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TELECOMMUNICATIONS
Research and Engineering Report 19

LEVEL II

TABULATIONS OF PROPAGATION DATA OVER IRREGULAR TERRAIN IN THE 230-TO 9200-MHz FREQUENCY RANGE PART IV: RECEIVER SITE IN GROVE OF TREES

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Institute for Telecommunication Sciences

OCTOBER 1971

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TELECOMMUNICATIONS
Research and Engineering Report 19

(6)

TABULATIONS OF PROPAGATION DATA OVER IRREGULAR TERRAIN IN THE 230-TO 9200-MHz FREQUENCY RANGE. PART IV. RECEIVER SITE IN GROVE OF TREES.

(10) P. L. McQUATE
J. M. HARMAN
M. E. McCLANAHAN
INSTITUTE FOR TELECOMMUNICATION SCIENCES
Boulder, Colorado 80302

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TABULATIONS OF PROPAGATION DATA OVER IRREGULAR TERRAIN IN THE 230- to 9200-MHz FREQUENCY RANGE

PART IV: Receiver Site in Grove of Trees

P. L. McQuate, J. M. Harman, and
M. E. McClanahan

This is the fourth part of a four-part report containing tabulations and graphs of transmission loss data resulting from propagation experiments in the 230- to 9200-MHz frequency range conducted over irregular terrain in Colorado. This part presents data obtained at a common receiver site, located in a small grove of cottonwood (Populus deltoides) trees, over propagation paths varying in length from 0.5 to 59 km.

Key Words: UHF propagation data, irregular terrain, UHF propagation through trees

1. INTRODUCTION

The purpose of this four-part report series is to present tabulations of transmission loss data resulting from propagation over irregular terrain in Colorado with path length ranging from 0.5 to 120 km at seven frequencies in the 230- to 9200-MHz range.

The measurement program was sponsored by the U.S. Army Electronics Command and the U.S. Army Security Agency as part of a study of propagation characteristics under conditions resembling the operations of an army in the field.

Part 1 of this report series (McQuate, et al., 1968) presented data obtained at a common receiver site (R1) located near the summit of a hill in the open plains, about 15 km northeast of Boulder. Several of the transmitting sites associated with this common receiver site were located in the mountains west of Boulder and east of the

continental divide; all others were located in the relatively open and rolling plains area. This part includes also a more complete description of the equipment used, and of data collection and measurement techniques.

Part II of this series (McQuate, et al., 1968) presents data obtained at a common receiver site (R2) located in the mountains near Rollinsville, about 20 km southwest of Boulder. The mountains shield this site from the plains. Only eight of the 44 transmitting sites associated with this receiving location are in the plains area.

Part III (McQuate, et al., 1970) presents data obtained at a common receiver site (R3) located on the eastern edge of a high mesa at a juncture between the mountains and plains near Golden, about 25 km south of Boulder. This site was selected to represent propagation from ground to low-flying aircraft. All of the 57 transmitting sites associated with this receiver site are located in the relatively open and rolling plains area.

This, the fourth part of the four-part report series, presents data obtained from common receiver site R4, located in a cluster of trees in in the broad St. Vrain Creek valley near Longmont, about 25 km northeast of Boulder.

Figure 1 is an aerial photograph of the area. The receiver antenna tower is located near the center of the left edge of the largest tree cluster. A white cross was placed at the top of the tower to help locate it in the aerial photograph and it also serves as the northern terminal of a true north-south line. The southern terminal of this line is a white cross on the ground shown near the bottom edge of the photograph. The dark area, near the cross marking the top of the tower, is the area where the tree foliage was removed to permit unobstructed vertical movement of the receiving antennas.

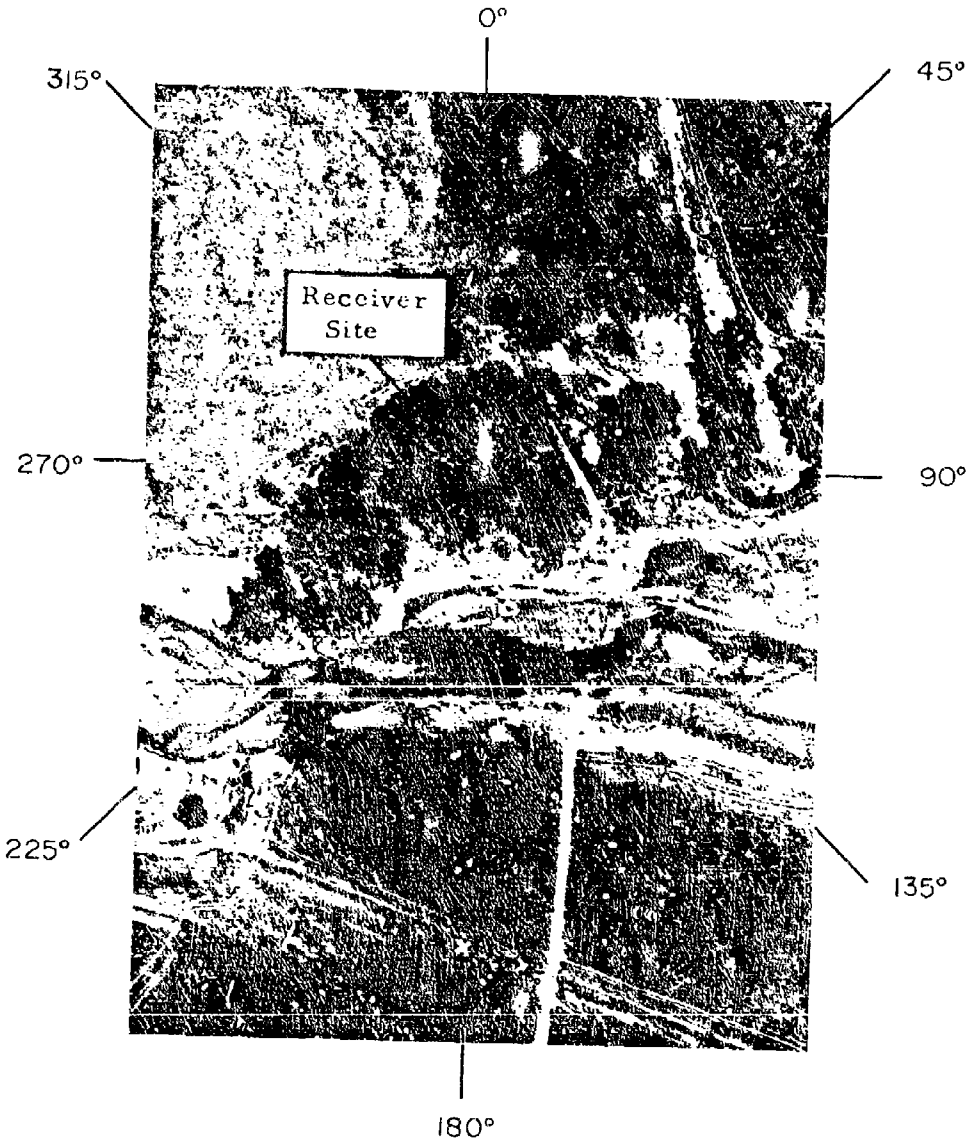


Figure 1. Aerial view of the common receiver site. Azimuths in degrees from true north.

All path loss measurements were made at the fixed receiving site using mobile transmitters. Received signal levels were recorded continuously as the receiving antennas were raised from near ground to a point well above the top of the trees; therefore, the received signal levels reflect, to a varying degree, the effects of foliage and branches on the electromagnetic field.

2. MEASUREMENT PROGRAM

Figure 2 presents an overall view of the measurement area and shows for clarity only 27 of the 36 transmitter locations. Most of those not shown are within 10 km of the common receiver site. The measurement points are arranged around the common receiver in concentric circles at nominal distances of 0.5, 3, 5, 10, 20, 30, and 50 km.

Figures 3, 4, and 5 are panoramic views of the measurement area as seen from the top of the receiving antenna tower (26.8 m above ground) and figures 6, 7, and 8 are views of the trees as seen by the receiving antennas 1.5 m above ground. Maximum leaf cover begins about 7 m above ground and continues to the top of the trees. Figures 3 and 5 show that the trees are of uniform height, approximately 18 m above ground. No transmitting sites were located in the west-to-northeast sector between approximately 270° and 40° true azimuth.

All except two transmitting sites lie in the relatively open and rolling plains area east of the mountains, and, unlike the transmitter sites used in earlier reports of this report series, all transmitter sites were selected to provide a clear and unobstructed foreground in the direction of the receiving antenna.

Signals were recorded for the six frequencies from all 36 transmitting sites while the leaves were on the trees and then the measurements were repeated after the leaves had fallen from the trees and the trees were dormant.

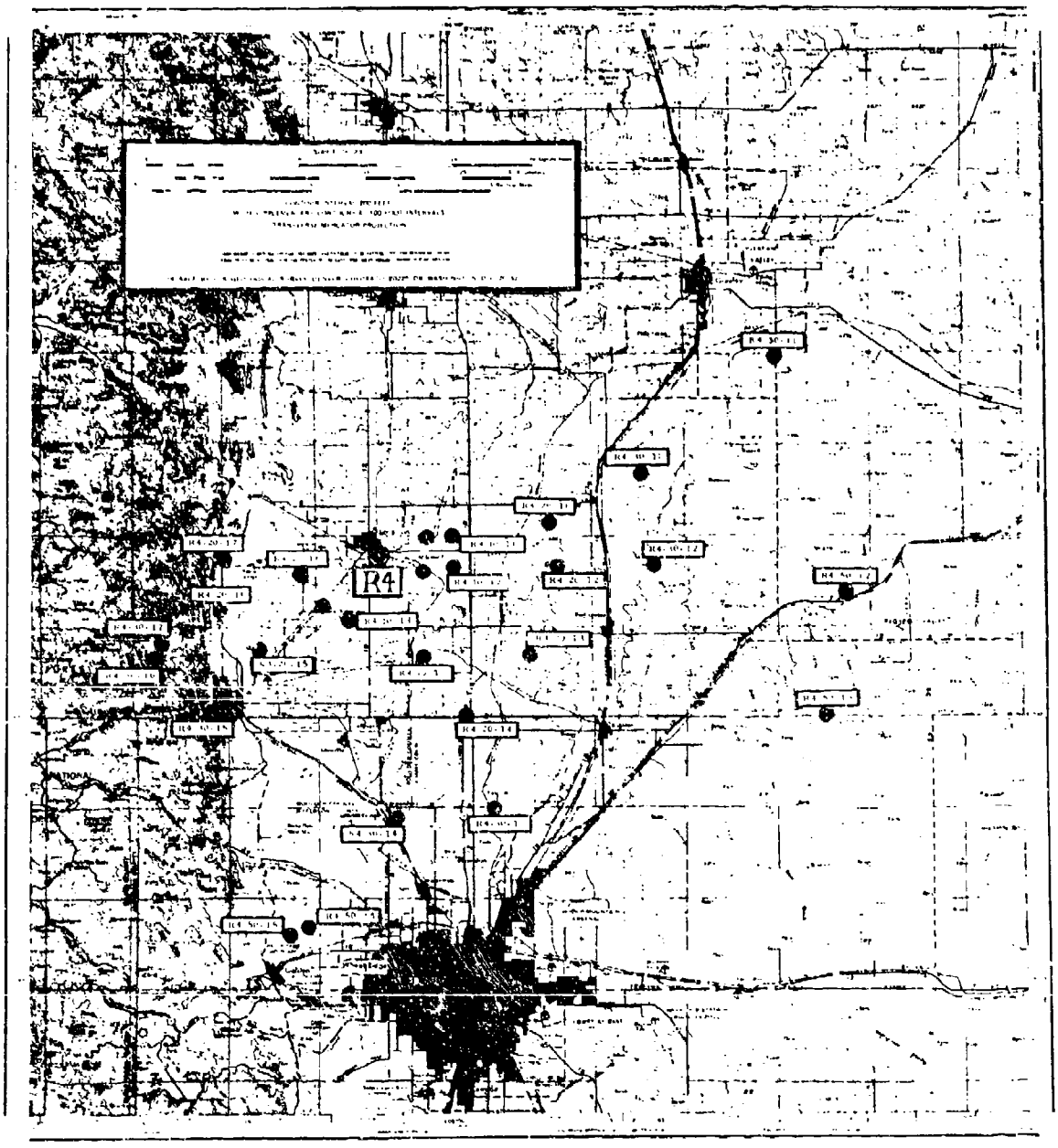


Figure 2. Layout of transmitter sites in relation to the common receiver site R4.

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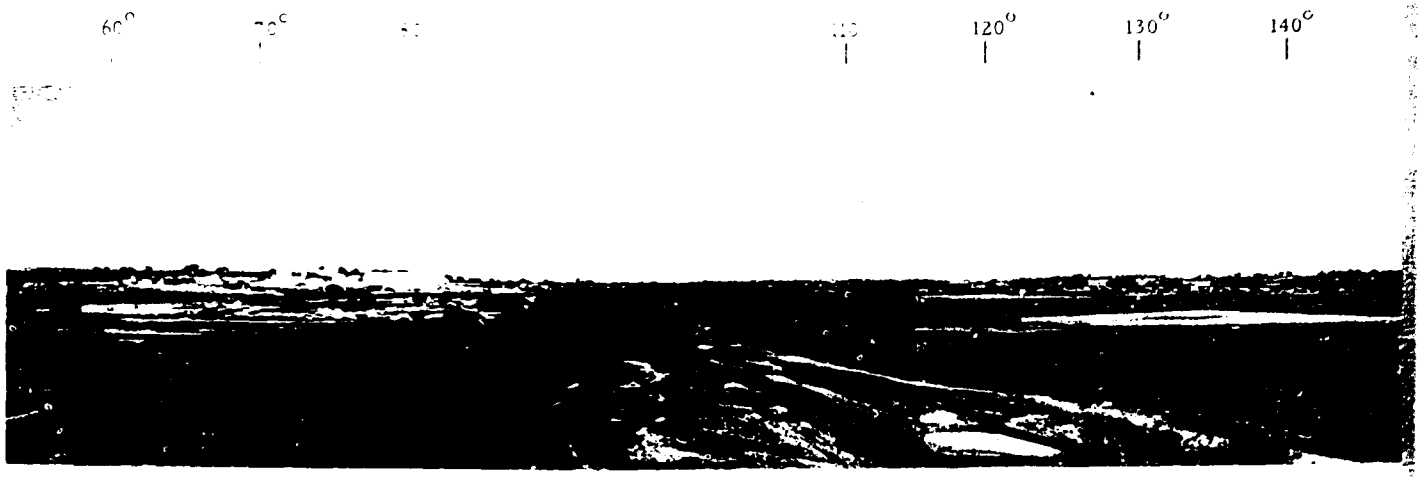


Figure 3. Panoramic view of eastern sector from top of receiver antenna tower.

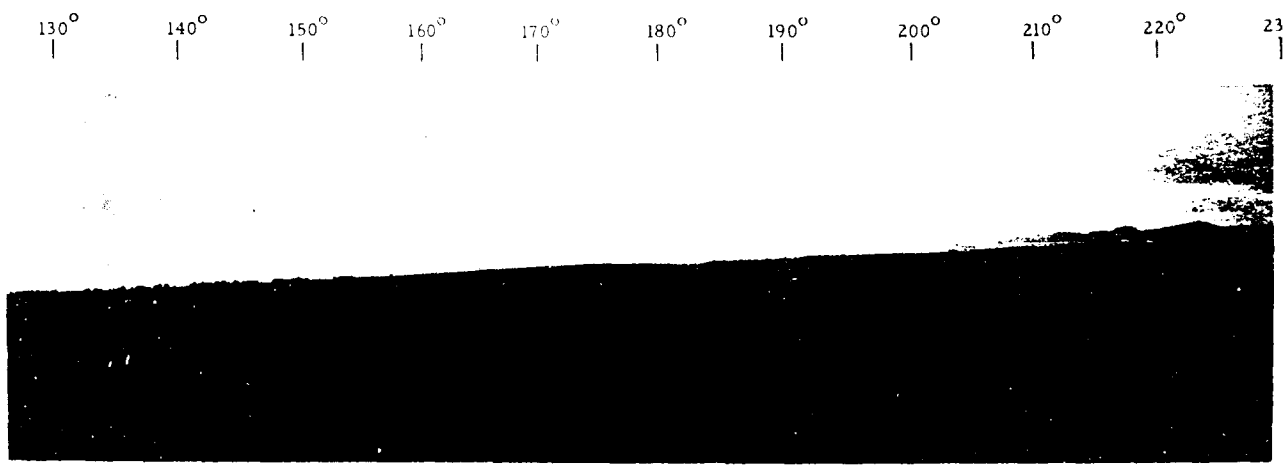


Figure 4. Panoramic view of southern sector from top of receiver antenna tower.

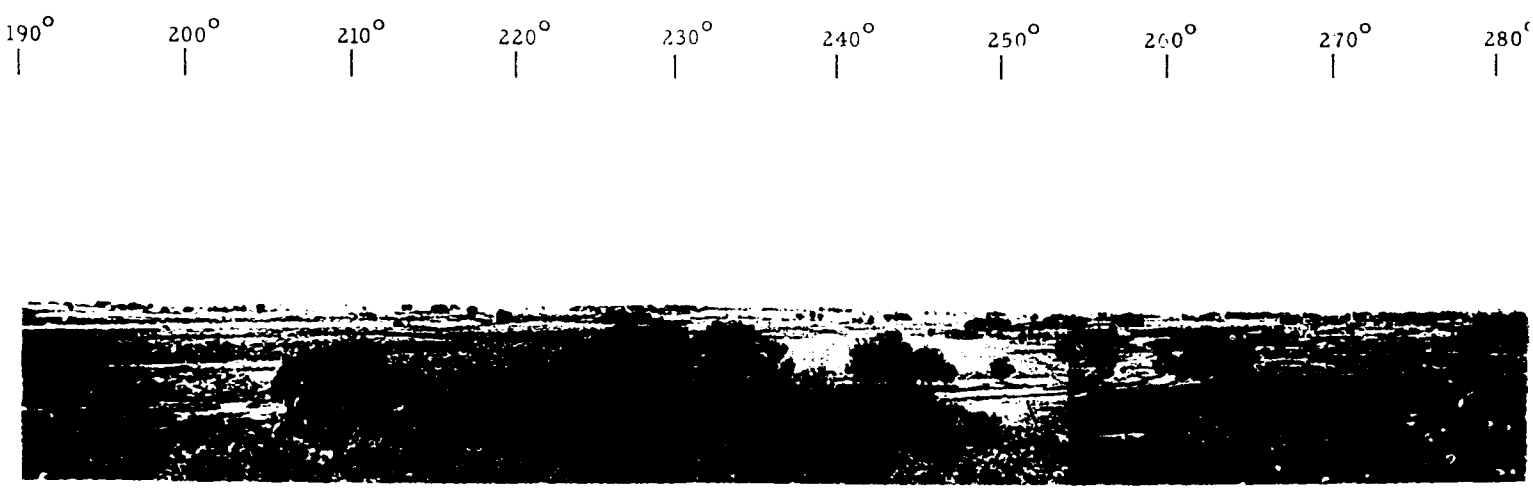
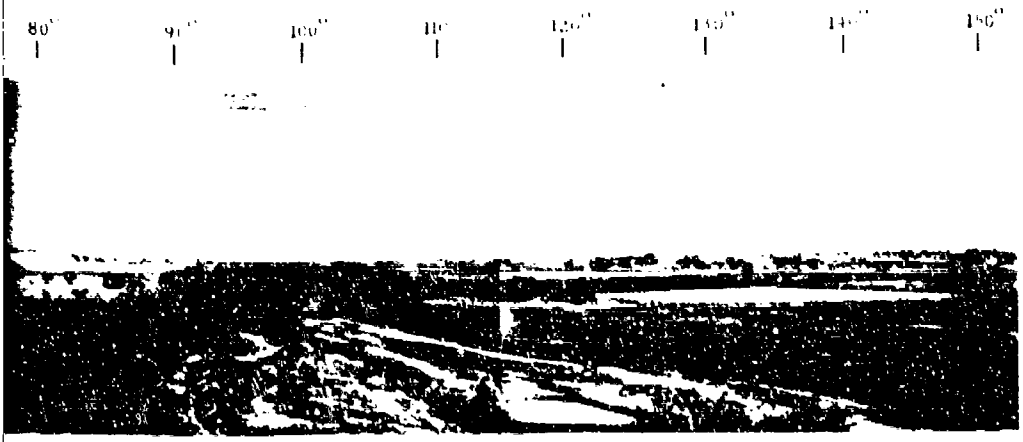
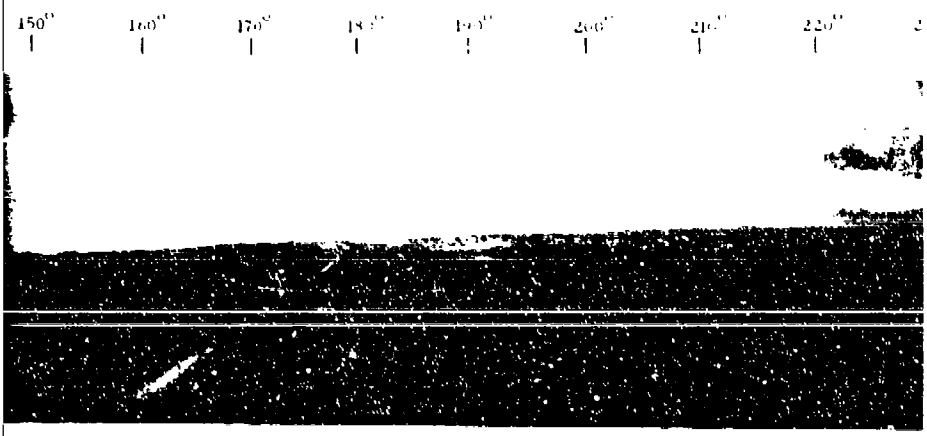


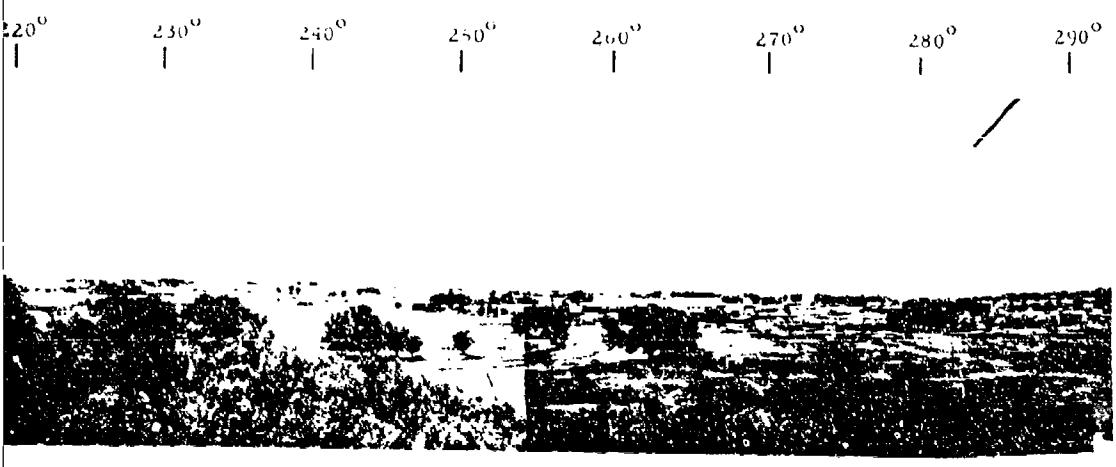
Figure 5. Panoramic view of western sector from top of receiver antenna tower.



ramic view of eastern sector from top of receiver antenna tower.



ramic view of southern sector from top of receiver antenna tower.



amic view of western sector from top of receiver antenna tower.



Figure 6. View of eastern sector from 1.5m above the ground.

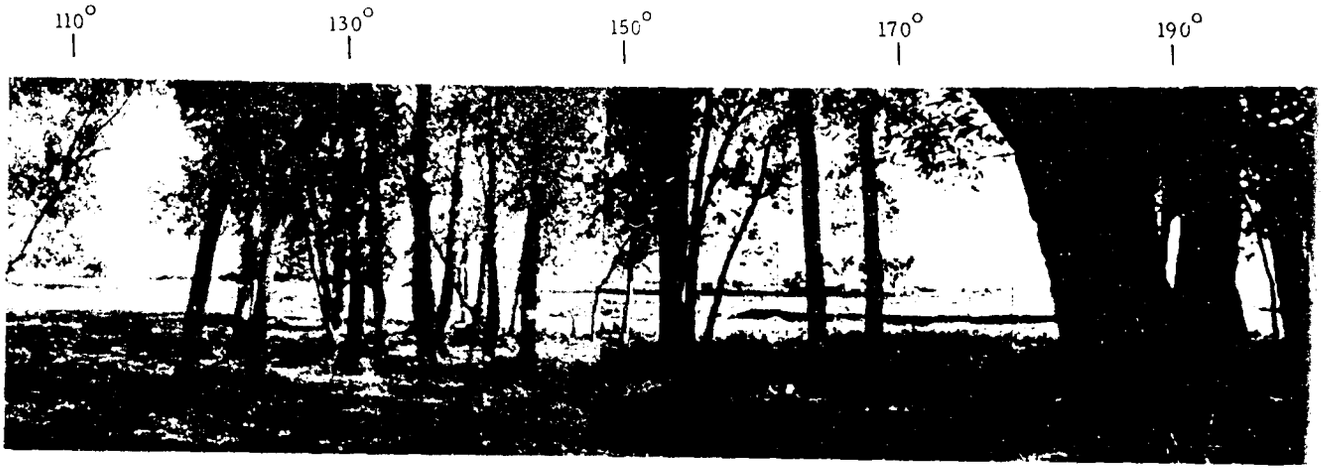


Figure 7. View of southern sector from 1.5m above the ground.

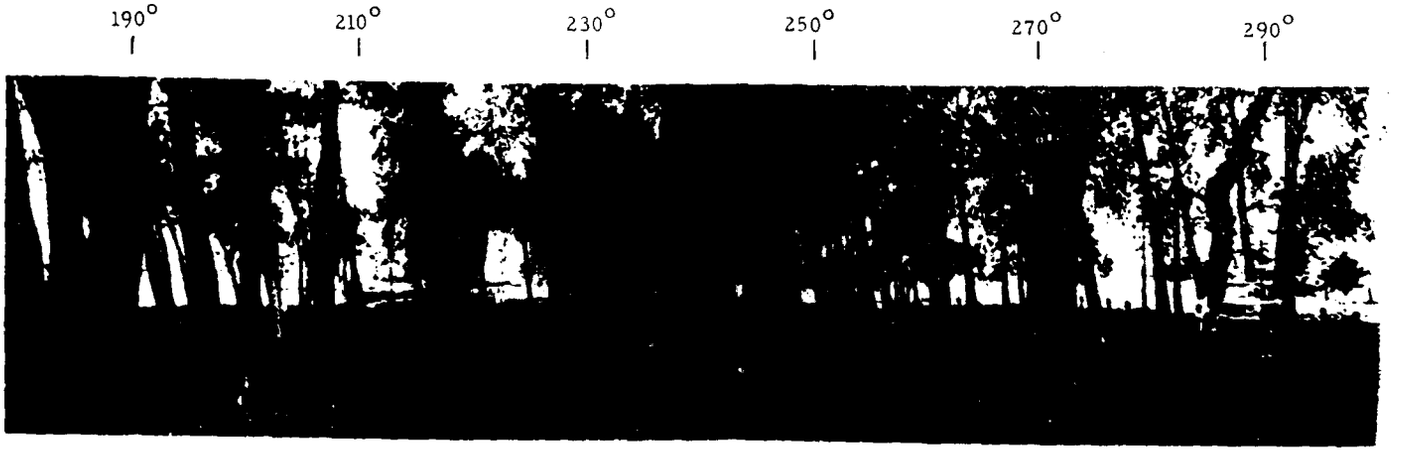
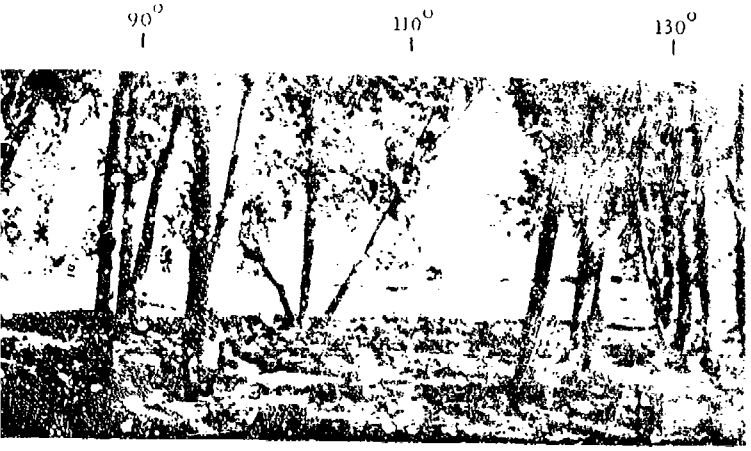
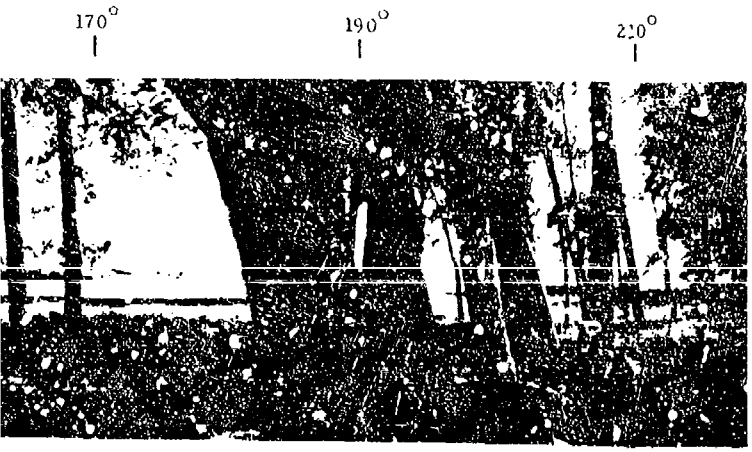


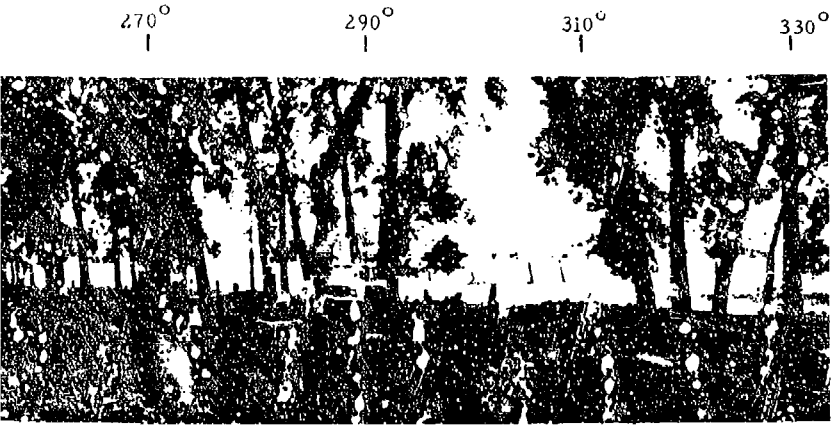
Figure 8. View of western sector from 1.5 m above the ground.



or from 1.5m above the ground.



or from 1.5m above the ground.



r from 1.5 m above the ground.

All transmissions were continuous wave and frequencies of 230, 410, 910, 1846, 4595, and 9190 MHz were used with horizontal polarization. However, at the conclusion of the measurement program, additional measurements were made from three of the transmitter sites (R4-10-T5, R4-20-T6, and R4-30-T6) on 230 and 410 MHz, using horizontally polarized, vertically polarized, and cross polarized antennas in order to evaluate the polarization losses caused by trees without leaves. These transmitter sites were in the direction of maximum tree depth as seen from the receiver site (bearing 235° true, see figure 1). Finally, an elevated transmitter site (Test Site), also in the direction of maximum tree depth at the receiver site, was selected to provide an unobstructed path between the transmitting antennas and the cluster of trees surrounding the receiver site. The data resulting from these measurements are shown in the Appendix.

3. RECEIVING EQUIPMENT

The six frequencies were divided into two groups and separate receiving and transmitting vans were outfitted for each group. Although seven frequencies had been used for the measurements reported in the three preceding parts of this report series, the 751-MHz equipment was seldom employed at the R4 site because of operational problems. Thus, path loss data are not available for this frequency. Figure 9 shows the low-frequency group (230, 410 and the inoperative 751 MHz) receiver trailer at common receiver site R2, and figure 10 shows the receiver trailer used for the four higher frequencies (910, 1846, 4595, and 9190 MHz) at common receiver site R3. Both figures show the antennas associated with each frequency group mounted on a movable carriage attached to identical towers, and the same installation was used for the R4 measurements reported here. The carriages could be installed on any of the four tower faces and raised or lowered between the limits of

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1 and 25 m above ground for the low-frequency group, or 1 and 24.5 m for the nigher-frequency group, both at a speed of approximately 0.6 m/sec. A servo system on the antenna carriage drove a strip-chart recorder for the continuous signal strength versus antenna height recordings.

Propagation data were obtained between August 2 and September 30, 1966 (when the leaves were on the trees) and between November 11, 1966 and March 14, 1967 (when trees were without leaves).

Identical transmitting and receiving antennas were used for each frequency group, and the electrical characteristics of each pair were essentially identical; parameters are given in Table 1. The VSWR of the antenna systems, as viewed at the receiver input, exhibited essentially no change as the antennas were moved up and down the tower; thus we believe that effects of the immediate environment on the antenna impedance can be neglected.

4. TRANSMITTING EQUIPMENT

The transmitting equipment was contained in two vans; one, for the two lower frequencies, the other for the four higher frequencies. Figures 11 and 12 show the vans. The antennas were mounted side by side on a framework attached to a rigid mast that pivoted in elevation and azimuth on a base mounted on top of the vans. This arrangement assured constant antenna height above ground for each frequency group (6.6 m for the lower frequency group and 7.3 m for the higher). After the antenna assembly had been raised and before transmission, the antennas were oriented to the path azimuth by sighting through a device on the mast, if the receiver location was visible, or with the aid of a magnetic compass, corrected for magnetic declination, when the receiver location was obscured.

5. DATA PRESENTATIONS AND TABULATIONS

The data, except for antenna polarization and patterns, are arranged

Table 1. Antenna Parameters

Freq. in MHz	1/2 Power Beamwidth	Description	Free-Space Gain Above Isotropic, dB	Height Above Ground, m Transmitting	Height Above Ground, m Receiving
230	38°	half-wave center-fed dipole with reflector	6.9	6.6	1-15 (continuously variable at all frequencies)
410	58°	three-element Yagi with reflector	8.6	6.6	
751	59°	half-wave center-fed folded dipole with reflector	7.9	6.6	
910	52.5°	four-element Yagi with reflector	9.1	7.3	
1846	33°	horn	15.2	7.3	
4595	12.5°	horn	19.7	7.3	
9190	12.5°	horn	21.0	7.3	



Figure 9. The lower frequency group receiving equipment at common receiver site R4.



