5.48
Connector loss (dB)	0.25	0.25
Frequency (MHz)	900.00	
Polarization	Vertical	
Path length (mi)	9.70	
Free space loss (dB)	115.42	
Atmospheric absorption loss (dB)	0.08	
Diffraction loss	22.41	
Net path loss (dB)	135.28	135.28
Radio model	Trio J-Series	Trio J-Series
TX power (dBm)	30.00	30.00
Emission designator	36 dBm	36 dBm
EIRP (dBm)	26.20	36.42
RX threshold criteria	5.62	5.62
RX threshold level (dBm)	-92.00	-92.00
Receive signal (dBm)	-105.28	-105.28
Thermal fade margin (dB)	-13.28	-13.28
Dispersive fade occurrence factor	1.00	
Climatic factor	1.00	
Terrain roughness (ft)	20.19	
C factor	3.25	
Average annual temperature (°F)	68.17	
Fade occurrence factor (Po)	6.676E-003	

Multipath fading method - Vigants - Barnett

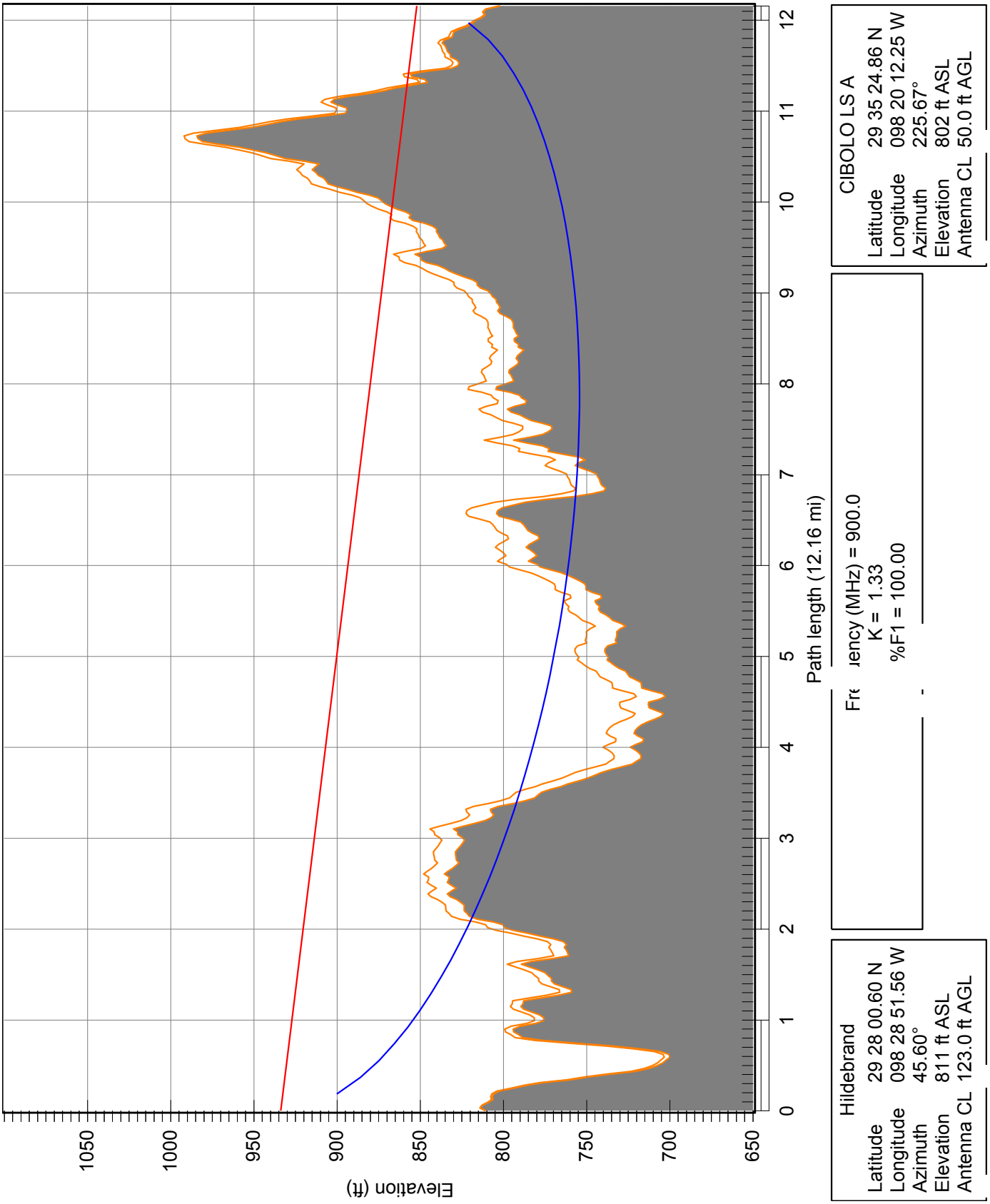
Transmission summary (FOSTER TOWER-CIBOLO LS A.pl5)



F = 900.00 MHz K = 1.33 %F1 = 100.0, 60.0

	FOSTER TOWER	CIBOLO LS A
Latitude	29 26 58.17 N	29 35 24.86 N
Longitude	098 20 31.74 W	098 20 12.25 W
True azimuth (°)	1.93	181.93
Vertical angle (°)	-0.09	0.71
Elevation (ft)	703.69	802.00
Antenna model	OGB9-915N (TR)	TY-900 (TR)
Antenna gain (dBi)	11.15	12.15
Antenna height (ft)	280.00	50.00
TX line model	LMR-900	LMR-600
TX line length (ft)	300.00	75.00
Diffraction loss	22.41	
Radio model	Trio J-Series	Trio J-Series
TX power (dBm)	30.00	30.00
EIRP (dBm)	26.20	36.42
Receive signal (dBm)	-105.28	-105.28
Thermal fade margin (dB)	-13.28	-13.28

Multipath fading method - Vigants - Barnett

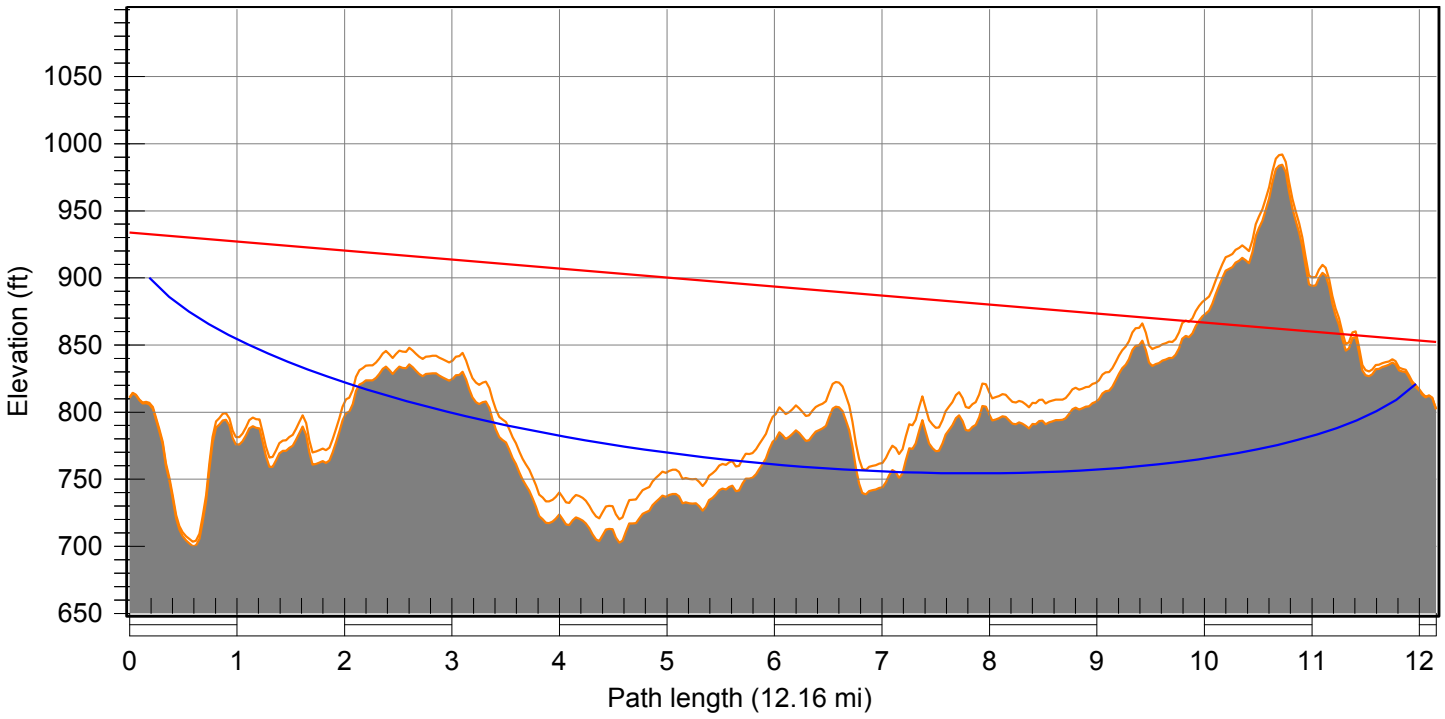

Elevation (ft)
1050
1000
950
900
850
800
750
700
650
0 1 2 3 4 5 6 7 8 9 10 11 12
Path length (12.16 mi)
Hildebrand
Latitude 29 28 00.60 N
Longitude 098 28 51.56 W
Azimuth 45.60°
Elevation 811 ft ASL
Antenna CL 123.0 ft AGL
Frequency (MHz) = 900.0
K = 1.33
%F1 = 100.00
CIBOLO LS A
Latitude 29 35 24.86 N
Longitude 098 20 12.25 W
Azimuth 225.67°
Elevation 802 ft ASL
Antenna CL 50.0 ft AGL

Transmission details (Hildebrand-CIBOLO LS A.pl5)

	Hildebrand	CIBOLO LS A
Latitude	29 28 00.60 N	29 35 24.86 N
Longitude	098 28 51.56 W	098 20 12.25 W
True azimuth (°)	45.60	225.67
Vertical angle (°)	-0.01	1.00
Elevation (ft)	810.70	802.00
Antenna model	OGB9-915N (TR)	TY-900 (TR)
Antenna file name	ogb9-915n_0902-mhz_vpol	ty-900_0925-mhz_hpol
Antenna gain (dBi)	11.15	12.15
Antenna height (ft)	123.00	50.00
TX line model	LMR-900	LMR-600
TX line unit loss (dB/100 ft)	4.30	7.90
TX line length (ft)	150.00	75.00
TX line loss (dB)	6.45	5.92
Connector loss (dB)	0.25	0.25
Frequency (MHz)	900.00	
Polarization	Vertical	
Path length (mi)	12.16	
Free space loss (dB)	117.38	
Atmospheric absorption loss (dB)	0.09	
Diffraction loss	25.67	
Net path loss (dB)	132.72	132.72
Radio model	Trio J-Series	Trio J-Series
TX power (dBm)	30.00	30.00
Emission designator	36 dBm	36 dBm
EIRP (dBm)	34.45	35.97
RX threshold criteria	5.62	5.62
RX threshold level (dBm)	-92.00	-92.00
Receive signal (dBm)	-102.72	-102.72
Thermal fade margin (dB)	-10.72	-10.72
Dispersive fade occurrence factor	1.00	
Climatic factor	1.00	
Terrain roughness (ft)	50.12	
C factor	1.00	
Average annual temperature (°F)	68.08	
Fade occurrence factor (Po)	4.029E-003	

Multipath fading method - Vigants - Barnett

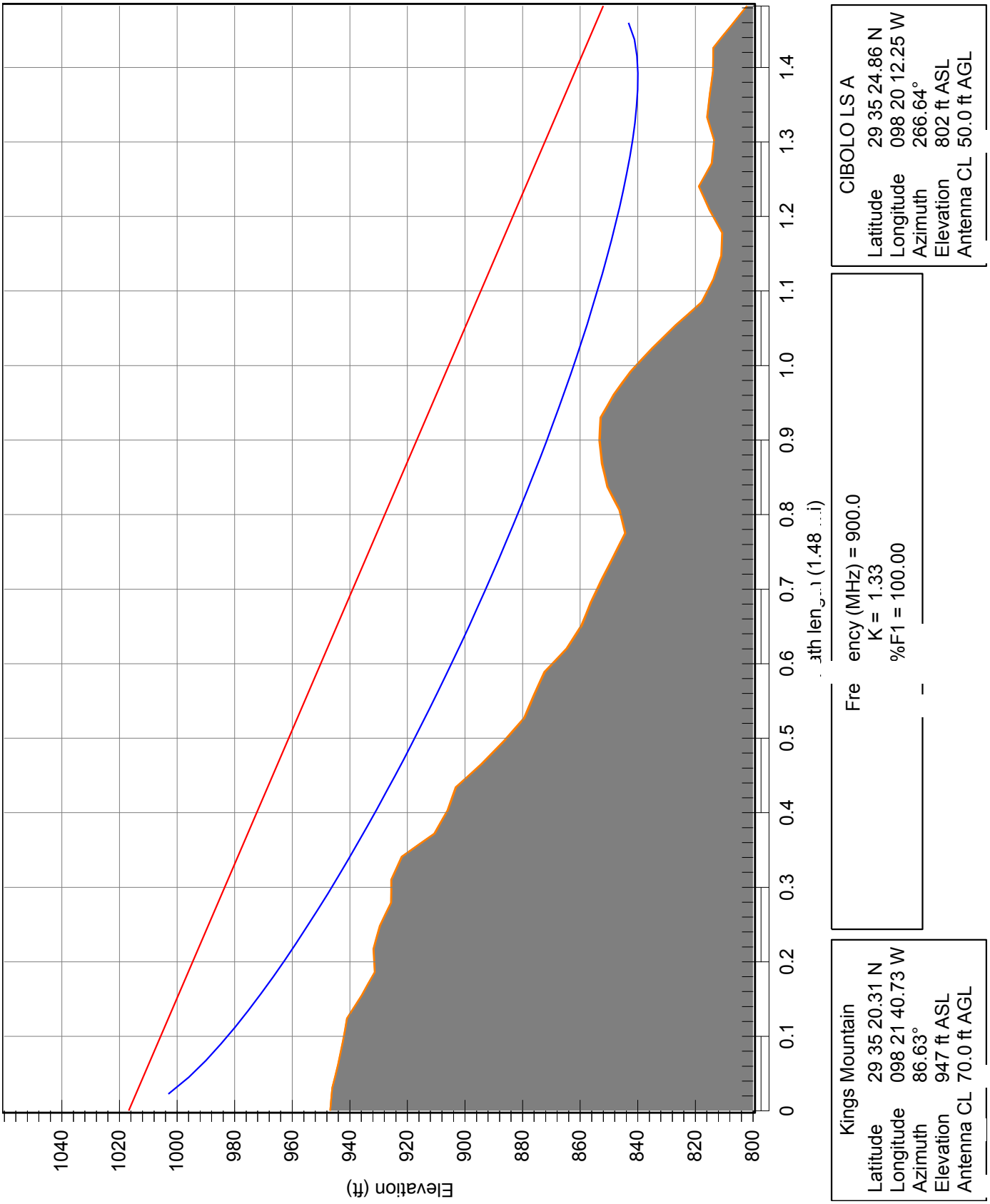
Transmission summary (Hildebrand-CIBOLO LS A.pl5)



F = 900.00 MHz K = 1.33 %F1 = 100.0, 60.0

	Hildebrand	CIBOLO LS A
Latitude	29 28 00.60 N	29 35 24.86 N
Longitude	098 28 51.56 W	098 20 12.25 W
True azimuth (°)	45.60	225.67
Vertical angle (°)	-0.01	1.00
Elevation (ft)	810.70	802.00
Antenna model	OGB9-915N (TR)	TY-900 (TR)
Antenna gain (dBi)	11.15	12.15
Antenna height (ft)	123.00	50.00
TX line model	LMR-900	LMR-600
TX line length (ft)	150.00	75.00
Diffraction loss	25.67	
Radio model	Trio J-Series	Trio J-Series
TX power (dBm)	30.00	30.00
EIRP (dBm)	34.45	35.97
Receive signal (dBm)	-102.72	-102.72
Thermal fade margin (dB)	-10.72	-10.72

Multipath fading method - Vigants - Barnett


Elevation (ft)
1040
1020
1000
980
960
940
920
900
880
860
840
820
800
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
1.1
1.2
1.3
1.4
Kings Mountain
Latitude 29 35 20.31 N
Longitude 098 21 40.73 W
Azimuth 86.63°
Elevation 947 ft ASL
Antenna CL 70.0 ft AGL
Fre ency (MHz) = 900.0
K = 1.33
%F1 = 100.00
CIBOLO LS A
Latitude 29 35 24.86 N
Longitude 098 20 12.25 W
Azimuth 266.64°
Elevation 802 ft ASL
Antenna CL 50.0 ft AGL

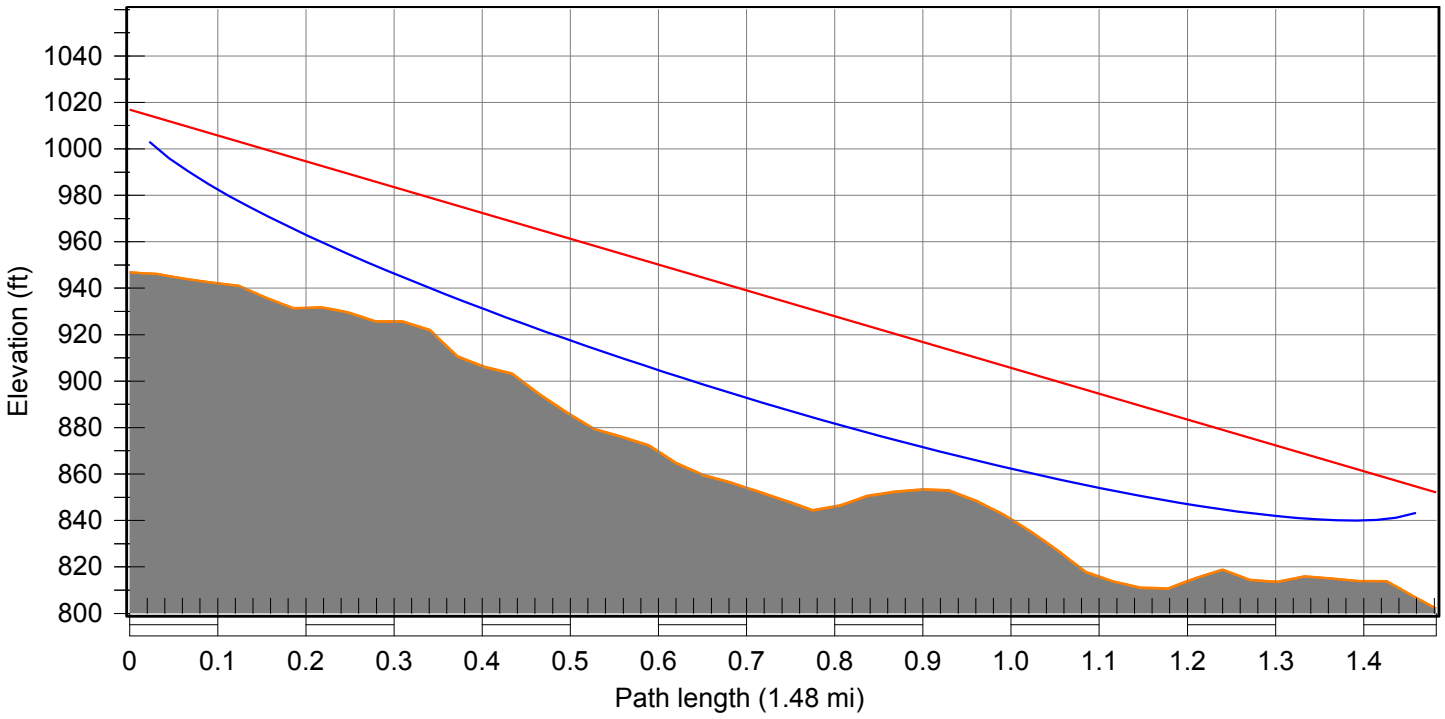
Transmission details ()