Figure 10. The upper frequency group receiving equipment at common receiver site R4.

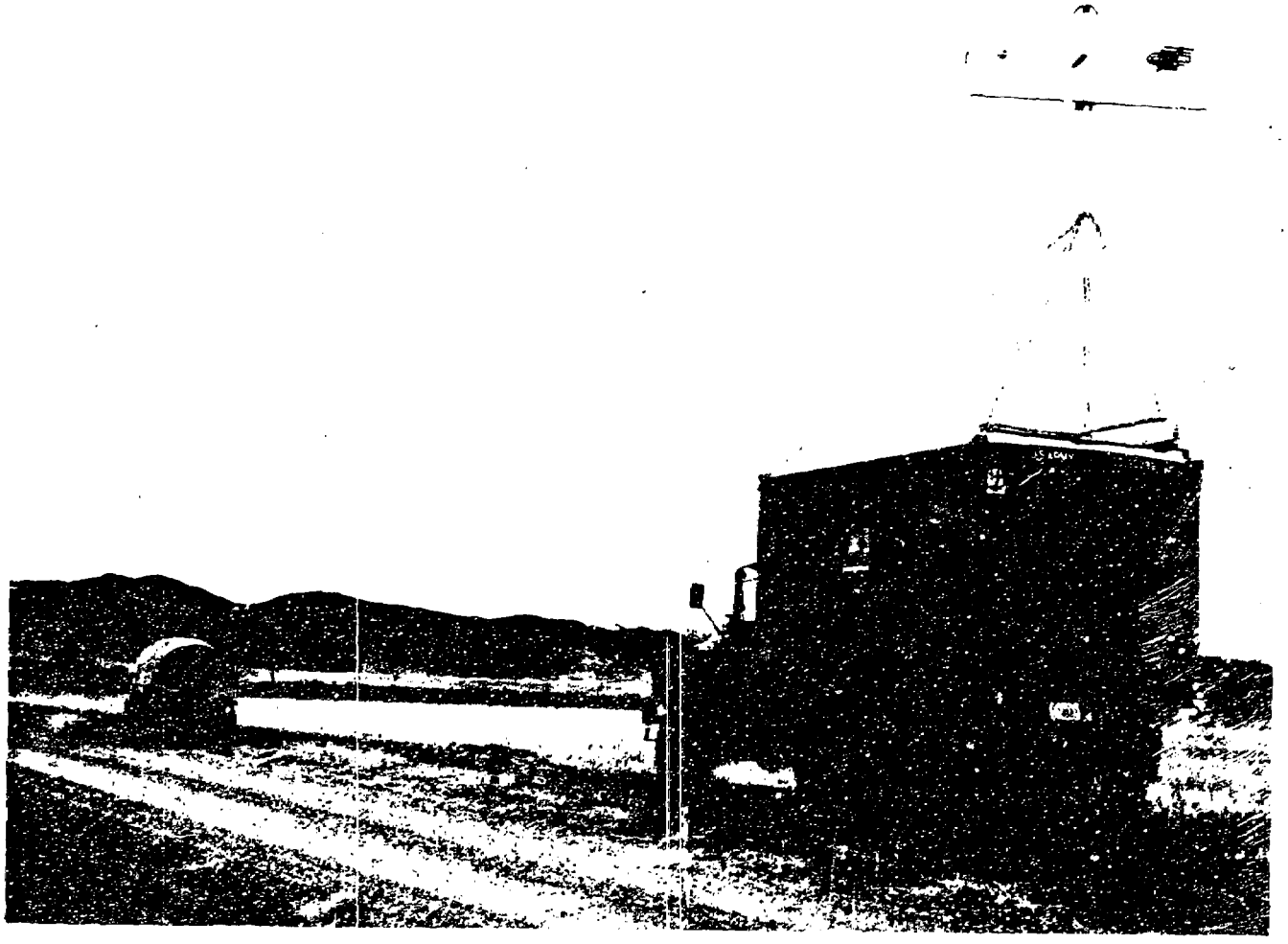


Figure 11. Lower frequency group transmitting unit.

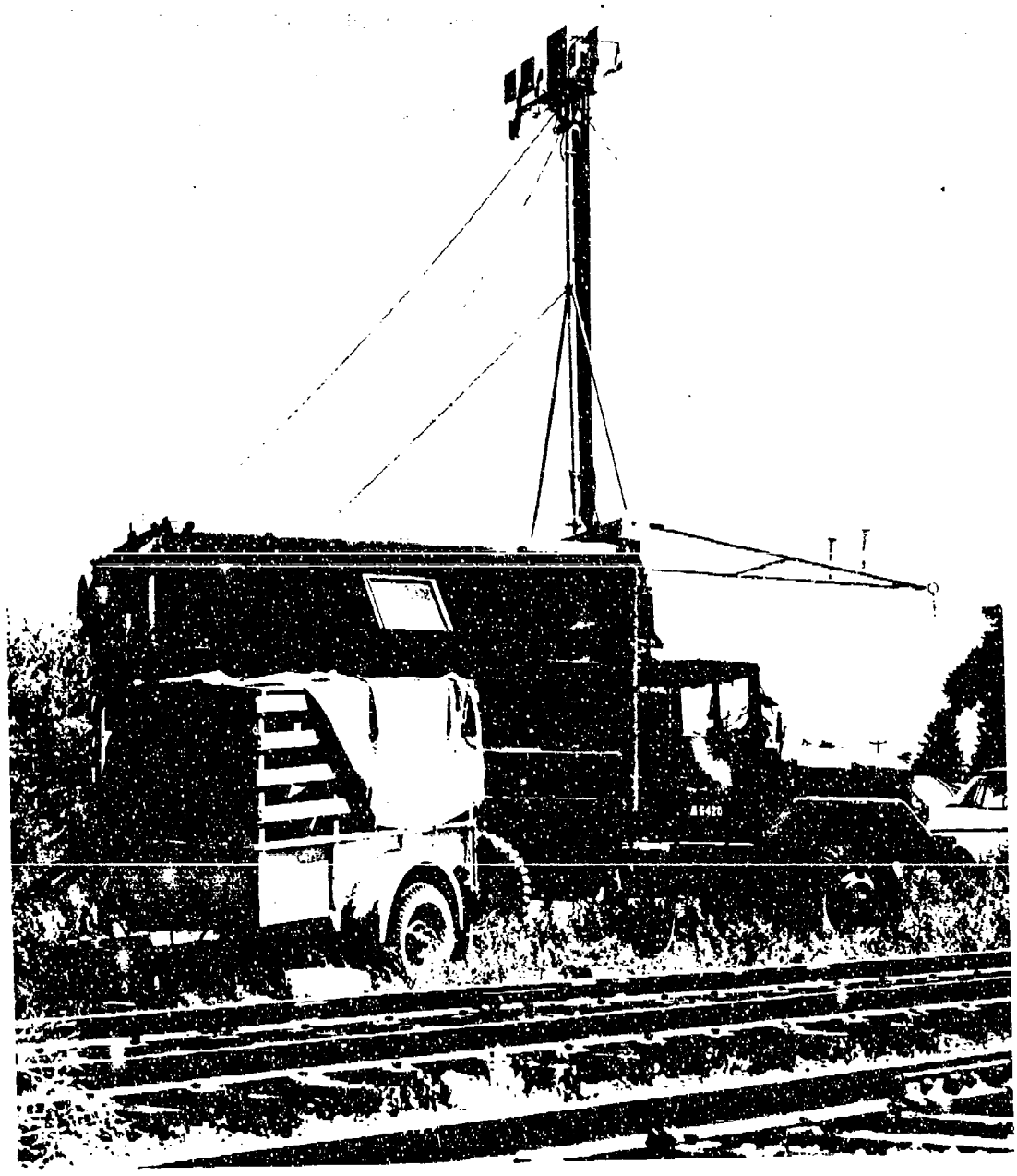


Figure 12. Upper frequency group transmitting unit.

as in Parts I, II and III of this report series; i.e., by path distance and for each distance sequentially by azimuth counted clockwise from true north. For example, R4-20-T2 indicates a 20-km path (nominal length) from the receiver site R4 to transmitter site T2, which is the second transmitter site at the 20-km distance counted clockwise, from true north. However, some of the proposed transmitter locations were inaccessible, or otherwise unsuitable, and other points had to be substituted. Particularly, sites R4-30-T5 and R4-30-T7 are at distances less than 25 km. The actual path lengths rather than code designations will be used in any subsequent analyses of the data but it is not practical to revise the numbering scheme. The data for each transmission path are arranged in the following order: The first page includes the site designation and code, a photograph of the terrain taken at the transmitter site in the direction of the receiver, and the true bearing from the receiver site to the transmitter site.

The next page contains the site designation and code, a graph of basic transmission loss vs. receiving antenna height and the date when each frequency group was measured. Only data taken with the leaves on the trees are shown here. Also indicated are the free-space basic transmission loss for each frequency and the level of the maximum measurable loss if the received signal level was below the receiver noise level. The graphs of basic transmission loss vs. antenna height were obtained directly from computer storage by a cathode ray tube plotter, and only a limited number of distinct line symbols were available. In most cases it is not difficult to identify and follow the traces for the various frequencies.

Part I of this report series (McQuate et al., 1968) includes a discussion of the assumptions used (including formulas, parameters, etc.) to correct receiver power level values to basic transmission loss.

A number of these graphs do not show curves for all six frequencies.

This is because of equipment malfunction, temporary inaccessibility of the transmitter sites, calibration errors, or misalignments of antennas.

The third page shows the site code and includes the following:

(a) The path profile, with site elevations and path length, is drawn by using an effective earth radius (a = 8330 km) based on an area average surface refractivity value of 290 N-units. The effective earth curvature is illustrated by an arc drawn arbitrarily through the second elevation mark in the center of the profile. This arc represents the intersection of a surface parallel to the earth's surface with the plane of the paper and provides a reference line for assessing relative elevation along the terrain profile. Note that horizontal and vertical scales are not constant for all terrain profiles. The scales were chosen to provide maximum clarity within the available space, and the effective earth radius concept requires a fixed relation between horizontal (distance) and vertical (elevation) scales to permit radio rays to be represented as straight lines.

(b) The results of the time recording, obtained just prior to each height-gain run, shown below the path profile and designated "L_b(dB) short-term signal variability". The 50 percent value is defined as the basic transmission loss value, in decibels, exceeded 50 percent of the time during the 10-min time recording period. The Δ10% - 90% value is defined as the decibel difference between the level of the received signal exceeded for 90 percent of the time during the recording period and the level exceeded only 10 percent of the time during the same period.

(c) Field notes describing the terrain and significant obstacles along the transmission path, as seen by an observer at the transmitter site. The field notes reflect the operator's observations particularly with regard to foreground while the terrain characteristics are shown more exactly by the profiles.

Additional pages include graphs of basic transmission loss vs. receiving antenna height derived from path loss measurements over a common path with the trees in full leaf (late summer) and after the leaves had fallen (winter). Data are plotted in pairs for each frequency for each transmitting site. Time run data for the winter measurements, similar to the time run data described earlier, follow the graphs of the transmission loss curves for each transmitter site.

6. ACKNOWLEDGEMENTS

All personnel within the former Tropospheric Radio Systems Predictions Group of the Institute for Telecommunication Sciences participated in the collection, analyses and evaluation of the data.

7. REFERENCES

McQuate, P.L., J.M. Harman, and A.P. Barsis (1968), Tabulations of propagation data over irregular terrain in the 230- to 9200-MHz frequency range, Part I: Gunbarrell Hill receiver site, ESSA Tech. Rept. ERL 65-ITS 58 (U.S. Gov't Printing Office, Washington, D.C. 20402).

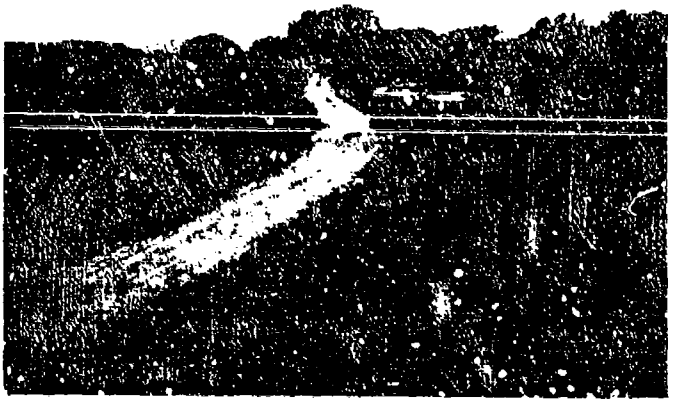
McQuate, P.L., J.M. Harman, M.E. Johnson, and A. P. Barsis (1968), Tabulations of propagation data over irregular terrain in the 230- to 9200-MHz frequency range, Part II: Fritz Peak receiver site, ESSA Tech. Rept. ERL 65-ITS 58-2 (U.S. Gov't Printing Office, Washington, D.C. 20402).

McQuate, P.L., J.M. Harman, M.E. McClanahan, and A.P. Barsis (1970), Tabulations of propagation data over irregular terrain in the 230- to 9200-MHz frequency range, Part III: North Table Mountain--Golden, ESSA Tech. Rept. ERL 65-ITS 58-3 (U.S. Gov't Printing Office, Washington, D.C. 20402).

8. TABULATION OF DATA

Propagation data tabulations are presented on pages 21 through 265. Figure numbers in this section have been omitted since all data, pictures, and graphs are identified by the appropriate site code number.

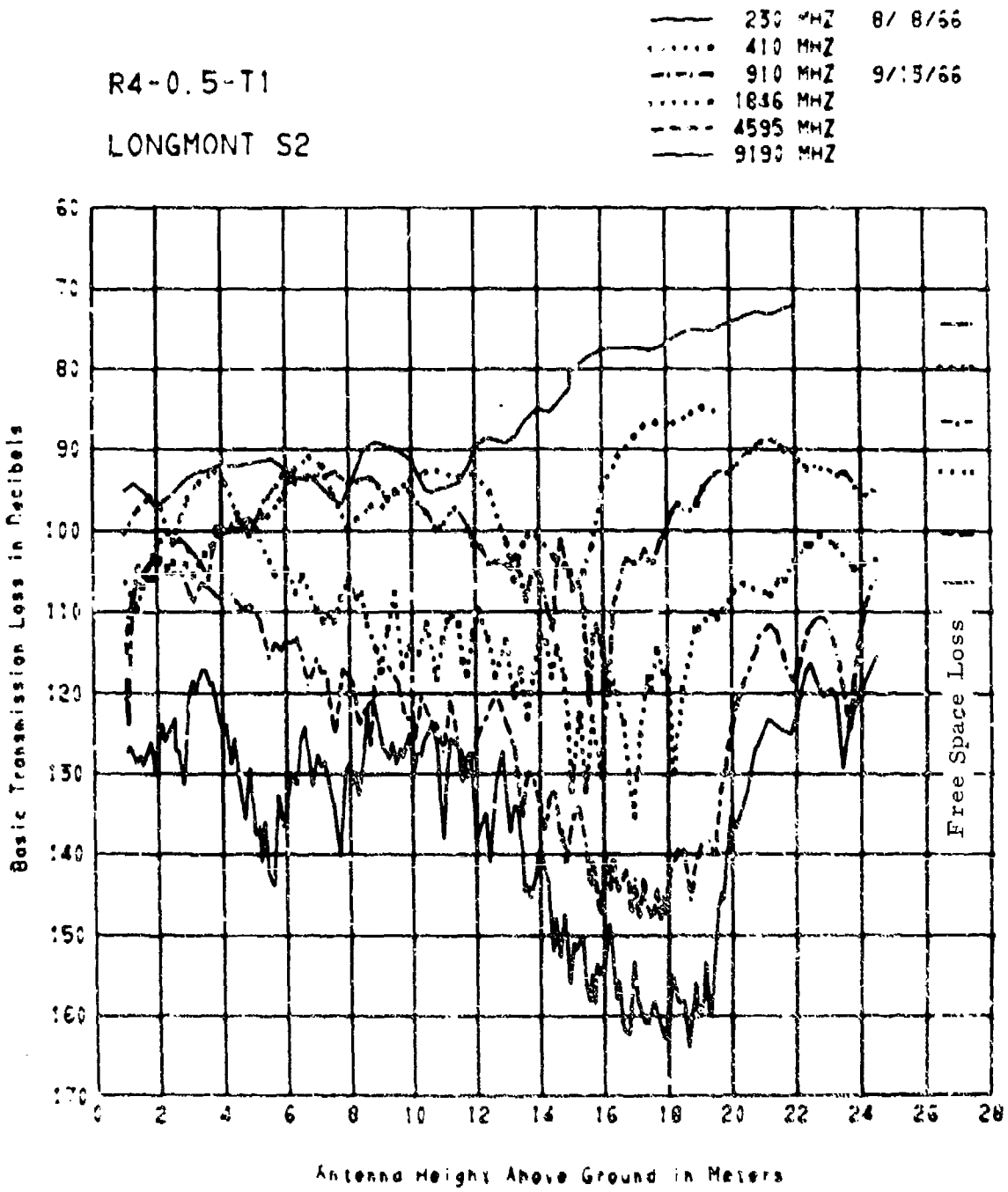
R4-0.5-T1
LONGMONT S1



PATH VIEW FROM TRANSMITTER
Bearing from common receiver site to transmitter site is
269° 41' 04"

R4-0.5-T1

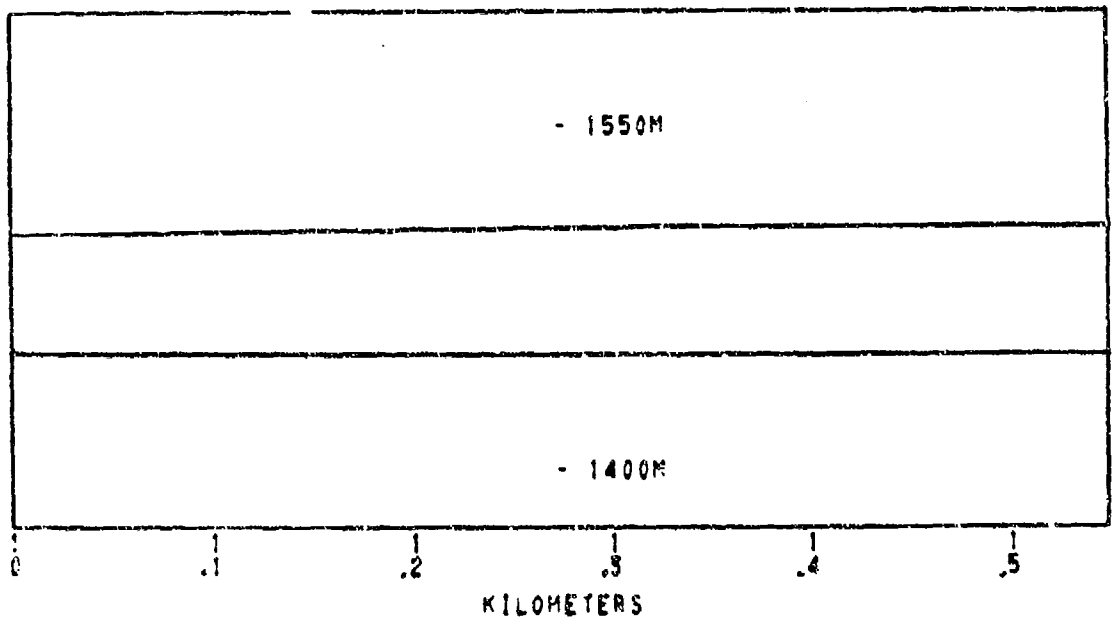
LONGMONT S2



RCVR. ELEV.
1503 M

R4-0.5-T1
PATH LENGTH 0.557 km

XMTR. ELEV.
1506 M

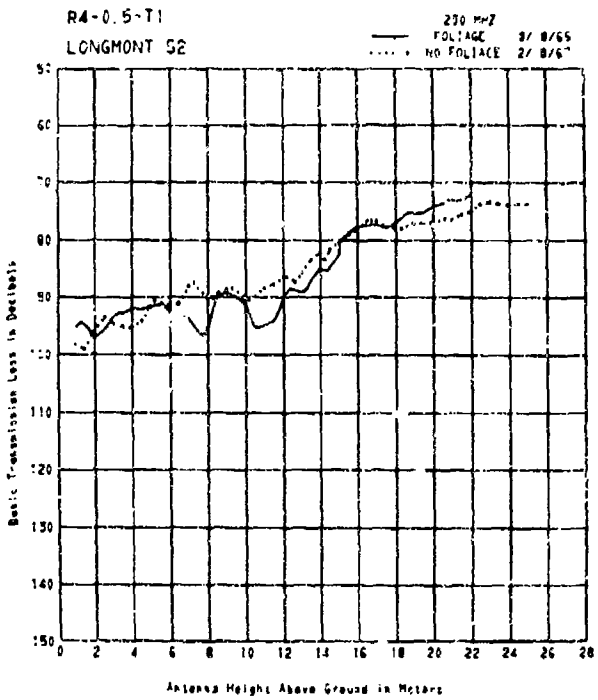


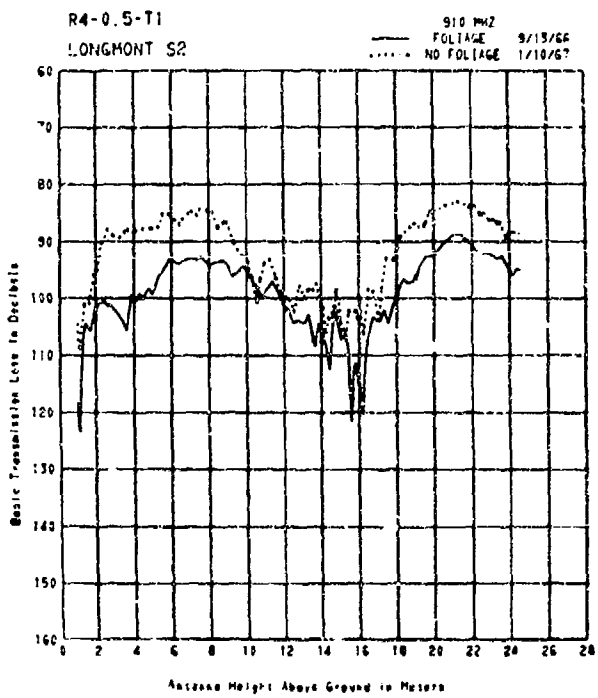
L_b (dB) SHORT TERM SIGNAL VARIABILITY

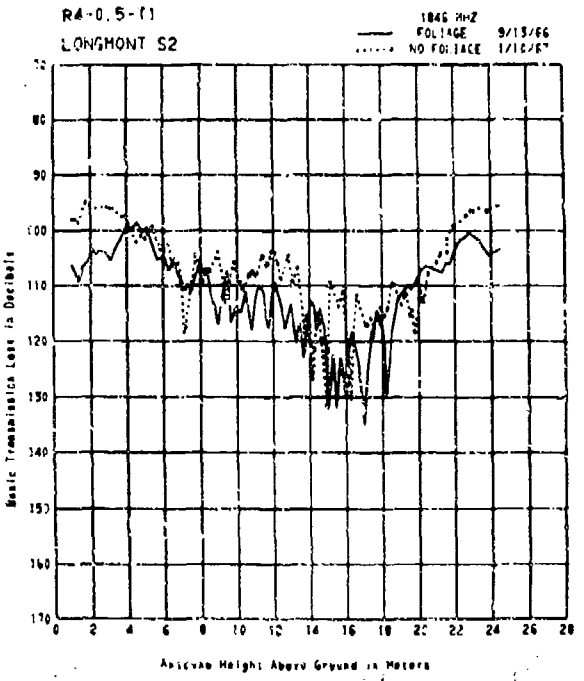
Freq(MHz)	230	410	910	1846	4595	9190

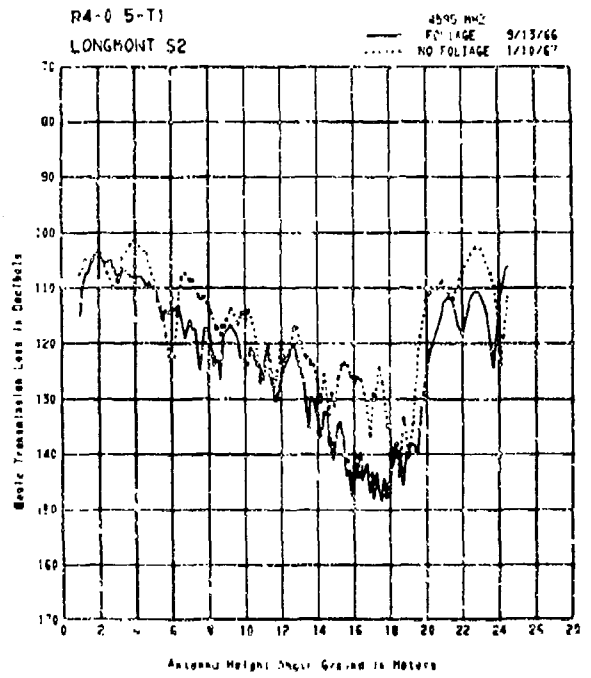
No data available.

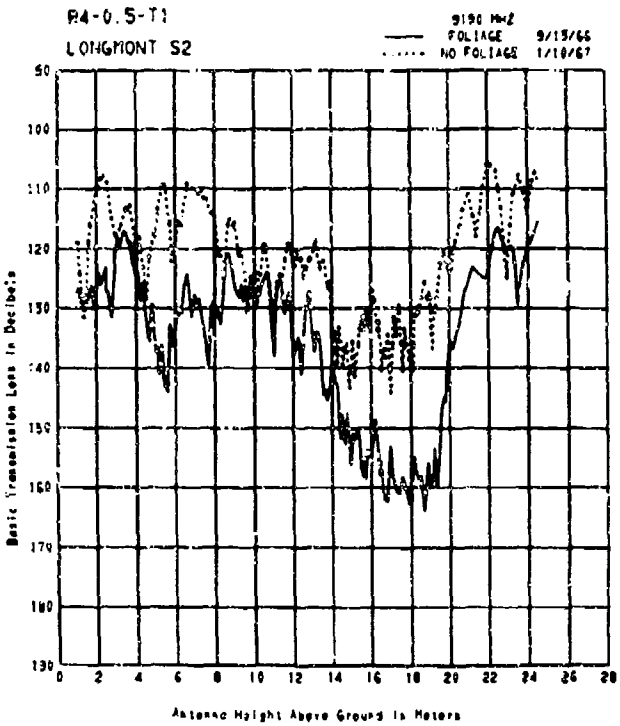
The radio path extends over open, grassy land. A barbed-wire fence, 1 m high, runs beside a dirt road and slightly to the left of the path. Two deciduous trees, approximately 20 m high, stand directly in the path, about 150 m from the transmitter.


R4-0.5-T1
LONGMONT S2
220 MHZ
FOLIAGE
NO FOLIAGE
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-0.5-T1
LONGMONT S2
910 MHZ
FOLIAGE
NO FOLIAGE
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-0.5-T1
LONGMONT S2
1846 MHZ
FOLIAGE 9/13/66
NO FOLIAGE 1/10/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-0.5-T1
LONGMONT S2
4595 MHZ
FOLIAGE 9/13/66
NO FOLIAGE 1/10/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters

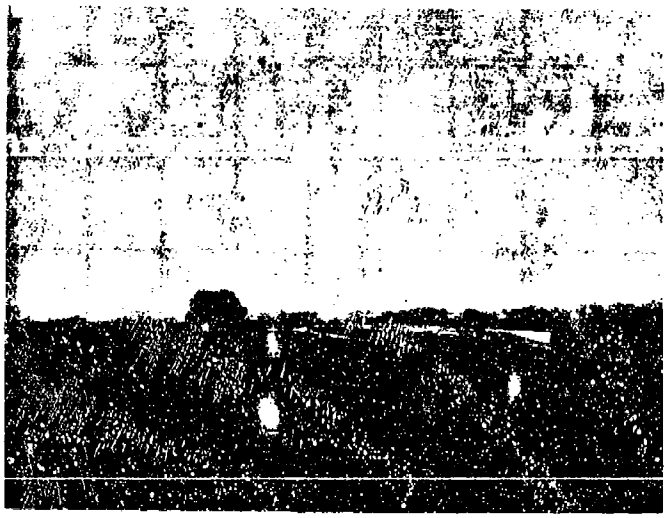


R4-0.5-T1

L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
	2-8-67 at 25 M			1-10-67 at 7.3 M		
50%	73.3		87.3	110.2	109.4	110.3
Δ 10% - 90%	< 3		< 3	< 3	< 3	< 3

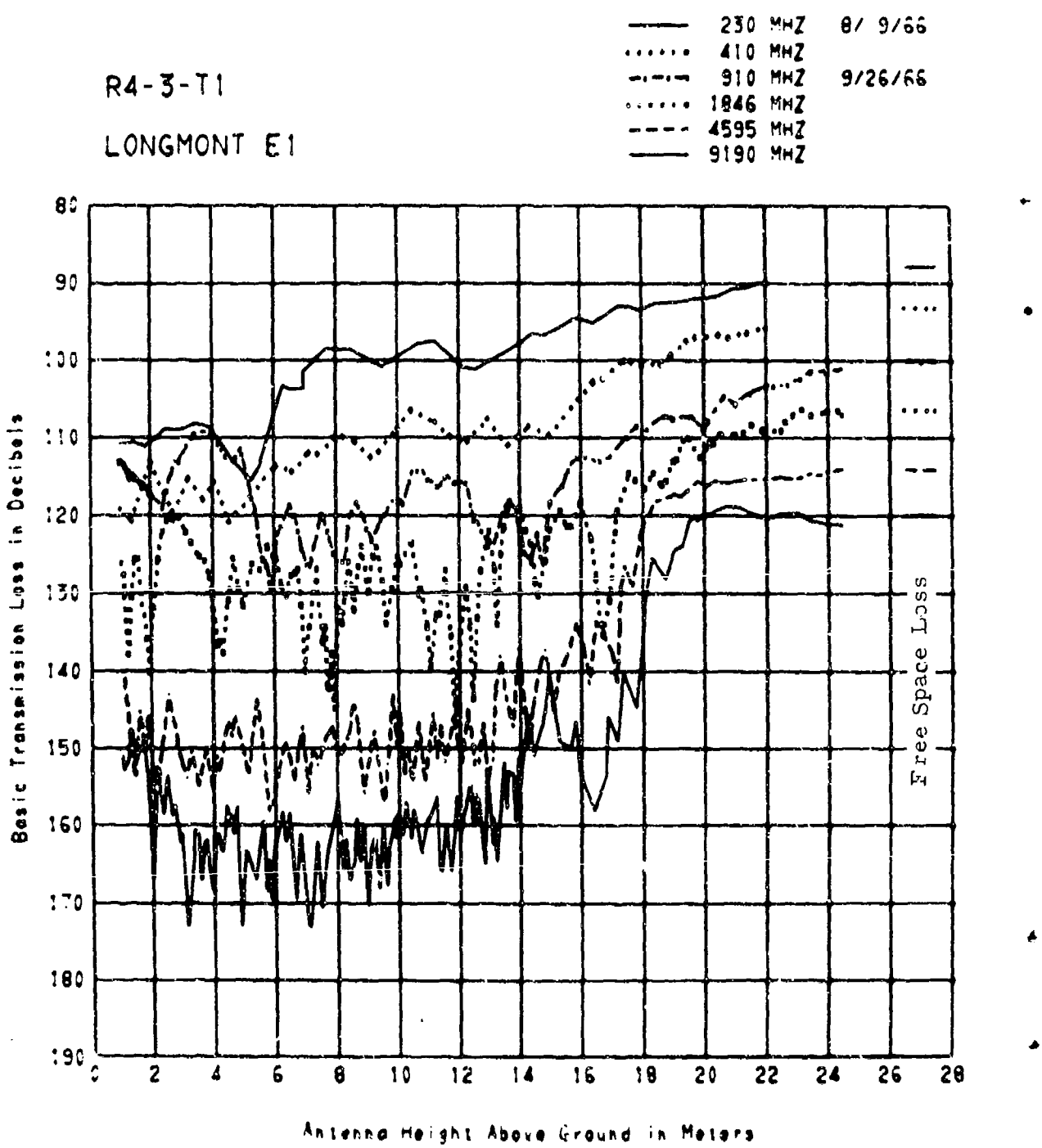
R4-3-T1
LONGMONT E1



PATH VIEW FROM TRANSMITTER
Bearing from common receiver site to transmitter site is
38° 44' 01"

R4-3-T1

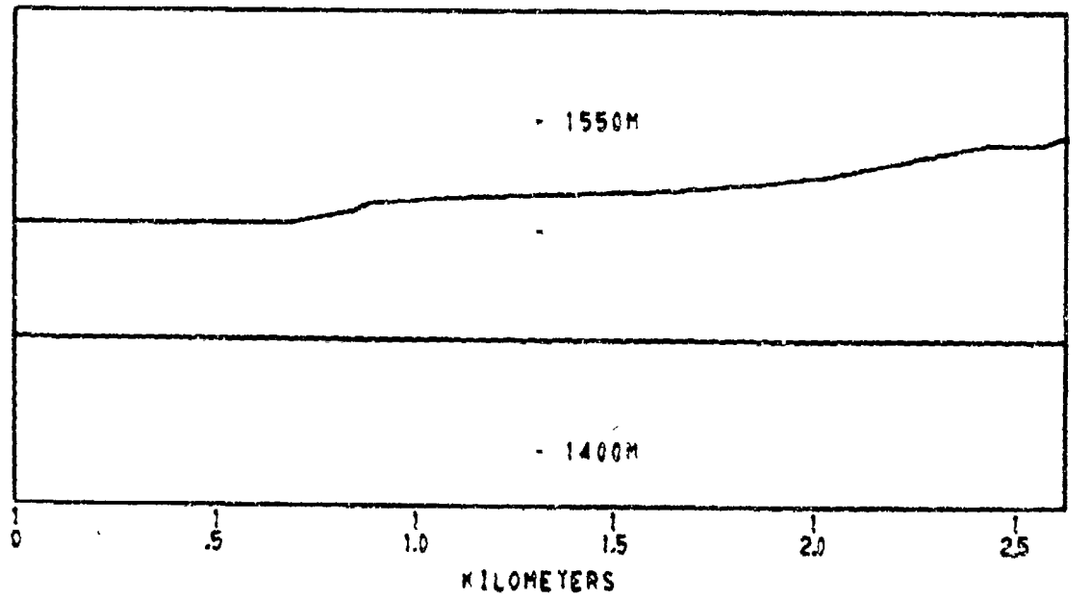
LONGMONT E1



RCVR. ELEV.
1503 M

R4-3-T1
PATH LENGTH 2.622 km

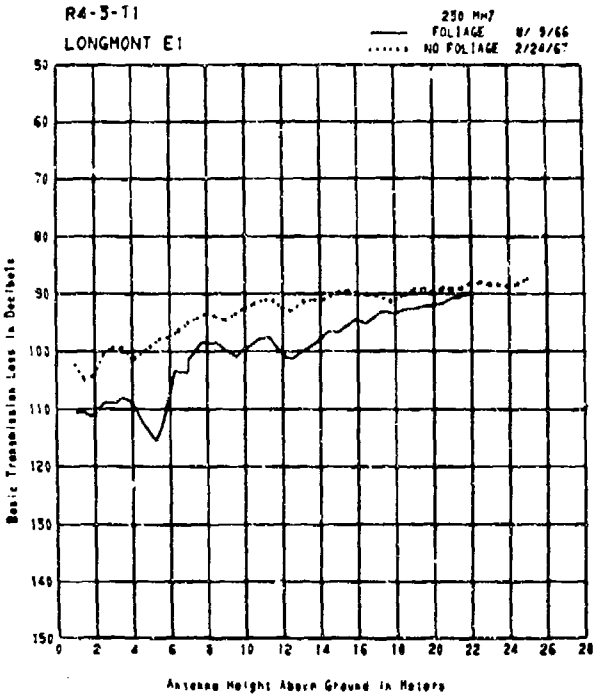
XMTR. ELEV.
1543 M

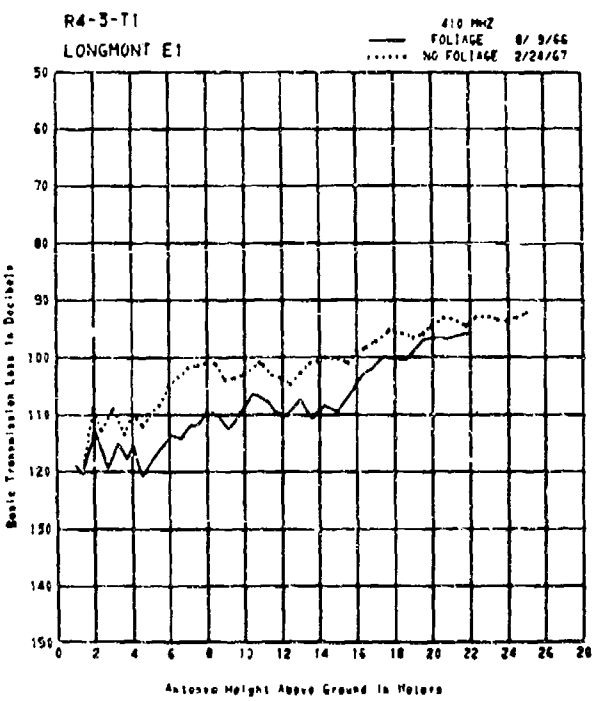


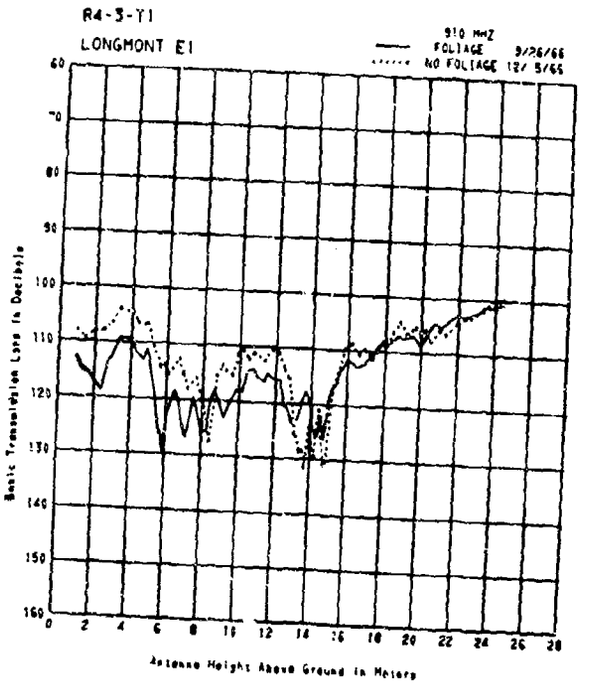
L_b (dB) SHORT TERM SIGNAL VARIABILITY

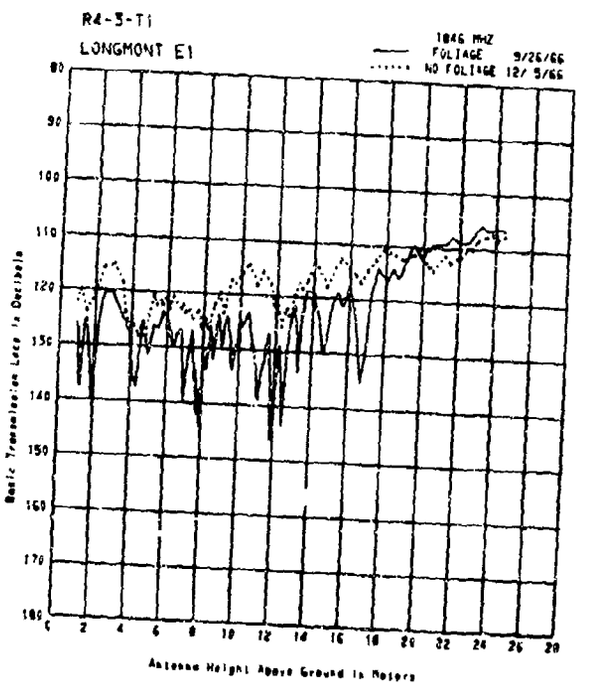
Freq (MHz)	230	410	910	1846	4595	9190
	8-9-66 at 3M			9-26-66 at 1M		
50%	108.1	114.1	110.1	129.8	140.7	149.6
Δ10%-90%	<3	<3	<3	4.5	3	5.8
	8-9-66 at 22M			9-26-66 at 7.3M		
50%	89.8	95.4	130.5	127.2	149.9	163.0
Δ10%-90%	<3	<3	6.3	<3	5.9	8.0
				9-26-66 at 14M		
50%			120.0	122.3	141.8	148.3
Δ10%-90%			<3	4.5	4.6	6.9
				9-26-66 at 24.5M		
50%			100.5	106.8	114.4	121.4
Δ10%-90%			<3	<3	<3	<3

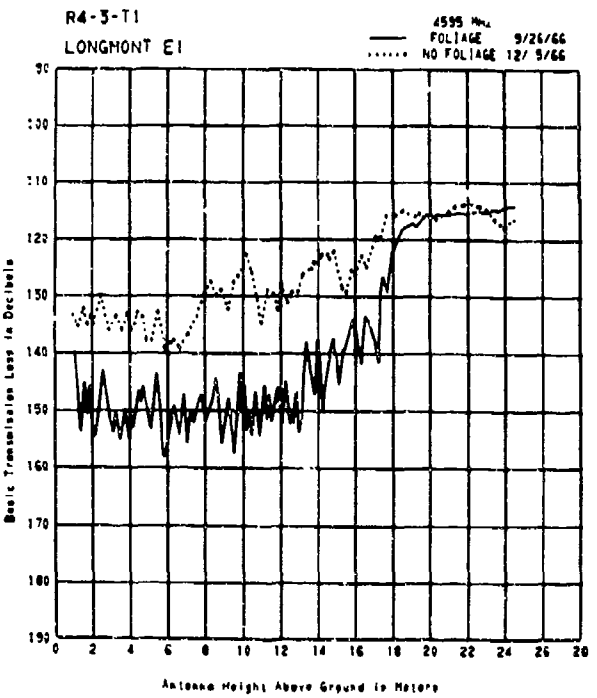
The foreground here is comprised of a recently plowed field, 120 m wide, which slopes gently down toward the receiver site. There are no apparent obstructions in the path, although one tree, approximately 20 m tall, is slightly to the left of the path.

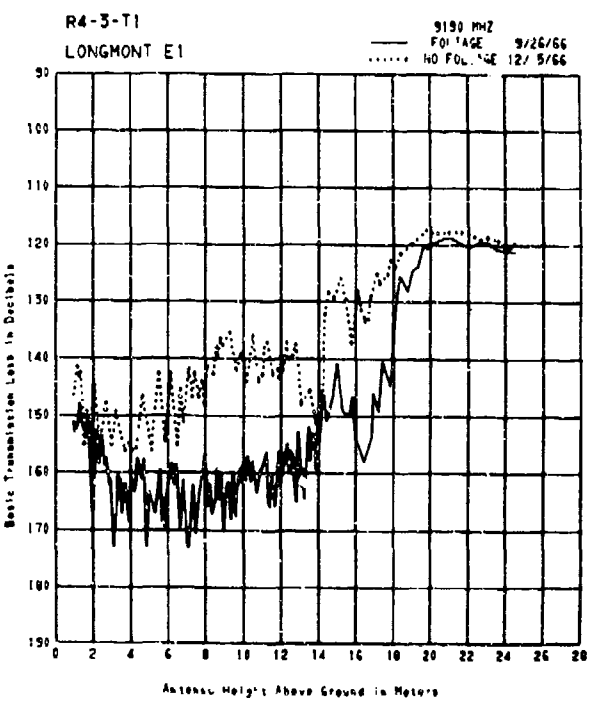

R4-3-T1
LONGMONT E1
250 MHZ
FOLIAGE 8/ 9/66
NO FOLIAGE 2/24/67
Basic Transmission Loss In Decibels
50
60
70
80
90
100
110
120
130
140
150
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground In Meters


R4-3-T1
LONGMONT E1
410 MHZ
FOLIAGE 8/ 9/66
NO FOLIAGE 2/24/67
Basic Transmission Loss In Decibels
50
60
70
80
90
100
110
120
130
140
150
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground In Meters


R4-3-T1
LONGMONT E1
910 MHZ
FOLIAGE 9/26/66
NO FOLIAGE 12/ 5/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-3-T1
LONGMONT E1
1846 MHZ
FOLIAGE 9/26/66
NO FOLIAGE 12/ 5/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-3-T1
LONGMONT E1
4595 MHz
FOLIAGE 9/26/66
NO FOLIAGE 12/ 5/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters

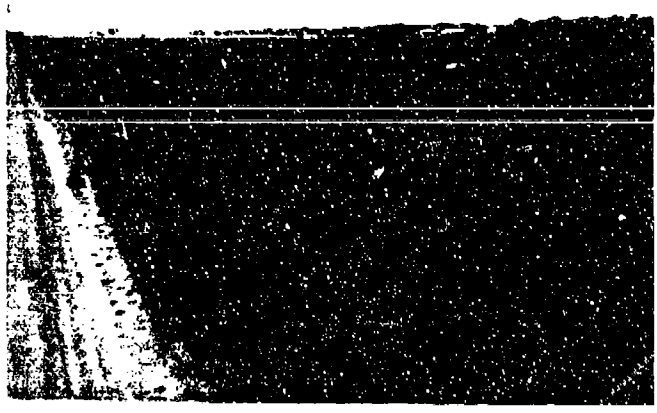

R4-3-T1
LONGMONT E1
9190 MHZ
FOLIAGE 9/26/66
NO FOLIAGE 12/ 5/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters

R4-3-T1

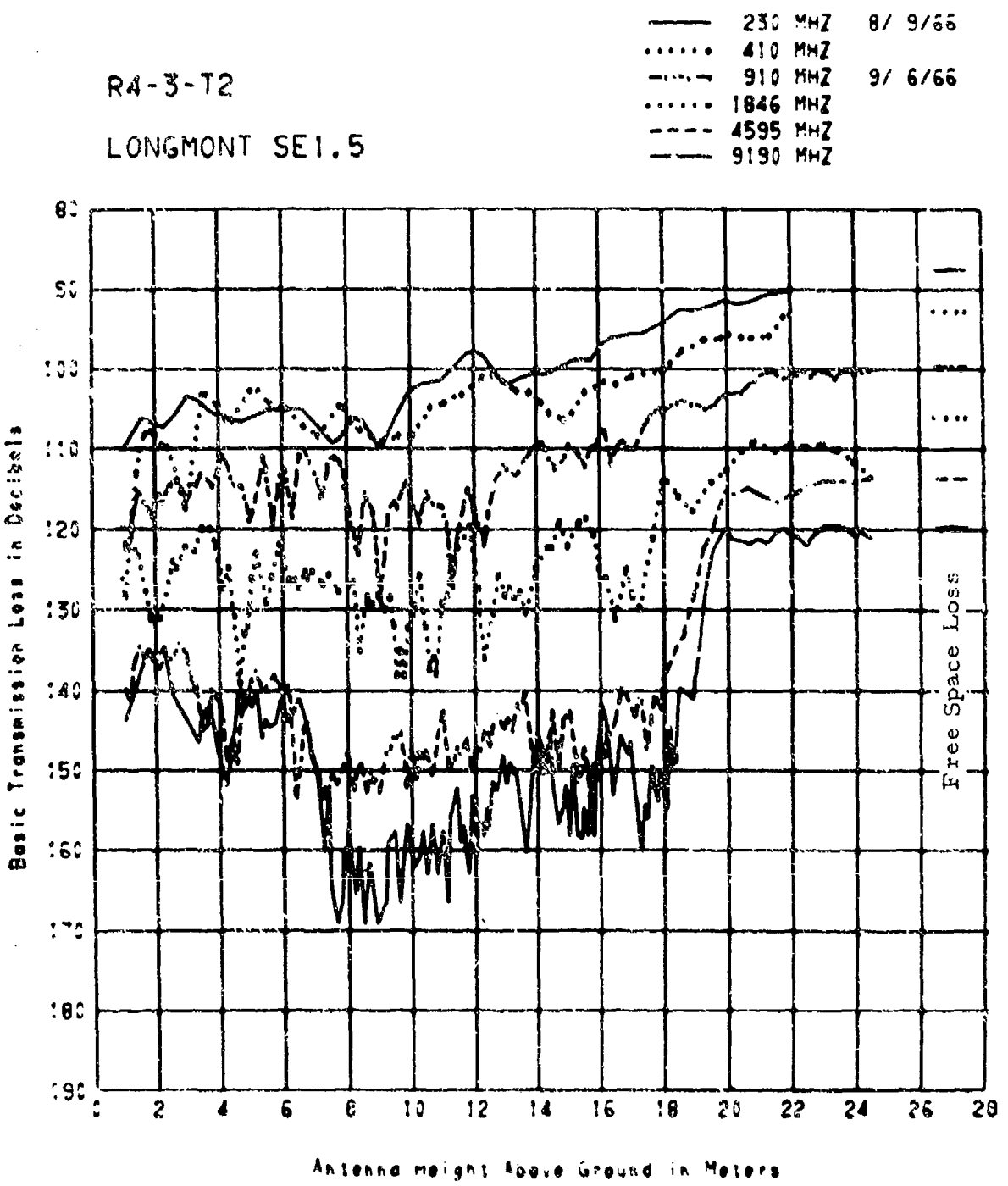
L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
	2-24-67 at 25 M		12-5-66 at 1 M			
50%	87.4	9.20	106.9	120.9	135.0	141.7
Δ10% - 90%	< 3	< 3	< 3	< 3 <	< 3	< 3
			12-5-66 at 7.3 M			
50%			121.9	124.4	138.3	141.2
Δ10% - 90%			< 3	< 3	< 3	< 3
			12-5-66 at 14 M			
50%			123.1	113.4	123.8	141.7
Δ10% - 90%			< 3	< 3	< 3	< 3
			12-5-66 at 24.5 M			
50%			99.9	106.4	117.2	120.2
Δ10% - 90%			< 3	< 3	< 3	< 3

R4-3-T2
LONGMONT SE 1.5



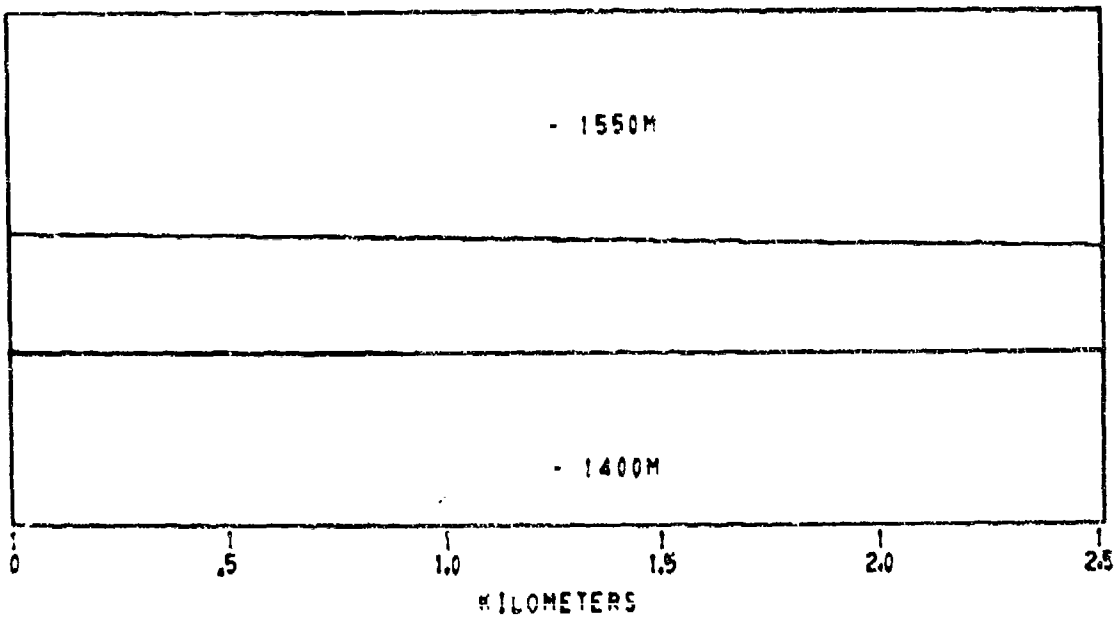
PATH VIEW FROM TRANSMITTER
Bearing from common receiver site to transmitter site is
107° 14' 08"


230 MHZ 8/ 9/66
410 MHZ
910 MHZ 9/ 6/66
1846 MHZ
4595 MHZ
9190 MHZ
R4-3-T2
LONGMONT SE1.5
Basic Transmission Loss in Decibels
Free Space Loss
Antenna Height Above Ground in Meters
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28

RCVR. ELEV. 1503 M

R4-3-T2
PATH LENGTH 2.521 km

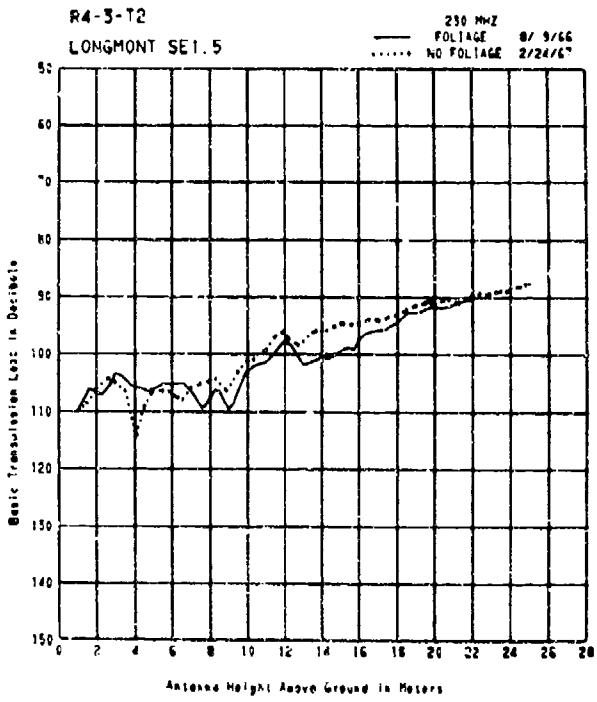
XMTR. ELEV. 1496 M

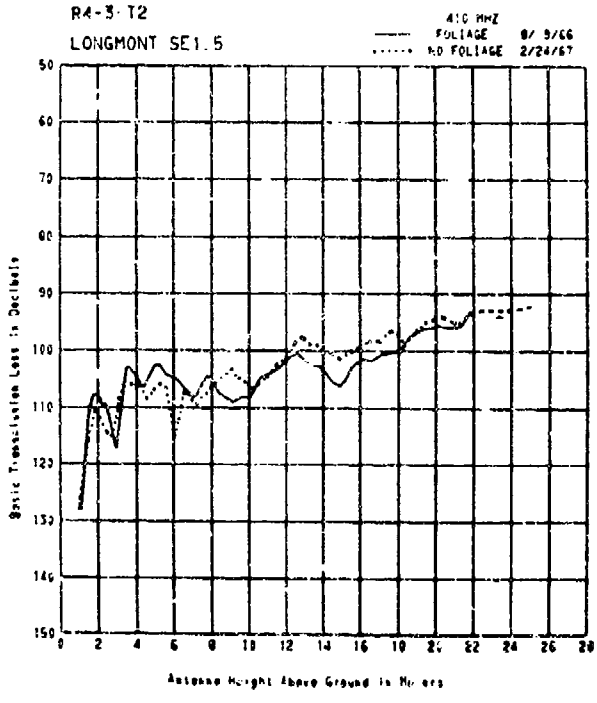


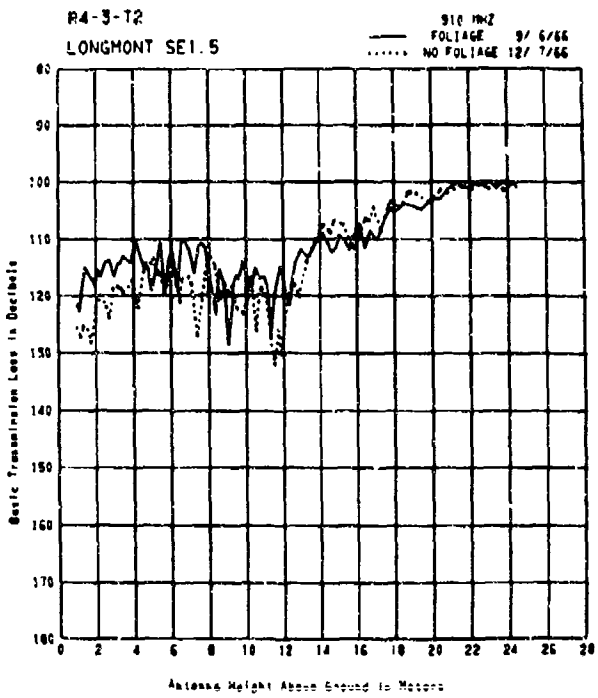
Lb (dB) SHORT TERM SIGNAL VARIABILITY

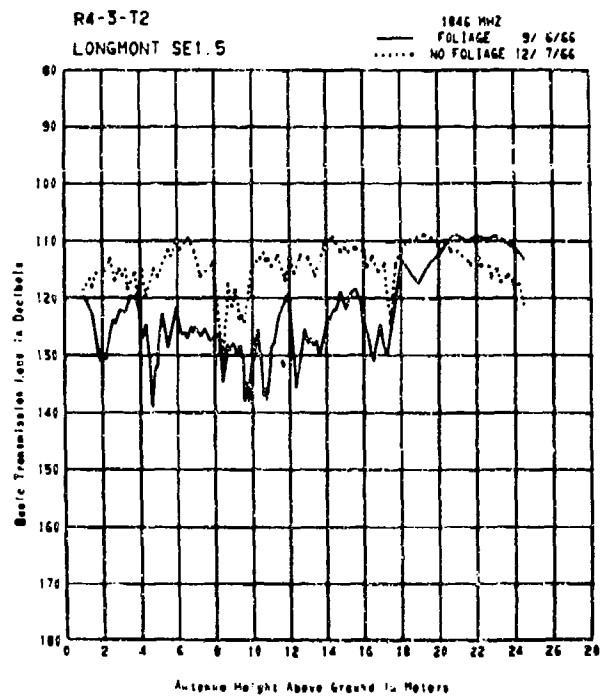
Freq(MHz)	230	410	910	1846	4595	9190
	8-9-66 at 22M			9-6-66 at 1M		
50%	90.1	93.7	120.8	120.0	137.4	136.0
Δ10%-90%	<3	<3	<3	3	3.2	<3
				9-6-66 at 7.3M		
50%			118.4	125.3	152.0	160.5
Δ 10%-90%			<3	<3	7.7	4.5
				9-6-66 at 24.5M		
50%			102.5	113.9	115.4	121.1
Δ10%-90%			<3	<3	<3	<3

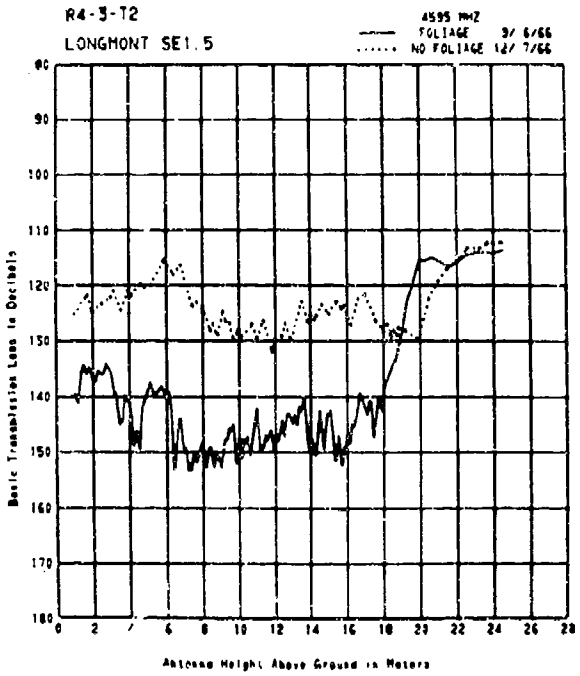
The immediate foreground is covered with low brush and grass for about 60 m. As far as one can see clearly, the remainder of the path is relatively level, and extends over plowed fields.

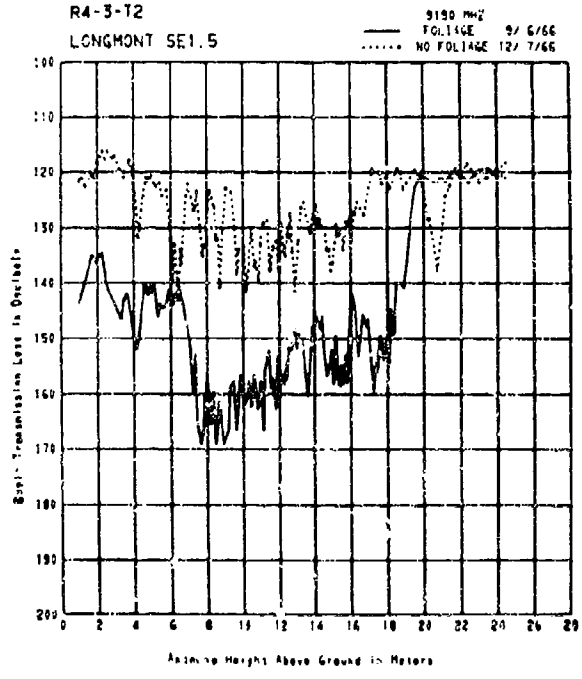

R4-3-T2
LONGMONT SE1.5
230 MHZ
FOLIAGE 8/ 9/66
NO FOLIAGE 2/24/67
Basic Transmission Loss in Decibels
50
60
70
80
90
100
110
120
130
140
150
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-3-T2
LONGMONT SE1.5
410 MHZ
FOLIAGE 8/ 9/66
NO FOLIAGE 2/24/67
Basic Transmission Loss in Decibels
50
60
70
80
90
100
110
120
130
140
150
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-3-T2
LONGMONT SE1.5
910 MHZ
FOLIAGE 9/ 6/66
NO FOLIAGE 12/ 7/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-3-T2
LONGMONT SE1.5
1846 MHZ
FOLIAGE 9/ 6/66
NO FOLIAGE 12/ 7/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-3-T2
LONGMONT SE1.5
4595 MHZ
FOLIAGE 9/ 6/66
NO FOLIAGE 12/ 7/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-3-T2
LONGMONT SE1.5
9190 MHZ
FOLIAGE 9/ 6/66
NO FOLIAGE 12/ 7/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters

R4-3-T2

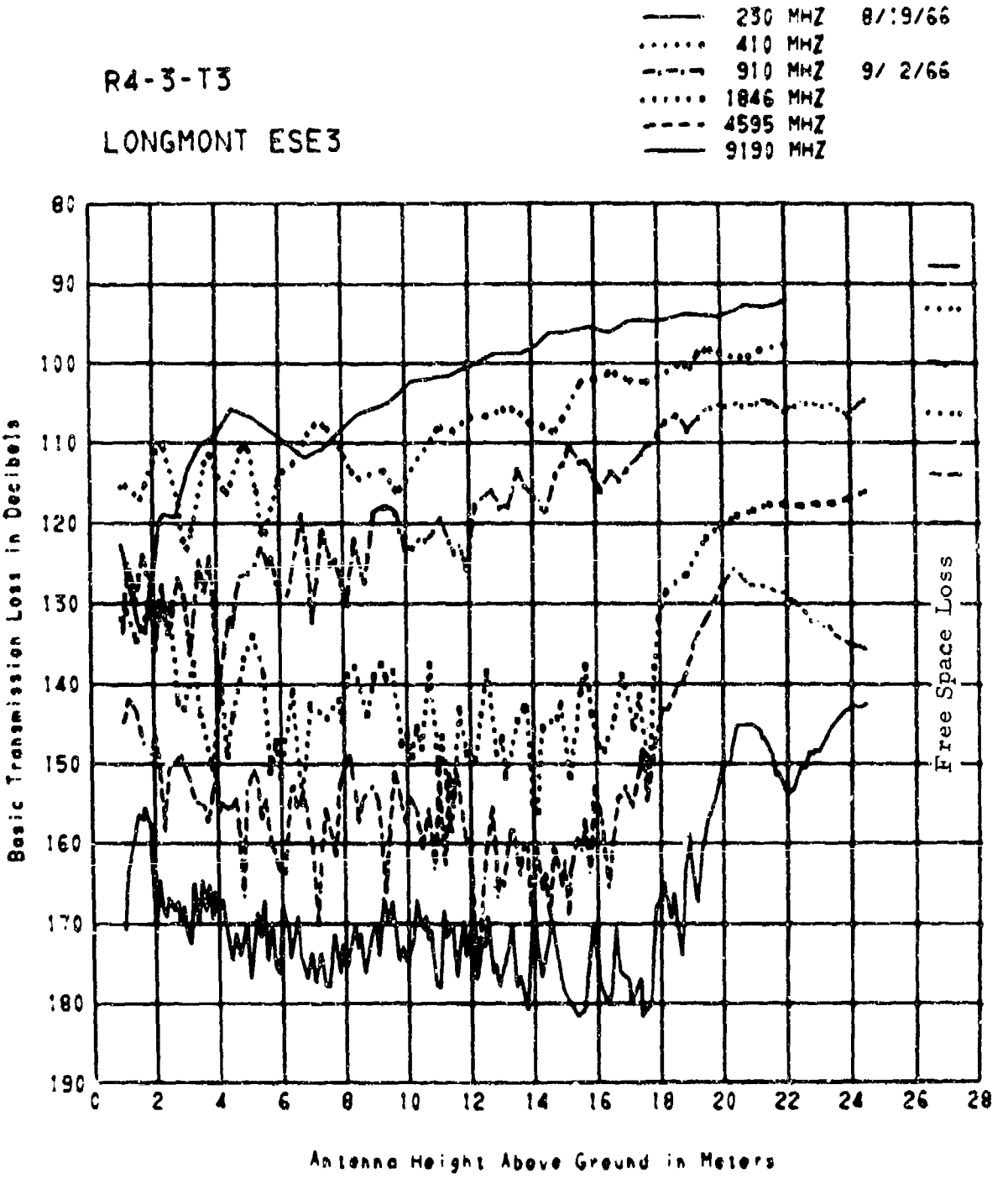
L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
	2-24-67 at 25 M		12-7-66 at 7.3 M			
50%	87.7	92.1	111.5	115.8	120.2	124.2
Δ10% - 90%	< 3	< 3	< 3	< 3	< 3	< 3

R4-3-T3
LONGMONT ESE 3



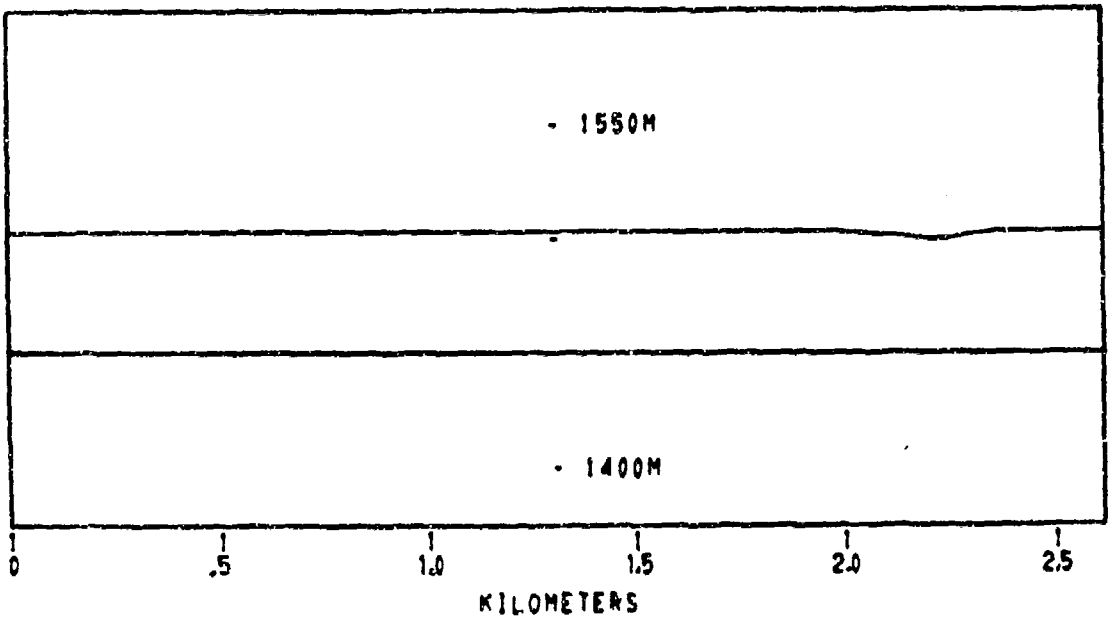
PATH VIEW FROM TRANSMITTER
Bearing from common receiver site to transmitter site is
130° 40' 31"


230 MHZ 8/19/66
410 MHZ
910 MHZ 9/ 2/66
1846 MHZ
4595 MHZ
9190 MHZ
R4-3-T3
LONGMONT ESE3
Basic Transmission Loss in Decibels
80
90
100
110
120
130
140
150
160
170
180
190
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
Free Space Loss
Antenna Height Above Ground in Meters