	Kings Mountain	CIBOLO LS A
Latitude	29 35 20.31 N	29 35 24.86 N
Longitude	098 21 40.73 W	098 20 12.25 W
True azimuth (°)	86.63	266.64
Vertical angle (°)	-1.21	1.20
Elevation (ft)	946.77	802.00
Antenna model	OGB9-915N (TR)	TY-900 (TR)
Antenna file name	ogb9-915n_0902-mhz_vpol	ty-900_0925-mhz_hpol
Antenna gain (dBi)	11.15	12.15
Antenna height (ft)	70.00	50.00
TX line model	LMR-600	LMR-600
TX line unit loss (dB/100 ft)	7.30	7.30
TX line length (ft)	95.00	75.00
TX line loss (dB)	6.94	5.48
Connector loss (dB)	0.25	0.25
Frequency (MHz)	900.00	
Polarization	Vertical	
Path length (mi)	1.48	
Free space loss (dB)	99.10	
Atmospheric absorption loss (dB)	0.01	
Net path loss (dB)	88.73	88.73
Radio model	MDS TransNET 900	MDS TransNET 900
TX power (dBm)	30.00	30.00
EIRP (dBm)	33.96	36.42
RX threshold criteria	.9	.9
RX threshold level (dBm)	-108.00	-108.00
Receive signal (dBm)	-58.73	-58.73
Thermal fade margin (dB)	49.27	49.27
Dispersive fade occurrence factor	1.00	
Effective fade margin (dB)	49.27	49.27
Climatic factor	1.00	
Terrain roughness (ft)	20.00	
C factor	3.29	
Average annual temperature (°F)	67.97	
Fade occurrence factor (Po)	2.412E-005	
Worst month multipath availability (%)	100.00000	100.00000

	Kings Mountain	CIBOLO LS A
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)	0.01	

Multipath fading method - Vigants - Barnett

Transmission summary ()

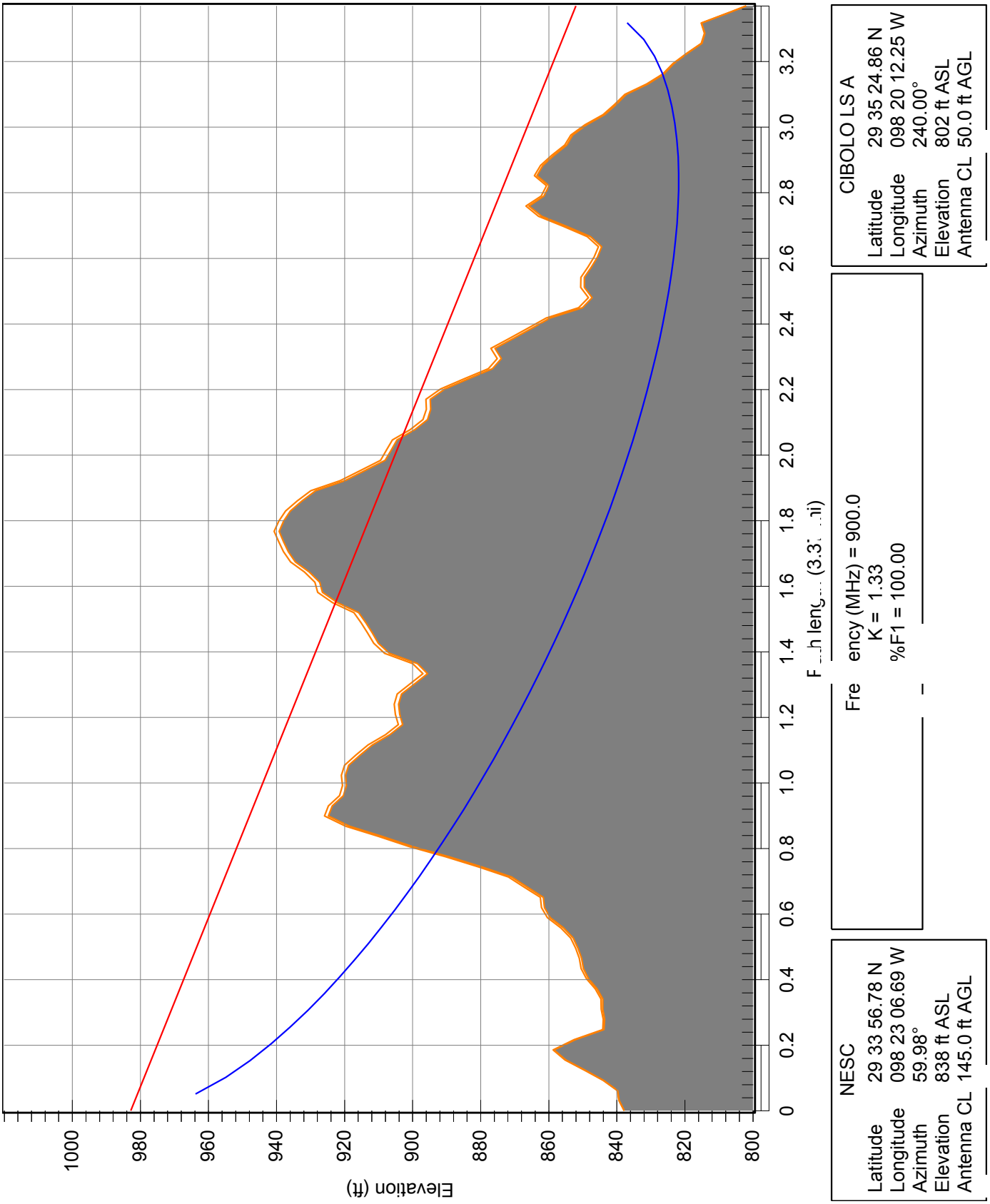


F = 900.00 MHz K = 1.33 %F1 = 100.0, 60.0

	Kings Mountain	CIBOLO LS A
Latitude	29 35 20.31 N	29 35 24.86 N
Longitude	098 21 40.73 W	098 20 12.25 W
True azimuth (°)	86.63	266.64
Vertical angle (°)	-1.21	1.20
Elevation (ft)	946.77	802.00
Antenna model	OGB9-915N (TR)	TY-900 (TR)
Antenna gain (dBi)	11.15	12.15
Antenna height (ft)	70.00	50.00
TX line model	LMR-600	LMR-600
TX line length (ft)	95.00	75.00
Radio model	MDS TransNET 900	MDS TransNET 900
TX power (dBm)	30.00	30.00
EIRP (dBm)	33.96	36.42
Receive signal (dBm)	-58.73	-58.73
Thermal fade margin (dB)	49.27	49.27
Effective fade margin (dB)	49.27	49.27
Annual 2 way multipath availability (%)	100.00000	

	Kings Mountain	CIBOLO LS A
Annual 2 way multipath unavailability (sec)	0.01	

Multipath fading method - Vigants - Barnett


Elevation (ft)
1000
980
960
940
920
900
880
860
840
820
800
0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
F ...h leng... (3.3' ..ii)
Fre ency (MHz) = 900.0
K = 1.33
%F1 = 100.00
NESC
Latitude 29 33 56.78 N
Longitude 098 23 06.69 W
Azimuth 59.98°
Elevation 838 ft ASL
Antenna CL 145.0 ft AGL
CIBOLO LS A
Latitude 29 35 24.86 N
Longitude 098 20 12.25 W
Azimuth 240.00°
Elevation 802 ft ASL
Antenna CL 50.0 ft AGL

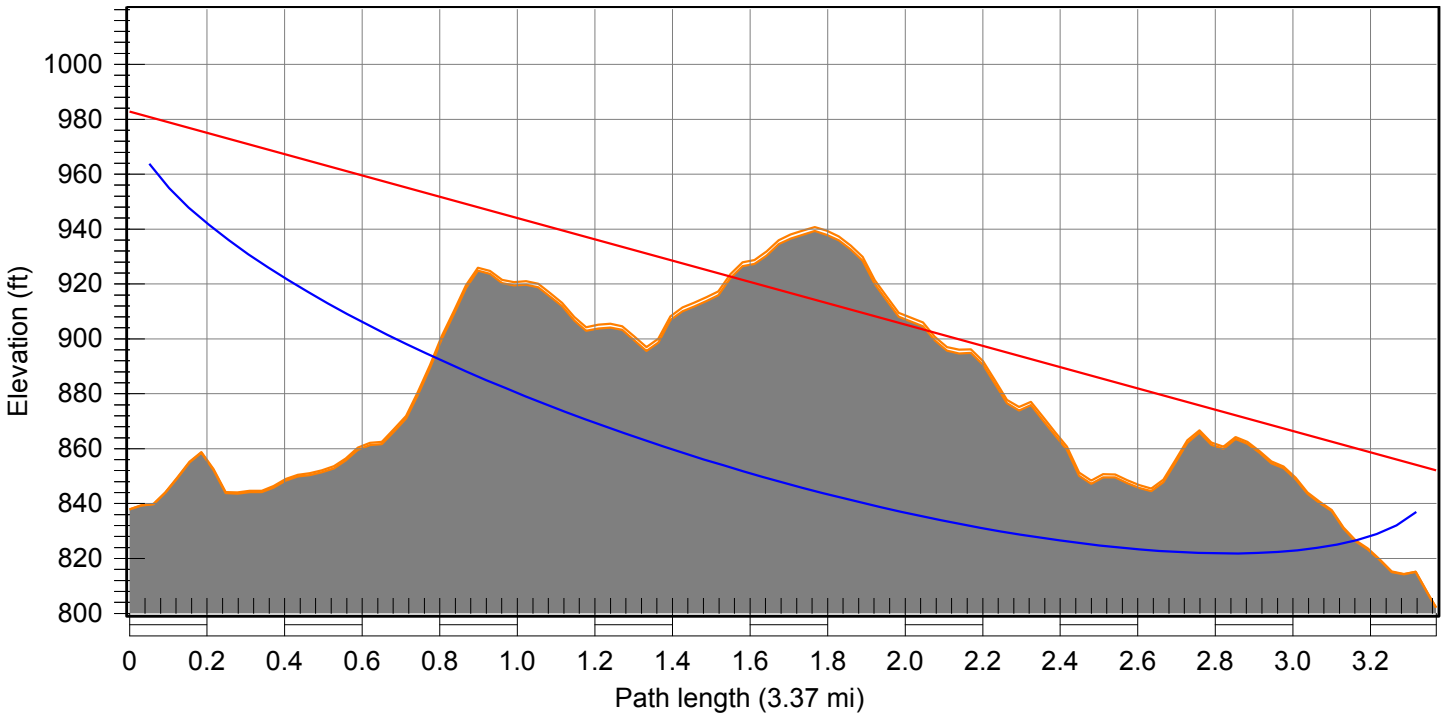
Transmission details (NESC-CIBOLO LS A.pl5)

	NESC	CIBOLO LS A
Latitude	29 33 56.78 N	29 35 24.86 N
Longitude	098 23 06.69 W	098 20 12.25 W
True azimuth (°)	59.98	240.00
Vertical angle (°)	-0.28	0.58
Elevation (ft)	837.77	802.00
Antenna model	OGB9-915N (TR)	TY-900 (TR)
Antenna file name	ogb9-915n_0902-mhz_vpol	ty-900_0925-mhz_hpol
Antenna gain (dBi)	11.15	12.15
Antenna height (ft)	145.00	50.00
TX line model	LMR-900	LMR-600
TX line unit loss (dB/100 ft)	4.90	7.30
TX line length (ft)	170.00	75.00
TX line loss (dB)	8.33	5.48
Connector loss (dB)	0.25	0.25
Frequency (MHz)	900.00	
Polarization	Vertical	
Path length (mi)	3.37	
Free space loss (dB)	106.24	
Atmospheric absorption loss (dB)	0.03	
Diffraction loss	17.53	
Net path loss (dB)	114.80	114.80
Radio model	Trio J-Series	Trio J-Series
TX power (dBm)	30.00	30.00
Emission designator	36 dBm	36 dBm
EIRP (dBm)	32.57	36.42
RX threshold criteria	5.62	5.62
RX threshold level (dBm)	-92.00	-92.00
Receive signal (dBm)	-84.80	-84.80
Thermal fade margin (dB)	7.20	7.20
Dispersive fade occurrence factor	1.00	
Effective fade margin (dB)	7.20	7.20
Climatic factor	1.00	
Terrain roughness (ft)	29.93	
C factor	1.95	
Average annual temperature (°F)	67.99	

	NESC	CIBOLO LS A
Fade occurrence factor (Po)	1.677E-004	
Worst month multipath availability (%)	99.99681	99.99681
Worst month multipath unavailability (sec)	83.91	83.91
Annual multipath availability (%)	99.99891	99.99891
Annual multipath unavailability (sec)	342.32	342.32
Annual 2 way multipath availability (%)	99.99783	
Annual 2 way multipath unavailability (sec)	684.63	

Multipath fading method - Vigants - Barnett

Transmission summary (NESC-CIBOLO LS A.pl5)

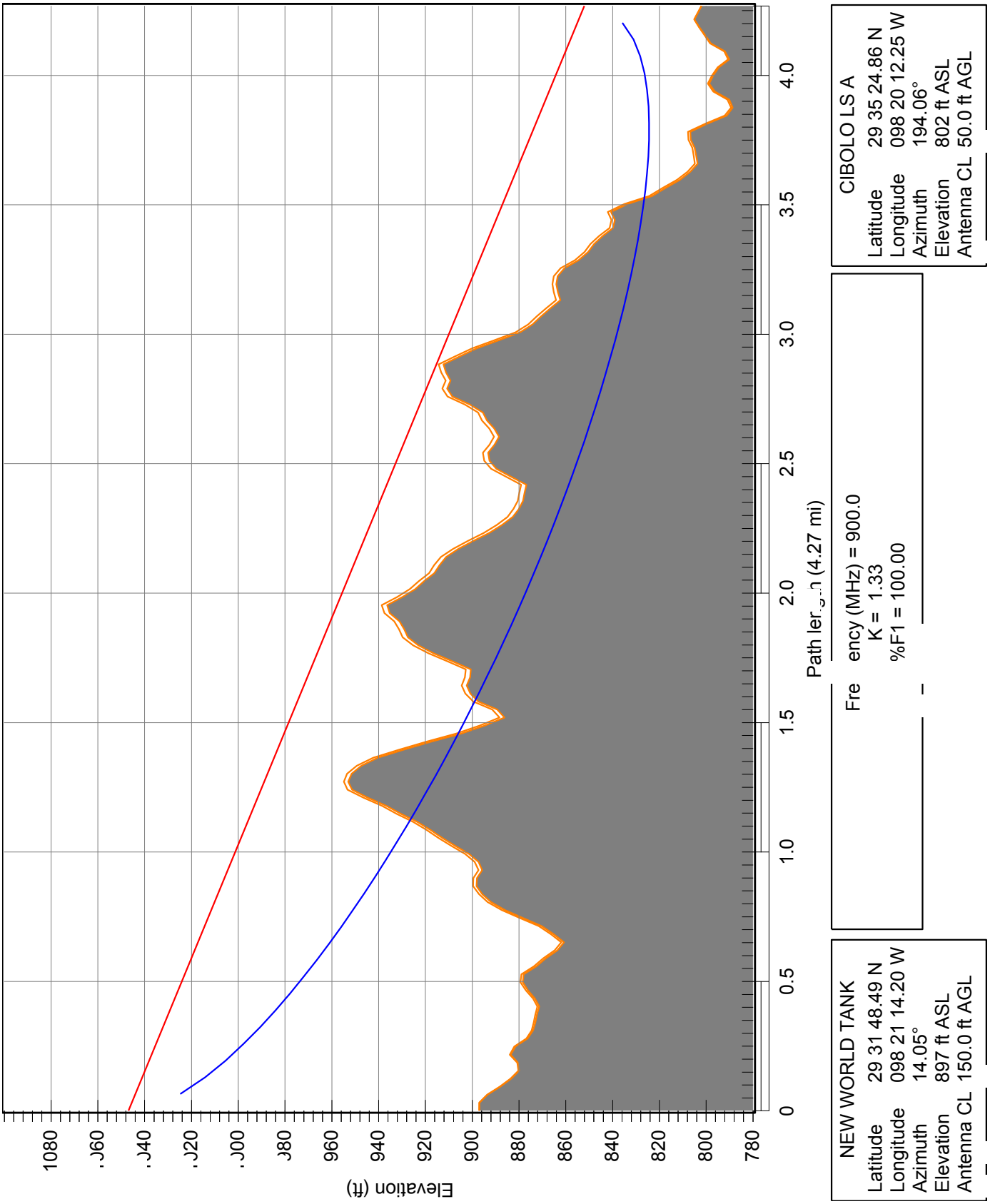


F = 900.00 MHz K = 1.33 %F1 = 100.0, 60.0

	NESC	CIBOLO LS A
Latitude	29 33 56.78 N	29 35 24.86 N
Longitude	098 23 06.69 W	098 20 12.25 W
True azimuth (°)	59.98	240.00
Vertical angle (°)	-0.28	0.58
Elevation (ft)	837.77	802.00
Antenna model	OGB9-915N (TR)	TY-900 (TR)
Antenna gain (dBi)	11.15	12.15
Antenna height (ft)	145.00	50.00
TX line model	LMR-900	LMR-600
TX line length (ft)	170.00	75.00
Diffraction loss	17.53	
Radio model	Trio J-Series	Trio J-Series
TX power (dBm)	30.00	30.00
EIRP (dBm)	32.57	36.42
Receive signal (dBm)	-84.80	-84.80
Thermal fade margin (dB)	7.20	7.20
Effective fade margin (dB)	7.20	7.20

	NESC	CIBOLO LS A
Annual 2 way multipath availability (%)	99.99783	
Annual 2 way multipath unavailability (sec)	684.63	

Multipath fading method - Vigants - Barnett


Elevation (ft)
780
800
820
840
860
880
900
920
940
960
980
1000
1020
1040
1060
1080
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Path length (4.27 mi)
NEW WORLD TANK
Latitude 29 31 48.49 N
Longitude 098 21 14.20 W
Azimuth 14.05°
Elevation 897 ft ASL
Antenna CL 150.0 ft AGL
Frequency (MHz) = 900.0
K = 1.33
%F1 = 100.00
CIBOLO LS A
Latitude 29 35 24.86 N
Longitude 098 20 12.25 W
Azimuth 194.06°
Elevation 802 ft ASL
Antenna CL 50.0 ft AGL

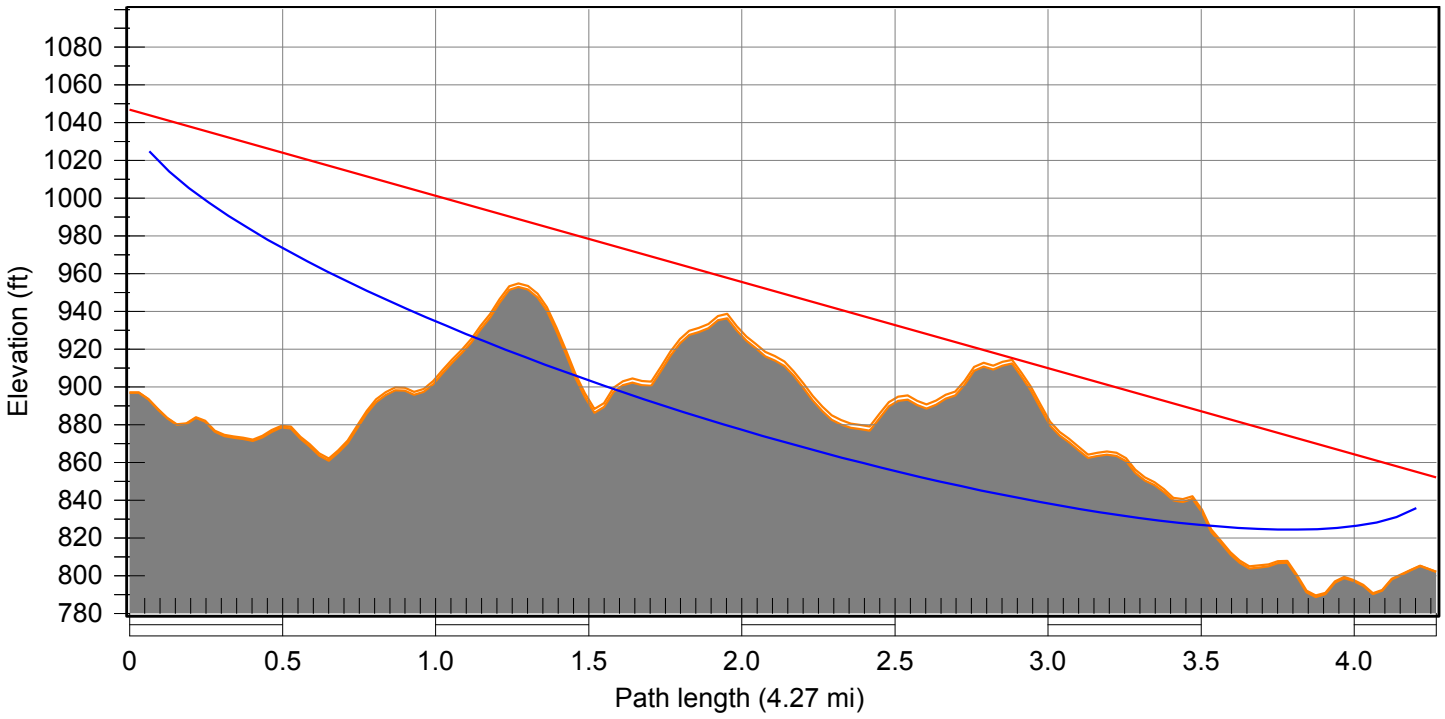
Transmission details ()