RCVR. ELEV.
1503 M

R4-3-T3
PATH LENGTH 2.597 km

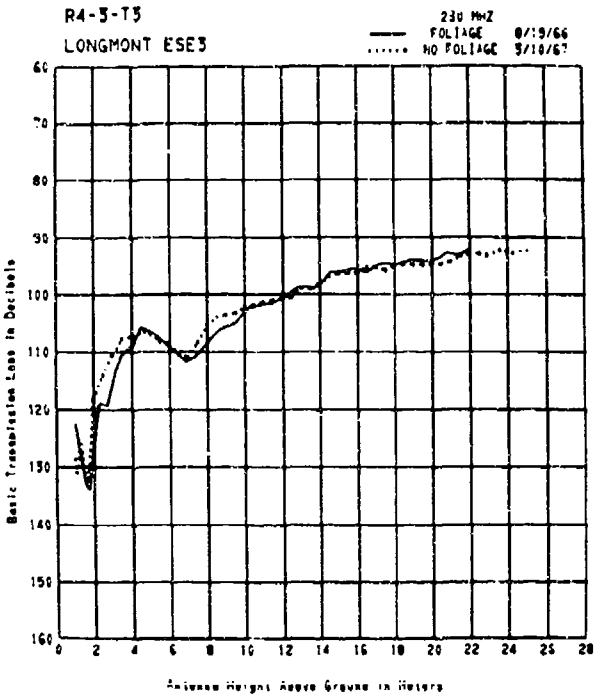
XMTR. ELEV.
1503 M

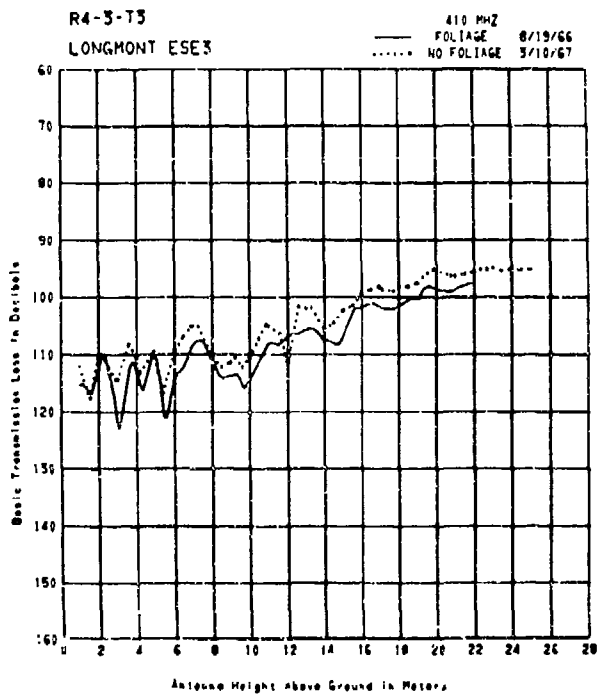


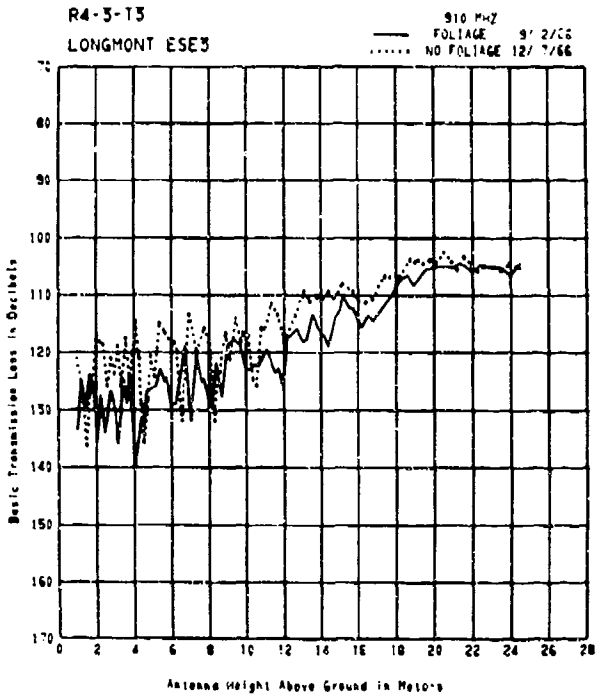
L_b (dB) SHORT TERM SIGNAL VARIABILITY

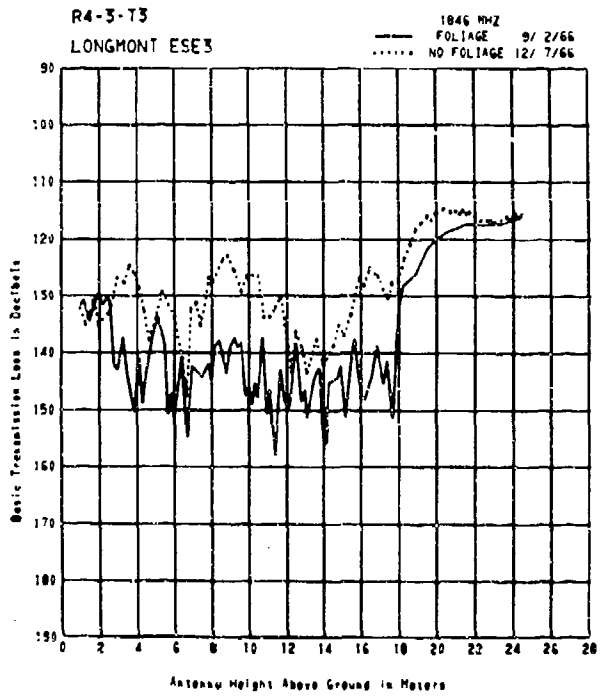
Freq(MHz)	230	410	910	1846	4595	9190
	8-19-66 at 22M			9-2-66 at 1M		
50%	91.6	95.4	127.6	131.8	144.6	165.6
Δ10%-90%	<3	<3	<3	<3	<3	6.6
				9-2-66 at 7.3M		
50%			122.6	145.3	170.1	184.3
Δ10%-90%			<3	<3	9.8	<3
				9-2-66 at 24.5M		
50%			103.1	116.3	136.8	141.6
Δ10%-90%			<3	<3	<3	<3

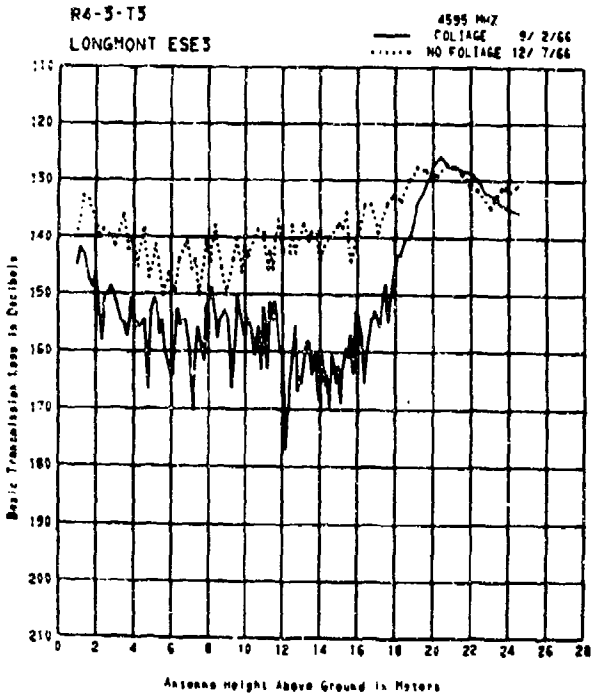
The first 200 m of the path consist of level farmland. A farm building and silo are immediately to the left of the path. As far as one can see, the path extends over level, open farmland with farm buildings scattered over its remaining distance.

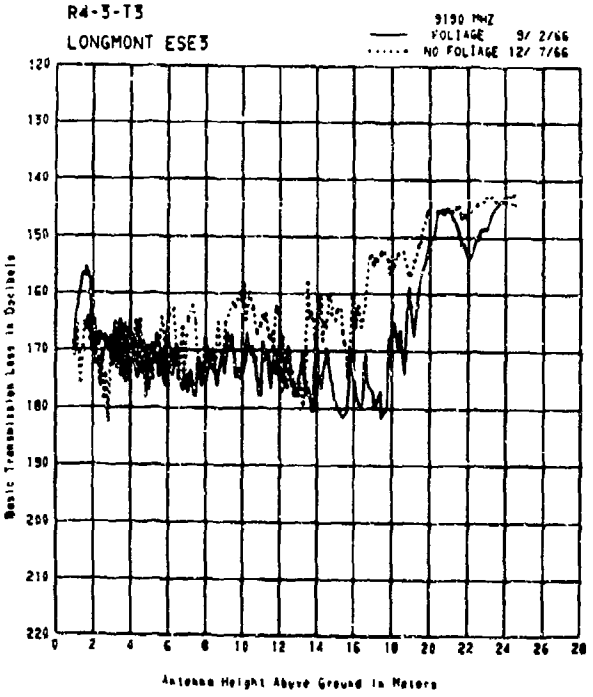

R4-3-T3
LONGMONT ESE3
230 MHZ
FOLIAGE 8/19/66
NO FOLIAGE 5/10/67
Basic Transmission Loss in Decibels
60
70
80
90
100
110
120
130
140
150
160
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-3-T3
LONGMONT ESE3
410 MHZ
FOLIAGE 8/19/66
NO FOLIAGE 5/10/67
Basic Transmission Loss in Decibels
60
70
80
90
100
110
120
130
140
150
160
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-3-T3
LONGMONT ESE3
910 MHZ
FOLIAGE 9/ 2/66
NO FOLIAGE 12/ 7/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-3-T3
LONGMONT ESE3
1846 MHZ
FOLIAGE 9/ 2/66
NO FOLIAGE 12/ 7/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-3-T3
LONGMONT ESE3
4595 MHZ
FOLIAGE 9/ 2/66
NO FOLIAGE 12/ 7/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-3-T3
LONGMONT ESE3
9190 MHZ
FOLIAGE 9/ 2/66
NO FOLIAGE 12/ 7/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters

R4-3-T3

L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
	3-10-67 at 25 M		12-7-66 at 7.3 M			
50%	92.5	94.8	120.6	135.3	142.8	162.3
Δ10% - 90%	< 3	< 3	< 3	< 3	< 3	< 3

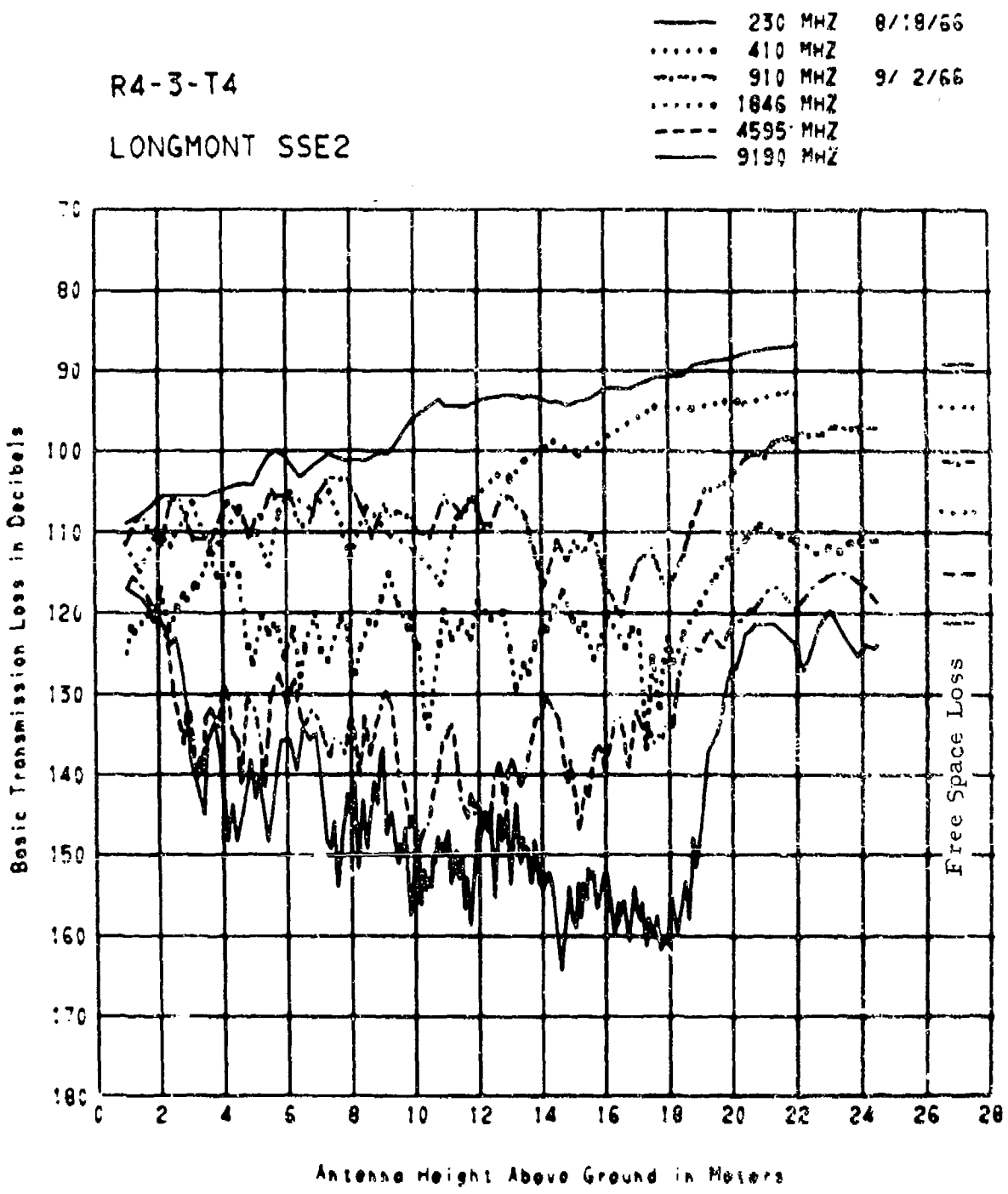
R4-3-T4
LONGMONT SSE 2



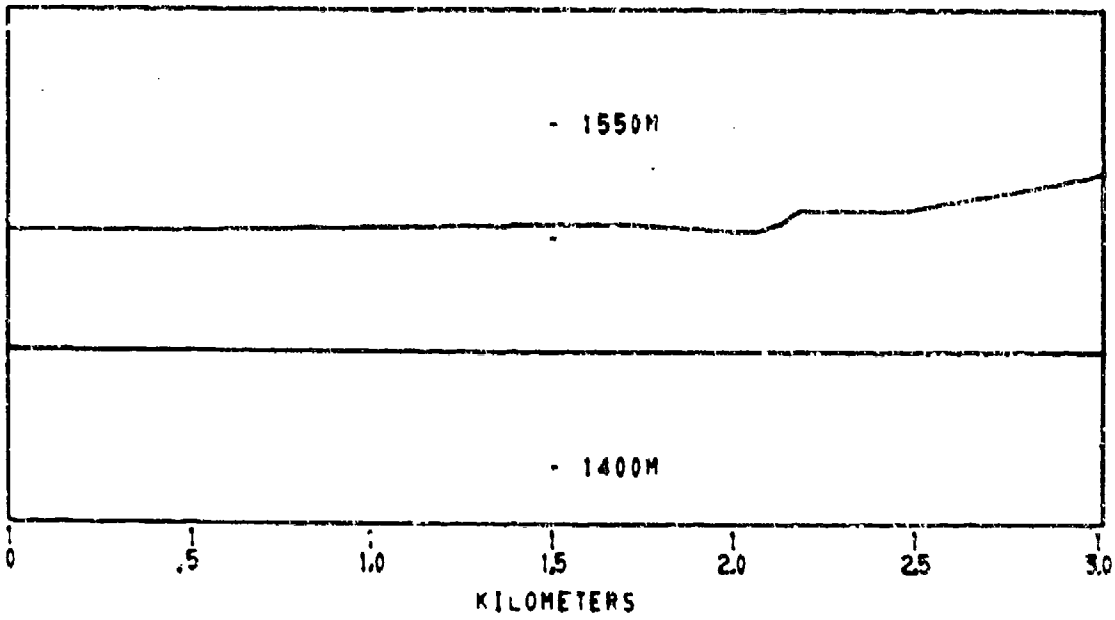
PATH VIEW FROM TRANSMITTER
Bearing from common receiver site to transmitter site is
147° 40' 45"

R4-3-T4

LONGMONT SSE2



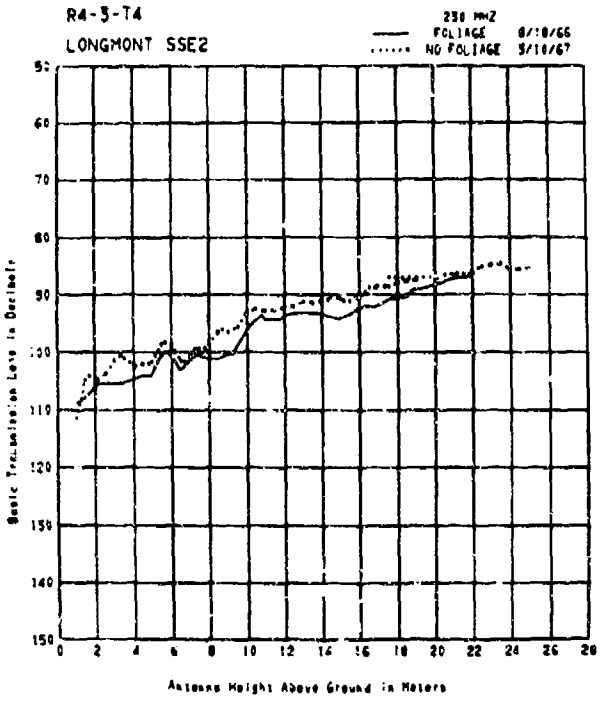
RCVR. ELEV. 1503 M | R4-3-T4 PATH LENGTH 3.008 km | XMTR. ELEV. 1528 M

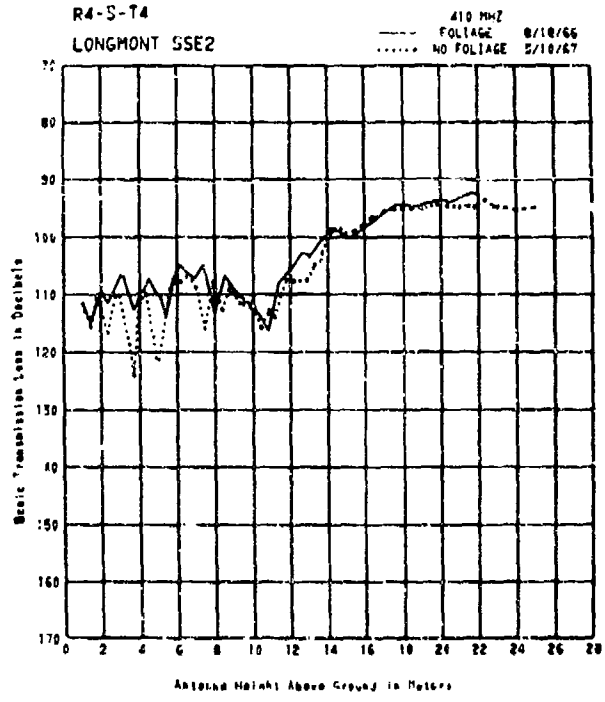


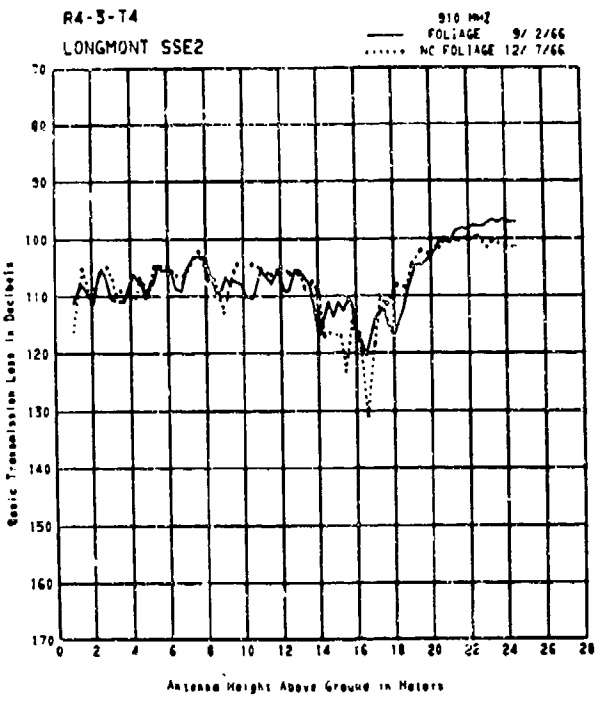
L_b (dB) SHORT TERM SIGNAL VARIABILITY

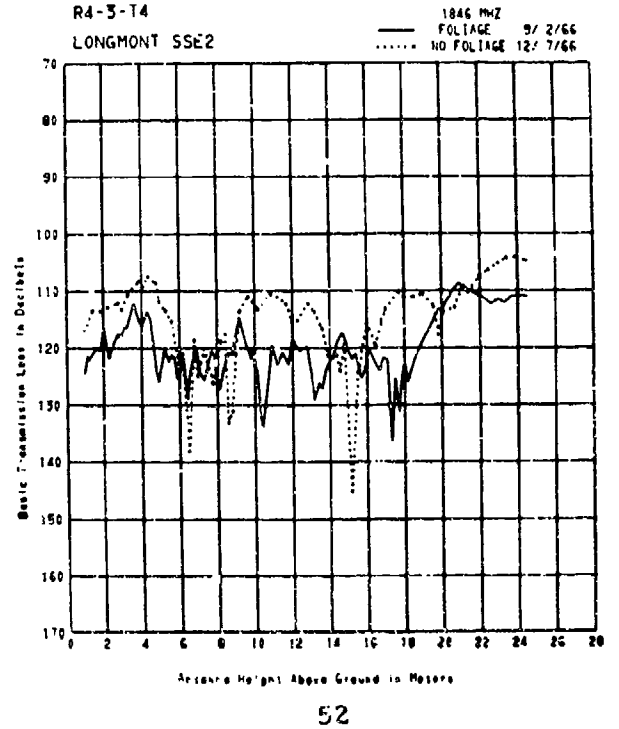
Freq(MHz)	230	410	910	1846	4595	9190
	8-18-66 at 1M			9-2-66 at 1M		
50%	110.5	114.6	111.6	124.3	118.3	117.4
Δ10%-90%	<3	<3	<3	<3	<3	<3
	8-18-66 at 11M			9-2-66 at 7.3M		
50%	92.9	102.1	105.5	124.3	140.2	148.5
Δ10%-90%	<3	<3	<3	<3	<3	<3
	8-18-66 at 22M			9-2-66 at 24.5M		
50%	86.3	92.4	97.0	111.1	119.2	124.0
Δ10%-90%	<3	<3	<3	<3	<3	<3

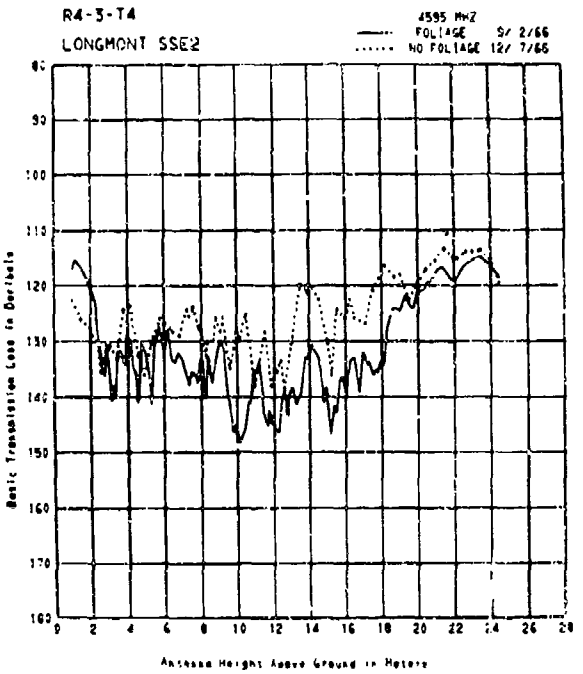
The immediate foreground consists of open fields, which slope downward toward the receiver for about 1 km to a farm building complex. From there, open fields extend toward the receiver site. a 2-wire telephone line passes near the transmitter van, but is about 2 m below the antennas.

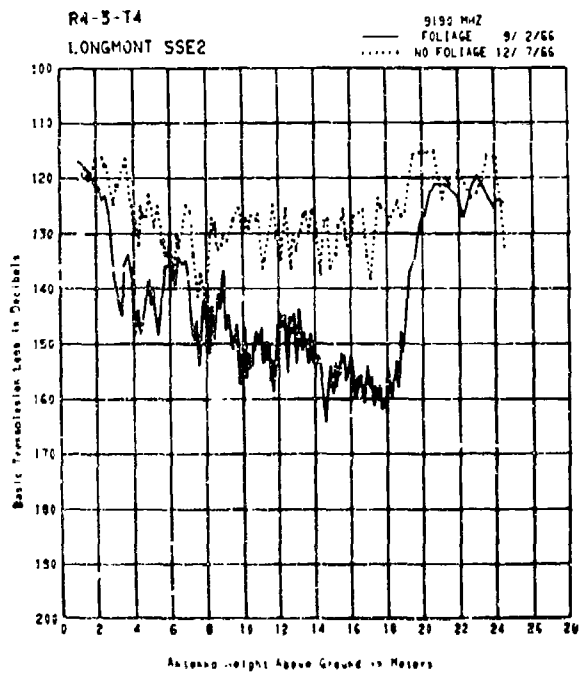

R4-S-T4
LONGMONT SSE2
230 MHZ
FOLIAGE 8/10/66
NO FOLIAGE 5/10/67
Basic Transmission Loss in Decibels
50
60
70
80
90
100
110
120
130
140
150
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-S-T4
LONGMONT SSE2
410 MHZ
FOLIAGE 8/10/66
NO FOLIAGE 5/10/67
Basic Transmission Loss in Decibels
70
80
90
100
110
120
130
140
150
160
170
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-3-T4
LONGMONT SSE2
910 MHZ
FOLIAGE 9/ 2/66
NO FOLIAGE 12/ 7/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-3-T4
LONGMONT SSE2
1846 MHZ
FOLIAGE 9/ 2/66
NO FOLIAGE 12/ 7/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-3-T4
LONGMONT SSE2
4595 MHZ
FOLIAGE 9/ 2/66
NO FOLIAGE 12/ 7/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-3-T4
LONGMONT SSE2
9190 MHZ
FOLIAGE 9/ 2/66
NO FOLIAGE 12/ 7/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters

R4-3-T4

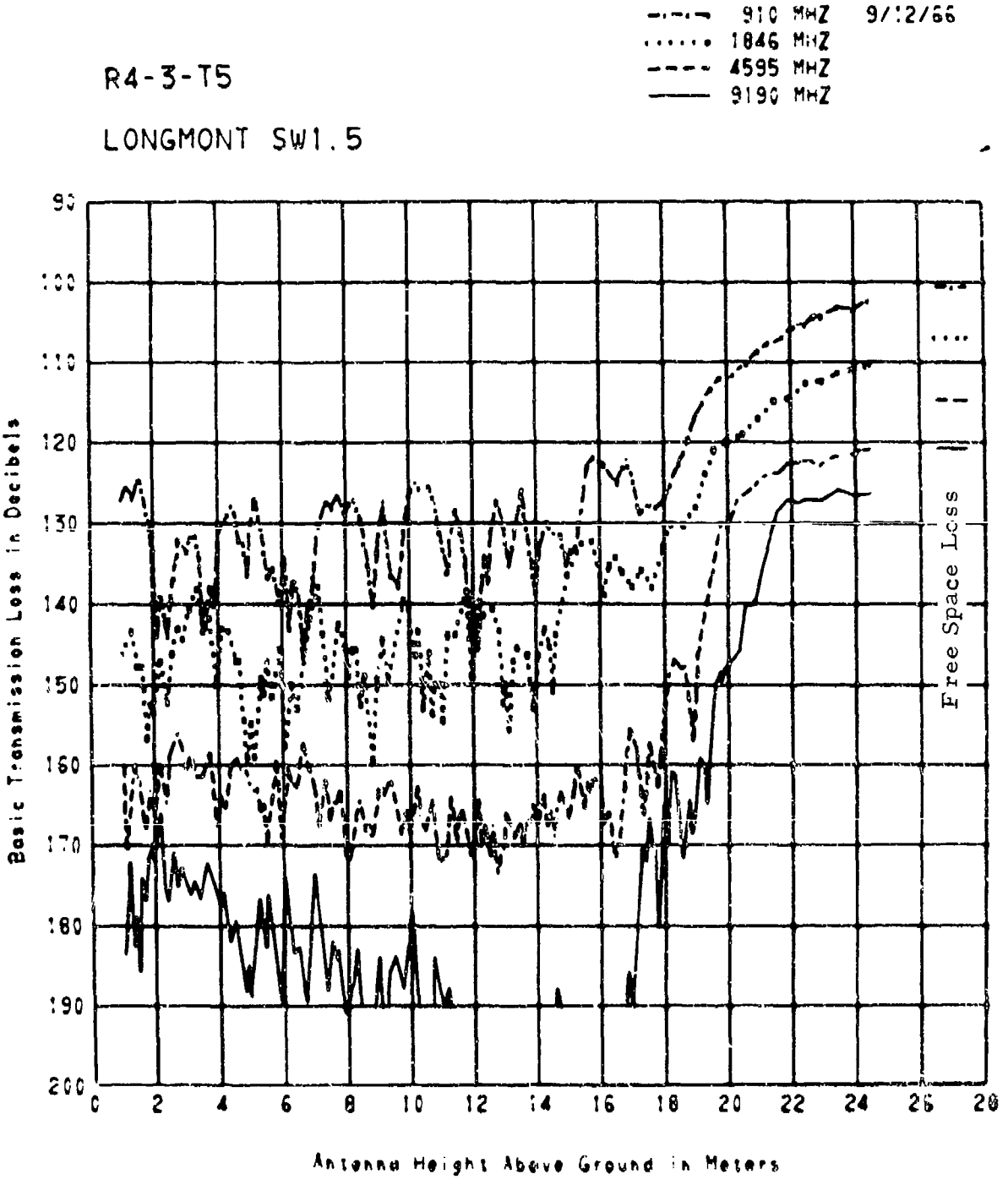
L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
	3-10-67 at 22 M		12-7-66 at 7.3 M			
50%	85.4	94.6	102.8	118.5	124.6	140.0
Δ10% - 90%	< 3	< 3	< 3	< 3	< 3	< 3

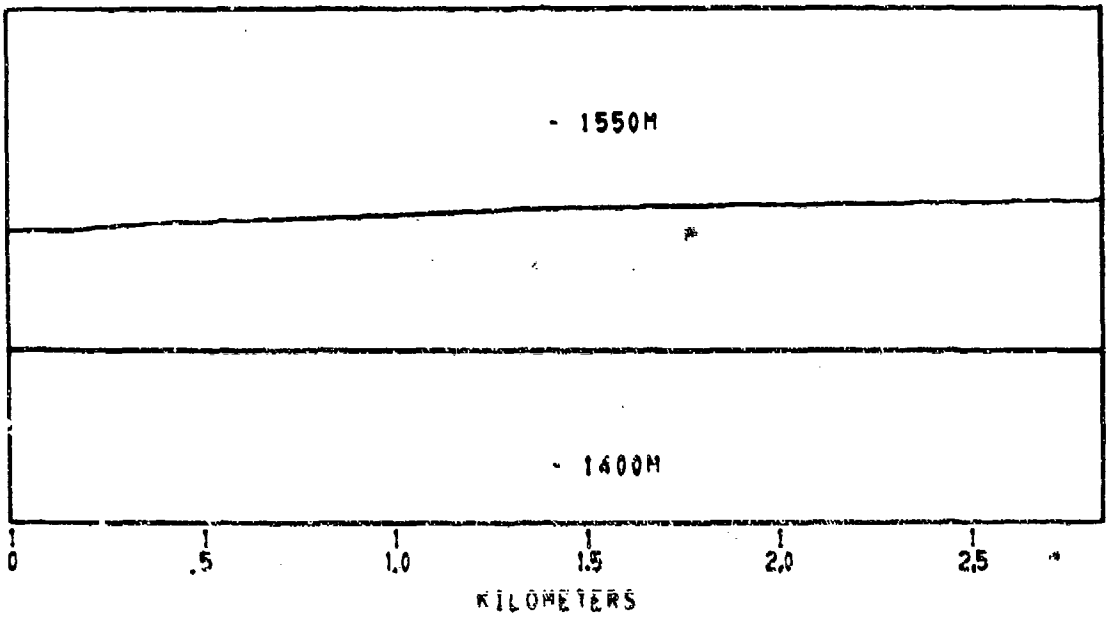
R4-3-T5
LONGMONT SW 1.5



PATH VIEW FROM TRANSMITTER
Bearing from common receiver site to transmitter site is
227° 21' 05"


910 MHZ 9/12/66
1846 MHZ
4595 MHZ
9190 MHZ
R4-3-T5
LONGMONT SW1.5
Basic Transmission Loss in Decibels
90
100
110
120
130
140
150
160
170
180
190
200
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
Free Space Loss
Antenna Height Above Ground in Meters

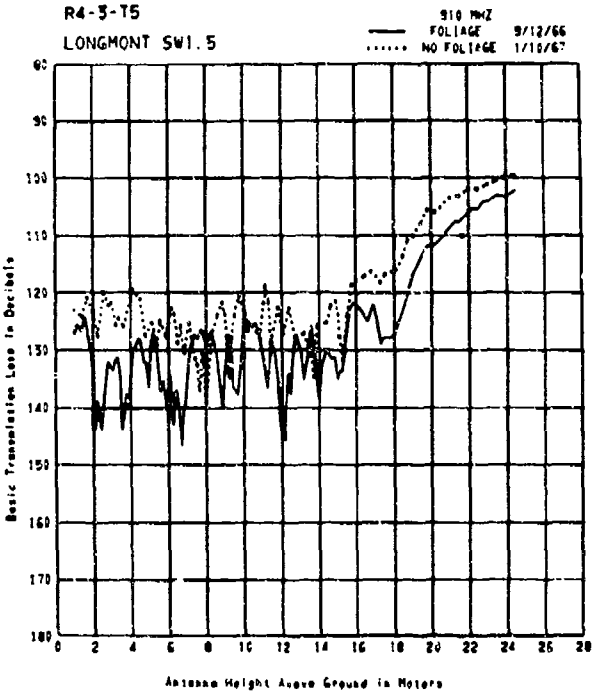
RCVR. ELEV. 1503 M | R4-3-T5 PATH LENGTH 2.844 km | XMTR. ELEV. 1515 M

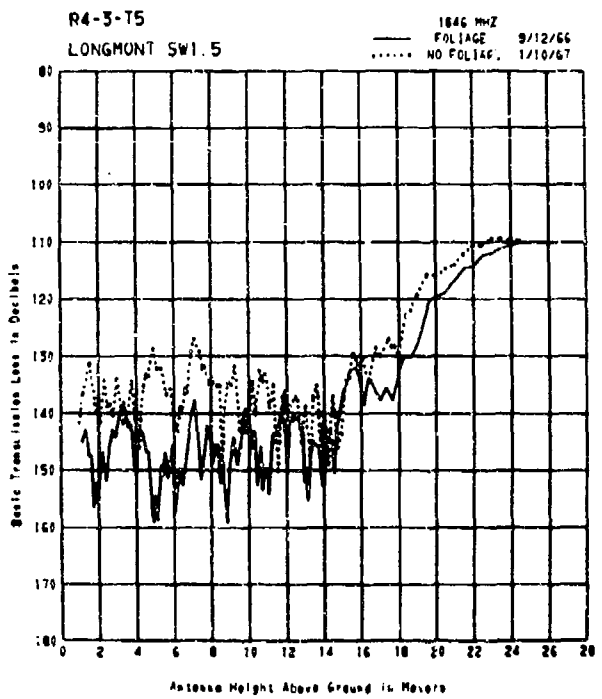


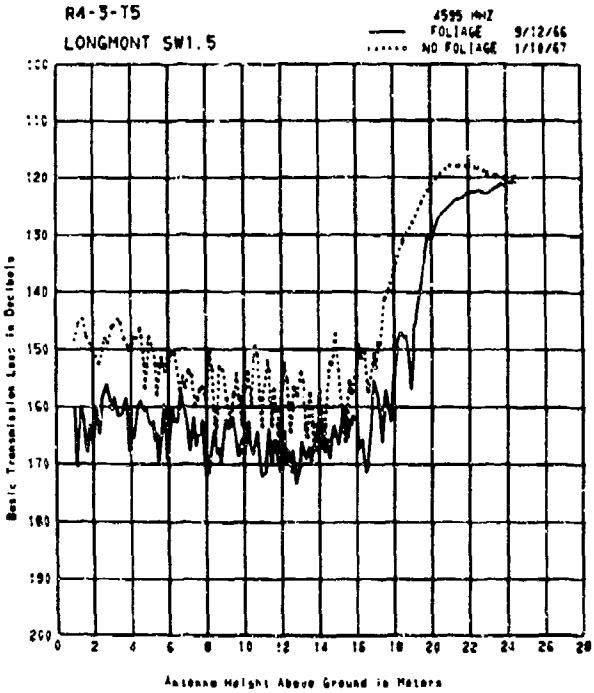
L_b (dB) SHORT TERM SIGNAL VARIABILITY

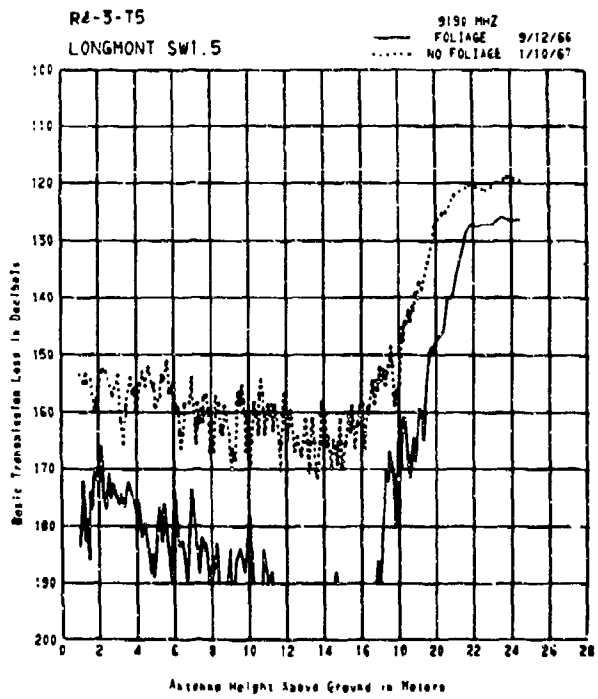
Freq(MHz)	230	410	910	1846	4595	9190
				9-12-66 at 1M		
50%			126.0	144.5	161.4	175.6
Δ10%-90%			3.1	4.8	7.4	10.9
				9-12-66 at 7.3M		
50%			127.6	141.1	161.1	185.8
Δ10%-90%			<3	<3	4.2	10.2
				9-12-66 at 24.5M		
50%			105.3	109.9	119.9	125.7
Δ10%-90%			<3	<3	<3	<3

The first 400 m of foreground are open, level, plowed fields. Beyond are low trees and scattered farm buildings. The path is almost flat in the remaining distance to the receiver.