	NEW WORLD TANK	CIBOLO LS A
Latitude	29 31 48.49 N	29 35 24.86 N
Longitude	098 21 14.20 W	098 20 12.25 W
True azimuth (°)	14.05	194.06
Vertical angle (°)	-0.52	0.47
Elevation (ft)	896.90	802.00
Antenna model	OGB9-915N (TR)	TY-900 (TR)
Antenna file name	ogb9-915n_0902-mhz_vpol	ty-900_0925-mhz_hpol
Antenna gain (dBi)	11.15	12.15
Antenna height (ft)	150.00	50.00
TX line model	LMR-900	LMR-600
TX line unit loss (dB/100 ft)	4.90	7.30
TX line length (ft)	175.00	75.00
TX line loss (dB)	8.58	5.48
Connector loss (dB)	0.25	0.25
Frequency (MHz)	900.00	
Polarization	Vertical	
Path length (mi)	4.27	
Free space loss (dB)	108.29	
Atmospheric absorption loss (dB)	0.03	
Diffraction loss	14.25	
Net path loss (dB)	113.82	113.82
Radio model	Trio J-Series	Trio J-Series
TX power (dBm)	30.00	30.00
Emission designator	36 dBm	36 dBm
EIRP (dBm)	32.32	36.42
RX threshold criteria	5.62	5.62
RX threshold level (dBm)	-92.00	-92.00
Receive signal (dBm)	-83.82	-83.82
Thermal fade margin (dB)	8.18	8.18
Dispersive fade occurrence factor	1.00	
Effective fade margin (dB)	8.18	8.18
Climatic factor	1.00	
Terrain roughness (ft)	30.20	
C factor	1.93	
Average annual temperature (°F)	68.05	

	NEW WORLD TANK	CIBOLO LS A
Fade occurrence factor (Po)	3.368E-004	
Worst month multipath availability (%)	99.99488	99.99488
Worst month multipath unavailability (sec)	134.60	134.60
Annual multipath availability (%)	99.99826	99.99826
Annual multipath unavailability (sec)	549.60	549.60
Annual 2 way multipath availability (%)	99.99651	
Annual 2 way multipath unavailability (sec)	1099.21	

Multipath fading method - Vigants - Barnett

Transmission summary ()

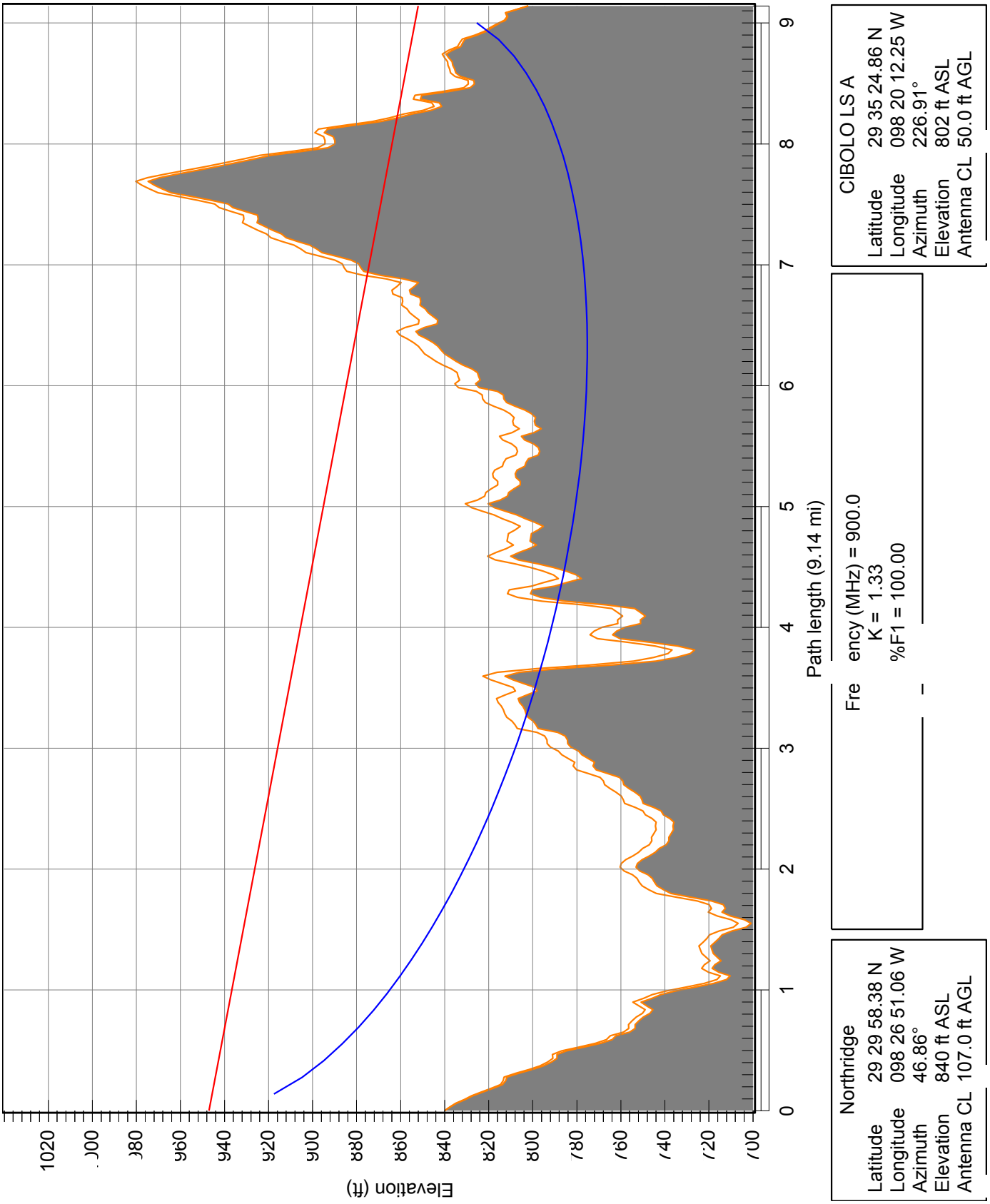


F = 900.00 MHz K = 1.33 %F1 = 100.0, 60.0

	NEW WORLD TANK	CIBOLO LS A
Latitude	29 31 48.49 N	29 35 24.86 N
Longitude	098 21 14.20 W	098 20 12.25 W
True azimuth (°)	14.05	194.06
Vertical angle (°)	-0.52	0.47
Elevation (ft)	896.90	802.00
Antenna model	OGB9-915N (TR)	TY-900 (TR)
Antenna gain (dBi)	11.15	12.15
Antenna height (ft)	150.00	50.00
TX line model	LMR-900	LMR-600
TX line length (ft)	175.00	75.00
Diffraction loss	14.25	
Radio model	Trio J-Series	Trio J-Series
TX power (dBm)	30.00	30.00
EIRP (dBm)	32.32	36.42
Receive signal (dBm)	-83.82	-83.82
Thermal fade margin (dB)	8.18	8.18
Effective fade margin (dB)	8.18	8.18

	NEW WORLD TANK	CIBOLO LS A
Annual 2 way multipath availability (%)	99.99651	
Annual 2 way multipath unavailability (sec)	1099.21	

Multipath fading method - Vigants - Barnett

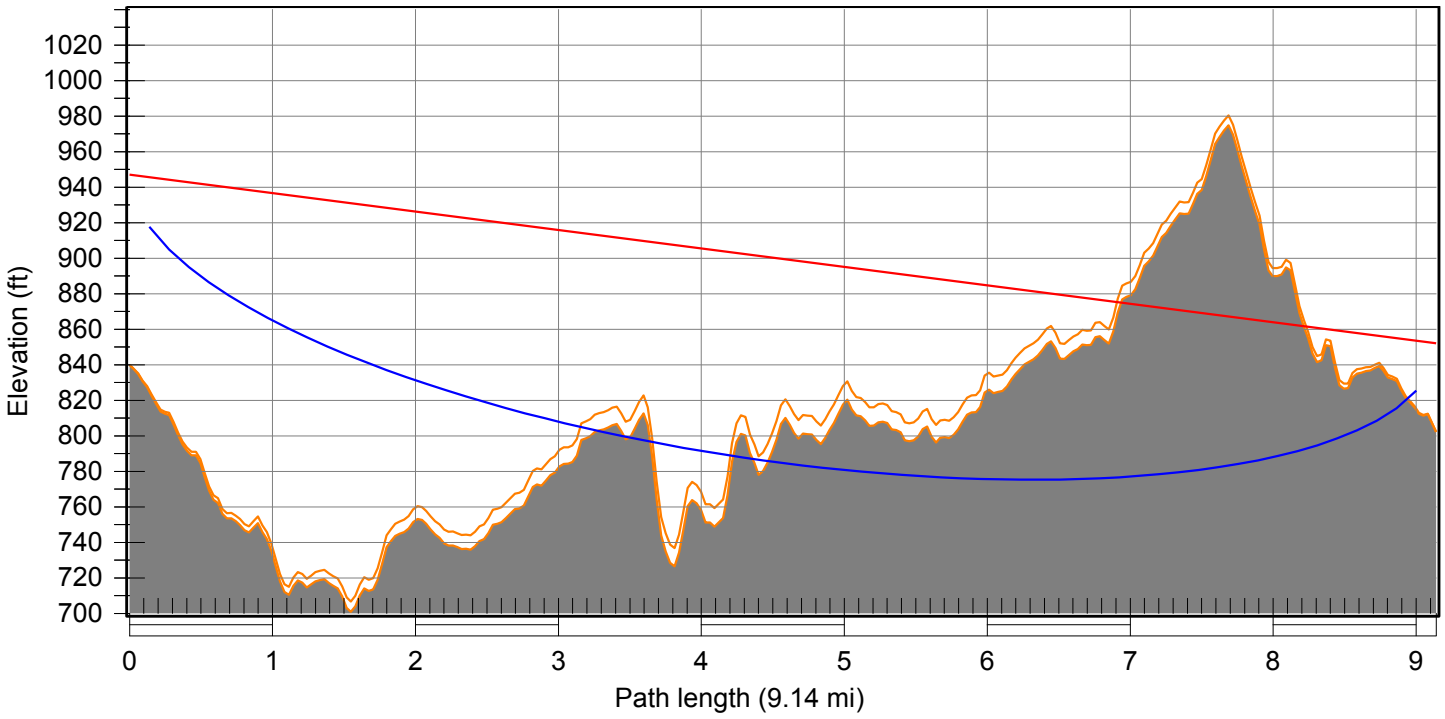

Elevation (ft)
1020
1000
980
960
940
920
900
880
860
840
820
800
780
760
740
720
700
0
1
2
3
4
5
6
7
8
9
Path length (9.14 mi)
Northridge
Latitude 29 29 58.38 N
Longitude 098 26 51.06 W
Azimuth 46.86°
Elevation 840 ft ASL
Antenna CL 107.0 ft AGL
Fre ency (MHz) = 900.0
K = 1.33
%F1 = 100.00
CIBOLO LS A
Latitude 29 35 24.86 N
Longitude 098 20 12.25 W
Azimuth 226.91°
Elevation 802 ft ASL
Antenna CL 50.0 ft AGL

Transmission details ()

	Northridge	CIBOLO LS A
Latitude	29 29 58.38 N	29 35 24.86 N
Longitude	098 26 51.06 W	098 20 12.25 W
True azimuth (°)	46.86	226.91
Vertical angle (°)	-0.00	0.91
Elevation (ft)	839.99	802.00
Antenna model	OGB9-915N (TR)	TY-900 (TR)
Antenna file name	ogb9-915n_0902-mhz_vpol	ty-900_0925-mhz_hpol
Antenna gain (dBi)	11.15	12.15
Antenna height (ft)	107.00	50.00
TX line model	LMR-900	LMR-600
TX line unit loss (dB/100 ft)	4.30	7.30
TX line length (ft)	132.00	75.00
TX line loss (dB)	5.68	5.48
Connector loss (dB)	0.25	0.25
Frequency (MHz)	900.00	
Polarization	Vertical	
Path length (mi)	9.14	
Free space loss (dB)	114.90	
Atmospheric absorption loss (dB)	0.07	
Diffraction loss	24.57	
Net path loss (dB)	127.90	127.90
Radio model	Trio J-Series	Trio J-Series
TX power (dBm)	30.00	30.00
Emission designator	36 dBm	36 dBm
EIRP (dBm)	35.22	36.42
RX threshold criteria	5.62	5.62
RX threshold level (dBm)	-92.00	-92.00
Receive signal (dBm)	-97.90	-97.90
Thermal fade margin (dB)	-5.90	-5.90
Dispersive fade occurrence factor	1.00	
Climatic factor	1.00	
Terrain roughness (ft)	26.82	
C factor	2.25	
Average annual temperature (°F)	68.05	
Fade occurrence factor (Po)	3.860E-003	

Multipath fading method - Vigants - Barnett

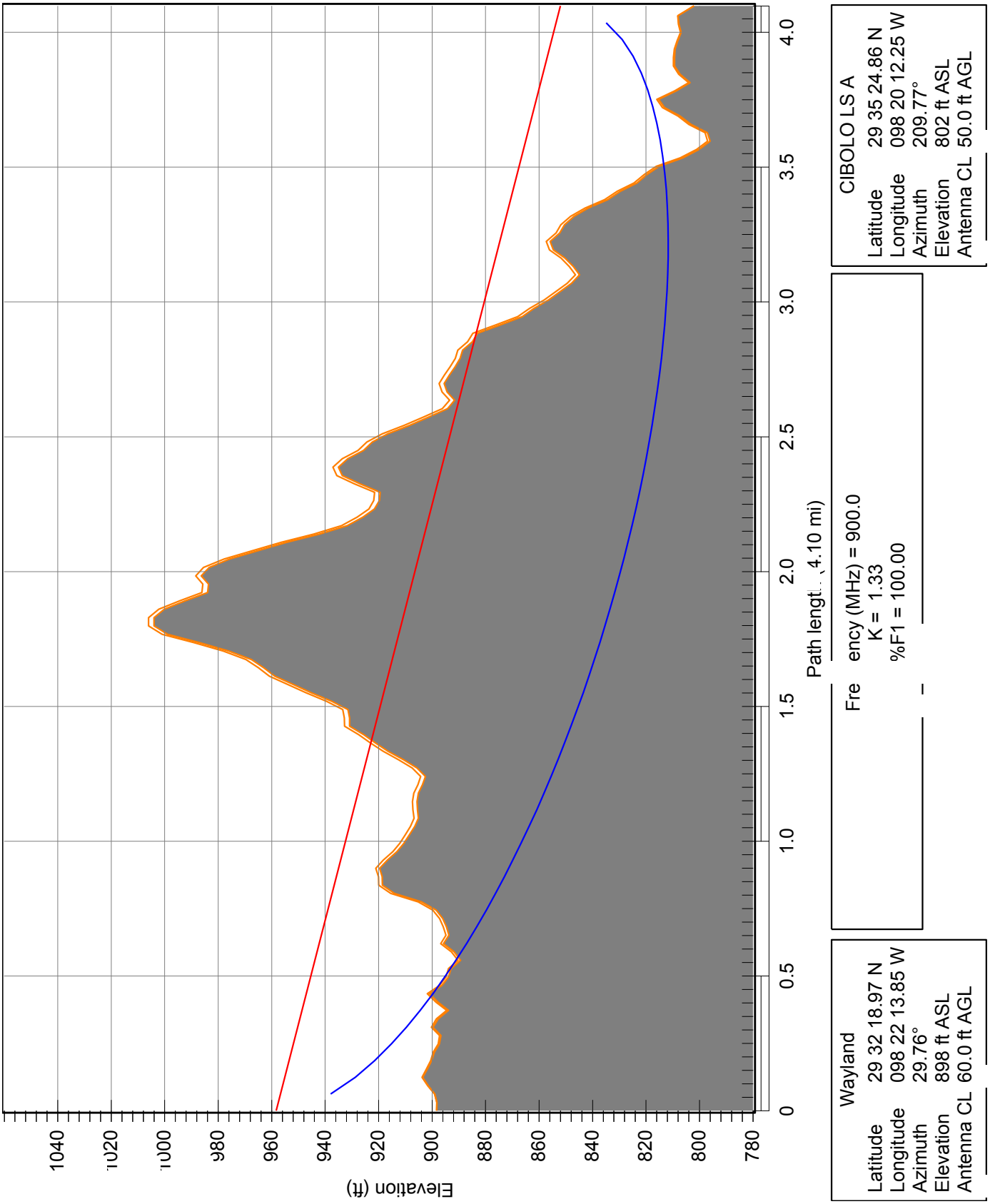
Transmission summary ()



F = 900.00 MHz K = 1.33 %F1 = 100.0, 60.0

	Northridge	CIBOLO LS A
Latitude	29 29 58.38 N	29 35 24.86 N
Longitude	098 26 51.06 W	098 20 12.25 W
True azimuth (°)	46.86	226.91
Vertical angle (°)	-0.00	0.91
Elevation (ft)	839.99	802.00
Antenna model	OGB9-915N (TR)	TY-900 (TR)
Antenna gain (dBi)	11.15	12.15
Antenna height (ft)	107.00	50.00
TX line model	LMR-900	LMR-600
TX line length (ft)	132.00	75.00
Diffraction loss	24.57	
Radio model	Trio J-Series	Trio J-Series
TX power (dBm)	30.00	30.00
EIRP (dBm)	35.22	36.42
Receive signal (dBm)	-97.90	-97.90
Thermal fade margin (dB)	-5.90	-5.90

Multipath fading method - Vigants - Barnett


Elevation (ft)
1040
1020
1000
980
960
940
920
900
880
860
840
820
800
780
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
Path lengt... 4.10 mi)
Wayland
Latitude 29 32 18.97 N
Longitude 098 22 13.85 W
Azimuth 29.76°
Elevation 898 ft ASL
Antenna CL 60.0 ft AGL
Fre ency (MHz) = 900.0
K = 1.33
%F1 = 100.00
CIBOLO LS A
Latitude 29 35 24.86 N
Longitude 098 20 12.25 W
Azimuth 209.77°
Elevation 802 ft ASL
Antenna CL 50.0 ft AGL