R4-3-T5
LONGMONT SW1.5
910 MHZ
FOLIAGE 9/12/66
NO FOLIAGE 1/10/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-3-T5
LONGMONT SW1.5
1646 MHZ
FOLIAGE 9/12/66
NO FOLIAGE 1/10/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-3-T5
LONGMONT SW1.5
4595 MHZ
FOLIAGE 9/12/66
NO FOLIAGE 1/10/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-3-T5
LONGMONT SW1.5
9190 MHZ
FOLIAGE 9/12/66
NO FOLIAGE 1/10/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters

R4-3-T5

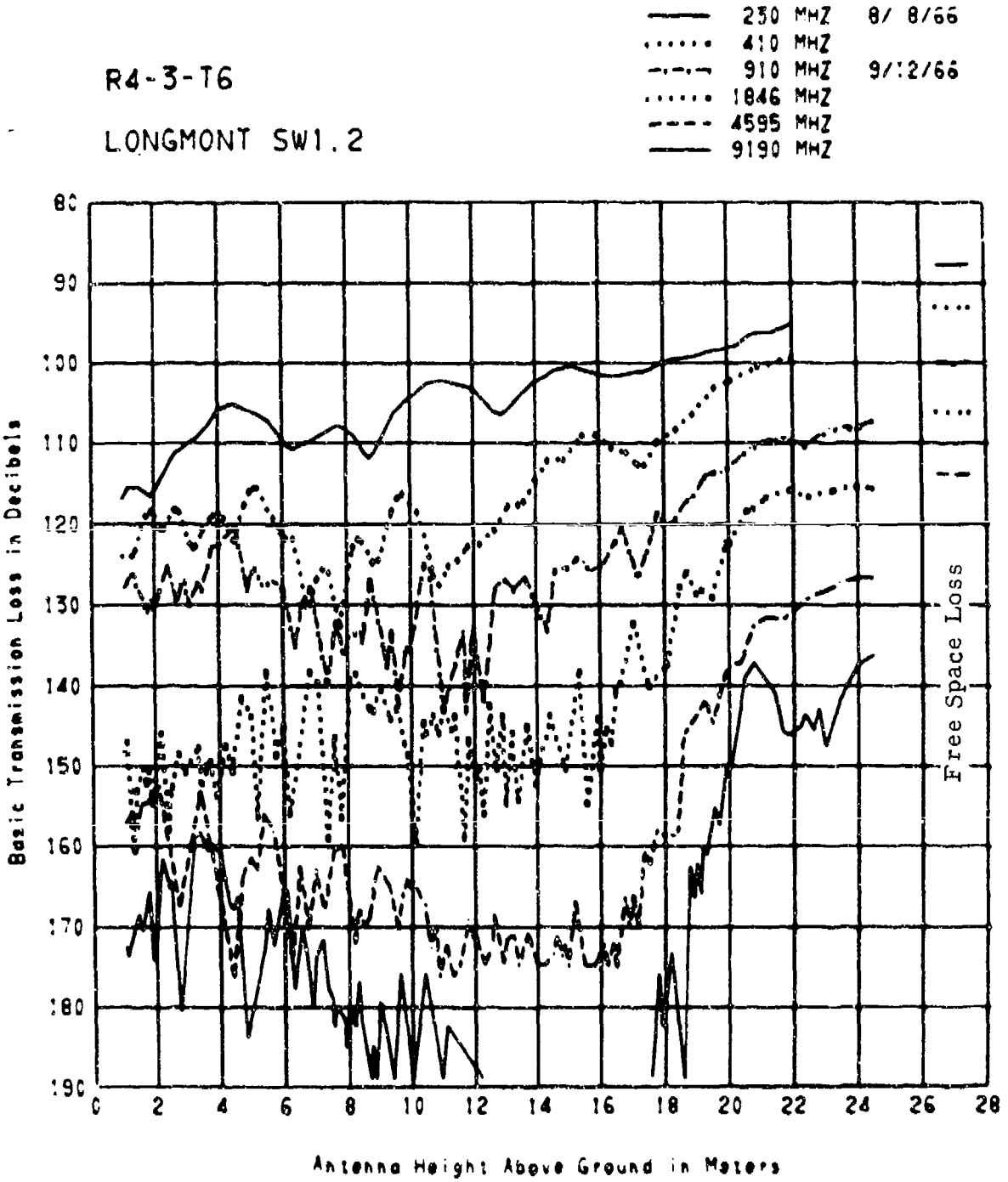
L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
			1-10-67 at 7.3 M			
50%			125.9	127.3	156.7	159.3
Δ10% - 90%			< 3	< 3	< 3	< 3

R4-3-T6
LONGMONT W 2.5



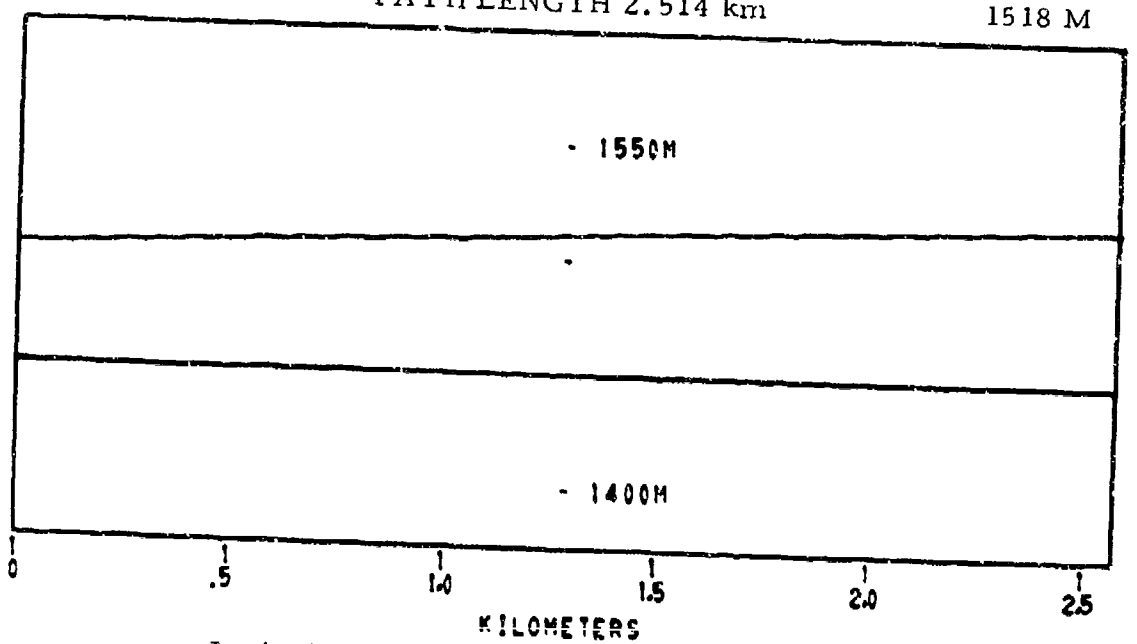
PATH VIEW FROM TRANSMITTER
Bearing from common receiver site to transmitter site is
245° 01' 05"


230 MHZ 8/ 8/66
410 MHZ
910 MHZ 9/12/66
1846 MHZ
4595 MHZ
9190 MHZ
R4-3-T6
LONGMONT SW1.2
Basic Transmission Loss in Decibels
80
90
100
110
120
130
140
150
160
170
180
190
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
Free Space Loss
Antenna Height Above Ground in Meters

RCVR. ELEV.
1503 M

R4-3-T6
PATH LENGTH 2.514 km

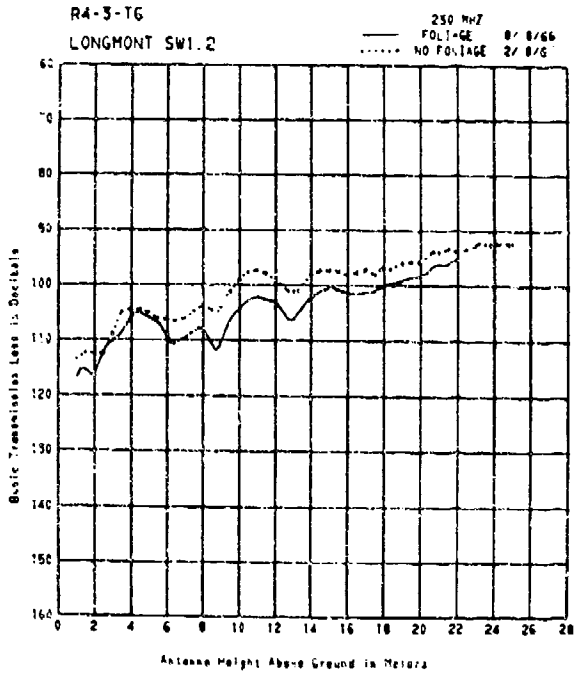
XMTR. ELEV.
1518 M

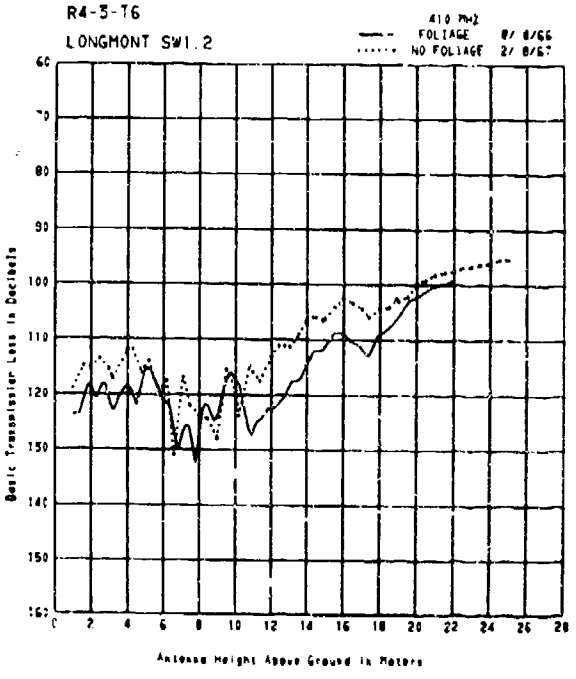


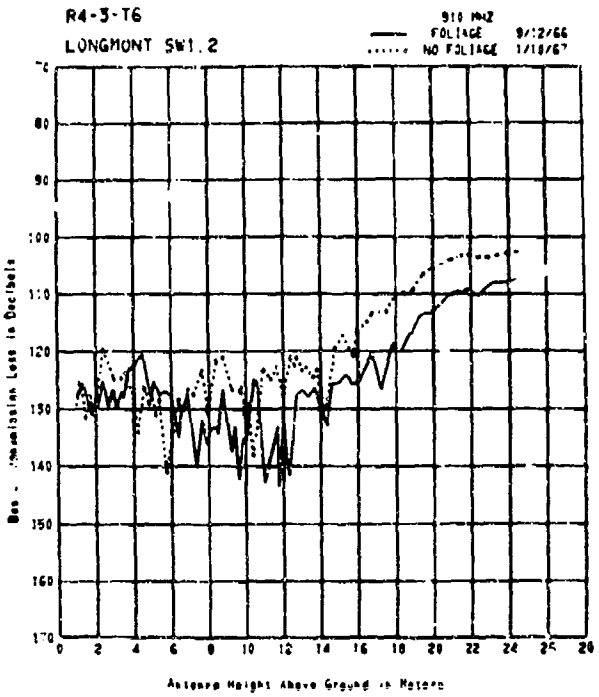
L_b (dB) SHORT TERM SIGNAL VARIABILITY

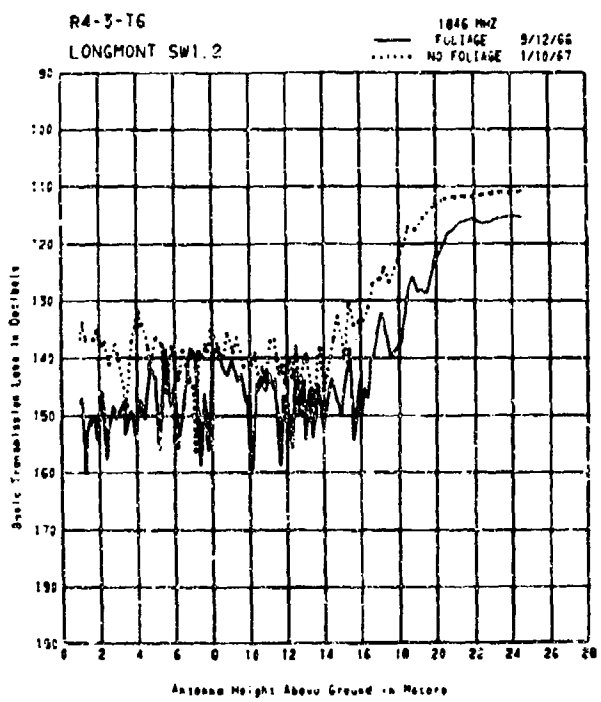
Freq(MHz)	230	410	910	1846	4595	9190
	8-8-66 at 3M			9-12-66 at 1M		
50%	108.8	122.7	129.9	145.8	148.2	168.2
Δ10%-90%	<3	<3	3.0	<3	5.3	11.3
	8-8-66 at 22M			9-12-66 at 7.3M		
50%	93.2	97.1	129.1	156.5	154.2	175.1
Δ10%-90%	<3	<3	4.0	13.6	4.2	11.0
				9-12-66 at 24.5M		
50%			109.0	116.3	126.8	136.9
Δ10%-90%			<3	<3	<3	<3

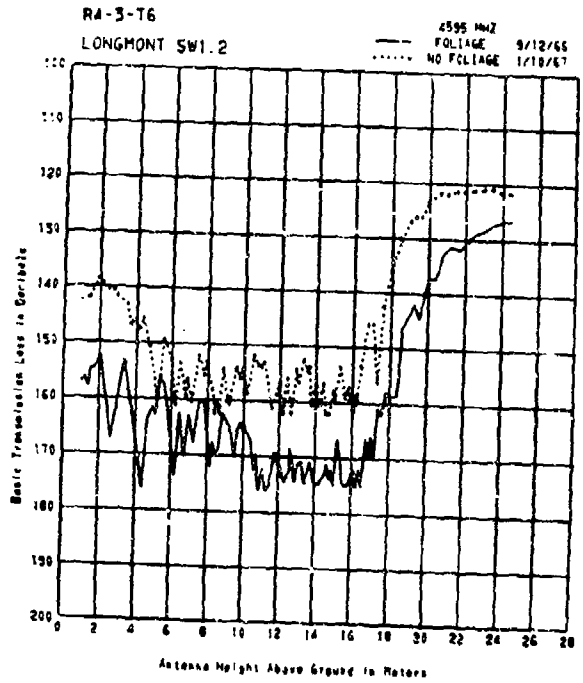
The foreground over which this path passes consists of freshly plowed fields for about 1.2 km. These fields are level and unobstructed. The remainder of the path, as far as one can see, is covered with scattered farm buildings and trees.

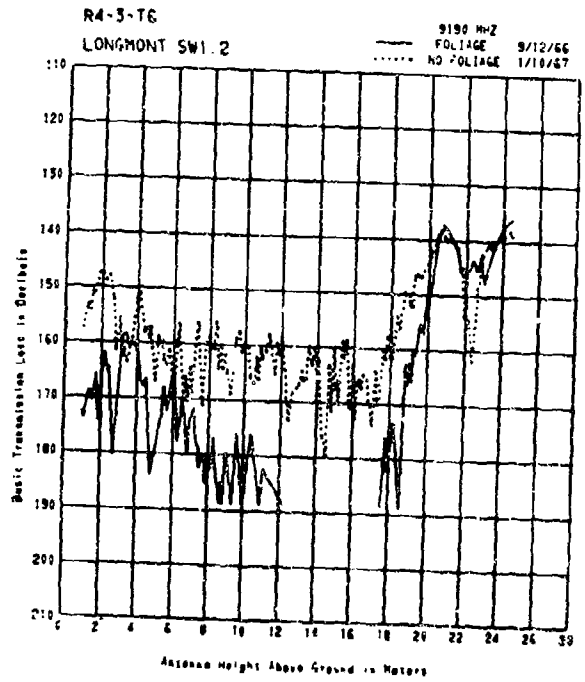

R4-3-T6
LONGMONT SW1.2
250 MHZ
FOLIAGE
NO FOLIAGE
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-3-T6
LONGMONT SW1.2
410 MHZ
FOLIAGE
NO FOLIAGE
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-3-T6
LONGMONT SW1.2
910 MHZ
FOLIAGE 9/12/66
NO FOLIAGE 1/10/67
80
90
100
110
120
130
140
150
160
170
0 2 4 6 8 10 12 14 16 18 20 22 24 26
Antenna Height Above Ground in Meters


R4-3-T6
LONGMONT SW1.2
1046 MHZ
FOLIAGE 9/12/66
NO FOLIAGE 1/10/67
90
100
110
120
130
140
150
160
170
180
190
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-3-T6
LONGMONT SW1.2
4595 MHZ
FOLIAGE 9/12/66
NO FOLIAGE 1/10/67
Basic Transmission Loss in Decibels
110
120
130
140
150
160
170
180
190
200
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-3-T6
LONGMONT SW1.2
9190 MHZ
FOLIAGE 9/12/66
NO FOLIAGE 1/10/67
Basic Transmission Loss in Decibels
110
120
130
140
150
160
170
180
190
200
210
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters

R4-3-T6

L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
	2-8-67 at 25 M		1-10-67 at 7.3 M			
50%	9.23	95.5	128.4	137.5	153.2	155.7
Δ10% - 90%	< 3	< 3	< 3	< 3	< 3	< 3

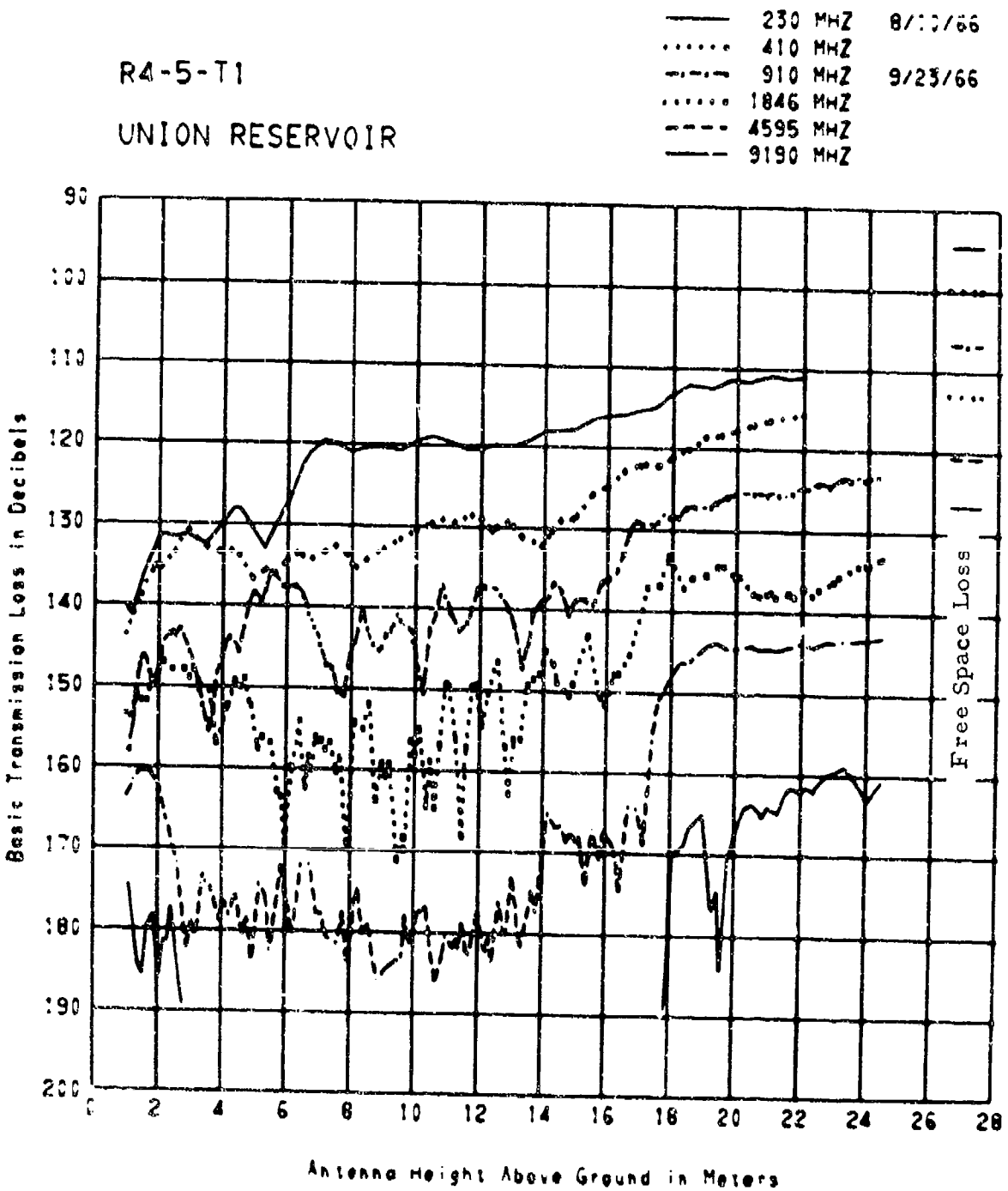
R4-5-T1
UNION RESERVOIR



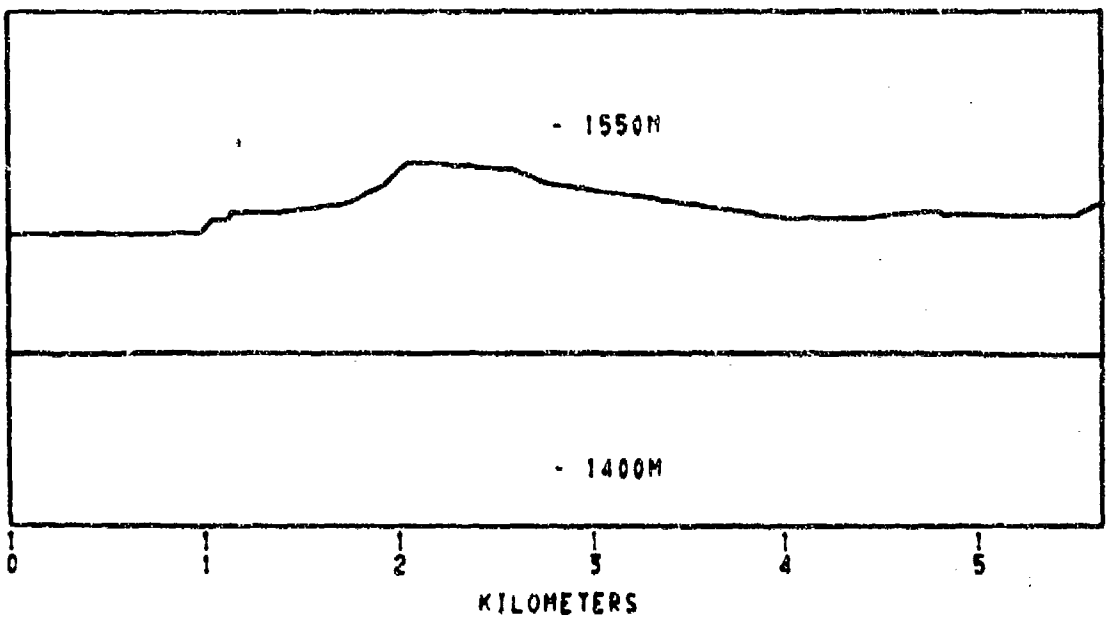
PATH VIEW FROM TRANSMITTER
Bearing from common receiver site to transmitter site is
67° 41' 18"

R4-5-T1

UNION RESERVOIR



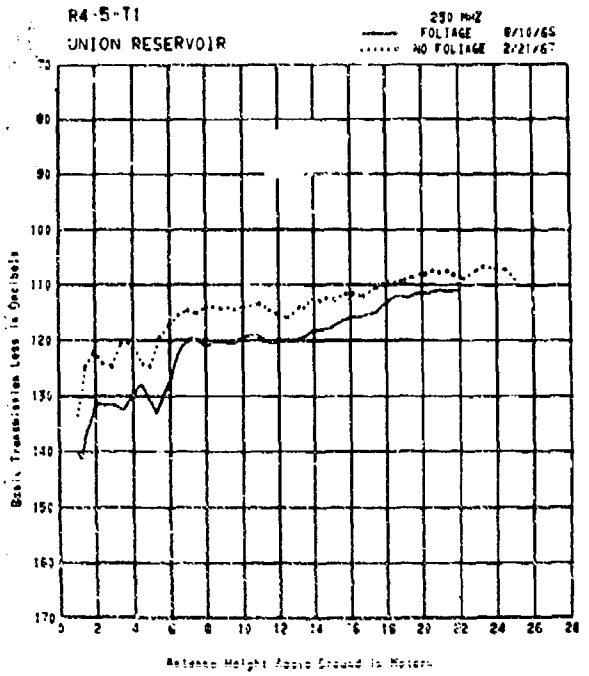
RCVR. ELEV. 1503 M | R4-5-T1 PATH LENGTH 5.643 km. | XMTR. ELEV. 1516 M

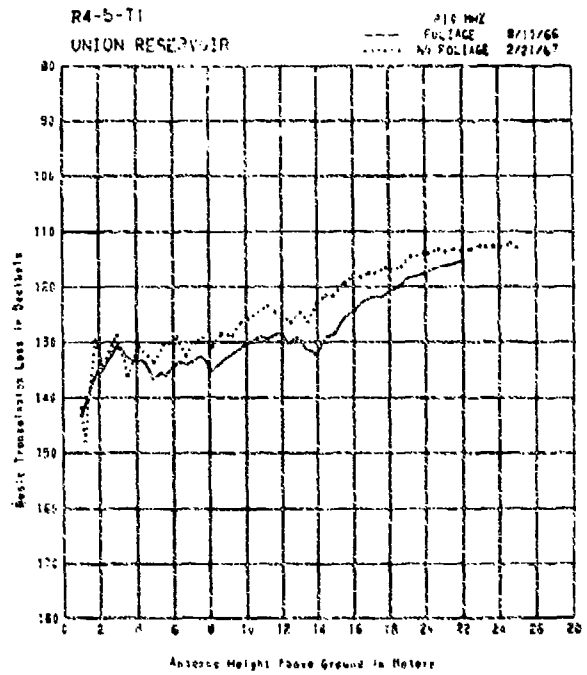


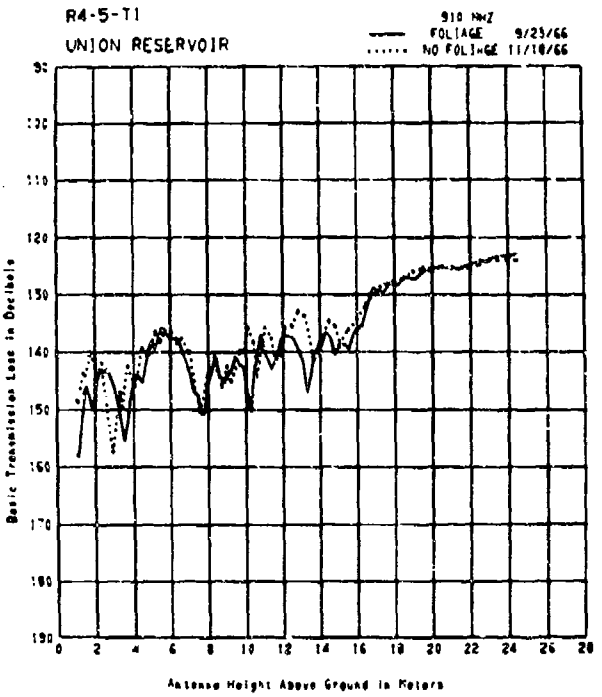
L_b (dB) SHORT TERM SIGNAL VARIABILITY

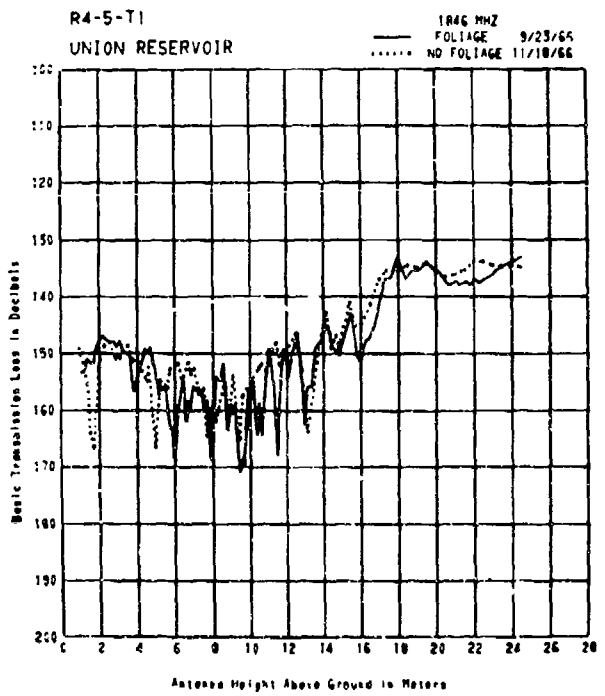
Freq(MHz)	230	410	910	1846	4595	9190
	8-10-66 at 3M			9-23-66 at 1M		
50%	130.4	130.3	158.1	155.0	161.4	166.5
Δ10%-90%	<3	<3	<3	<3	<3	<3
	8-10-66 at 22M			9-23-66 at 7.3M		
50%	110.9	114.3	146.8	155.8	184.0	
Δ10%-90%	<3	<3	<3	<3	<3	
				9-23-66 at 14M		
50%			137.8	145.4	170.7	
Δ10%-90%			<3	<3	<3	
				9-23-66 at 24.5M		
50%			122.6	132.9	142.9	161.6
Δ10%-90%			<3	<3	<3	5.1

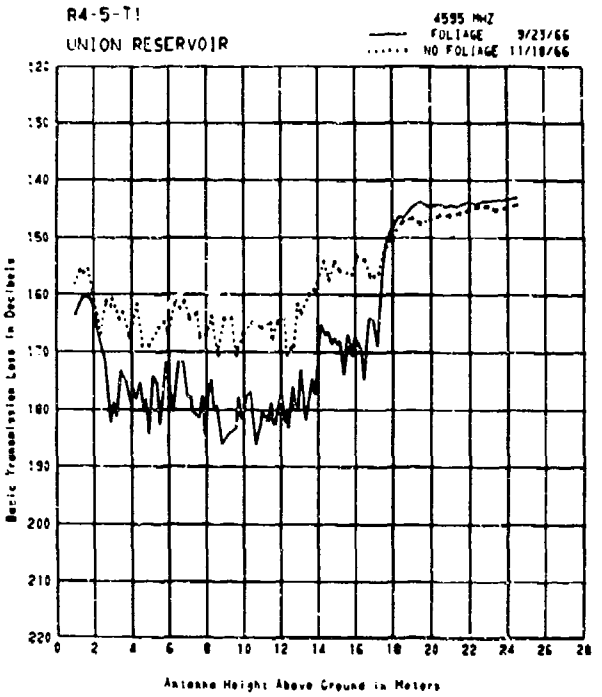
The path extends for about 800 m over the south edge of Union Reservoir. At the far edge of the reservoir, there is a line of deciduous trees, 12 to 20 m high. The only other apparent obstruction in the path is a large factory building about 3 km away.

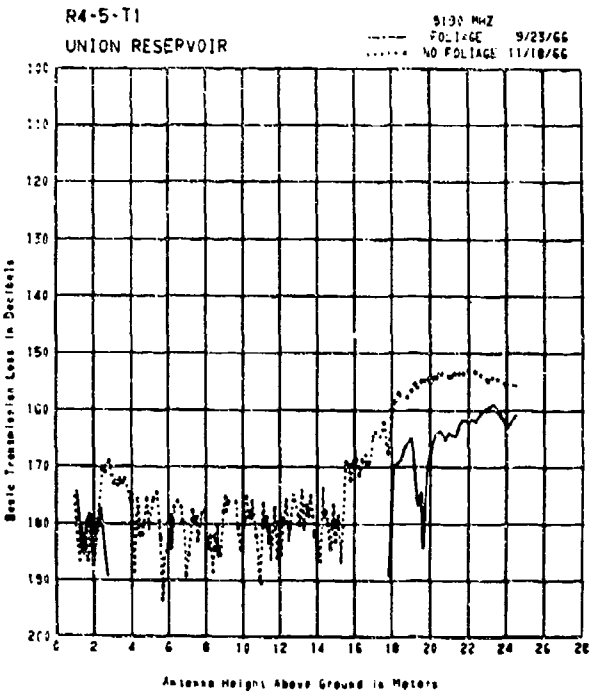

R4-5-T1
UNION RESERVOIR
250 MHZ
FOLIAGE 8/10/65
NO FOLIAGE 2/21/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-5-T1
UNION RESERVOIR
FOLIAGE 8/11/66
NO FOLIAGE 2/21/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-5-T1
UNION RESERVOIR
910 MHZ
FOLIAGE 9/23/66
NO FOLIAGE 11/10/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-5-T1
UNION RESERVOIR
1846 MHZ
FOLIAGE 9/23/66
NO FOLIAGE 11/10/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-5-T1
UNION RESERVOIR
4595 MHZ
FOLIAGE 9/23/66
NO FOLIAGE 11/18/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-5-T1
UNION RESERVOIR
9190 MHZ
FOLIAGE 9/23/66
NO FOLIAGE 11/18/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters

R4-5-T1

L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
	2-21-67 at 25 M		11-18-66 at 7.3 M			
50%	107.2	113.8	146.8	155.2	169.7	177.6
Δ10% - 90%	< 3	< 3	< 3	< 3	< 3	< 3

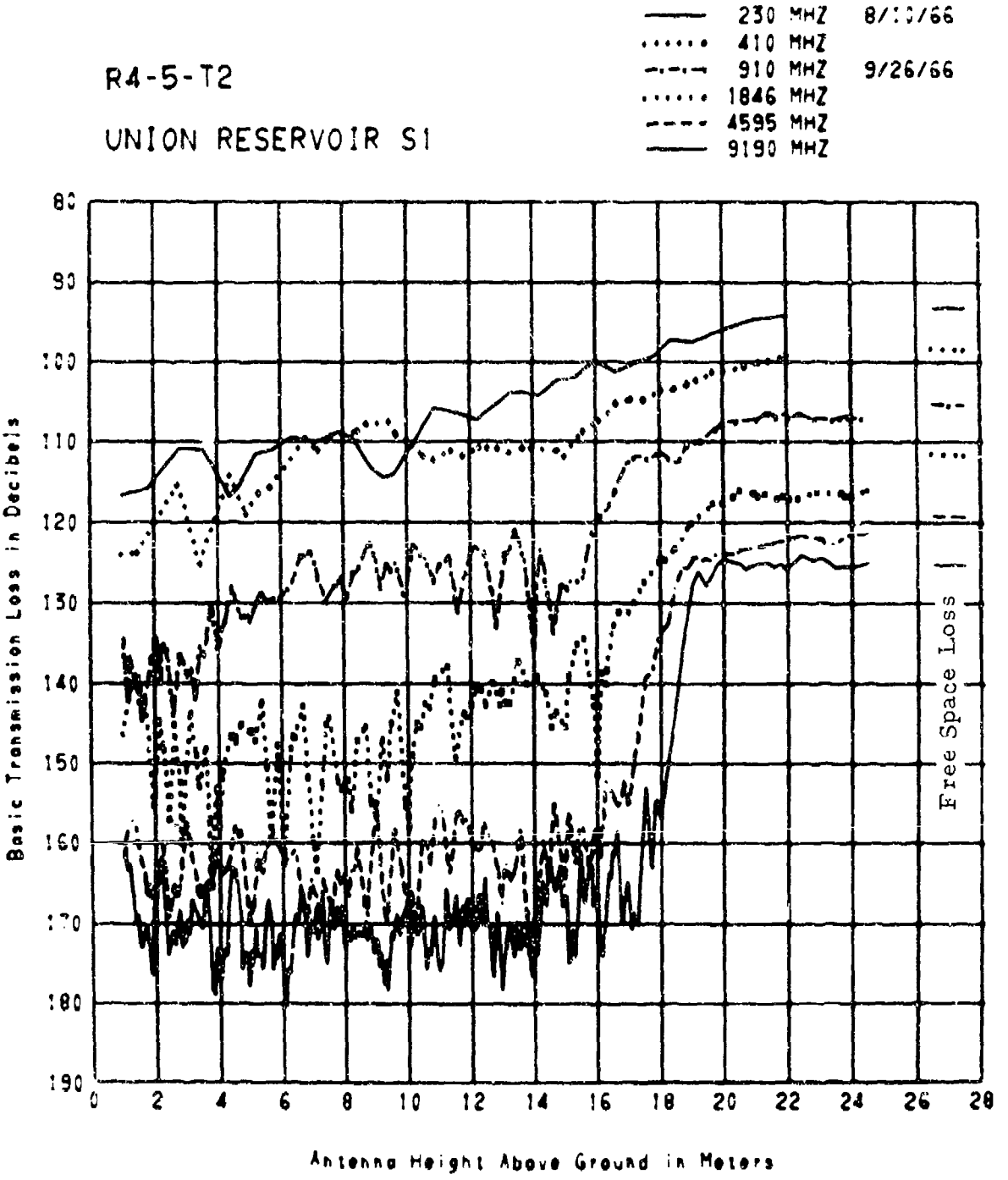
R4-5-T2
UNION RESERVOIR S 1



PATH VIEW FROM TRANSMITTER
Bearing from common receiver site to transmitter site is
89° 23' 28"

R4-5-T2

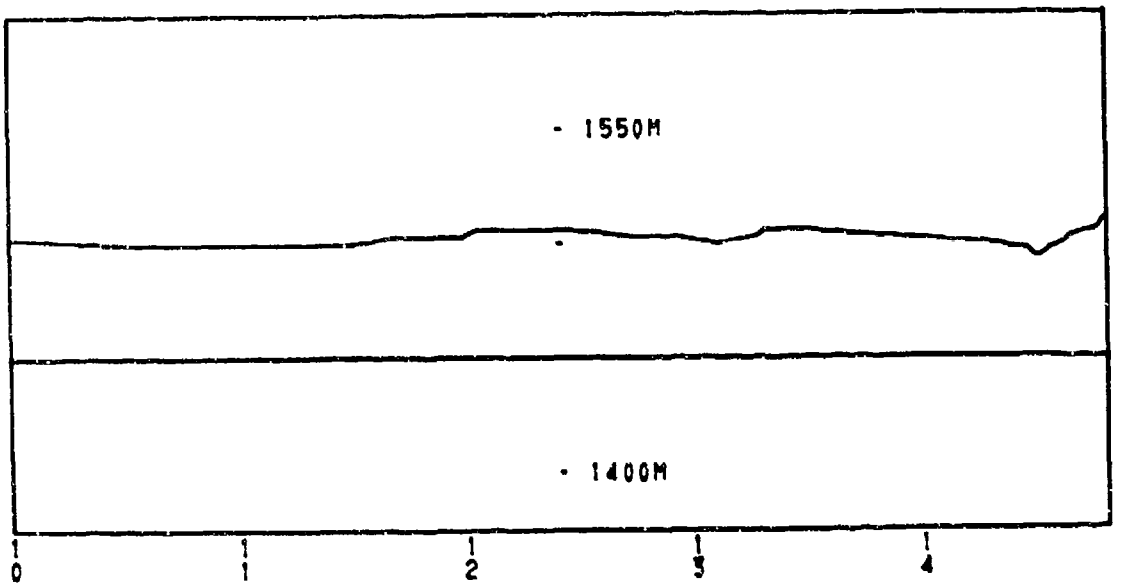
UNION RESERVOIR S1



RCVR. ELEV. 1503 M

R4-5-T2
PATH LENGTH 4.793 km

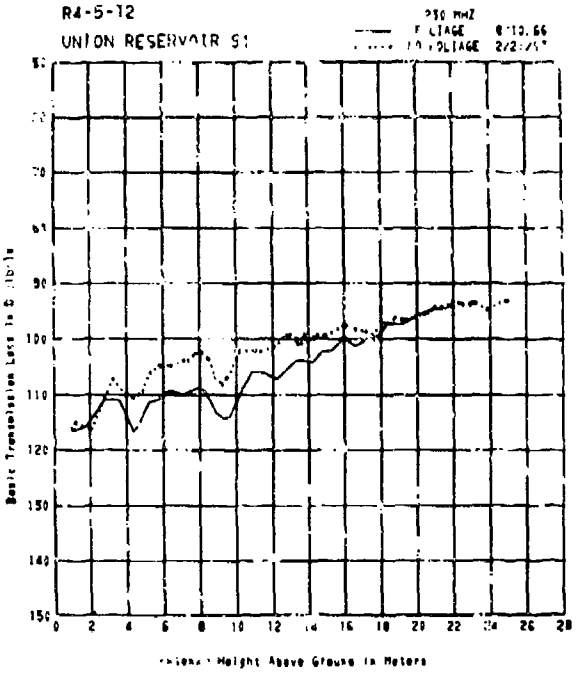
XMTR. ELEV. 1510 M

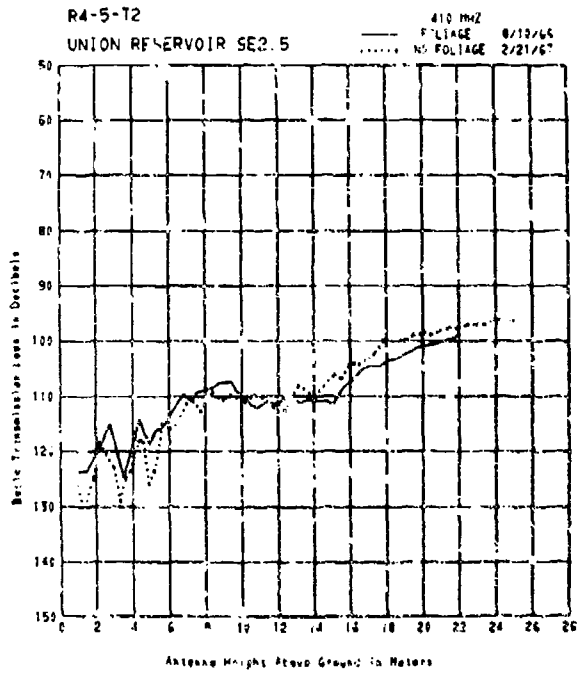


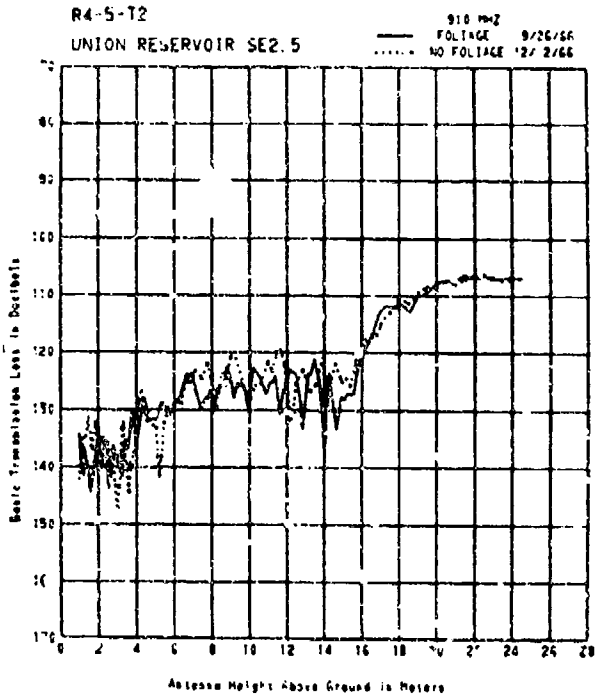
L_b (dB) SHORT TERM SIGNAL VARIABILITY

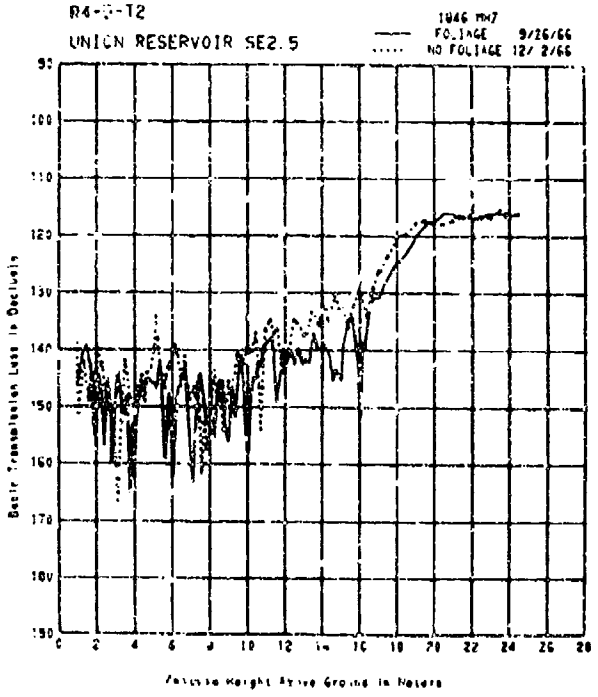
Freq(MHz)	230	410	910	1846	4595	9190
	8-10-66 at 22M			9-26-66 at 1M		
50%	94.6	99.9	129.6	144.3	165.5	165.4
Δ10%-90%	<3	<3	3.8	4.0	9.7	8.8
				9-26-66 at 7.3M		
50%			126.6	152.0	166.6	171.4
Δ10%-90%			3.9	11.8	8.1	8.1
				9-26-66 at 14M		
50%			133.1	143.0	161.3	169.9
Δ10%-90%			14.3	9.8	9.0	7.9
				9-26-66 at 24.5M		
50%			106.8	115.6	122.0	125.0
Δ10%-90%			<3	<3	<3	<3

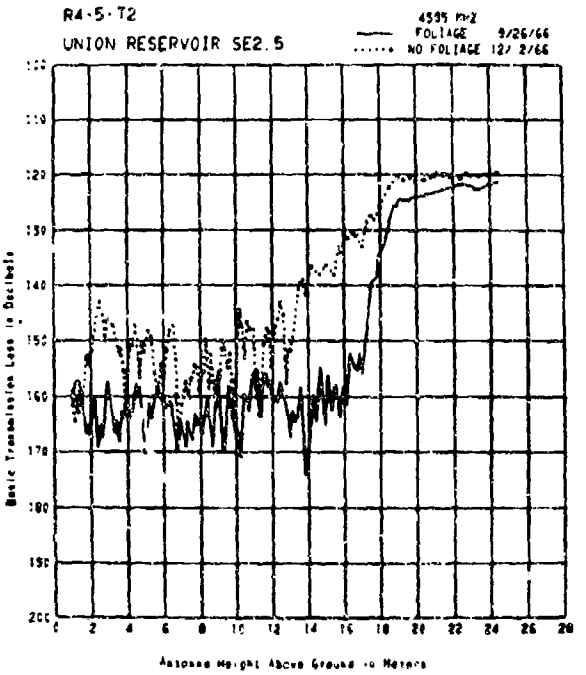
The immediate foreground is unobstructed for 150 m. At this point, a 4-wire telephone line runs roughly perpendicular to the path. The ground slopes down and away from the transmitter for about 300 m, and then becomes level for the remainder of the path that one can see. About 1.6 km away are farm buildings and trees.

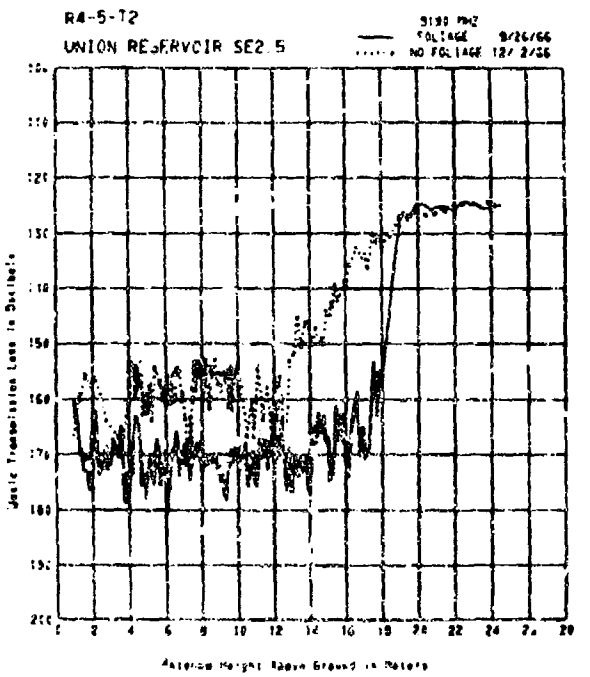

R4-5-T2
UNION RESERVOIR S1
910 MHZ
FOLIAGE
NO FOLIAGE
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-5-T2
UNION RESERVOIR SE2.5
410 MHZ
FOLIAGE
NO FOLIAGE
50
60
70
80
90
100
110
120
130
140
150
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-5-T2
UNION RESERVOIR SE2.5
910 MHZ
FOLIAGE 9/26/66
NO FOLIAGE 12/ 2/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-5-T2
UNION RESERVOIR SE2.5
1046 MHZ
FOLIAGE 9/26/66
NO FOLIAGE 12/ 2/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-5-T2
UNION RESERVOIR SE2.5
4595 MHz
FOLIAGE 9/26/66
NO FOLIAGE 12/ 2/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-5-T2
UNION RESERVOIR SE2.5
9190 MHz
FOLIAGE 9/26/66
NO FOLIAGE 12/ 2/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters

R4-5-T2

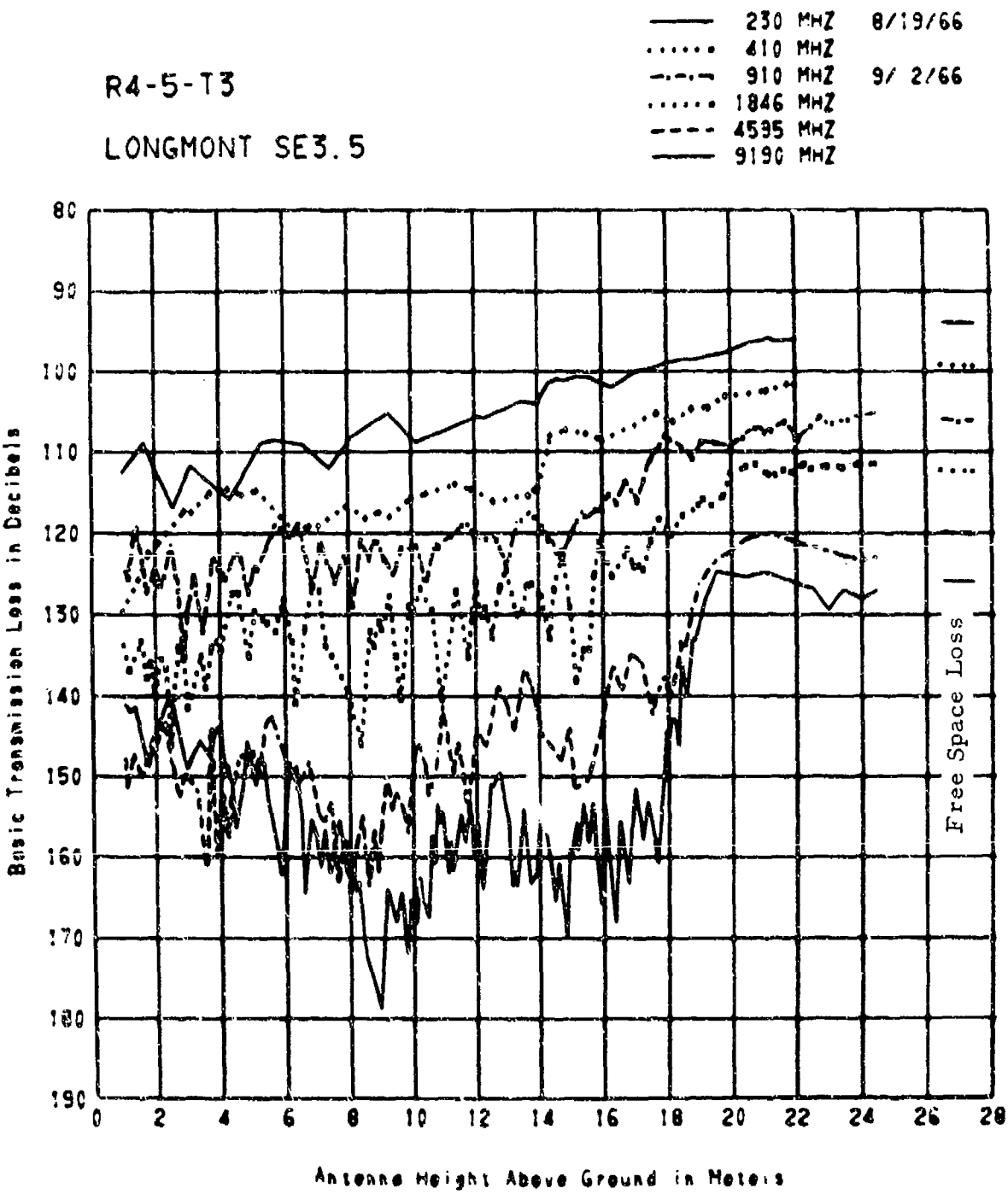
L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
	2-21-67 at 25 M			12-2-66 at 1 M		
50%	93.5	95.4	137.8	140.4	157.0	157.7
Δ10% - 90%	< 3	< 3	< 3	< 3	< 3	< 3
				12-2-66 at 7.3 M		
50%			126.0	144.9	159.3	163.2
Δ10% - 90%			< 3	< 3	< 3	< 3
				12-2-66 at 14 M		
50%			127.6	133.8	143.9	151.7
Δ10% - 90%			< 3	< 3	< 3	< 3
				12-2-66 at 24.5 M		
50%			105.3	118.0	120.3	129.7
Δ10% - 90%			< 3	< 3	< 3	< 3

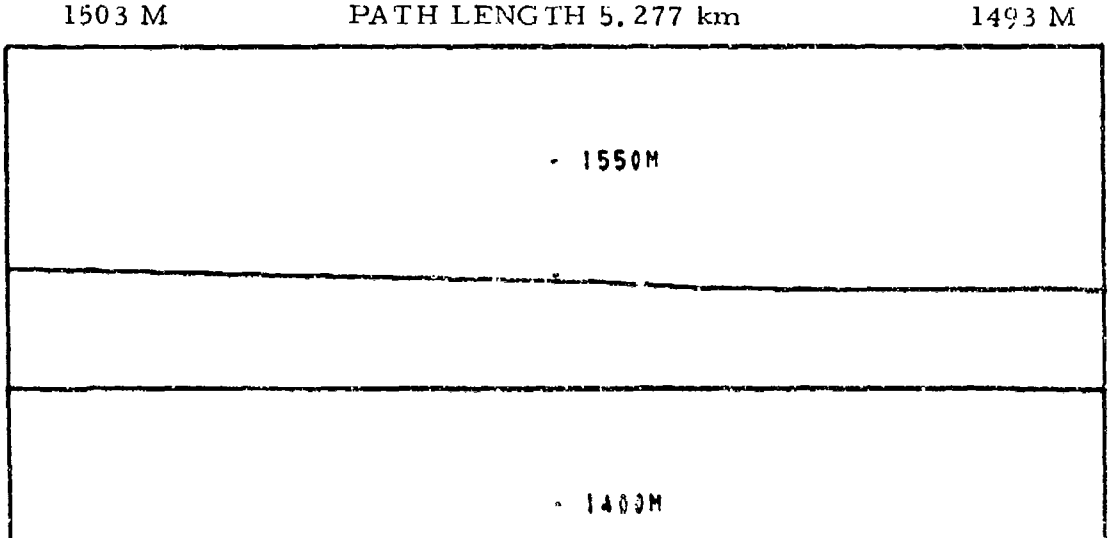
R4-5-T3
LONGMONT SE 3.5



PATH VIEW FROM TRANSMITTER
Bearing from common receiver site to transmitter site is
110° 18' 47"


230 MHZ 8/19/66
410 MHZ
910 MHZ 9/ 2/66
1846 MHZ
4595 MHZ
9190 MHZ
R4-5-T3
LONGMONT SE3.5
Basic Transmission Loss in Decibels
80
90
100
110
120
130
140
150
160
170
180
190
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
Free Space Loss
Antenna Height Above Ground in Meters

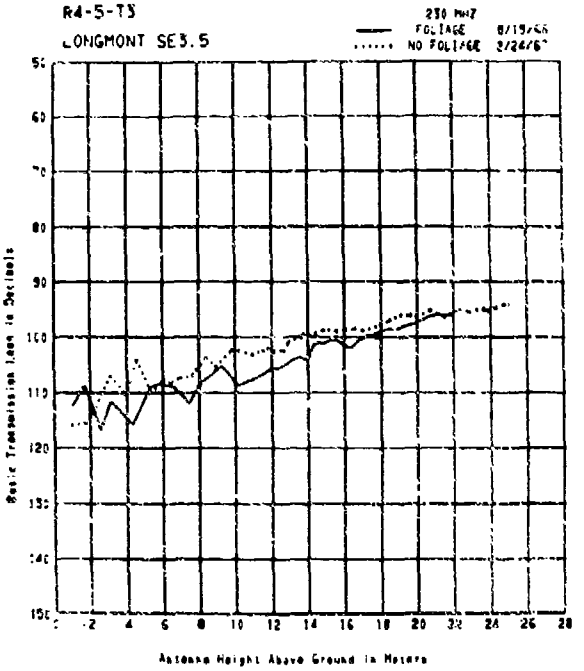
RCVR. ELEV. 1503 M | R4-5-T3 PATH LENGTH 5.277 km | XMTR. ELEV. 1493 M

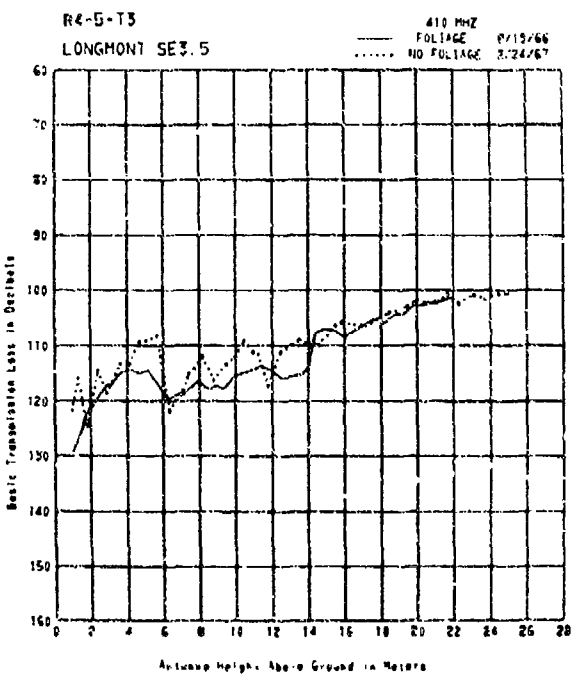


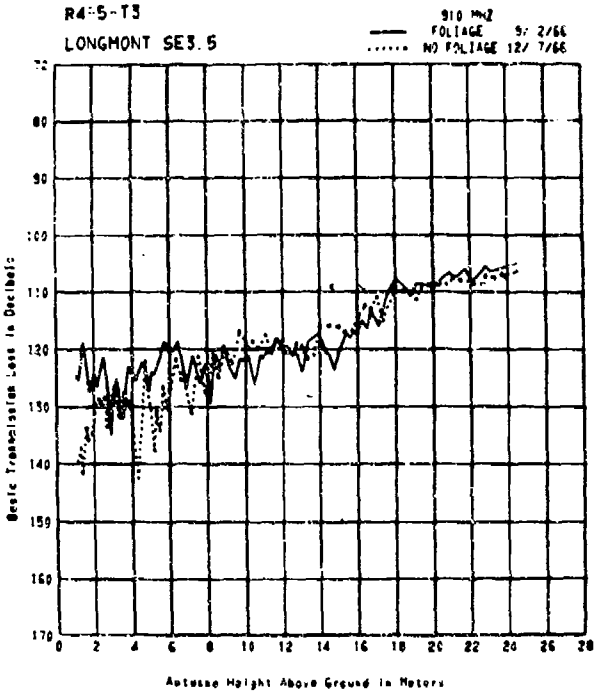
L_b (dB) SHORT TERM SIGNAL VARIABILITY

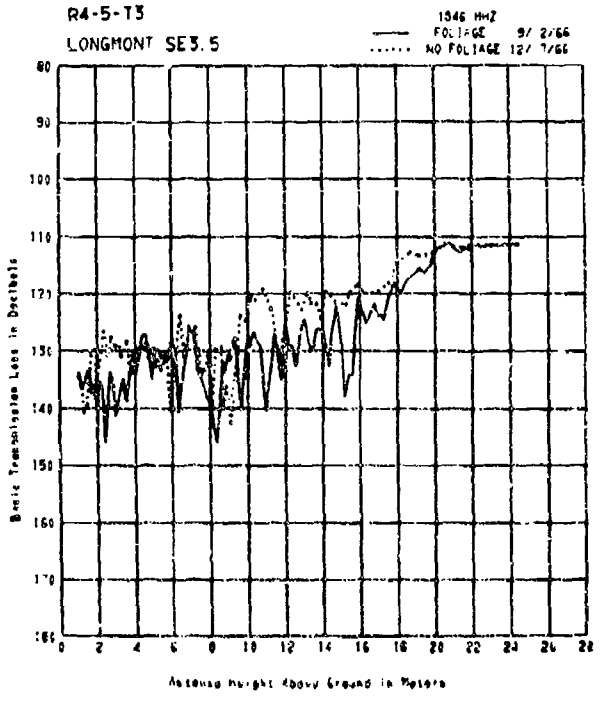
Freq(MHz)	230	410	910	1846	4595	9190
	8-19-66 at 22M			9-2-66 at 1M		
50%	93.8	106.0	125.0	132.3	147.2	141.3
Δ10%-90%	<3	<3	<3	<3	3.6	<3
				9-2-66 at 7.3M		
50%			119.4	134.8	154.5	159.1
Δ10%-90%			<3	<3	<3	<3
				9-2-66 at 24.5M		
50%			105.0	111.3	123.0	127.3
Δ10%-90%			<3	<3	<3	<3

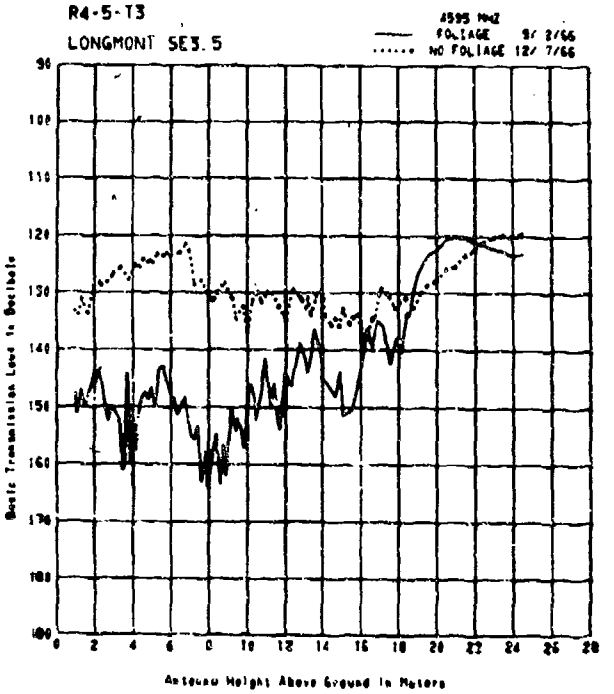
The path, as far as one can see, extends over grassy farmland, with trees and farm buildings scattered throughout the area. A 6-wire telephone line crosses perpendicular to the path, about 2 m in front of and 3 m below the antennas.