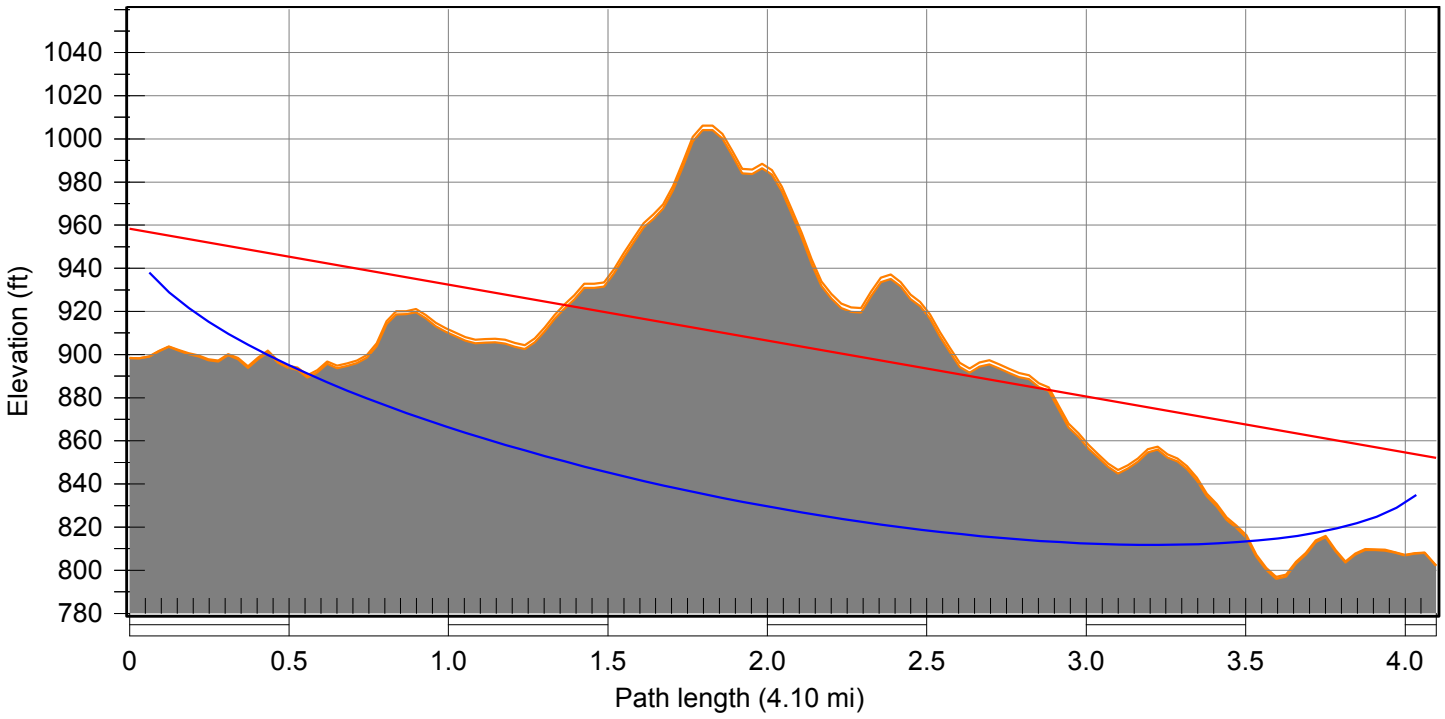
Transmission details ()

	Wayland	CIBOLO LS A
Latitude	29 32 18.97 N	29 35 24.86 N
Longitude	098 22 13.85 W	098 20 12.25 W
True azimuth (°)	29.76	209.77
Vertical angle (°)	0.27	0.71
Elevation (ft)	898.30	802.00
Antenna model	OGB9-915N (TR)	TY-900 (TR)
Antenna file name	ogb9-915n_0902-mhz_vpol	ty-900_0925-mhz_hpol
Antenna gain (dBi)	11.15	12.15
Antenna height (ft)	60.00	50.00
TX line model	LMR-600	LMR-600
TX line unit loss (dB/100 ft)	7.30	7.30
TX line length (ft)	85.00	75.00
TX line loss (dB)	6.21	5.48
Connector loss (dB)	0.25	0.25
Frequency (MHz)	900.00	
Polarization	Vertical	
Path length (mi)	4.10	
Free space loss (dB)	107.93	
Atmospheric absorption loss (dB)	0.03	
Diffraction loss	24.81	
Net path loss (dB)	121.65	121.65
Radio model	Trio J-Series	Trio J-Series
TX power (dBm)	30.00	30.00
Emission designator	36 dBm	36 dBm
EIRP (dBm)	34.69	36.42
RX threshold criteria	5.62	5.62
RX threshold level (dBm)	-92.00	-92.00
Receive signal (dBm)	-91.65	-91.65
Thermal fade margin (dB)	0.35	0.35
Dispersive fade occurrence factor	1.00	
Effective fade margin (dB)	0.35	0.35
Climatic factor	1.00	
Terrain roughness (ft)	41.61	
C factor	1.27	
Average annual temperature (°F)	68.03	

	Wayland	CIBOLO LS A
Fade occurrence factor (Po)	1.965E-004	
Worst month multipath availability (%)	99.98186	99.98186
Worst month multipath unavailability (sec)	476.66	476.66
Annual multipath availability (%)	99.99383	99.99383
Annual multipath unavailability (sec)	1945.71	1945.71
Annual 2 way multipath availability (%)	99.98766	
Annual 2 way multipath unavailability (sec)	3891.43	

Multipath fading method - Vigants - Barnett

Transmission summary ()



F = 900.00 MHz K = 1.33 %F1 = 100.0, 60.0

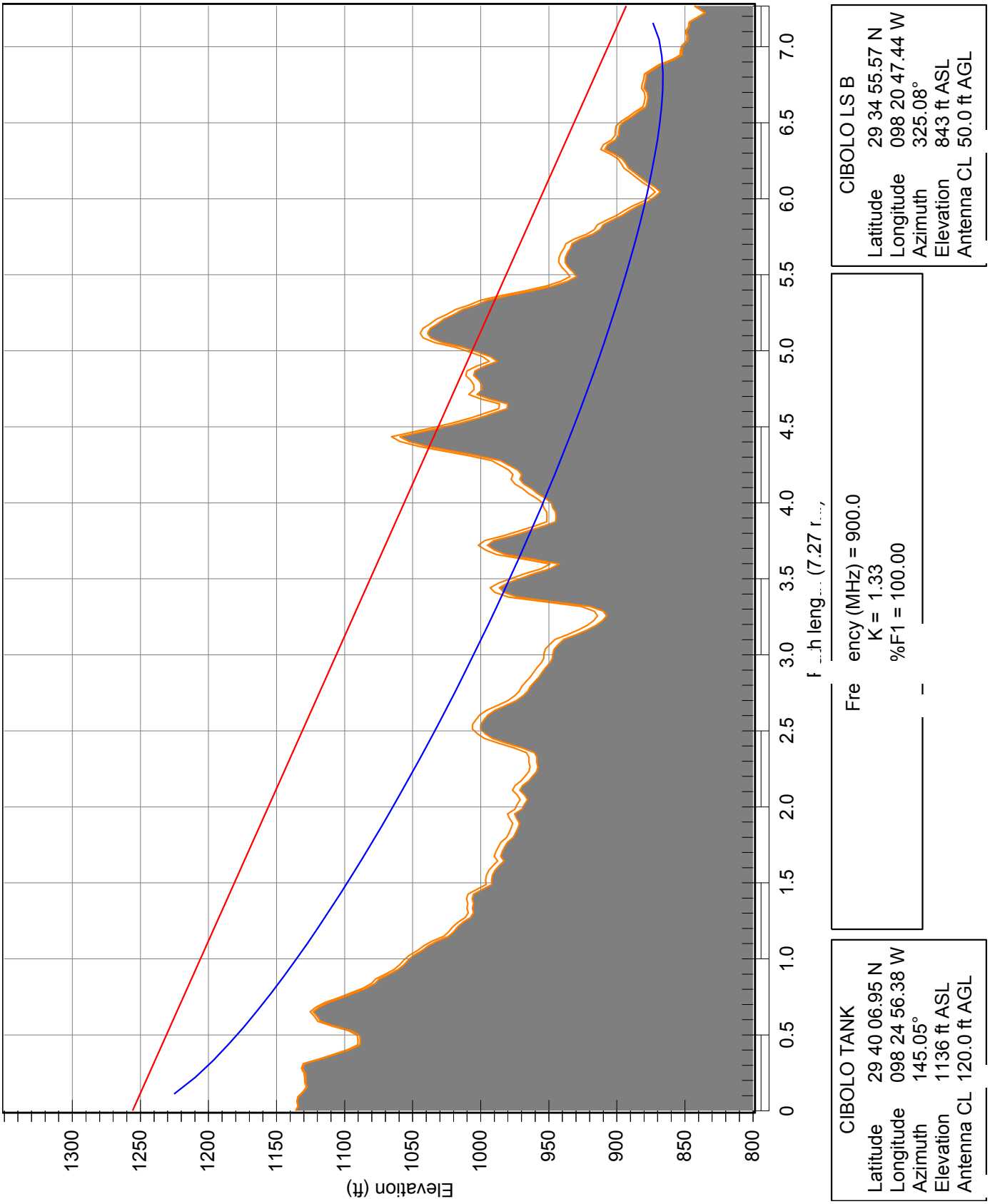
	Wayland	CIBOLO LS A
Latitude	29 32 18.97 N	29 35 24.86 N
Longitude	098 22 13.85 W	098 20 12.25 W
True azimuth (°)	29.76	209.77
Vertical angle (°)	0.27	0.71
Elevation (ft)	898.30	802.00
Antenna model	OGB9-915N (TR)	TY-900 (TR)
Antenna gain (dBi)	11.15	12.15
Antenna height (ft)	60.00	50.00
TX line model	LMR-600	LMR-600
TX line length (ft)	85.00	75.00
Diffraction loss	24.81	
Radio model	Trio J-Series	Trio J-Series
TX power (dBm)	30.00	30.00
EIRP (dBm)	34.69	36.42
Receive signal (dBm)	-91.65	-91.65
Thermal fade margin (dB)	0.35	0.35
Effective fade margin (dB)	0.35	0.35

	Wayland	CIBOLO LS A
Annual 2 way multipath availability (%)	99.98766	
Annual 2 way multipath unavailability (sec)	3891.43	

Multipath fading method - Vigants - Barnett

APPENDIX A

LIFT STATION B
COMPUTER-BASE
RADIO PATH STUDY
AND ELEVATION PLOTS


Elevation (ft)
1300
1250
1200
1150
1100
1050
1000
950
900
850
800
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0
5.5
6.0
6.5
7.0
CIBOLO TANK
Latitude 29 40 06.95 N
Longitude 098 24 56.38 W
Azimuth 145.05°
Elevation 1136 ft ASL
Antenna CL 120.0 ft AGL
Fre ency (MHz) = 900.0
K = 1.33
%F1 = 100.00
CIBOLO LS B
Latitude 29 34 55.57 N
Longitude 098 20 47.44 W
Azimuth 325.08°
Elevation 843 ft ASL
Antenna CL 50.0 ft AGL

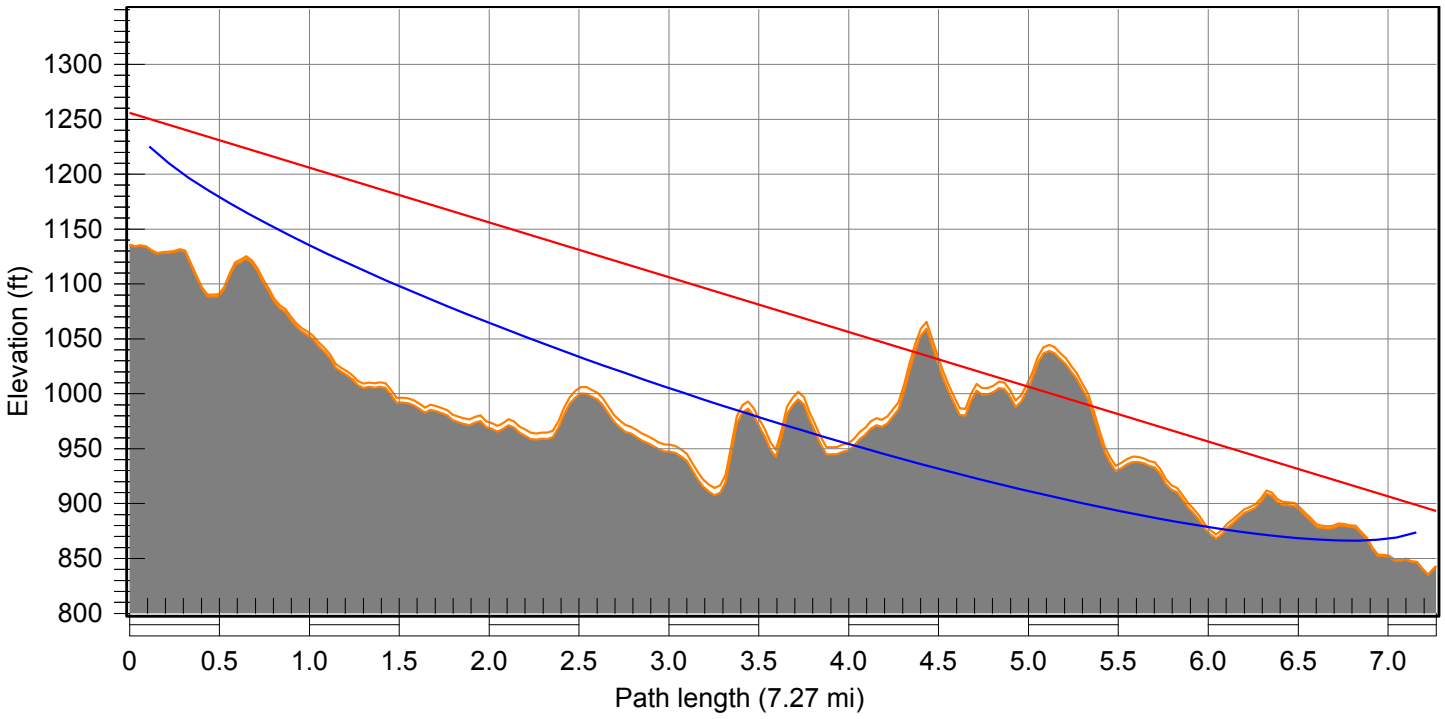
Transmission details (CIBOLO TANK-CIBOLO LS B.pl5)

	CIBOLO TANK	CIBOLO LS B
Latitude	29 40 06.95 N	29 34 55.57 N
Longitude	098 24 56.38 W	098 20 47.44 W
True azimuth (°)	145.05	325.08
Vertical angle (°)	-0.49	0.72
Elevation (ft)	1135.72	843.03
Antenna model	OGB9-915N (TR)	TY-900 (TR)
Antenna file name	ogb9-915n_0902-mhz_vpol	ty-900_0925-mhz_hpol
Antenna gain (dBi)	11.15	12.15
Antenna height (ft)	120.00	50.00
TX line model	LMR-900	LMR-600
TX line unit loss (dB/100 ft)	4.90	7.30
TX line length (ft)	145.00	75.00
TX line loss (dB)	7.11	5.48
Connector loss (dB)	0.25	0.25
Frequency (MHz)	900.00	
Polarization	Vertical	
Path length (mi)	7.27	
Free space loss (dB)	112.91	
Atmospheric absorption loss (dB)	0.06	
Diffraction loss	14.17	
Net path loss (dB)	116.92	116.92
Radio model	Trio J-Series	Trio J-Series
TX power (dBm)	30.00	30.00
Emission designator	36 dBm	36 dBm
EIRP (dBm)	33.79	36.42
RX threshold criteria	5.62	5.62
RX threshold level (dBm)	-92.00	-92.00
Receive signal (dBm)	-86.92	-86.92
Thermal fade margin (dB)	5.08	5.08
Dispersive fade occurrence factor	1.00	
Effective fade margin (dB)	5.08	5.08
Climatic factor	1.00	
Terrain roughness (ft)	39.77	
C factor	1.35	
Average annual temperature (°F)	67.84	

	CIBOLO TANK	CIBOLO LS B
Fade occurrence factor (Po)	1.163E-003	
Worst month multipath availability (%)	99.96386	99.96386
Worst month multipath unavailability (sec)	949.84	949.84
Annual multipath availability (%)	99.98774	99.98774
Annual multipath unavailability (sec)	3866.15	3866.15
Annual 2 way multipath availability (%)	99.97548	
Annual 2 way multipath unavailability (sec)	7732.31	

Multipath fading method - Vigants - Barnett

Transmission summary (CIBOLO TANK-CIBOLO LS B.pl5)

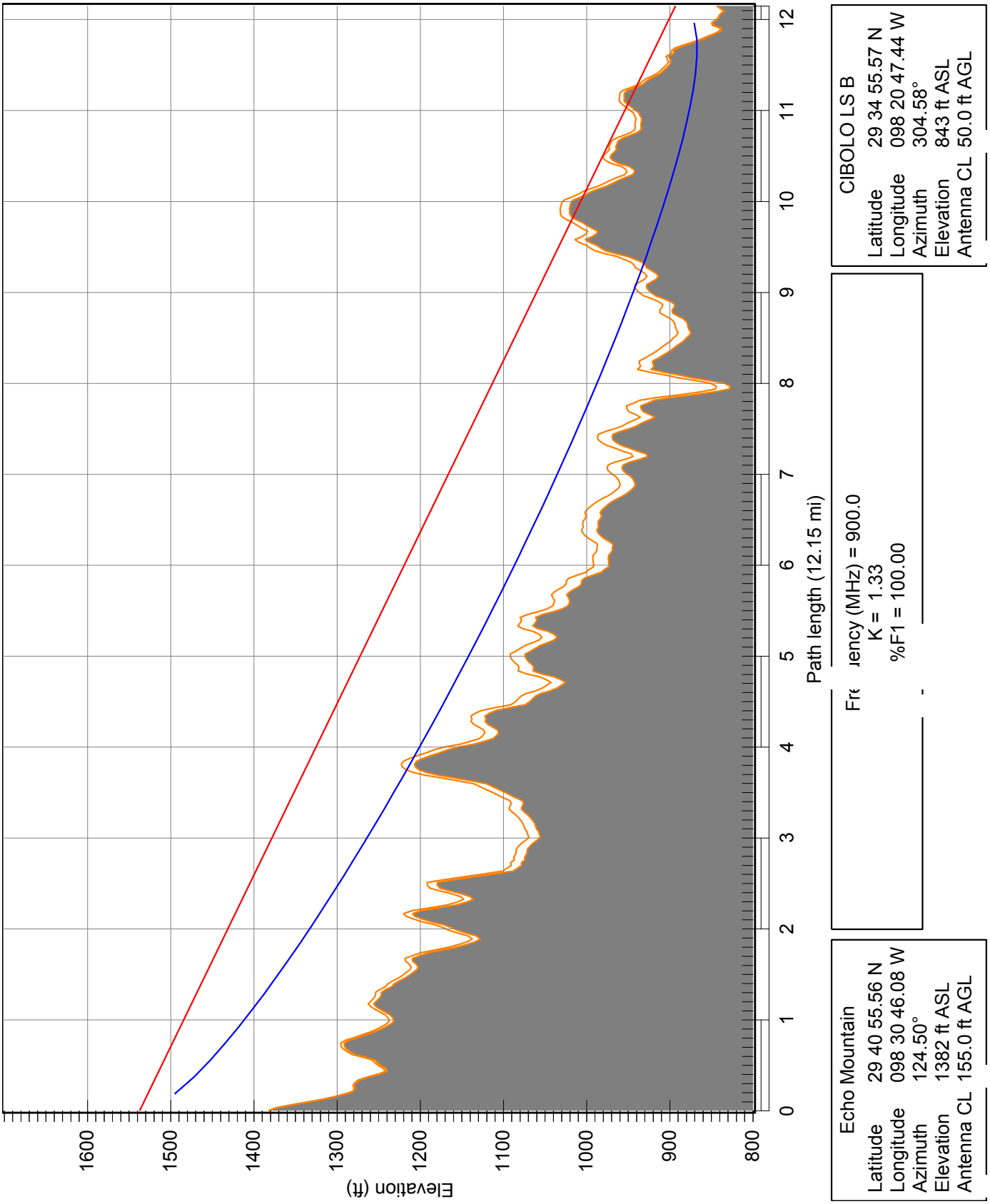


F = 900.00 MHz K = 1.33 %F1 = 100.0, 60.0

	CIBOLO TANK	CIBOLO LS B
Latitude	29 40 06.95 N	29 34 55.57 N
Longitude	098 24 56.38 W	098 20 47.44 W
True azimuth (°)	145.05	325.08
Vertical angle (°)	-0.49	0.72
Elevation (ft)	1135.72	843.03
Antenna model	OGB9-915N (TR)	TY-900 (TR)
Antenna gain (dBi)	11.15	12.15
Antenna height (ft)	120.00	50.00
TX line model	LMR-900	LMR-600
TX line length (ft)	145.00	75.00
Diffraction loss	14.17	
Radio model	Trio J-Series	Trio J-Series
TX power (dBm)	30.00	30.00
EIRP (dBm)	33.79	36.42
Receive signal (dBm)	-86.92	-86.92
Thermal fade margin (dB)	5.08	5.08
Effective fade margin (dB)	5.08	5.08

	CIBOLO TANK	CIBOLO LS B
Annual 2 way multipath availability (%)	99.97548	
Annual 2 way multipath unavailability (sec)	7732.31	

Multipath fading method - Vigants - Barnett

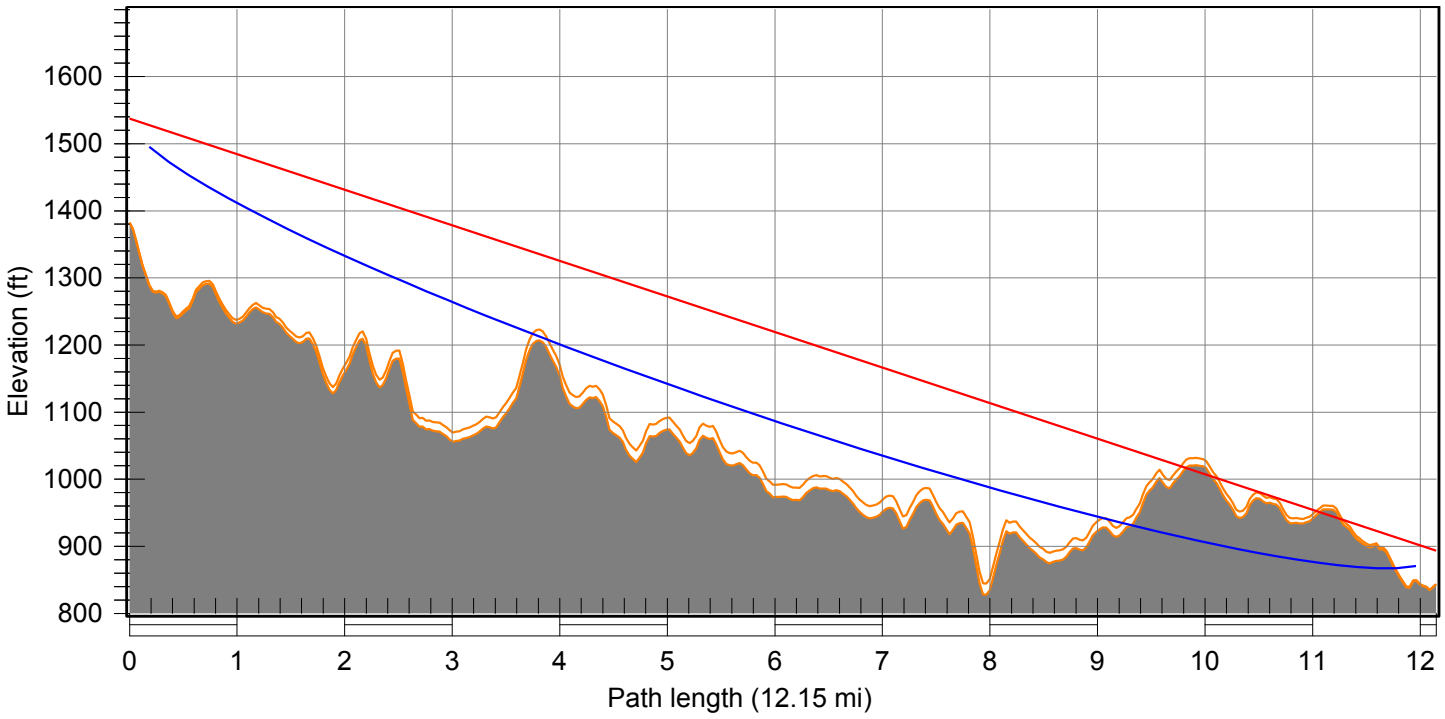

Elevation (ft)
1600
1500
1400
1300
1200
1100
1000
900
800
0
1
2
3
4
5
6
7
8
9
10
11
12
Path length (12.15 mi)
Echo Mountain
Latitude 29 40 55.56 N
Longitude 098 30 46.08 W
Azimuth 124.50°
Elevation 1382 ft ASL
Antenna CL 155.0 ft AGL
Frequency (MHz) = 900.0
K = 1.33
%F1 = 100.00
CIBOLO LS B
Latitude 29 34 55.57 N
Longitude 098 20 47.44 W
Azimuth 304.58°
Elevation 843 ft ASL
Antenna CL 50.0 ft AGL

Transmission details (Echo Mountain-CIBOLO LS B.pl5)

	Echo Mountain	CIBOLO LS B
Latitude	29 40 55.56 N	29 34 55.57 N
Longitude	098 30 46.08 W	098 20 47.44 W
True azimuth (°)	124.50	304.58
Vertical angle (°)	-0.62	0.69
Elevation (ft)	1382.19	843.03
Antenna model	OGB9-915N (TR)	TY-900 (TR)
Antenna file name	ogb9-915n_0902-mhz_vpol	ty-900_0925-mhz_hpol
Antenna gain (dBi)	11.15	12.15
Antenna height (ft)	155.00	50.00
TX line model	LMR-900	LMR-600
TX line unit loss (dB/100 ft)	7.30	4.90
TX line length (ft)	180.00	75.00
TX line loss (dB)	13.14	3.68
Connector loss (dB)	0.25	0.25
Frequency (MHz)	900.00	
Polarization	Vertical	
Path length (mi)	12.15	
Free space loss (dB)	117.38	
Atmospheric absorption loss (dB)	0.09	
Diffraction loss	21.14	
Net path loss (dB)	132.63	132.63
Radio model	Trio J-Series	Trio J-Series
TX power (dBm)	30.00	30.00
Emission designator	36 dBm	36 dBm
EIRP (dBm)	27.76	38.22
RX threshold criteria	5.62	5.62
RX threshold level (dBm)	-92.00	-92.00
Receive signal (dBm)	-102.63	-102.63
Thermal fade margin (dB)	-10.63	-10.63
Dispersive fade occurrence factor	1.00	
Climatic factor	1.00	
Terrain roughness (ft)	54.51	
C factor	0.89	
Average annual temperature (°F)	67.77	
Fade occurrence factor (Po)	3.606E-003	

Multipath fading method - Vigants - Barnett

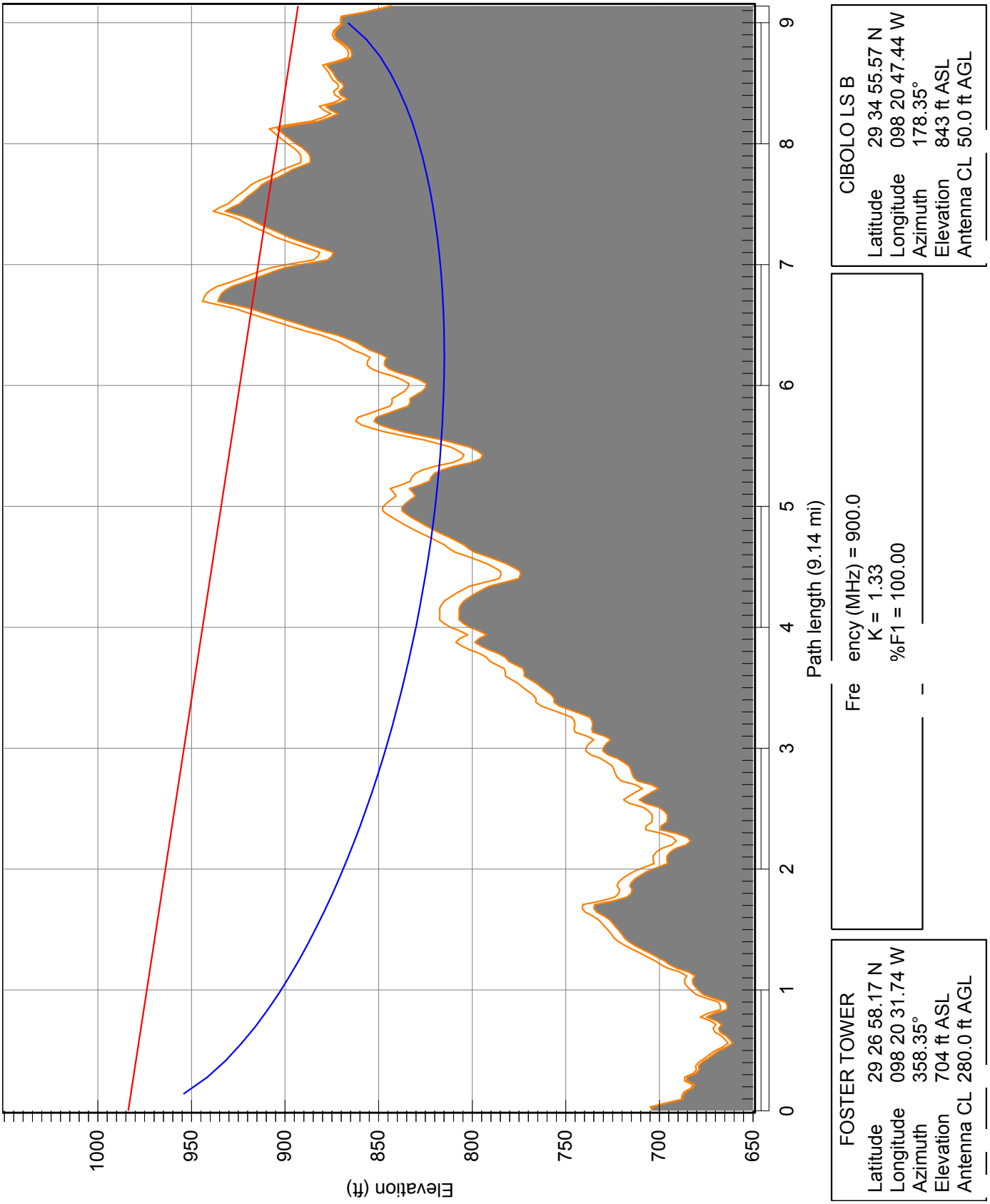
Transmission summary (Echo Mountain-CIBOLO LS B.pl5)



F = 900.00 MHz K = 1.33 %F1 = 100.0, 60.0

	Echo Mountain	CIBOLO LS B
Latitude	29 40 55.56 N	29 34 55.57 N
Longitude	098 30 46.08 W	098 20 47.44 W
True azimuth (°)	124.50	304.58
Vertical angle (°)	-0.62	0.69
Elevation (ft)	1382.19	843.03
Antenna model	OGB9-915N (TR)	TY-900 (TR)
Antenna gain (dBi)	11.15	12.15
Antenna height (ft)	155.00	50.00
TX line model	LMR-900	LMR-600
TX line length (ft)	180.00	75.00
Diffraction loss	21.14	
Radio model	Trio J-Series	Trio J-Series
TX power (dBm)	30.00	30.00
EIRP (dBm)	27.76	38.22
Receive signal (dBm)	-102.63	-102.63
Thermal fade margin (dB)	-10.63	-10.63

Multipath fading method - Vigants - Barnett


Elevation (ft)
1000
950
900
850
800
750
700
650
0
1
2
3
4
5
6
7
8
9
Path length (9.14 mi)
FOSTER TOWER
Latitude 29 26 58.17 N
Longitude 098 20 31.74 W
Azimuth 358.35°
Elevation 704 ft ASL
Antenna CL 280.0 ft AGL
Fre ency (MHz) = 900.0
K = 1.33
%F1 = 100.00
CIBOLO LS B
Latitude 29 34 55.57 N
Longitude 098 20 47.44 W
Azimuth 178.35°
Elevation 843 ft ASL
Antenna CL 50.0 ft AGL

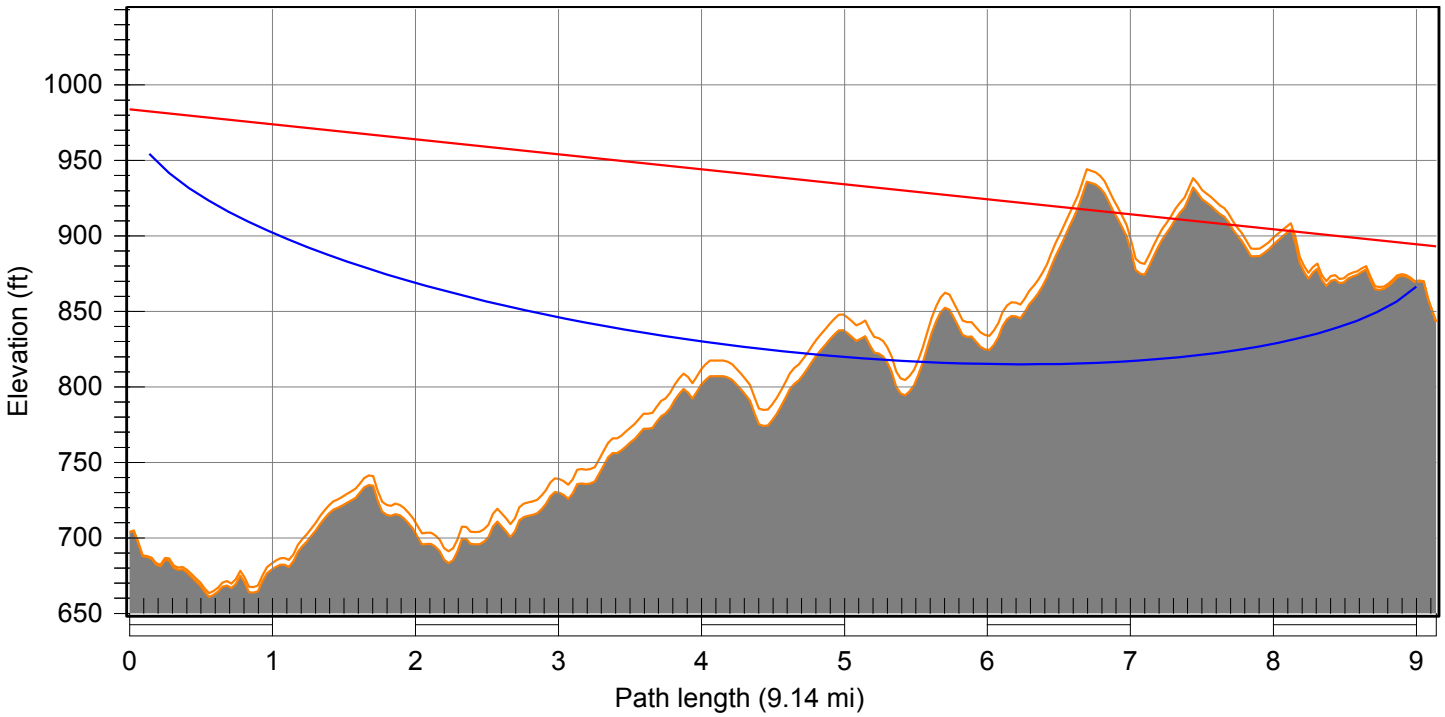
Transmission details (FOSTER TOWER-CIBOLO LS B.pl5)

	FOSTER TOWER	CIBOLO LS B
Latitude	29 26 58.17 N	29 34 55.57 N
Longitude	098 20 31.74 W	098 20 47.44 W
True azimuth (°)	358.35	178.35
Vertical angle (°)	-0.11	0.24
Elevation (ft)	703.69	843.03
Antenna model	OGB9-915N (TR)	TY-900 (TR)
Antenna file name	ogb9-915n_0902-mhz_vpol	ty-900_0925-mhz_hpol
Antenna gain (dBi)	11.15	12.15
Antenna height (ft)	280.00	50.00
Frequency (MHz)	900.00	
Polarization	Vertical	
Path length (mi)	9.14	
Free space loss (dB)	114.90	
Atmospheric absorption loss (dB)	0.07	
Diffraction loss	21.50	
Net path loss (dB)	113.18	113.18
Radio model	Trio J-Series	Trio J-Series
TX power (dBm)	30.00	30.00
Emission designator	36 dBm	36 dBm
EIRP (dBm)	41.15	42.15
RX threshold criteria	5.62	5.62
RX threshold level (dBm)	-92.00	-92.00
Receive signal (dBm)	-83.18	-83.18
Thermal fade margin (dB)	8.82	8.82
Dispersive fade occurrence factor	1.00	
Effective fade margin (dB)	8.82	8.82
Climatic factor	1.00	
Terrain roughness (ft)	22.22	
C factor	2.87	
Average annual temperature (°F)	68.17	
Fade occurrence factor (Po)	4.927E-003	
Worst month multipath availability (%)	99.93540	99.93540
Worst month multipath unavailability (sec)	1697.61	1697.61
Annual multipath availability (%)	99.97798	99.97798
Annual multipath unavailability (sec)	6943.98	6943.98

	FOSTER TOWER	CIBOLO LS B
Annual 2 way multipath availability (%)	99.95596	
Annual 2 way multipath unavailability (sec)	13887.96	

Multipath fading method - Vigants - Barnett

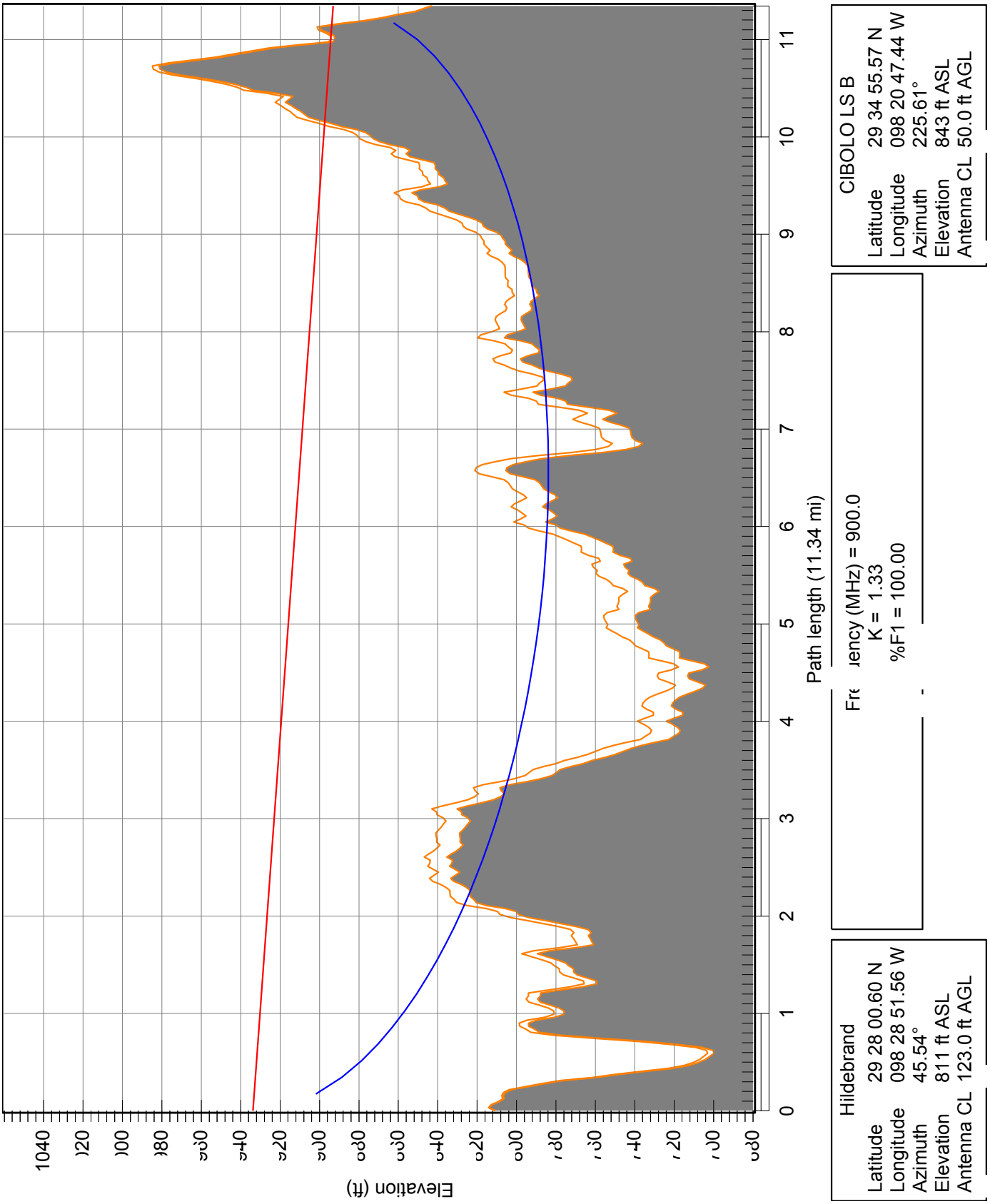
Transmission summary (FOSTER TOWER-CIBOLO LS B.pl5)



F = 900.00 MHz K = 1.33 %F1 = 100.0, 60.0

	FOSTER TOWER	CIBOLO LS B
Latitude	29 26 58.17 N	29 34 55.57 N
Longitude	098 20 31.74 W	098 20 47.44 W
True azimuth (°)	358.35	178.35
Vertical angle (°)	-0.11	0.24
Elevation (ft)	703.69	843.03
Antenna model	OGB9-915N (TR)	TY-900 (TR)
Antenna gain (dBi)	11.15	12.15
Antenna height (ft)	280.00	50.00
Diffraction loss	21.50	
Radio model	Trio J-Series	Trio J-Series
TX power (dBm)	30.00	30.00
EIRP (dBm)	41.15	42.15
Receive signal (dBm)	-83.18	-83.18
Thermal fade margin (dB)	8.82	8.82
Effective fade margin (dB)	8.82	8.82
Annual 2 way multipath availability (%)	99.95596	
Annual 2 way multipath unavailability (sec)	13887.96	