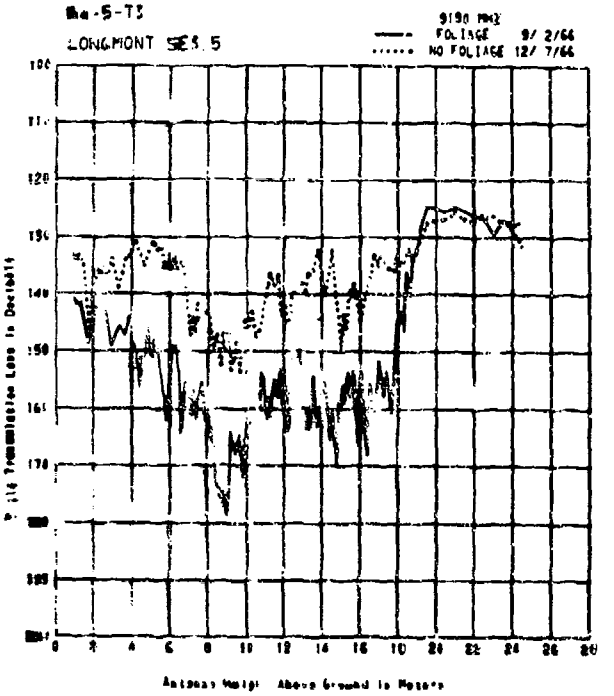

R4-5-T3
LONGMONT SE3.5
230 MHZ
FOLIAGE
NO FOLIAGE
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-5-T3
LONGMONT SE3.5
410 MHZ
FOLIAGE
NO FOLIAGE
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-5-T3
LONGMONT SE3.5
910 MHZ
FOLIAGE 9/ 2/66
NO FOLIAGE 12/ 7/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-5-T3
LONGMONT SE3.5
1546 MHZ
FOLIAGE 9/ 2/66
NO FOLIAGE 12/ 7/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-5-T3
LONGMONT SE3.5
4595 MHz
FOLIAGE 9/ 2/66
NO FOLIAGE 12/ 7/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters

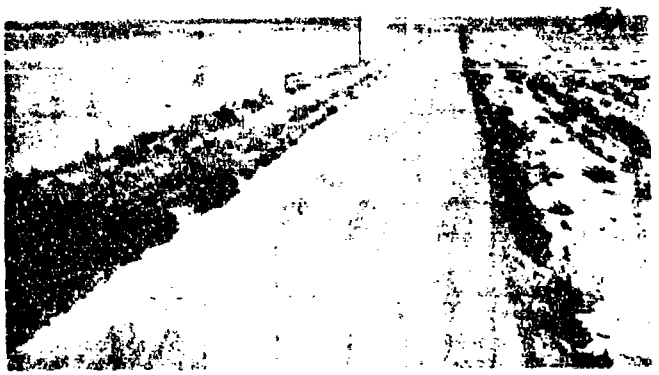

R4-5-T3
LONGMONT SE3.5
9190 MHz
FOLIAGE 9/ 2/66
NO FOLIAGE 12/ 7/66
Antenna Height Above Ground in Meters

R4-5-T3

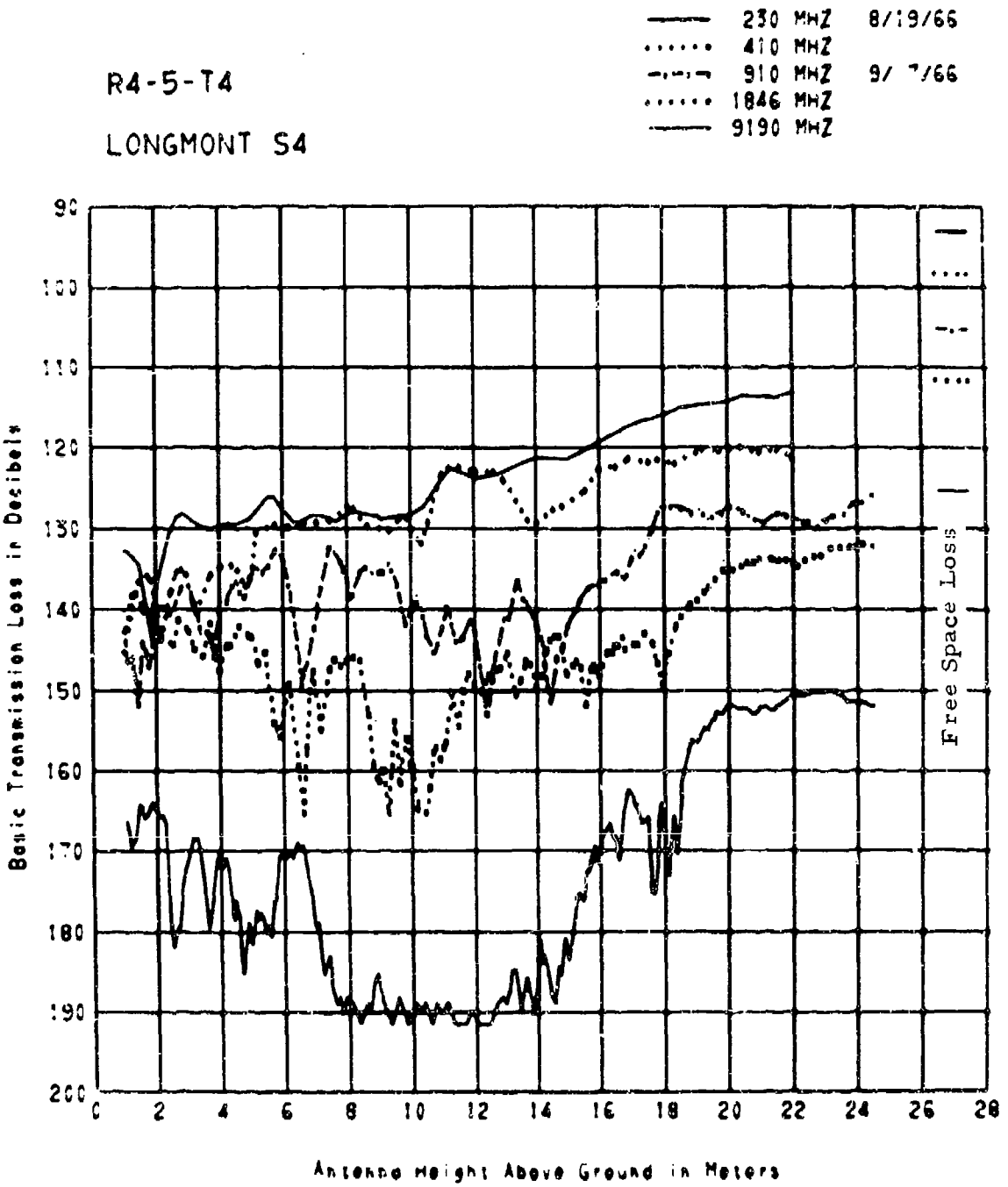
L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
	2-24-67 at 25 M			12-7-66 at 7.3 M		
50%	94.4	101.8	126.2	130.0	128.4	142.0
Δ10% - 90%	< 3	< 3	< 3	< 3	< 3	< 3

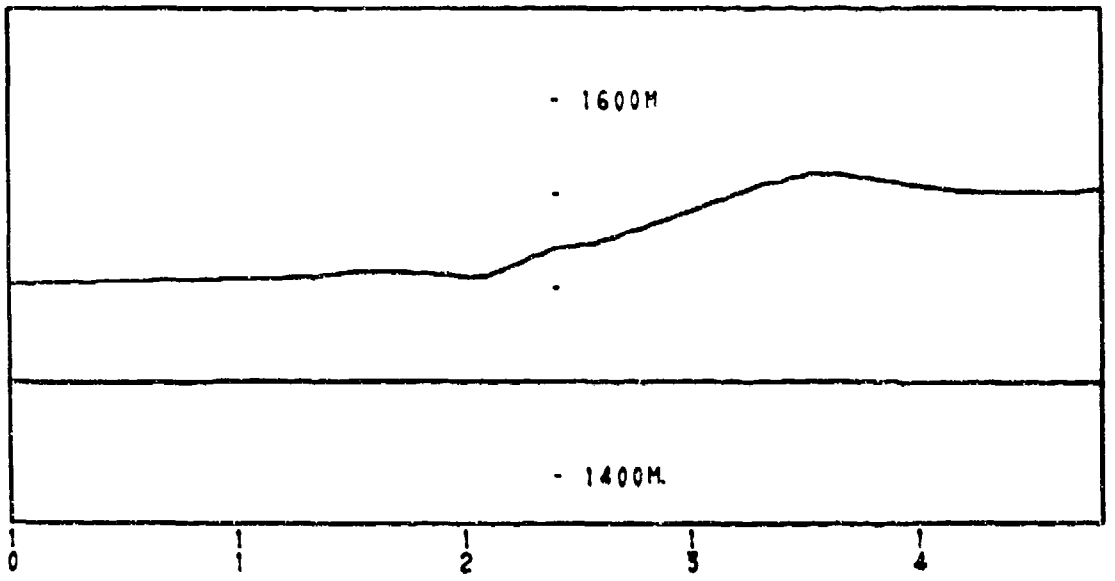
R4-5-T4
LONGMONT S 3



PATH VIEW FROM TRANSMITTER
Bearing from common receiver site to transmitter site is
169° 20' 56"


230 MHZ 8/19/66
410 MHZ
910 MHZ 9/ 7/66
1846 MHZ
9190 MHZ
R4-5-T4
LONGMONT S4
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters
Free Space Loss
90
100
110
120
130
140
150
160
170
180
190
200
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28

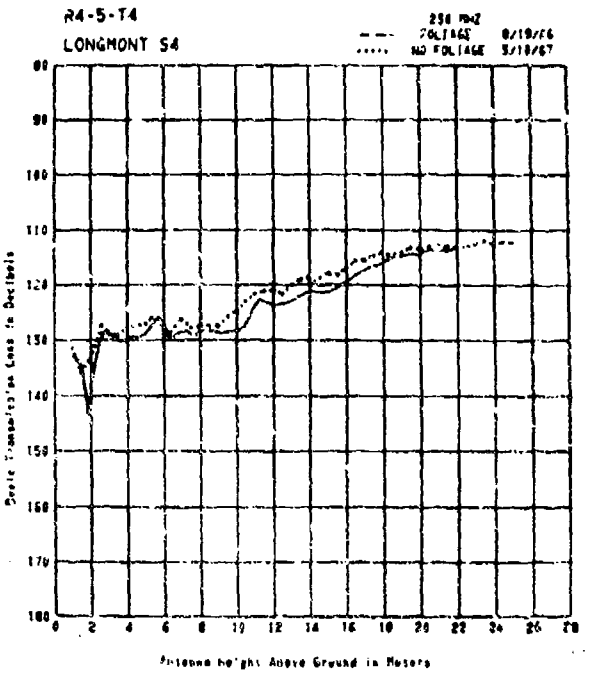
RCVR. ELEV. 1503 M | R4-5-T4 PATH LENGTH 4.806 km | XMTR. ELEV. 1544 M

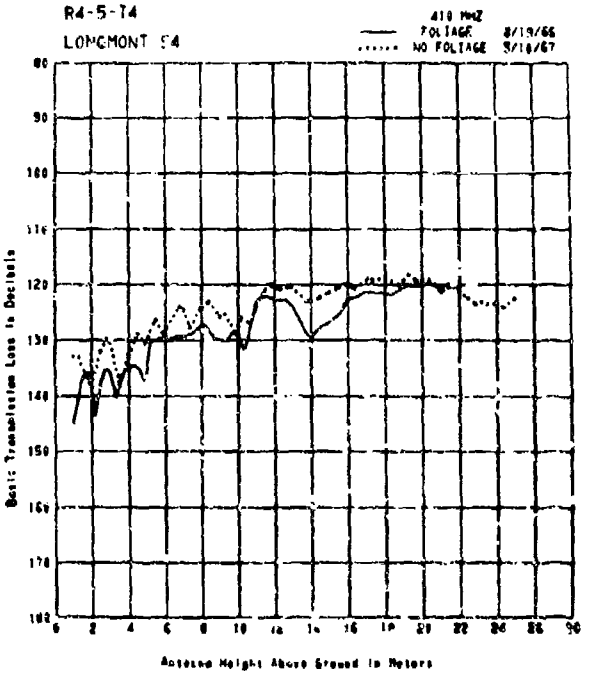


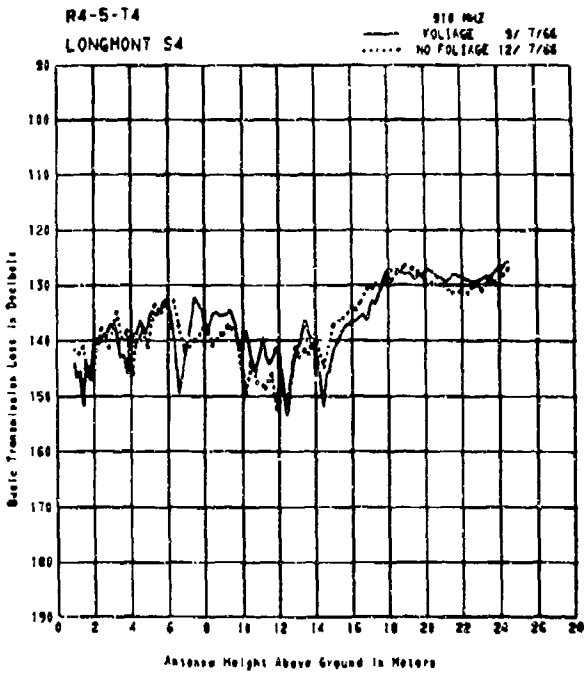
L_b (dB) SHORT TERM SIGNAL VARIABILITY

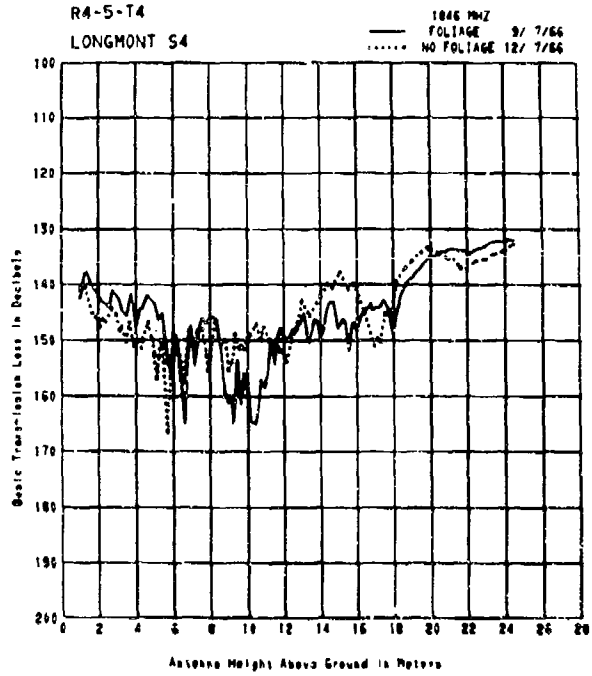
Freq(MHz)	230	410	910	1846	4595	9190
	8-19-66 at 22M			9-7-66 at 1M		
50%	114.3	120.8	142.2	142.2		167.1
Δ10%-90%	<3	<3	<3	<3		<3
				9-7-66 at 7.3M		
50%			136.7	145.2		185.0
Δ10%-90%			<3	<3		3.6
				9-7-66 at 24.5M		
50%			126.2	135.2		153.3
Δ10%-90%			<3	<3		<3

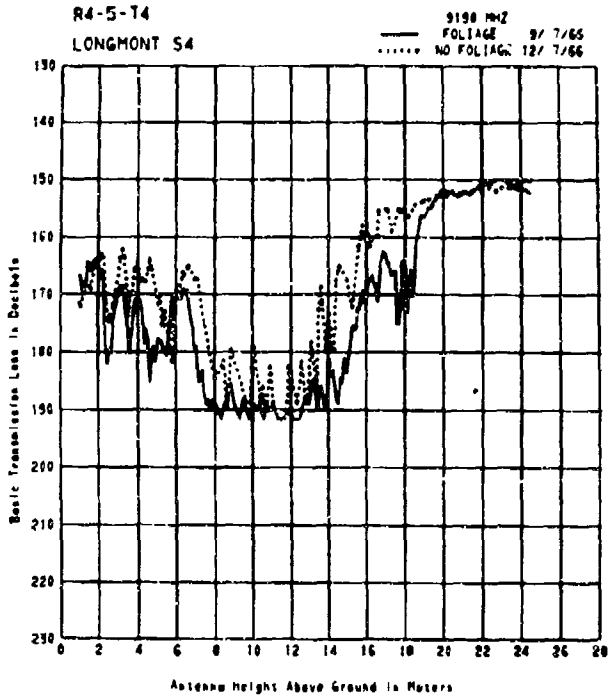
The apparent horizon for the path is about 1.5 km away from the transmitter. The foreground, which slopes upward from the transmitter, consists of plowed fields with no obstructions except for a 3-wire power line, which crosses the path obliquely about 45 m from the antennas.


R4-5-T4
LONGMONT S4
250 MHZ
FOLIAGE 8/19/66
NO FOLIAGE 5/18/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-5-T4
LONGMONT S4
410 MHZ
FOLIAGE 8/19/66
NO FOLIAGE 5/18/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-5-T4
LONGMONT S4
918 MHZ
FOLIAGE 9/ 7/66
NO FOLIAGE 12/ 7/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-5-T4
LONGMONT S4
1846 MHZ
FOLIAGE 9/ 7/66
NO FOLIAGE 12/ 7/66
Basic Trans-mission Loss in Decibels
Antenna Height Above Ground in Meters

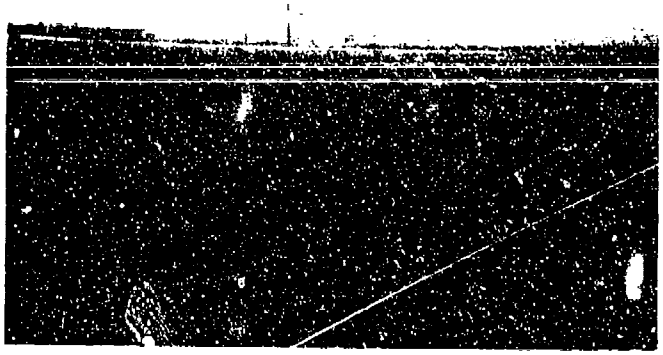


R4-5-T4

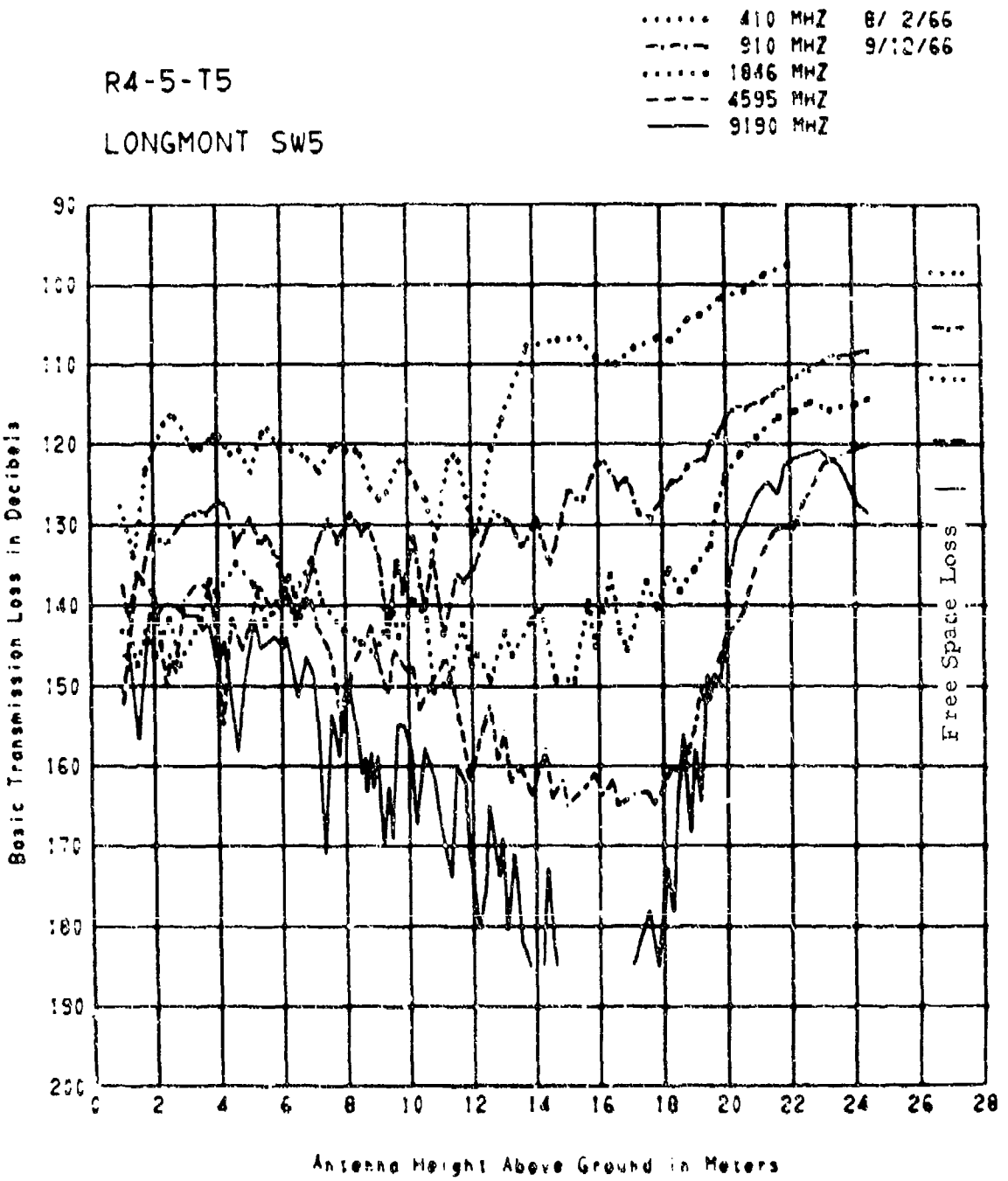
L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
	3-10-67 at 25 M			12-7-66 at 1 M		
50%	112.2	120.2	142.7	145.7		171.1
Δ10% - 90%	< 3	< 3	< 3	< 3		< 3
				12-7-66 at 7.3 M		
50%			140.5	149.2		170.6
Δ10% - 90%			< 3	< 3		< 3
				12-7-66 at 14 M		
50%			143.2	145.6		170.6
Δ10% - 90%			< 3	< 3		< 3
				12-7-66 at 24.5 M		
50%			128.2	133.6		149.8
Δ10% - 90%			< 3	< 3		< 3

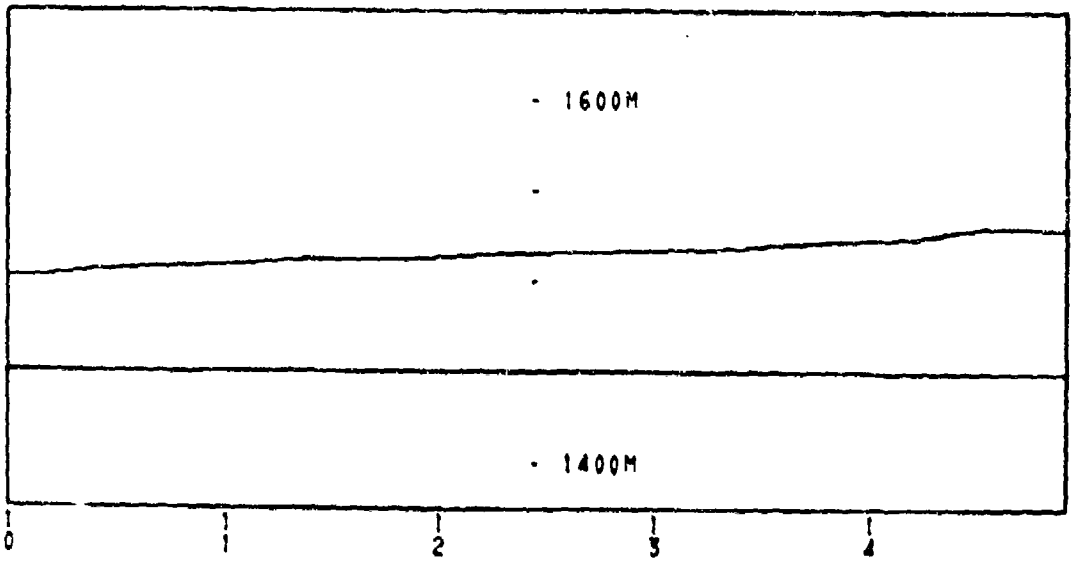
R4-5-T5
LONGMONT SW 5



PATH VIEW FROM TRANSMITTER
Bearing from common receiver site to transmitter site is
223° 59' 50"


410 MHZ 8/ 2/66
910 MHZ 9/12/66
1846 MHZ
4595 MHZ
9190 MHZ
R4-5-T5
LONGMONT SW5
Basic Transmission Loss in Decibels
Free Space Loss
Antenna Height Above Ground in Meters
90
100
110
120
130
140
150
160
170
180
190
200
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28

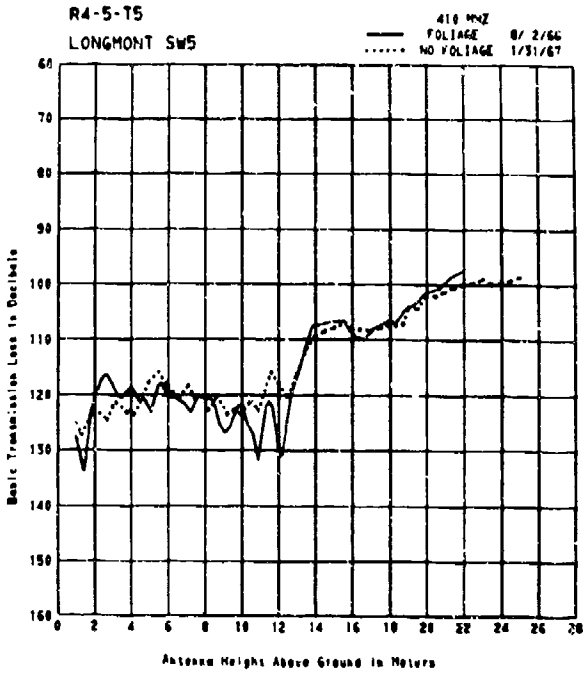
RCVR. ELEV. 1503 M | R4-5-T5 PATH LENGTH 4.890 km | XMTR. ELEV. 1529 M

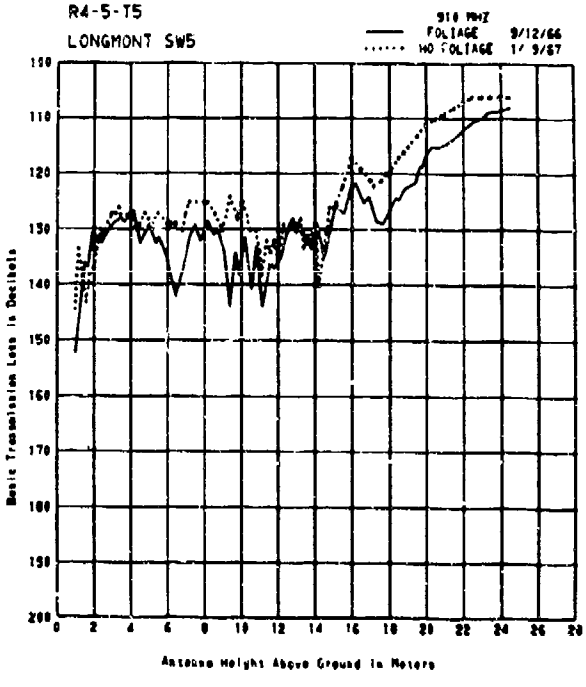


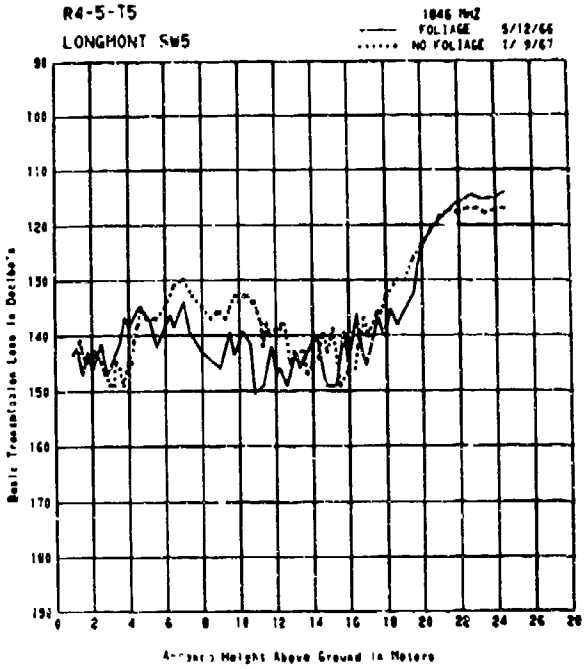
L_b (dB) SHORT TERM SIGNAL VARIABILITY

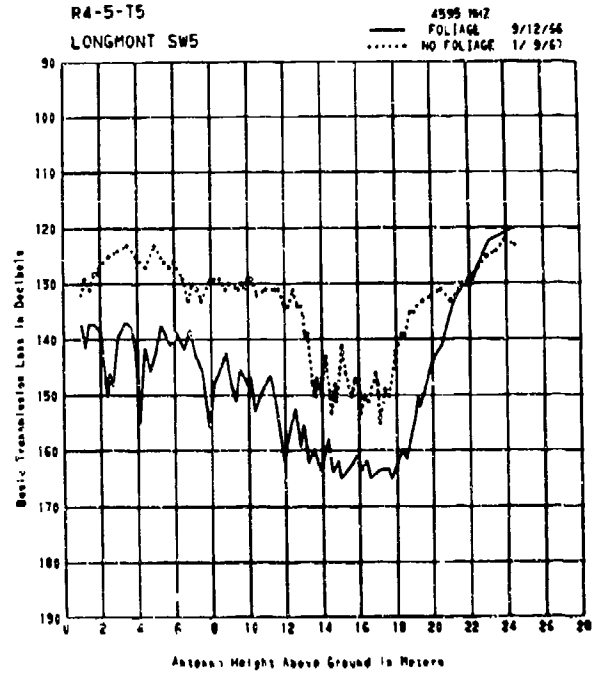
Freq(MHz)	230	410	910	1846	4595	9190
	8-2-66 at 1M			9-12-66 at 1M		
50%		126.4	145.5	145.3	136.4	143.2
Δ10%-90%		<3	11.8	<3	<3	<3
	8-2-66 at 11M			9-12-66 at 7.3M		
50%		125.9	134.7	137.8	143.4	
Δ10%-90%		<3	<3	<3	<3	
	8-2-66 at 22M			9-12-66 at 24.5M		
50%		96.0	109.7	113.6	120.4	129.4
Δ10%-90%		<3	<3	<3	<3	<3

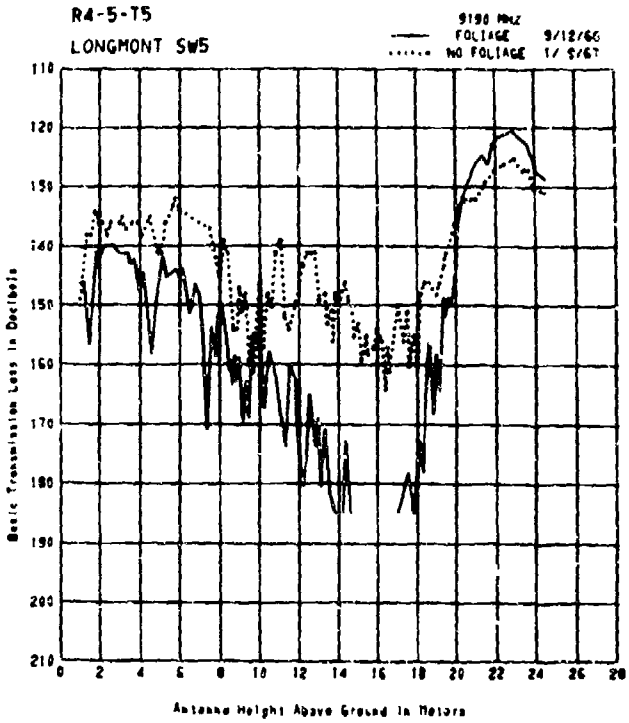
The foreground is open farmland with scattered trees and farm buildings. A telephone cable passes across the path about 5 m away and 3 m below the antennas. A power line crosses perpendicular to the path about 200 m away.