Multipath fading method - Vigants - Barnett


Elevation (ft)
Path length (11.34 mi)
Hildebrand
Latitude 29 28 00.60 N
Longitude 098 28 51.56 W
Azimuth 45.54°
Elevation 811 ft ASL
Antenna CL 123.0 ft AGL
Frequency (MHz) = 900.0
K = 1.33
%F1 = 100.00
CIBOLO LS B
Latitude 29 34 55.57 N
Longitude 098 20 47.44 W
Azimuth 225.61°
Elevation 843 ft ASL
Antenna CL 50.0 ft AGL

Transmission details (Hildebrand-CIBOLO LS B.pl5)

	Hildebrand	CIBOLO LS B
Latitude	29 28 00.60 N	29 34 55.57 N
Longitude	098 28 51.56 W	098 20 47.44 W
True azimuth (°)	45.54	225.61
Vertical angle (°)	-0.01	1.55
Elevation (ft)	810.70	843.03
Antenna model	OGB9-915N (TR)	TY-900 (TR)
Antenna file name	ogb9-915n_0902-mhz_vpol	ty-900_0925-mhz_hpol
Antenna gain (dBi)	11.15	12.15
Antenna height (ft)	123.00	50.00
TX line model	LMR-900	LMR-600
TX line unit loss (dB/100 ft)	4.90	7.30
TX line length (ft)	150.00	75.00
TX line loss (dB)	7.35	5.48
Connector loss (dB)	0.25	0.25
Frequency (MHz)	900.00	
Polarization	Vertical	
Path length (mi)	11.34	
Free space loss (dB)	116.78	
Atmospheric absorption loss (dB)	0.09	
Diffraction loss	28.45	
Net path loss (dB)	135.35	135.35
Radio model	Trio J-Series	Trio J-Series
TX power (dBm)	30.00	30.00
Emission designator	36 dBm	36 dBm
EIRP (dBm)	33.55	36.42
RX threshold criteria	5.62	5.62
RX threshold level (dBm)	-92.00	-92.00
Receive signal (dBm)	-105.35	-105.35
Thermal fade margin (dB)	-13.35	-13.35
Dispersive fade occurrence factor	1.00	
Climatic factor	1.00	
Terrain roughness (ft)	40.39	
C factor	1.32	
Average annual temperature (°F)	68.09	
Fade occurrence factor (Po)	4.334E-003	

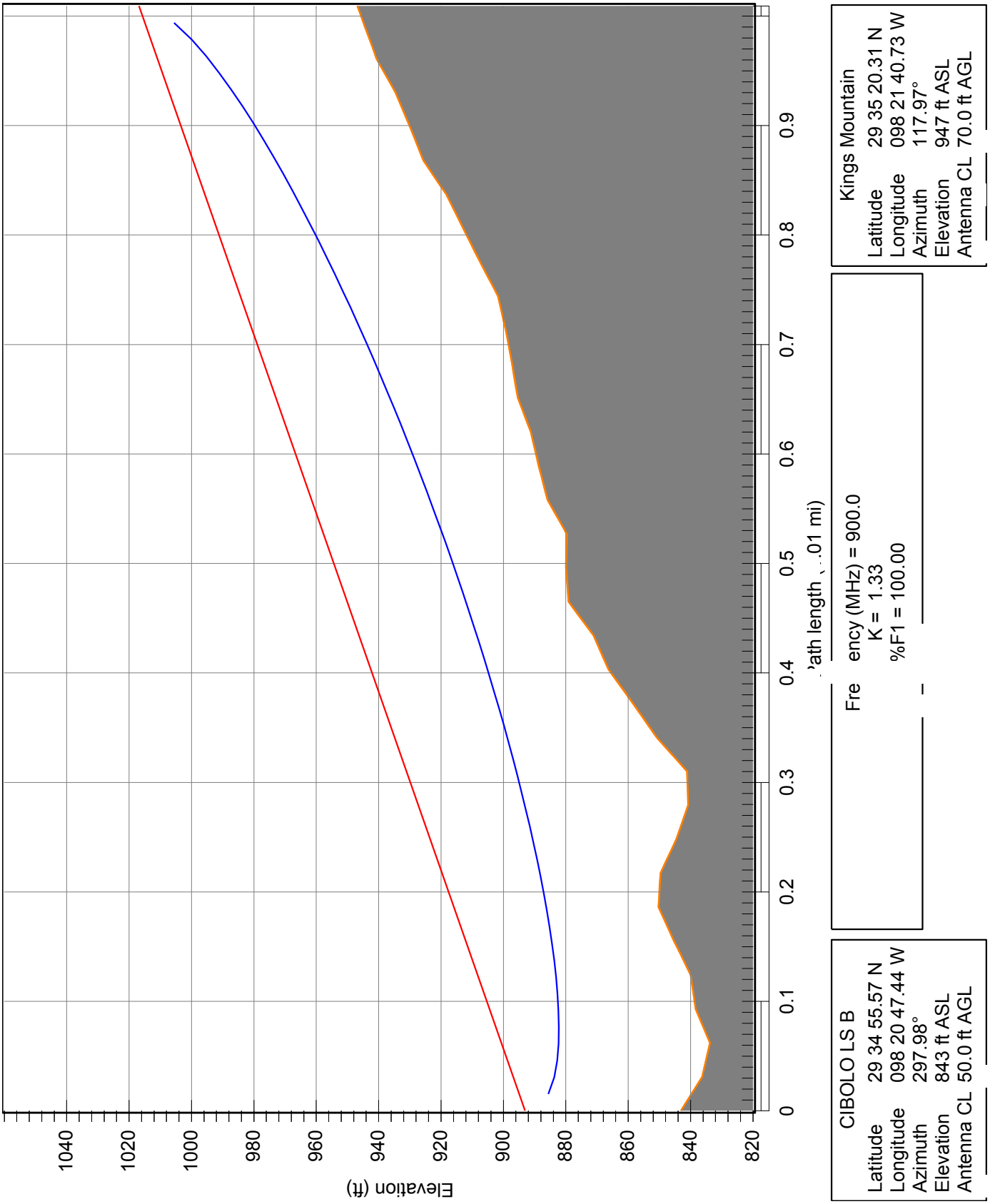
Multipath fading method - Vigants - Barnett

Transmission summary (Hildebrand-CIBOLO LS B.pl5)

F = 900.00 MHz K = 1.33 %F1 = 100.0, 60.0

	Hildebrand	CIBOLO LS B
Latitude	29 28 00.60 N	29 34 55.57 N
Longitude	098 28 51.56 W	098 20 47.44 W
True azimuth (°)	45.54	225.61
Vertical angle (°)	-0.01	1.55
Elevation (ft)	810.70	843.03
Antenna model	OGB9-915N (TR)	TY-900 (TR)
Antenna gain (dBi)	11.15	12.15
Antenna height (ft)	123.00	50.00
TX line model	LMR-900	LMR-600
TX line length (ft)	150.00	75.00
Diffraction loss	28.45	
Radio model	Trio J-Series	Trio J-Series
TX power (dBm)	30.00	30.00
EIRP (dBm)	33.55	36.42
Receive signal (dBm)	-105.35	-105.35
Thermal fade margin (dB)	-13.35	-13.35

Multipath fading method - Vigants - Barnett


Elevation (ft)
1040
1020
1000
980
960
940
920
900
880
860
840
820
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
ath length (.01 mi)
CIBOLO LS B
Latitude 29 34 55.57 N
Longitude 098 20 47.44 W
Azimuth 297.98°
Elevation 843 ft ASL
Antenna CL 50.0 ft AGL
Fre ency (MHz) = 900.0
K = 1.33
%F1 = 100.00
Kings Mountain
Latitude 29 35 20.31 N
Longitude 098 21 40.73 W
Azimuth 117.97°
Elevation 947 ft ASL
Antenna CL 70.0 ft AGL

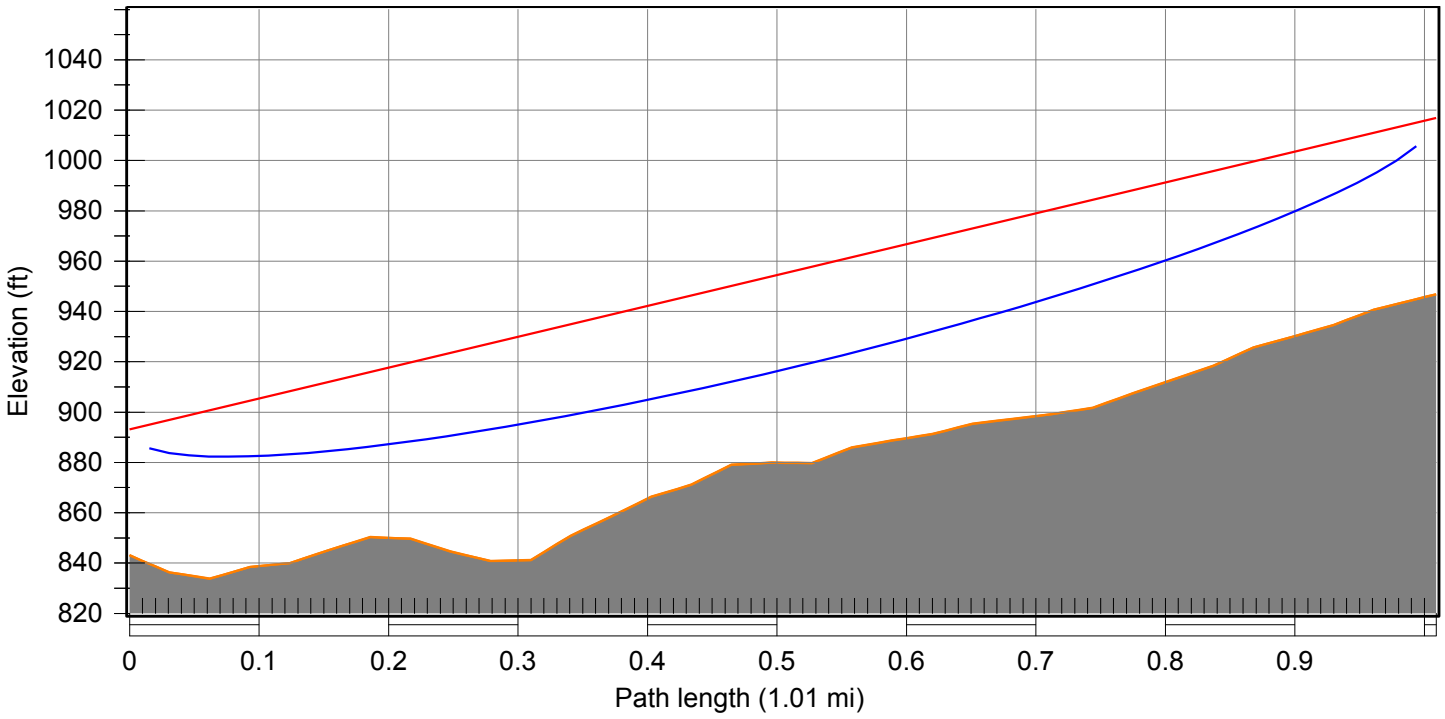
Transmission details ()

	CIBOLO LS B	Kings Mountain
Latitude	29 34 55.57 N	29 35 20.31 N
Longitude	098 20 47.44 W	098 21 40.73 W
True azimuth (°)	297.98	117.97
Vertical angle (°)	1.32	-1.34
Elevation (ft)	843.03	946.77
Antenna model	TY-900 (TR)	OGB9-915N (TR)
Antenna file name	ty-900_0925-mhz_hpol	ogb9-915n_0902-mhz_vpol
Antenna gain (dBi)	12.15	11.15
Antenna height (ft)	50.00	70.00
TX line model	LMR 600	LMR 600
TX line unit loss (dB/100 ft)	7.30	7.30
TX line length (ft)	75.00	75.00
TX line loss (dB)	5.48	5.48
Connector loss (dB)	0.25	0.25
Frequency (MHz)	900.00	
Polarization	Vertical	
Path length (mi)	1.01	
Free space loss (dB)	95.77	
Atmospheric absorption loss (dB)	0.01	
Net path loss (dB)	83.92	83.92
Radio model	MDS TransNET 900	MDS TransNET 900
TX power (dBm)	30.00	30.00
EIRP (dBm)	36.42	35.42
RX threshold criteria	.9	.9
RX threshold level (dBm)	-108.00	-108.00
Receive signal (dBm)	-53.92	-53.92
Thermal fade margin (dB)	54.08	54.08
Dispersive fade occurrence factor	1.00	
Effective fade margin (dB)	54.08	54.08
Climatic factor	1.00	
Terrain roughness (ft)	20.00	
C factor	3.29	
Average annual temperature (°F)	67.98	
Fade occurrence factor (Po)	7.613E-006	
Worst month multipath availability (%)	100.00000	100.00000

	CIBOLO LS B	Kings Mountain
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	

Multipath fading method - Vigants - Barnett

Transmission summary ()

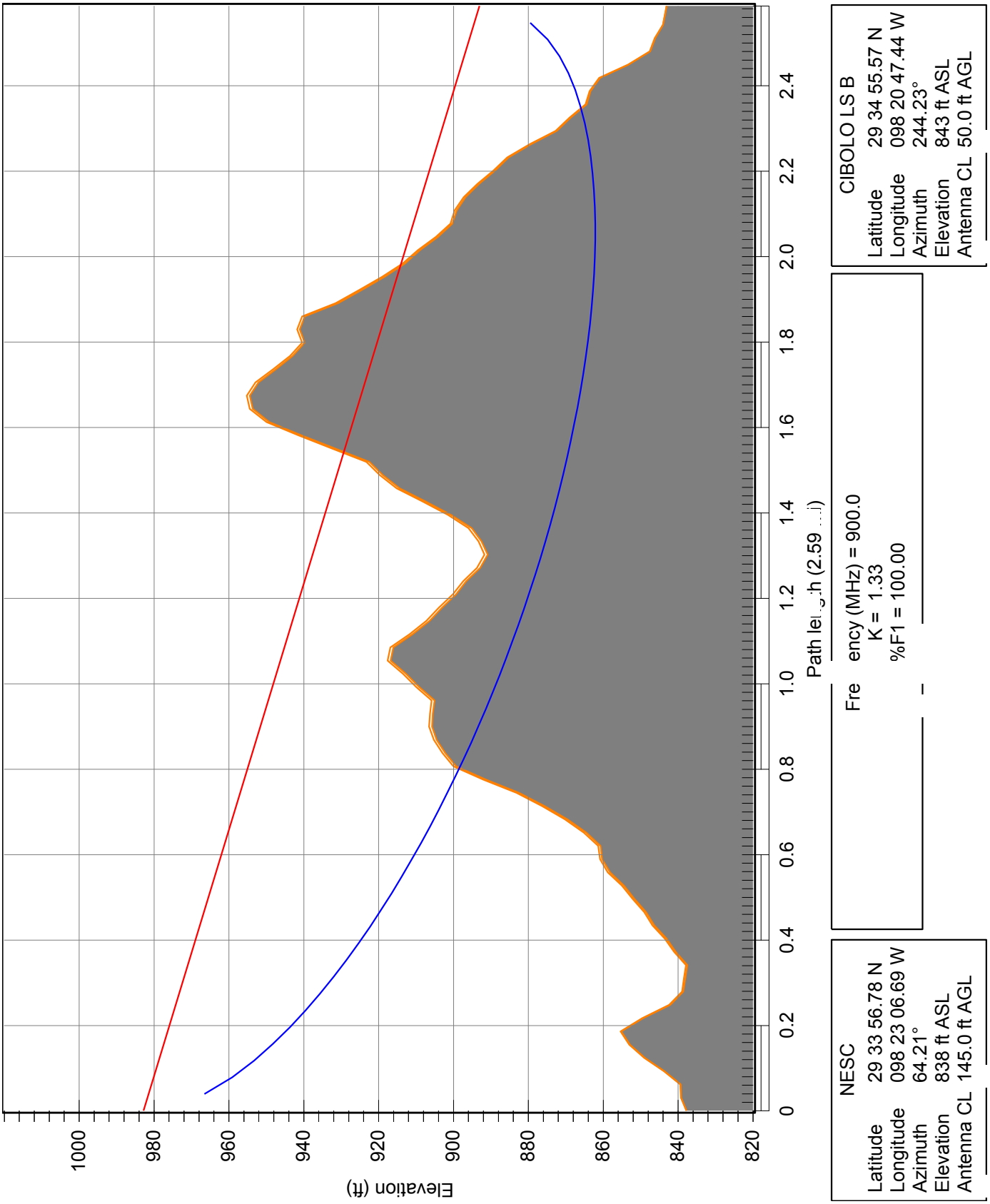


F = 900.00 MHz K = 1.33 %F1 = 100.0, 60.0

	CIBOLO LS B	Kings Mountain
Latitude	29 34 55.57 N	29 35 20.31 N
Longitude	098 20 47.44 W	098 21 40.73 W
True azimuth (°)	297.98	117.97
Vertical angle (°)	1.32	-1.34
Elevation (ft)	843.03	946.77
Antenna model	TY-900 (TR)	OGB9-915N (TR)
Antenna gain (dBi)	12.15	11.15
Antenna height (ft)	50.00	70.00
TX line model	LMR 600	LMR 600
TX line length (ft)	75.00	75.00
Radio model	MDS TransNET 900	MDS TransNET 900
TX power (dBm)	30.00	30.00
EIRP (dBm)	36.42	35.42
Receive signal (dBm)	-53.92	-53.92
Thermal fade margin (dB)	54.08	54.08
Effective fade margin (dB)	54.08	54.08
Annual 2 way multipath availability (%)	100.00000	

	CIBOLO LS B	Kings Mountain
Annual 2 way multipath unavailability (sec)	0.00	

Multipath fading method - Vigants - Barnett


Elevation (ft)
1000
980
960
940
920
900
880
860
840
820
0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
Path length (2.59 mi)
NESC
Latitude 29 33 56.78 N
Longitude 098 23 06.69 W
Azimuth 64.21°
Elevation 838 ft ASL
Antenna CL 145.0 ft AGL
Frequency (MHz) = 900.0
K = 1.33
%F1 = 100.00
CIBOLO LS B
Latitude 29 34 55.57 N
Longitude 098 20 47.44 W
Azimuth 244.23°
Elevation 843 ft ASL
Antenna CL 50.0 ft AGL

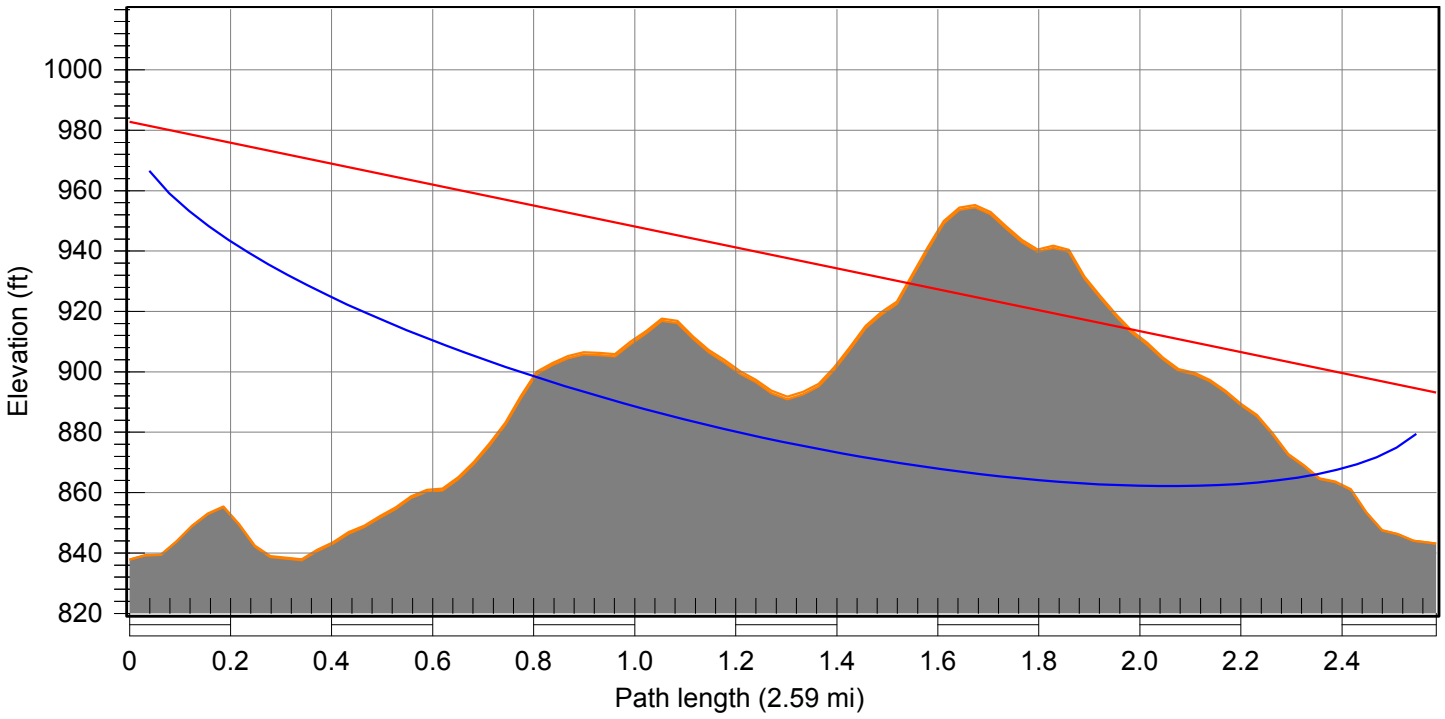
Transmission details (NESC-CIBOLO LS B.pl5)

	NESC	CIBOLO LS B
Latitude	29 33 56.78 N	29 34 55.57 N
Longitude	098 23 06.69 W	098 20 47.44 W
True azimuth (°)	64.21	244.23
Vertical angle (°)	-0.19	0.73
Elevation (ft)	837.77	843.03
Antenna model	OGB9-915N (TR)	TY-900 (TR)
Antenna file name	ogb9-915n_0902-mhz_vpol	ty-900_0925-mhz_hpol
Antenna gain (dBi)	11.15	12.15
Antenna height (ft)	145.00	50.00
TX line model	LMR-900	LMR-600
TX line unit loss (dB/100 ft)	4.90	7.30
TX line length (ft)	170.00	75.00
TX line loss (dB)	8.33	5.48
Connector loss (dB)	0.25	0.25
Frequency (MHz)	900.00	
Polarization	Vertical	
Path length (mi)	2.59	
Free space loss (dB)	103.94	
Atmospheric absorption loss (dB)	0.02	
Diffraction loss	16.76	
Net path loss (dB)	111.72	111.72
Radio model	Trio J-Series	Trio J-Series
TX power (dBm)	30.00	30.00
Emission designator	36 dBm	36 dBm
EIRP (dBm)	32.57	36.42
RX threshold criteria	5.62	5.62
RX threshold level (dBm)	-92.00	-92.00
Receive signal (dBm)	-81.72	-81.72
Thermal fade margin (dB)	10.28	10.28
Dispersive fade occurrence factor	1.00	
Effective fade margin (dB)	10.28	10.28
Climatic factor	1.00	
Terrain roughness (ft)	25.40	
C factor	2.41	
Average annual temperature (°F)	68.00	

	NESC	CIBOLO LS B
Fade occurrence factor (Po)	9.389E-005	
Worst month multipath availability (%)	99.99912	99.99912
Worst month multipath unavailability (sec)	23.15	23.15
Annual multipath availability (%)	99.99970	99.99970
Annual multipath unavailability (sec)	94.43	94.43
Annual 2 way multipath availability (%)	99.99940	
Annual 2 way multipath unavailability (sec)	188.86	

Multipath fading method - Vigants - Barnett

Transmission summary (NESC-CIBOLO LS B.pl5)

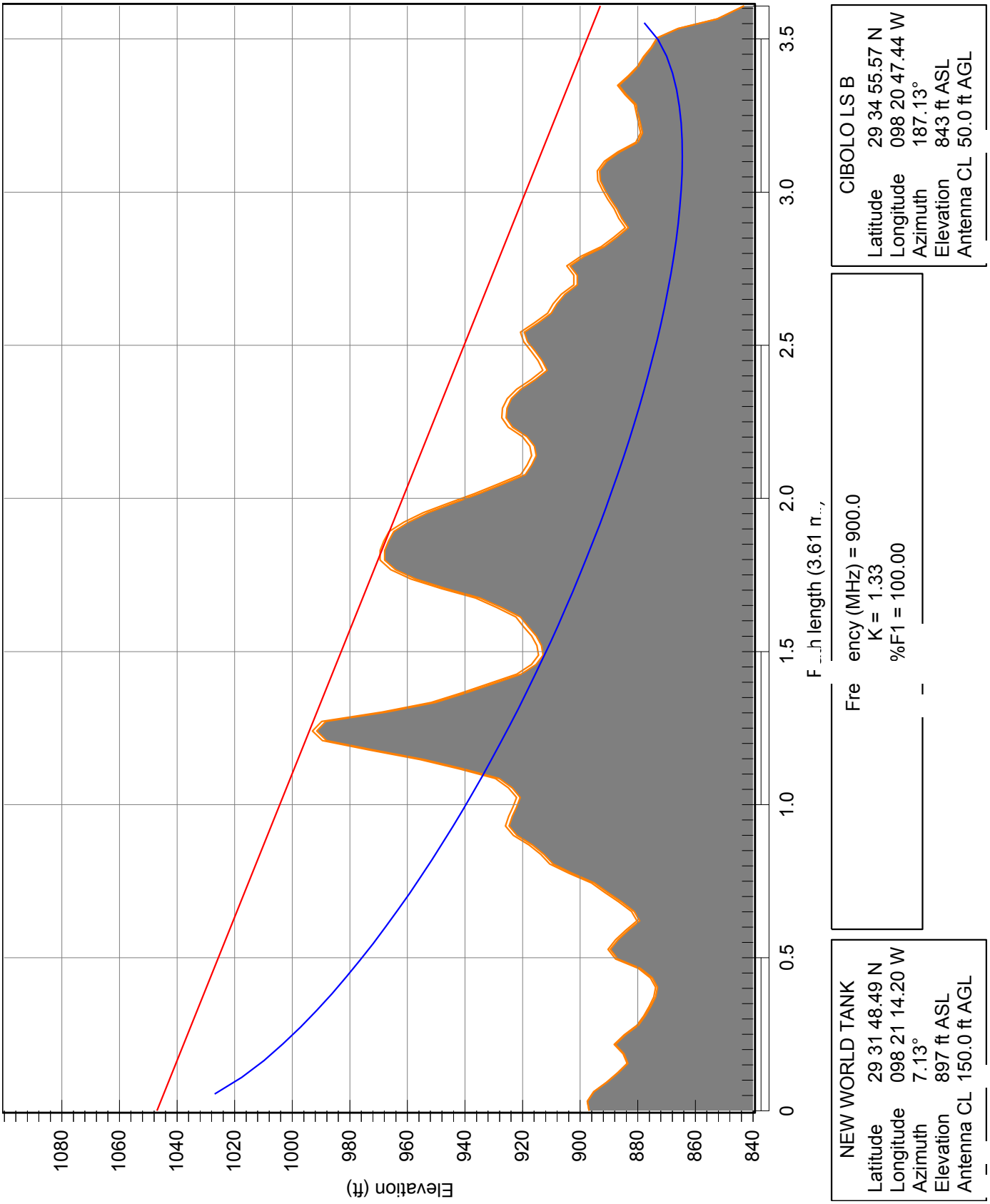


F = 900.00 MHz K = 1.33 %F1 = 100.0, 60.0

	NESC	CIBOLO LS B
Latitude	29 33 56.78 N	29 34 55.57 N
Longitude	098 23 06.69 W	098 20 47.44 W
True azimuth (°)	64.21	244.23
Vertical angle (°)	-0.19	0.73
Elevation (ft)	837.77	843.03
Antenna model	OGB9-915N (TR)	TY-900 (TR)
Antenna gain (dBi)	11.15	12.15
Antenna height (ft)	145.00	50.00
TX line model	LMR-900	LMR-600
TX line length (ft)	170.00	75.00
Diffraction loss	16.76	
Radio model	Trio J-Series	Trio J-Series
TX power (dBm)	30.00	30.00
EIRP (dBm)	32.57	36.42
Receive signal (dBm)	-81.72	-81.72
Thermal fade margin (dB)	10.28	10.28
Effective fade margin (dB)	10.28	10.28

	NESC	CIBOLO LS B
Annual 2 way multipath availability (%)	99.99940	
Annual 2 way multipath unavailability (sec)	188.86	

Multipath fading method - Vigants - Barnett


Elevation (ft)
1080
1060
1040
1020
1000
980
960
940
920
900
880
860
840
0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
F ...h length (3.61 n...
Fre ency (MHz) = 900.0
K = 1.33
%F1 = 100.00
NEW WORLD TANK
Latitude 29 31 48.49 N
Longitude 098 21 14.20 W
Azimuth 7.13°
Elevation 897 ft ASL
Antenna CL 150.0 ft AGL
CIBOLO LS B
Latitude 29 34 55.57 N
Longitude 098 20 47.44 W
Azimuth 187.13°
Elevation 843 ft ASL
Antenna CL 50.0 ft AGL

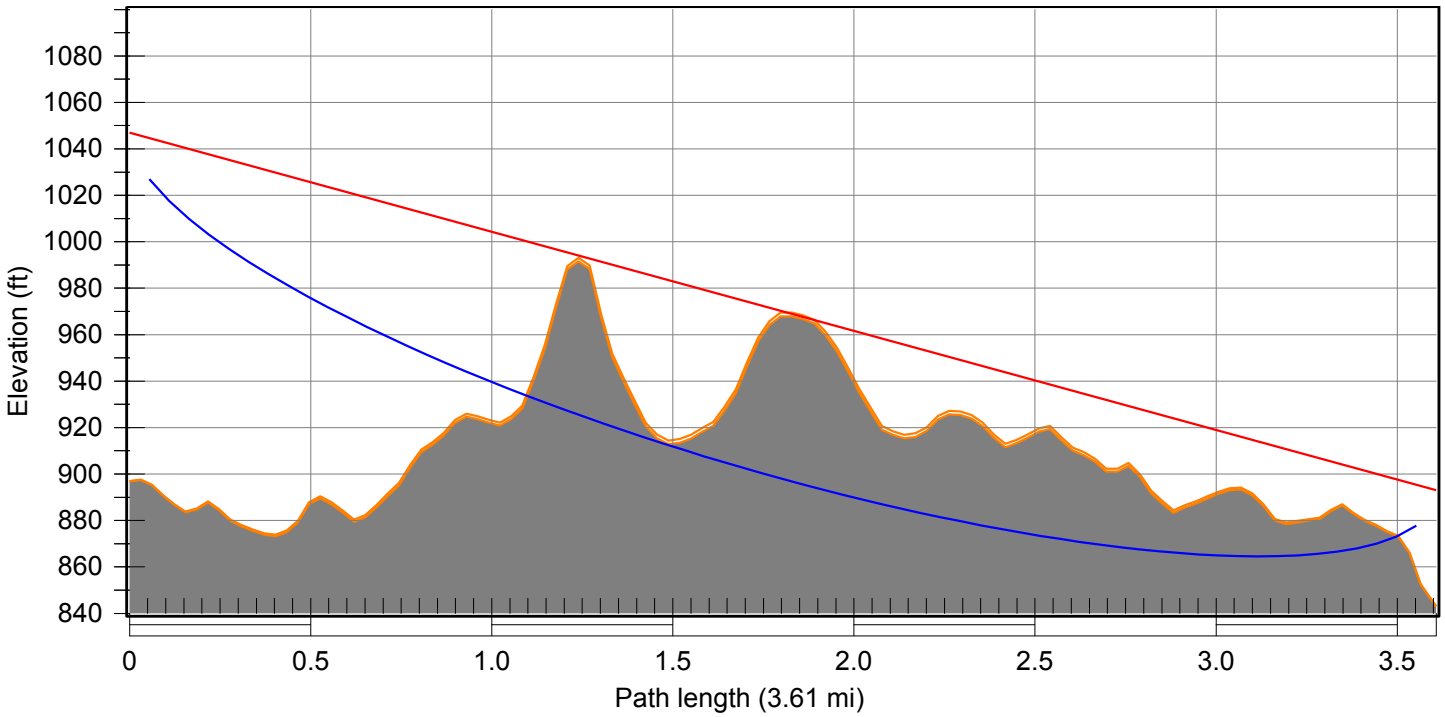
Transmission details (NEW WORLD TANK-CIBOLO LS B.pl5)

	NEW WORLD TANK	CIBOLO LS B
Latitude	29 31 48.49 N	29 34 55.57 N
Longitude	098 21 14.20 W	098 20 47.44 W
True azimuth (°)	7.13	187.13
Vertical angle (°)	-0.48	0.45
Elevation (ft)	896.90	843.03
Antenna model	OGB9-915N (TR)	TY-900 (TR)
Antenna file name	ogb9-915n_0902-mhz_vpol	ty-900_0925-mhz_hpol
Antenna gain (dBi)	11.15	12.15
Antenna height (ft)	150.00	50.00
TX line model	LMR-400	LMR-400
TX line unit loss (dB/100 ft)	10.80	10.80
TX line length (ft)	1.00	1.00
TX line loss (dB)	0.11	0.11
Connector loss (dB)	0.25	0.25
Frequency (MHz)	900.00	
Polarization	Vertical	
Path length (mi)	3.61	
Free space loss (dB)	106.83	
Atmospheric absorption loss (dB)	0.03	
Diffraction loss	11.99	
Net path loss (dB)	96.26	96.26
Radio model	Trio J-Series	Trio J-Series
TX power (dBm)	30.00	30.00
Emission designator	36 dBm	36 dBm
EIRP (dBm)	40.79	41.79
RX threshold criteria	5.62	5.62
RX threshold level (dBm)	-92.00	-92.00
Receive signal (dBm)	-66.26	-66.26
Thermal fade margin (dB)	25.74	25.74
Dispersive fade occurrence factor	1.00	
Effective fade margin (dB)	25.74	25.74
Climatic factor	1.00	
Terrain roughness (ft)	28.27	
C factor	2.10	
Average annual temperature (°F)	68.06	

	NEW WORLD TANK	CIBOLO LS B
Fade occurrence factor (Po)	2.217E-004	
Worst month multipath availability (%)	99.99994	99.99994
Worst month multipath unavailability (sec)	1.55	1.55
Annual multipath availability (%)	99.99998	99.99998
Annual multipath unavailability (sec)	6.35	6.35
Annual 2 way multipath availability (%)	99.99996	
Annual 2 way multipath unavailability (sec)	12.70	

Multipath fading method - Vigants - Barnett

Transmission summary (NEW WORLD TANK-CIBOLO LS B.pl5)

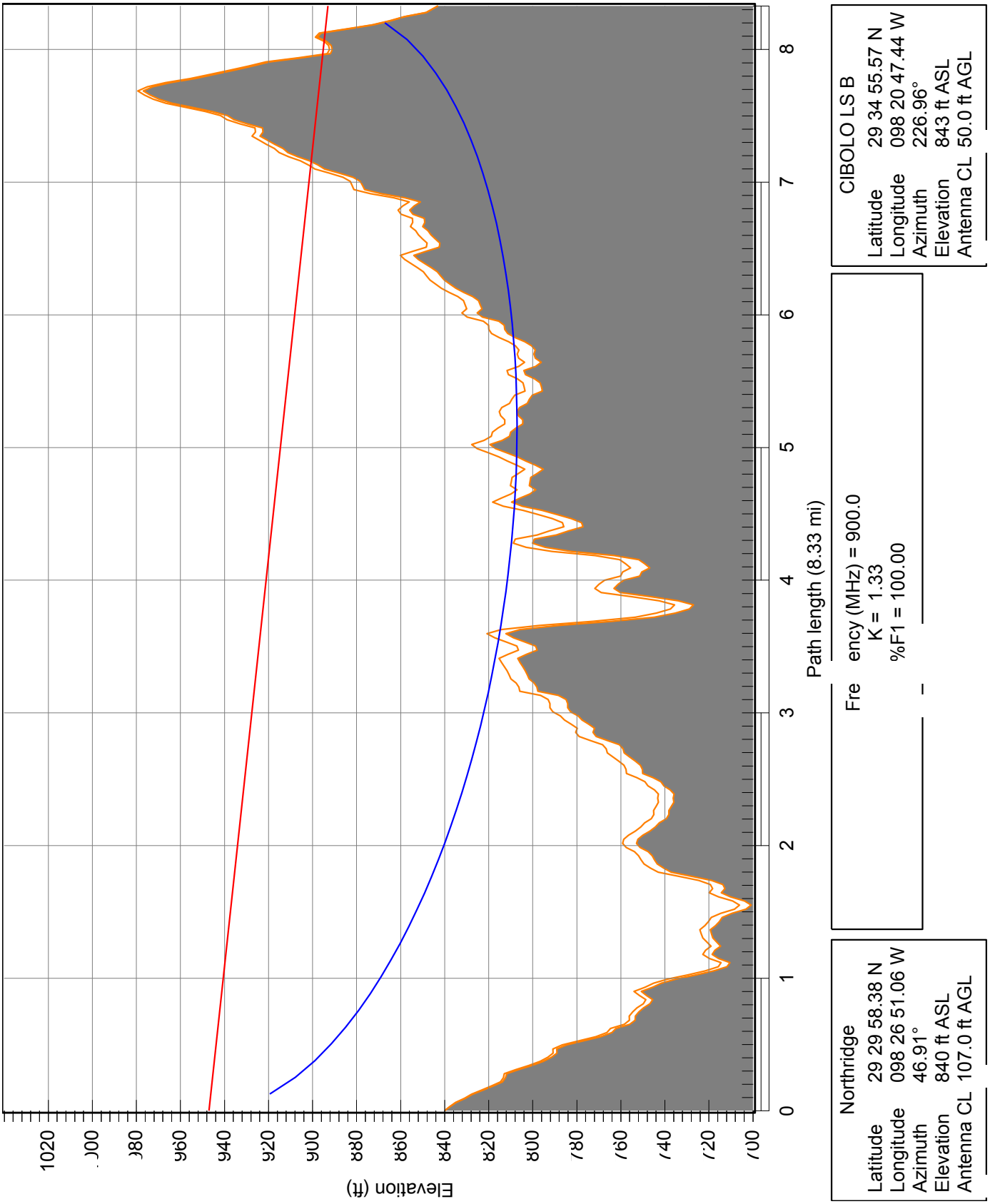


F = 900.00 MHz K = 1.33 %F1 = 100.0, 60.0

	NEW WORLD TANK	CIBOLO LS B
Latitude	29 31 48.49 N	29 34 55.57 N
Longitude	098 21 14.20 W	098 20 47.44 W
True azimuth (°)	7.13	187.13
Vertical angle (°)	-0.48	0.45
Elevation (ft)	896.90	843.03
Antenna model	OGB9-915N (TR)	TY-900 (TR)
Antenna gain (dBi)	11.15	12.15
Antenna height (ft)	150.00	50.00
TX line model	LMR-400	LMR-400
TX line length (ft)	1.00	1.00
Diffraction loss	11.99	
Radio model	Trio J-Series	Trio J-Series
TX power (dBm)	30.00	30.00
EIRP (dBm)	40.79	41.79
Receive signal (dBm)	-66.26	-66.26
Thermal fade margin (dB)	25.74	25.74
Effective fade margin (dB)	25.74	25.74

	NEW WORLD TANK	CIBOLO LS B
Annual 2 way multipath availability (%)	99.99996	
Annual 2 way multipath unavailability (sec)	12.70	

Multipath fading method - Vigants - Barnett

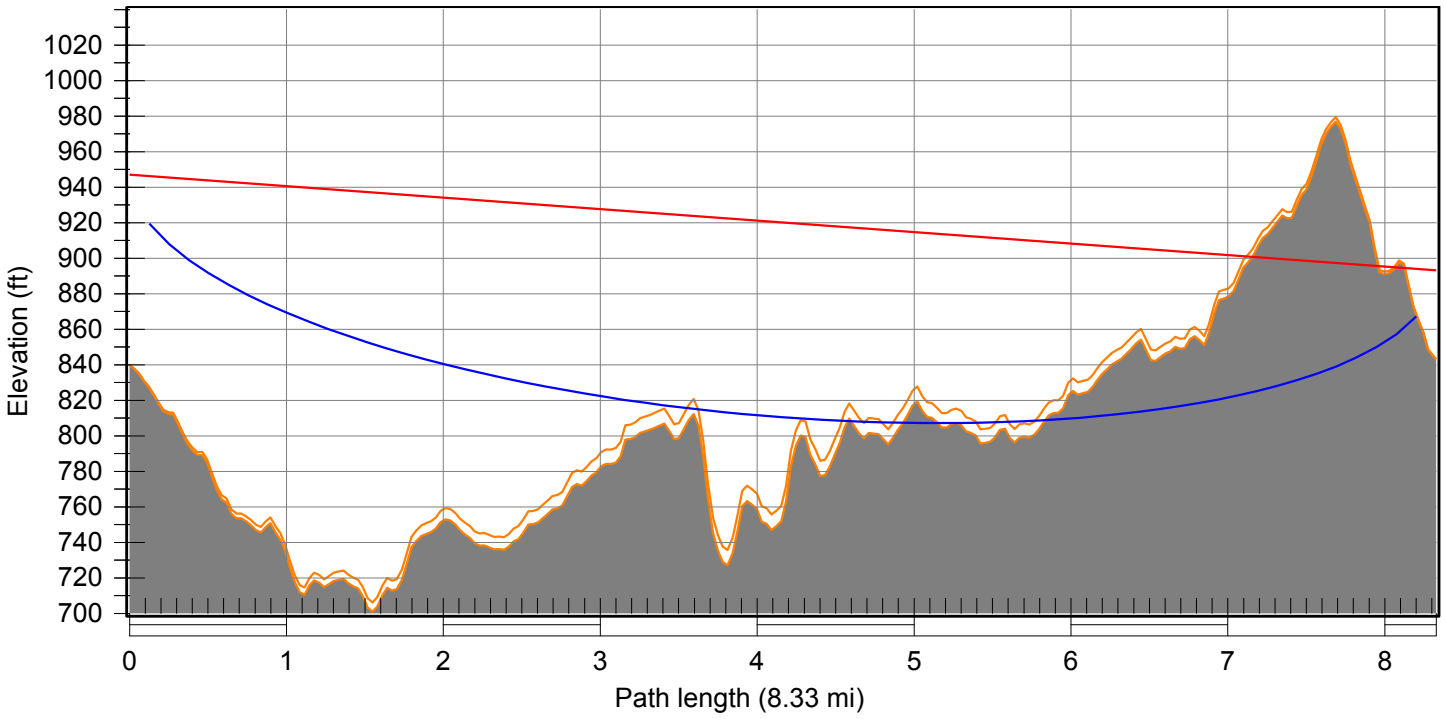

Elevation (ft)
1020
1000
980
960
940
920
900
880
860
840
820
800
780
760
740
720
700
0
1
2
3
4
5
6
7
8
Path length (8.33 mi)
Northridge
Latitude 29 29 58.38 N
Longitude 098 26 51.06 W
Azimuth 46.91°
Elevation 840 ft ASL
Antenna CL 107.0 ft AGL
Fre ency (MHz) = 900.0
K = 1.33
%F1 = 100.00
CIBOLO LS B
Latitude 29 34 55.57 N
Longitude 098 20 47.44 W
Azimuth 226.96°
Elevation 843 ft ASL
Antenna CL 50.0 ft AGL

Transmission details (Northridge-CIBOLO LS B.pl5)

	Northridge	CIBOLO LS B
Latitude	29 29 58.38 N	29 34 55.57 N
Longitude	098 26 51.06 W	098 20 47.44 W
True azimuth (°)	46.91	226.96
Vertical angle (°)	0.00	1.42
Elevation (ft)	839.99	843.03
Antenna model	OGB9-915N (TR)	TY-900 (TR)
Antenna file name	ogb9-915n_0902-mhz_vpol	ty-900_0925-mhz_hpol
Antenna gain (dBi)	11.15	12.15
Antenna height (ft)	107.00	50.00
TX line model	LMR-900	LMR-600
TX line unit loss (dB/100 ft)	4.90	7.30
TX line length (ft)	139.00	75.00
TX line loss (dB)	6.81	5.48
Connector loss (dB)	0.25	0.25
Frequency (MHz)	900.00	
Polarization	Vertical	
Path length (mi)	8.33	
Free space loss (dB)	114.10	
Atmospheric absorption loss (dB)	0.06	
Diffraction loss	27.94	
Net path loss (dB)	131.59	131.59
Radio model	Trio J-Series	Trio J-Series
TX power (dBm)	30.00	30.00
Emission designator	36 dBm	36 dBm
EIRP (dBm)	34.09	36.42
RX threshold criteria	5.62	5.62
RX threshold level (dBm)	-92.00	-92.00
Receive signal (dBm)	-101.59	-101.59
Thermal fade margin (dB)	-9.59	-9.59
Dispersive fade occurrence factor	1.00	
Climatic factor	1.00	
Terrain roughness (ft)	23.15	
C factor	2.72	
Average annual temperature (°F)	68.06	
Fade occurrence factor (Po)	3.535E-003	

Multipath fading method - Vigants - Barnett

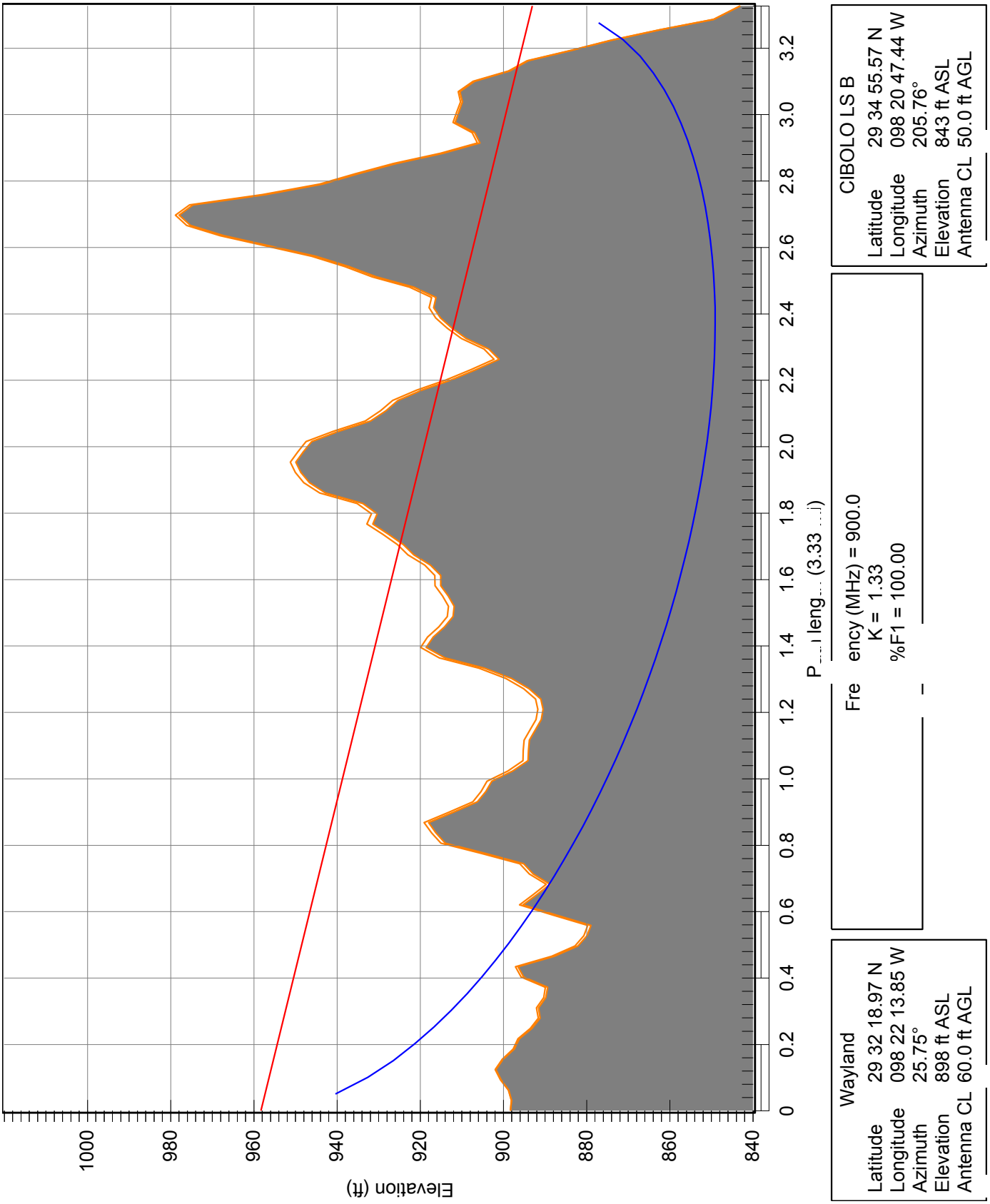
Transmission summary (Northridge-CIBOLO LS B.pl5)



F = 900.00 MHz K = 1.33 %F1 = 100.0, 60.0

	Northridge	CIBOLO LS B
Latitude	29 29 58.38 N	29 34 55.57 N
Longitude	098 26 51.06 W	098 20 47.44 W
True azimuth (°)	46.91	226.96
Vertical angle (°)	0.00	1.42
Elevation (ft)	839.99	843.03
Antenna model	OGB9-915N (TR)	TY-900 (TR)
Antenna gain (dBi)	11.15	12.15
Antenna height (ft)	107.00	50.00
TX line model	LMR-900	LMR-600
TX line length (ft)	139.00	75.00
Diffraction loss	27.94	
Radio model	Trio J-Series	Trio J-Series
TX power (dBm)	30.00	30.00
EIRP (dBm)	34.09	36.42
Receive signal (dBm)	-101.59	-101.59
Thermal fade margin (dB)	-9.59	-9.59

Multipath fading method - Vigants - Barnett


Elevation (ft)
1000
980
960
940
920
900
880
860
840
0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
1.8
2.0
2.2
2.4
2.6
2.8
3.0
3.2
P... l leng... (3.33 ...i)
Wayland
Latitude 29 32 18.97 N
Longitude 098 22 13.85 W
Azimuth 25.75°
Elevation 898 ft ASL
Antenna CL 60.0 ft AGL
Fre ency (MHz) = 900.0
K = 1.33
%F1 = 100.00
CIBOLO LS B
Latitude 29 34 55.57 N
Longitude 098 20 47.44 W
Azimuth 205.76°
Elevation 843 ft ASL
Antenna CL 50.0 ft AGL

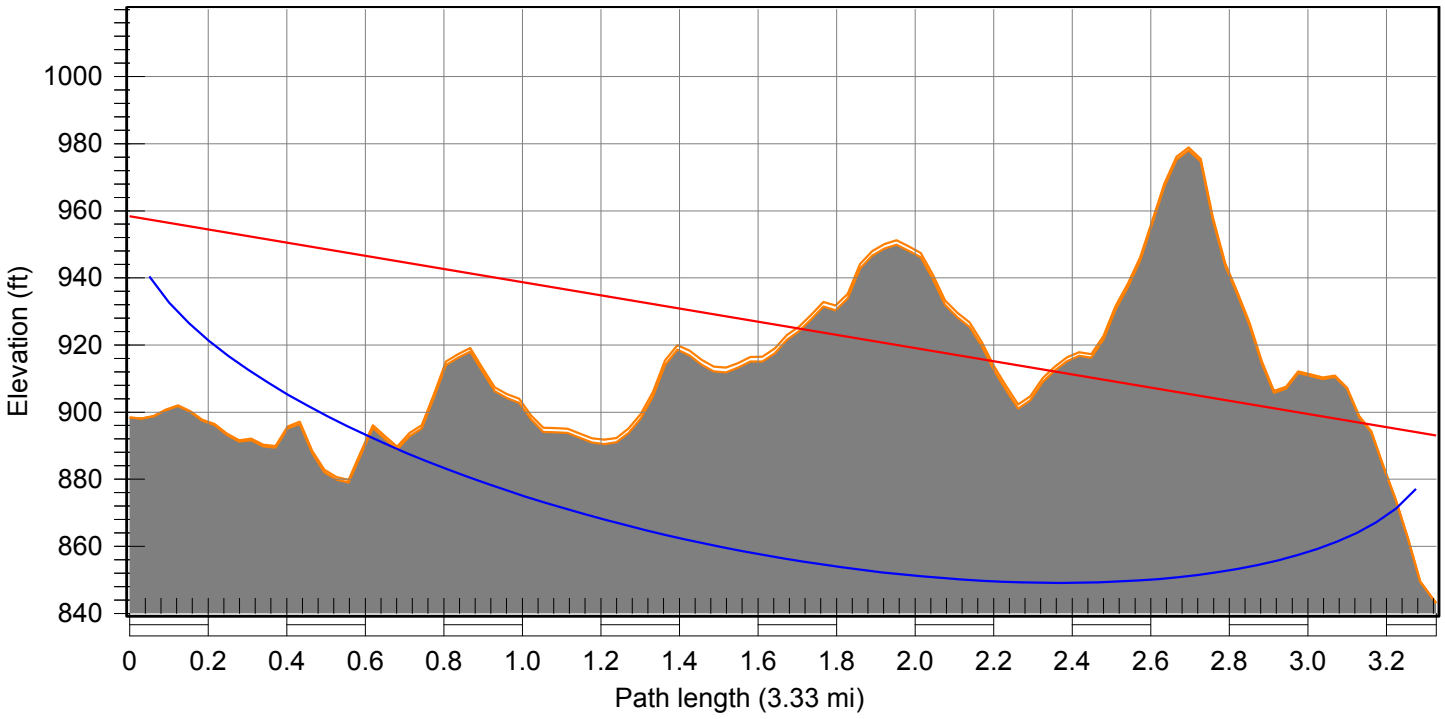
Transmission details (Wayland-CIBOLO LS B.pl5)

	Wayland	CIBOLO LS B
Latitude	29 32 18.97 N	29 34 55.57 N
Longitude	098 22 13.85 W	098 20 47.44 W
True azimuth (°)	25.75	205.76
Vertical angle (°)	0.06	1.48
Elevation (ft)	898.30	843.03
Antenna model	OGB9-915N (TR)	TY-900 (TR)
Antenna file name	ogb9-915n_0902-mhz_vpol	ty-900_0925-mhz_hpol
Antenna gain (dBi)	11.15	12.15
Antenna height (ft)	60.00	50.00
TX line model	LMR-600	LMR-600
TX line unit loss (dB/100 ft)	7.30	7.30
TX line length (ft)	85.00	75.00
TX line loss (dB)	6.21	5.48
Connector loss (dB)	0.25	0.25
Frequency (MHz)	900.00	
Polarization	Vertical	
Path length (mi)	3.33	
Free space loss (dB)	106.13	
Atmospheric absorption loss (dB)	0.03	
Diffraction loss	26.85	
Net path loss (dB)	121.89	121.89
Radio model	Trio J-Series	Trio J-Series
TX power (dBm)	30.00	30.00
Emission designator	36 dBm	36 dBm
EIRP (dBm)	34.69	36.42
RX threshold criteria	5.62	5.62
RX threshold level (dBm)	-92.00	-92.00
Receive signal (dBm)	-91.89	-91.89
Thermal fade margin (dB)	0.11	0.11
Dispersive fade occurrence factor	1.00	
Effective fade margin (dB)	0.11	0.11
Climatic factor	1.00	
Terrain roughness (ft)	20.00	
C factor	3.29	
Average annual temperature (°F)	68.04	

	Wayland	CIBOLO LS B
Fade occurrence factor (Po)	2.726E-004	
Worst month multipath availability (%)	99.97345	99.97345
Worst month multipath unavailability (sec)	697.83	697.83
Annual multipath availability (%)	99.99097	99.99097
Annual multipath unavailability (sec)	2848.81	2848.81
Annual 2 way multipath availability (%)	99.98193	
Annual 2 way multipath unavailability (sec)	5697.63	

Multipath fading method - Vigants - Barnett

Transmission summary (Wayland-CIBOLO LS B.pl5)



F = 900.00 MHz K = 1.33 %F1 = 100.0, 60.0

	Wayland	CIBOLO LS B
Latitude	29 32 18.97 N	29 34 55.57 N
Longitude	098 22 13.85 W	098 20 47.44 W
True azimuth (°)	25.75	205.76
Vertical angle (°)	0.06	1.48
Elevation (ft)	898.30	843.03
Antenna model	OGB9-915N (TR)	TY-900 (TR)
Antenna gain (dBi)	11.15	12.15
Antenna height (ft)	60.00	50.00
TX line model	LMR-600	LMR-600
TX line length (ft)	85.00	75.00
Diffraction loss	26.85	
Radio model	Trio J-Series	Trio J-Series
TX power (dBm)	30.00	30.00
EIRP (dBm)	34.69	36.42
Receive signal (dBm)	-91.89	-91.89
Thermal fade margin (dB)	0.11	0.11
Effective fade margin (dB)	0.11	0.11

	Wayland	CIBOLO LS B
Annual 2 way multipath availability (%)	99.98193	
Annual 2 way multipath unavailability (sec)	5697.63	

Multipath fading method - Vigants - Barnett

APPENDIX B

PHYSICAL RADIO PATH STUDY RESULTS

Results of Physical Radio Path Study for Cibolo Lift Station A to Kings Mountain at 40ft

GRUBB ENGINEERING
ELECTRICAL POWER SYSTEMS
DESIGNAND TESTING
SINCE 1981

Project Name:
Tech: RG
Date: Physical Study from April 12, 2011

Client:
Radio:
Frequency:
Station: CIBOLO LIFT STATION A
Output W:
Path:

Coordinates:
Address:
Study Coordinates: 29° 35' 21.8" N 98° 20' 11.8" W

HEIGHT	STRENGTH	REMARKS
10	-85	
20	-81	
30	-74	
40	-69	LINE OF SIGHT

REMARKS:

KINGS MOUNTAIN @ 40'

GRUBB ENGINEERING, INC.
ELECTRICAL POWER SYSTEMS
DESIGN AND TESTING

Project Name: *Cibolo Creek Sewershed Flow Diversion Poject*
Tech: *RDGj, TRM, LLD*
Date: *6/26/2015*

Client: *SAWS*
Radio: *Transnet 900*
Frequency: *900MHz*
Network Address:

Station: *Cibolo LS A*
Output W: *1Watt*
Path: *Cibolo LS A-Stahl Repeater*

Master Radio Coordinates: *29D 35M 20.31S=N; 98D 21M 40.73S=W*
Master Radio Height: *60*
Remote Radio Coordinates: *29D 35M 24.47S=N; 98D 20M 12.14S=W*

HEIGHT	STRENGTH	REMARKS
10'		*Trees*
20'	*-76*	*Tops of trees*
30'	*-65*	
40'	*-62*	
50'	*-63*	

REMARKS:

Weather conditions were clear, partly cloudy, 76deg.
Photo of line of site is attached.

Results of Physical Radio Path Study for Cibolo Lift Station B to Kings Mountain at 40ft

GRUBB ENGINEERING
ELECTRICAL POWER SYSTEMS
DESIGN AND TESTING
SINCE 1981

Project Name:
Tech: RGJ
Date: Physical Study from April 12, 2011

Client:
Radio:
Frequency:
Station: CIBOLO LIFT STATION B
Output W:
Path:

Coordinates:
Address:
Study Coordinates: 29°29'54.4"N 98°20'47.7"

HEIGHT	STRENGTH	REMARKS
10'	-63	
20'	-58	
30'	-58	LINE OF SIGHT
40'	-58	

REMARKS:
KINGS MOUNTAIN @ 40'

GRUBB ENGINEERING, INC.
ELECTRICAL POWER SYSTEMS
DESIGN AND TESTING

Project Name: *Cibolo Creek Sewershed Flow Diversion Poject*
Tech: *RDGj, TRM, LLD*
Date: *6/26/2015*

Client: *SAWS*
Station: *Cibolo LS B*
Radio: *Transnet 900*
Output W: *1Watt*
Frequency: *900MHz*
Path: *Cibolo LS B-Stahl Repeater*
Network Address:

Master Radio Coordinates: *29D 35M 20.31S=N; 98D 21M 40.73S=W*
Master Radio Height: *60*
Remote Radio Coordinates: *29D 34M 55.28S=N; 98D 20M 47.66S=W*

HEIGHT	STRENGTH	REMARKS
10'		*Trees*
20'	*-58*	
30'	*-56*	
40'	*-58*	
50'	*-58*	

REMARKS:

Weather conditions were clear, partly cloudy, 76deg.
Photo of line of site is attached.