R4-5-T5
LONGMONT SW5
410 MHZ
FOLIAGE 8/ 2/66
NO FOLIAGE 1/31/67
Basic Transmission Loss in Decibels
60
70
80
90
100
110
120
130
140
150
160
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-5-T5
LONGMONT SW5
910 MHZ
FOLIAGE 9/12/66
NO FOLIAGE 1/ 9/67
Basic Transmission Loss in Decibels
100
110
120
130
140
150
160
170
180
190
200
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-5-T5
LONGMONT SW5
1846 MHZ
FOLIAGE 5/12/66
NO FOLIAGE 1/ 9/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-5-T5
LONGMONT SW5
4595 MHZ
FOLIAGE 9/12/66
NO FOLIAGE 1/ 9/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters

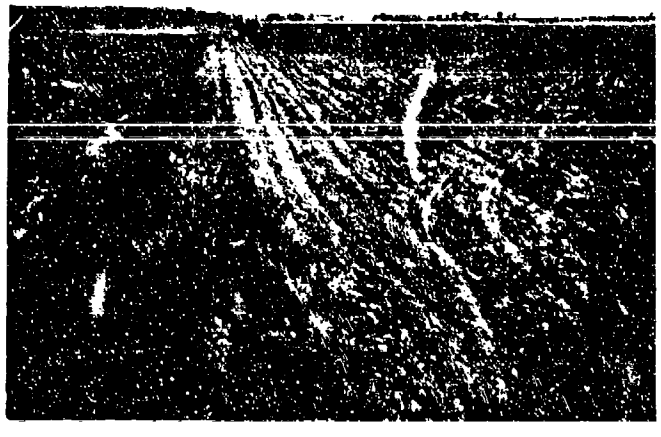


R4-5-T5

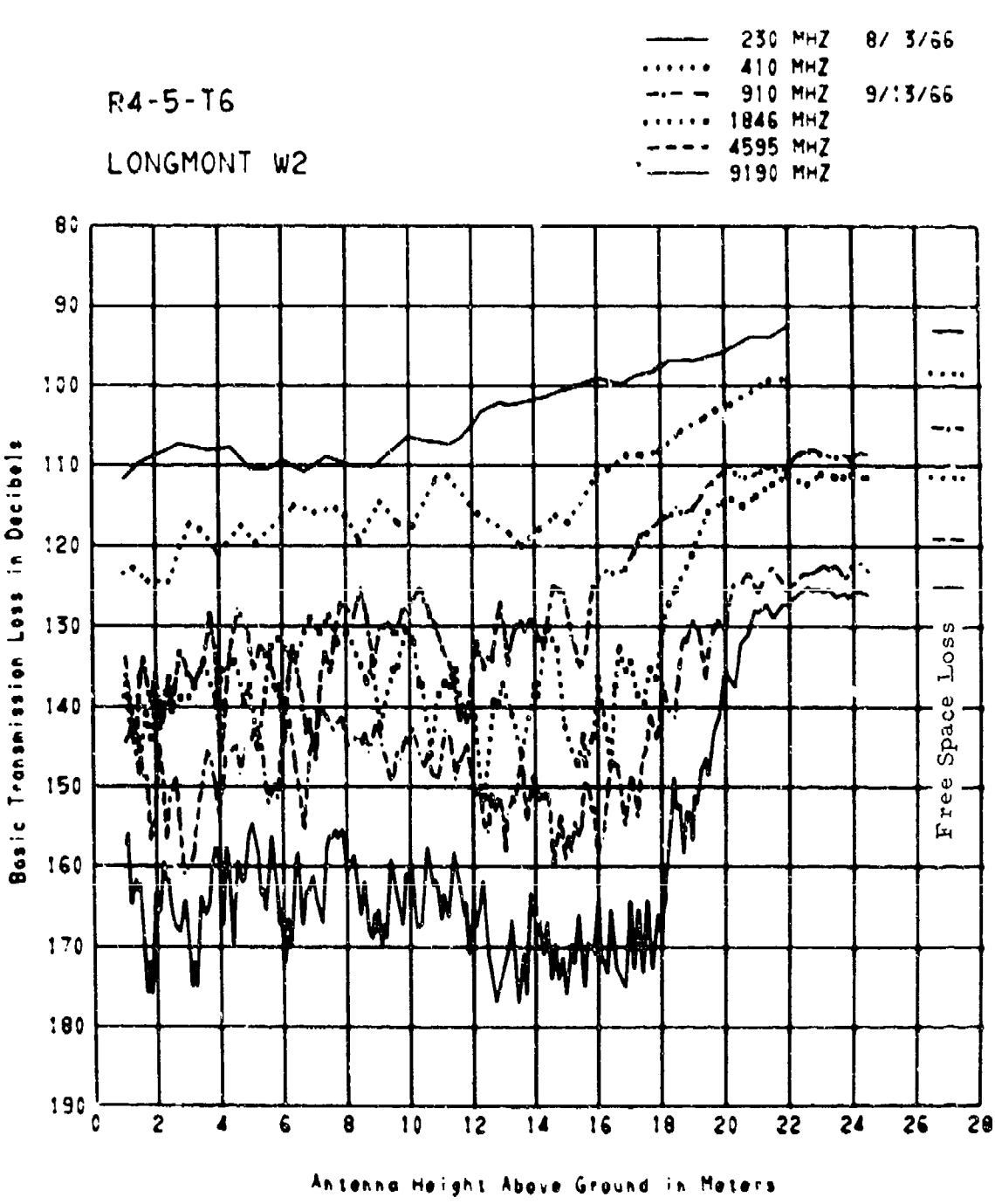
L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
	1-31-67 at 25 M			1-9-67 at 7.3 M		
50%		99.1	125.3	133.2	128.7	137.1
Δ10% - 90%		< 3	< 3	< 3	< 3	< 3

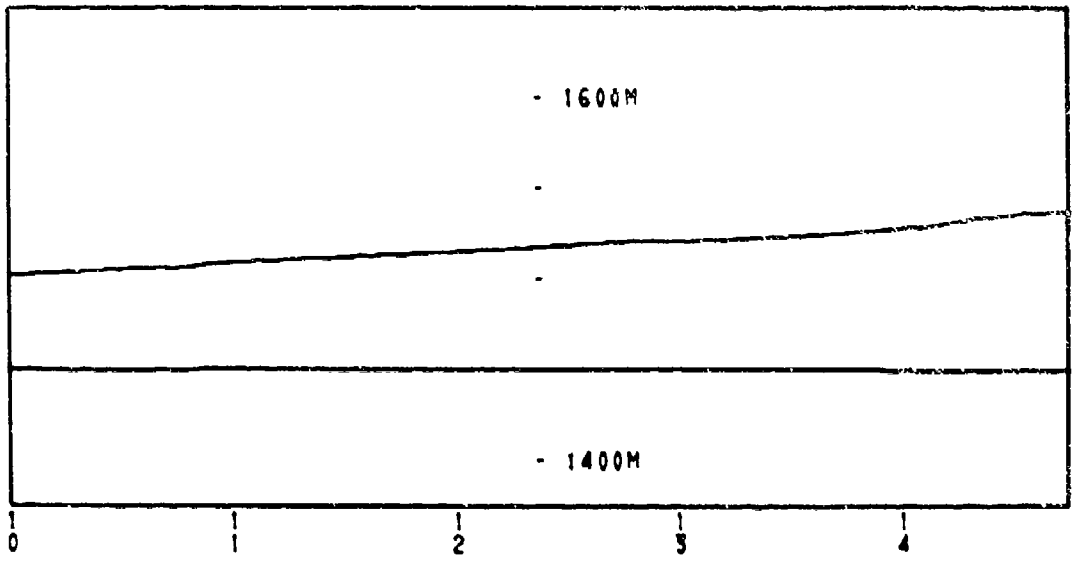
R4-5-T6
LONGMONT W 2.5



PATH VIEW FROM TRANSMITTER
Bearing from common receiver site to transmitter site is
246° 26' 39"


230 MHZ 8/ 3/66
410 MHZ
910 MHZ 9/13/66
1846 MHZ
4595 MHZ
9190 MHZ
R4-5-T6
LONGMONT W2
Basic Transmission Loss in Decibels
80
90
100
110
120
130
140
150
160
170
180
190
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
Free Space Loss
Antenna Height Above Ground in Meters

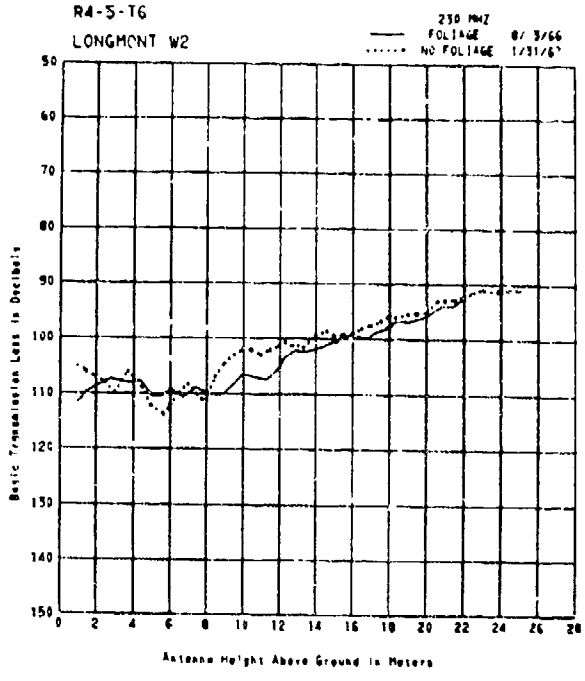
RCVR. ELEV. 1503 M | R4-5-T6 PATH LENGTH 4.719 km | XMTR. ELEV. 1537 M

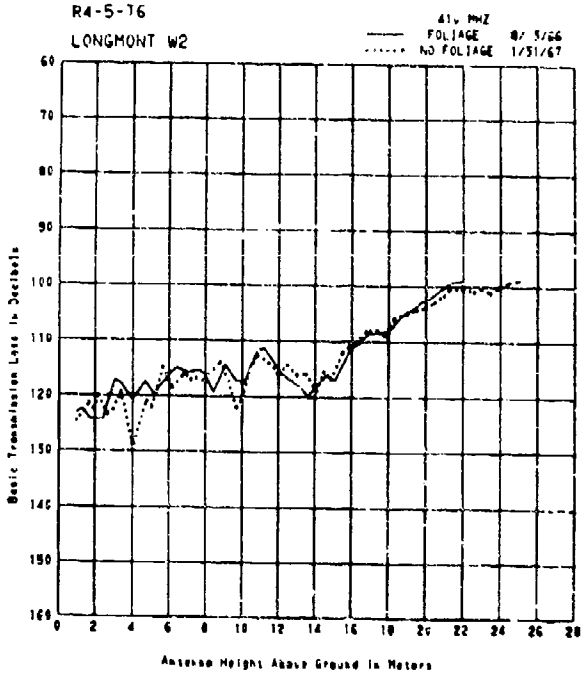


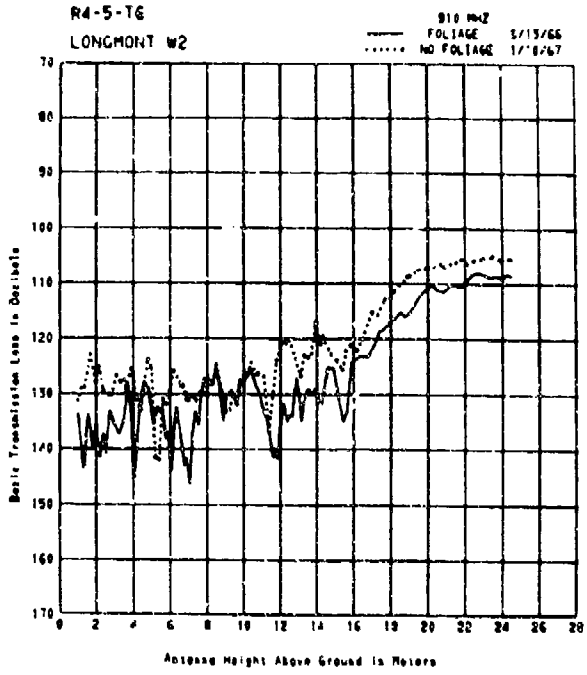
L_b (dB) SHORT TERM SIGNAL VARIABILITY

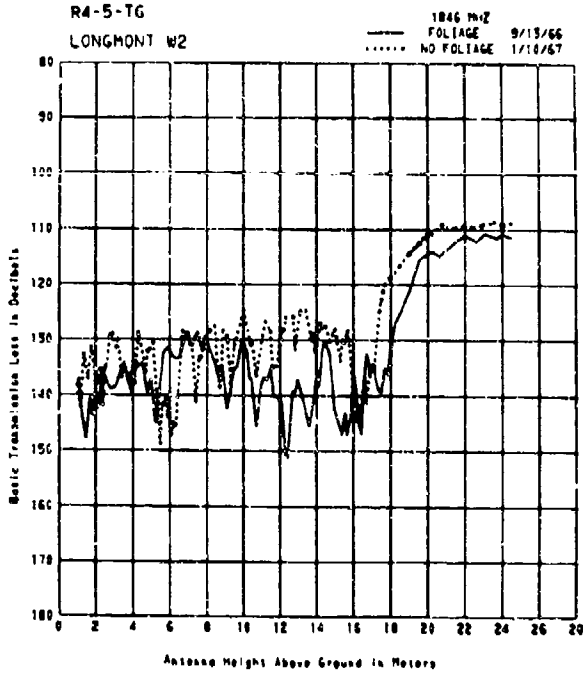
Freq(MHz)	230	410	910	1846	4595	9190
	8-3-66 at 1M			9-16-66 at 1M		
50%	111.3	125.3	132.1	137.9	147.6	163.4
Δ10%-90%	<3	<3	<3	<3	<3	8.3
	8-3-66 at 11M			9-16-66 at 7.3M		
50%	101.8	117.6	134.4	130.7	140.5	156.7
Δ10%-90%	<3	<3	<3	<3	<3	3.0
	8-3-66 at 22M			9-16-66 at 21.5M		
50%	92.4	98.6	109.0	111.0	124.7	126.3
Δ10%-90%	<3	<3	<3	<3	<3	<3

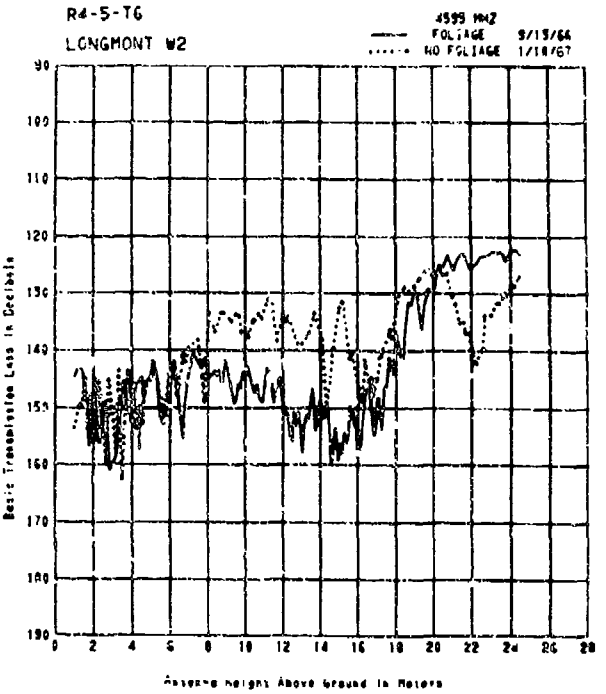
The path extends over open farmland for about 3 km, and slopes gently downward and away from the transmitter. Beyond 3 km the land is covered with scattered trees and farm buildings.

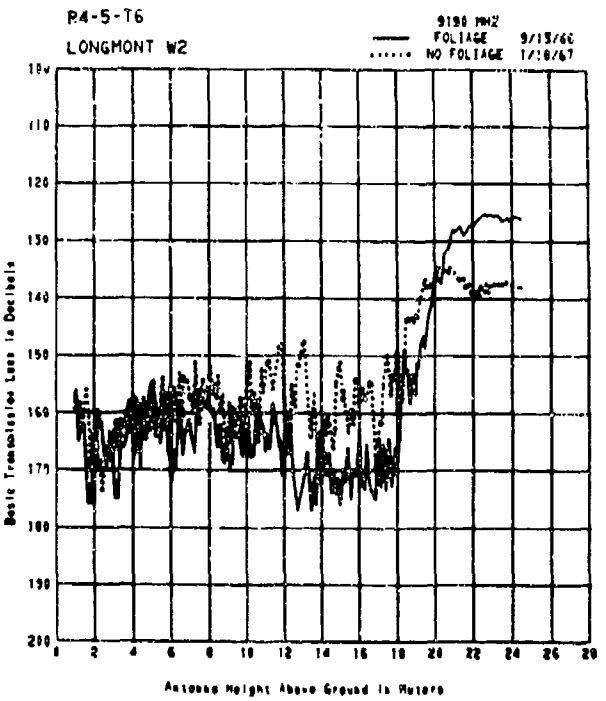

R4-5-T6
LONGMONT W2
230 MHZ
FOLIAGE 8/ 3/66
NO FOLIAGE 1/31/67
Basic Transmission Loss in Decibels
50
60
70
80
90
100
110
120
130
140
150
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-5-T6
LONGMONT W2
41y MHZ
FOLIAGE 8/ 3/66
NO FOLIAGE 1/31/67
Basic Transmission Loss in Decibels
60
70
80
90
100
110
120
130
140
150
160
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-5-TG
LONGMONT W2
910 MHZ
FOLIAGE 9/13/66
NO FOLIAGE 1/18/67
Basic Transmission Loss in Decibels
70
80
90
100
110
120
130
140
150
160
170
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-5-TG
LONGMONT W2
1846 MHZ
FOLIAGE 9/13/66
NO FOLIAGE 1/18/67
Basic Transmission Loss in Decibels
80
90
100
110
120
130
140
150
160
170
180
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-5-T6
LONGMONT W2
4599 MHZ
FOLIAGE 9/13/66
NO FOLIAGE 1/18/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters

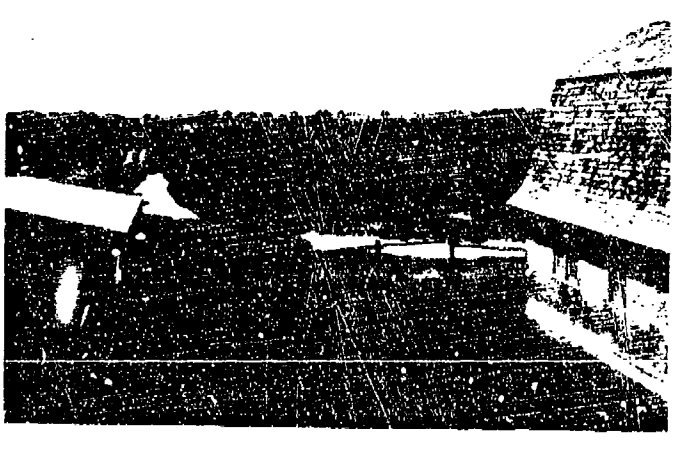

R4-5-T6
LONGMONT W2
9198 MHZ
FOLIAGE 9/13/66
NO FOLIAGE 1/18/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters

R4-5-T6

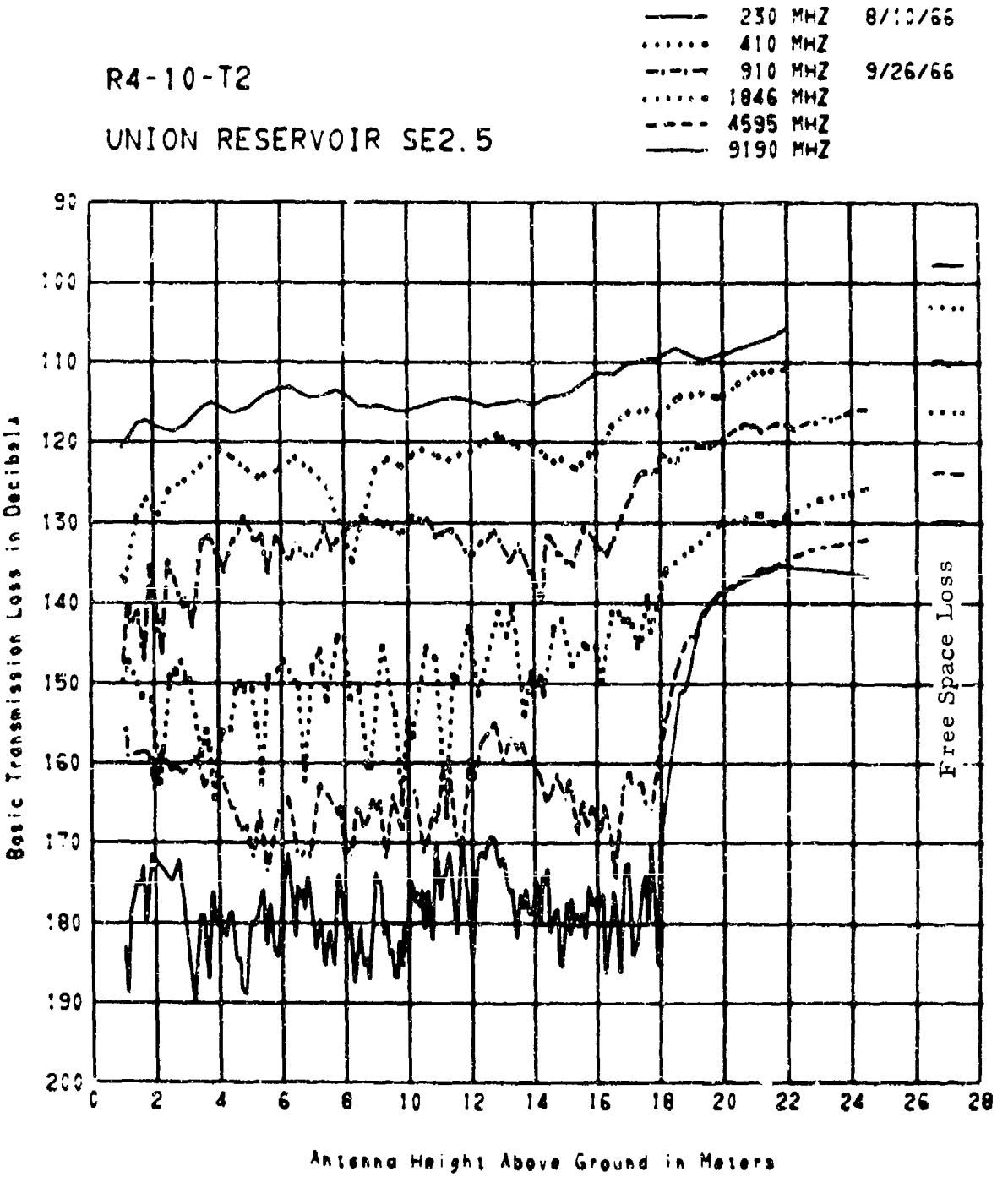
L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
	1-31-67 at 25 M			1-10-67 at 7.3M		
50%	94.5	96.0	131.9	140.7	137.8	152.3
Δ10% - 90%	< 3	< 3	< 3	< 3	< 3	< 3

R4-10-T2
UNION RESERVOIR SE 2.5



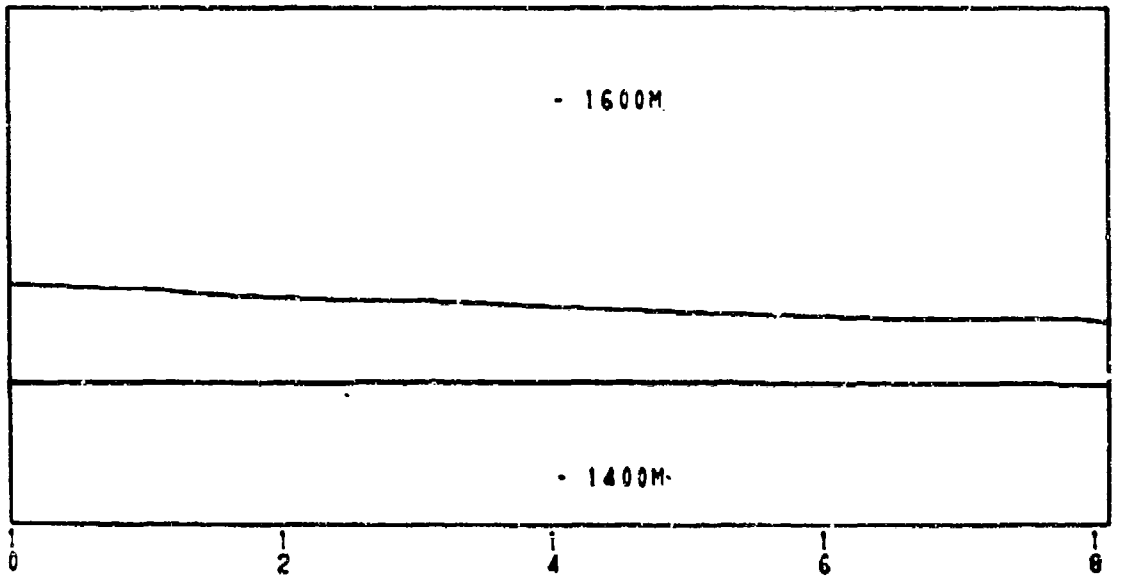
PATH VIEW FROM TRANSMITTER
Bearing from common receiver site to transmitter site is
99° 22' 24"


230 MHZ 8/10/66
410 MHZ
910 MHZ 9/26/66
1846 MHZ
4595 MHZ
9190 MHZ
R4-10-T2
UNION RESERVOIR SE2.5
Basic Transmission Loss in Decibels
90
100
110
120
130
140
150
160
170
180
190
200
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
Free Space Loss
Antenna Height Above Ground in Meters

RCVR. ELEV. 1503 M

R4-10-T2
PATH LENGTH 8.091 km

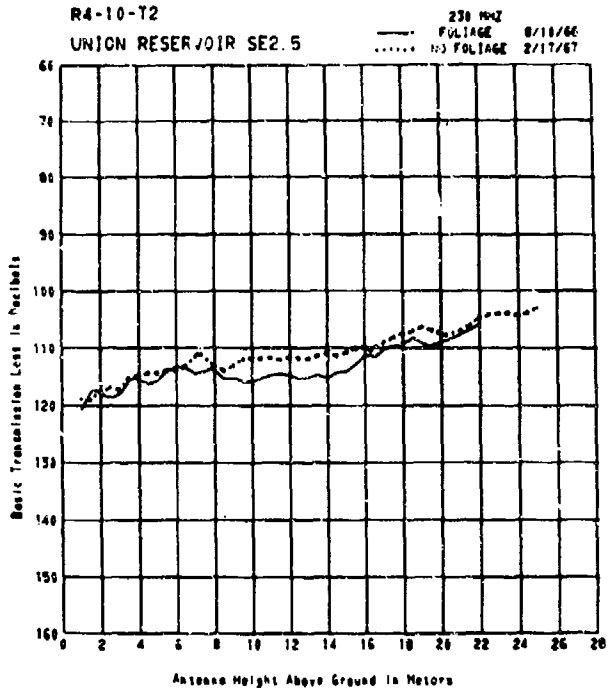
XMTR. ELEV. 1483 M

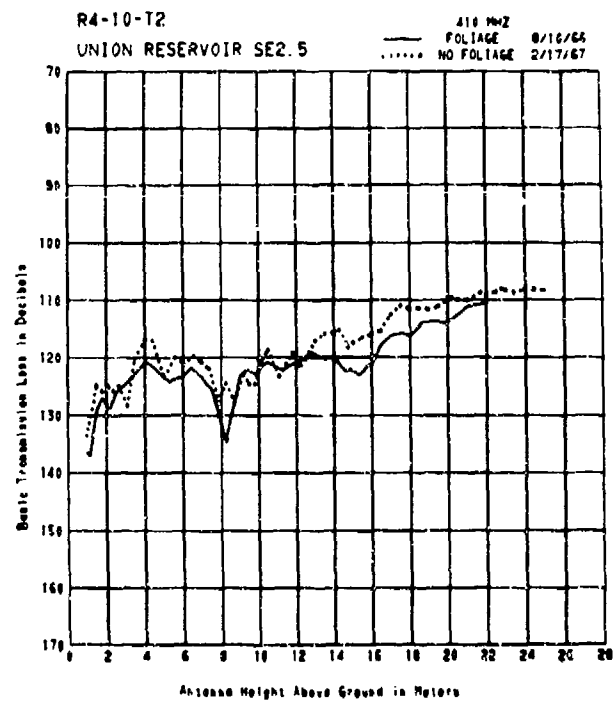


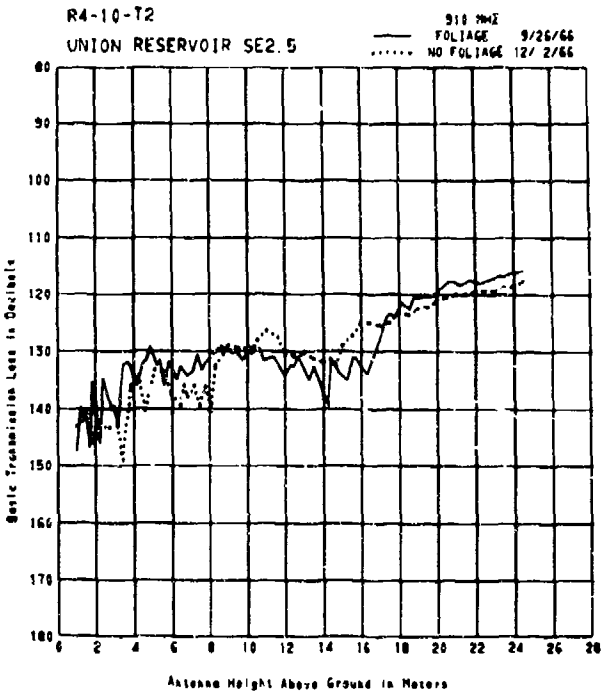
L_b (dB) SHORT TERM SIGNAL VARIABILITY

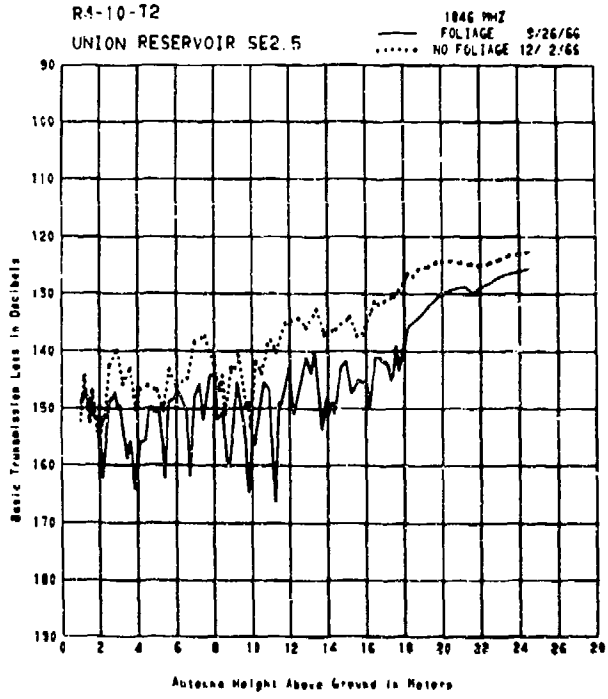
Freq(MHz)	230	410	910	1846	4595	9190
	8-10-66 at 3M			9-26-66 at 1M		
50%	109.5	122.1	141.8	147.7	158.0	179.0
Δ10%-90%	<3	<3	6.0	3.5	<3	11.9
	8-22-66 at 22M			9-26-66 at 7.3M		
50%	105.3	107.6	130.5	149.5	164.2	179.6
Δ10%-90%	<3	<3	<3	3.5	5.5	14.2
				9-26-66 at 14M		
50%			134.2	150.7	160.2	181.0
Δ10%-90%			4.5	9.8	<3	11.7
				9-26-66 at 24.5M		
50%			116.2	125.8	132.0	136.5
Δ10%-90%			<3	<3	<3	<3

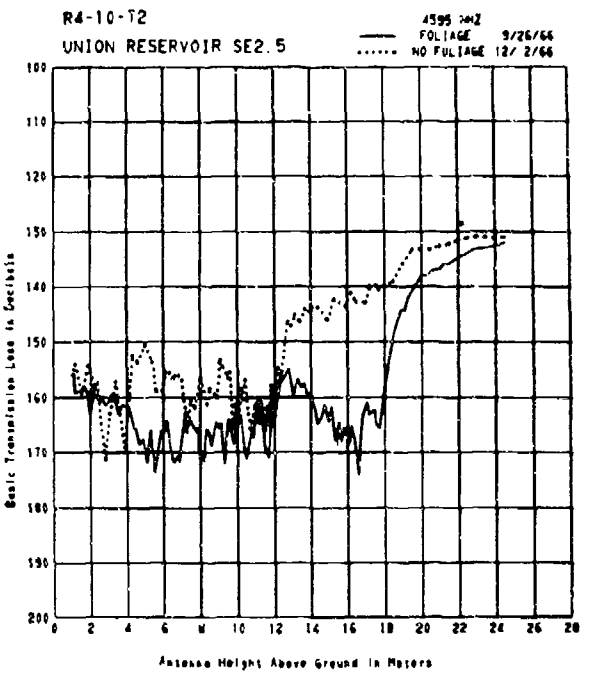
The site is located in a farmyard with buildings on three sides. A open foreground of farmland extends down the path as far as one can see. The terrain slopes upward toward the receiver with the apparent horizon about 3 km away. Scattered trees appear about 2 km from the transmitter.

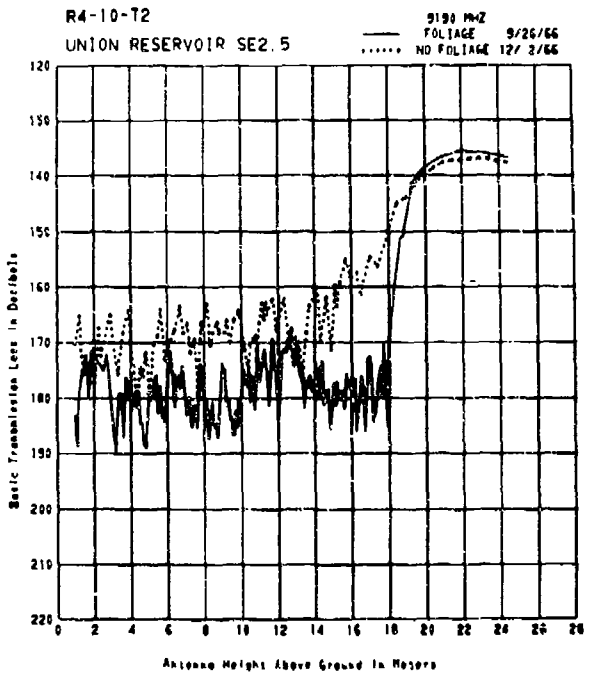

R4-10-T2
UNION RESERVOIR SE2.5
230 MHZ
FOLIAGE 8/16/66
NO FOLIAGE 2/17/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-10-T2
UNION RESERVOIR SE2.5
410 MHZ
FOLIAGE 8/16/66
NO FOLIAGE 2/17/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-10-T2
UNION RESERVOIR SE2.5
918 MHZ
FOLIAGE 9/26/66
NO FOLIAGE 12/ 2/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-10-T2
UNION RESERVOIR SE2.5
1846 MHZ
FOLIAGE 9/26/66
NO FOLIAGE 12/ 2/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-10-T2
UNION RESERVOIR SE2.5
4595 MHZ
FOLIAGE 9/26/66
NO FOLIAGE 12/ 2/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-10-T2
UNION RESERVOIR SE2.5
9190 MHZ
FOLIAGE 9/26/66
NO FOLIAGE 12/ 2/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters

R4-10-T2

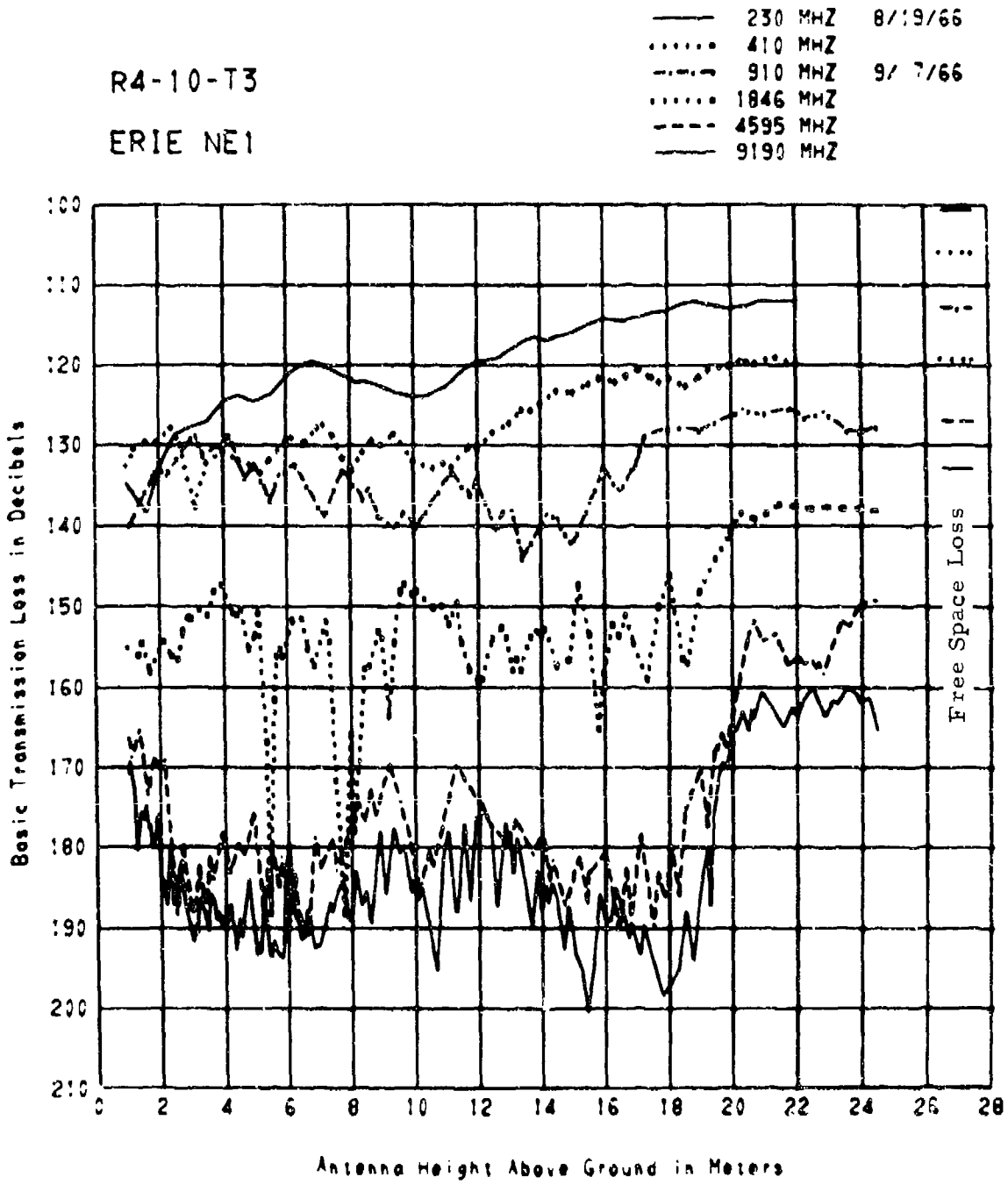
L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
	2-17-67 at 25 M			12-2-66 at 1 M		
50%	103.2	108.1	141.8	155.3	156.5	168.5
Δ10% - 90%	< 3	< 3	< 3	< 3	< 3	< 3
				12-2-66 at 7.3 M		
50%			137.8	136.9	154.5	172.0
Δ10% - 90%			< 3	< 3	< 3	< 3
				12-2-66 at 14 M		
50%			130.8	135.9	145.5	162.6
Δ10% - 90%			< 3	< 3	< 3	< 3
				12-2-66 at 24.5 M		
50%			116.8	121.9	131.0	138.0
Δ10% - 90%			< 3	< 3	< 3	< 3

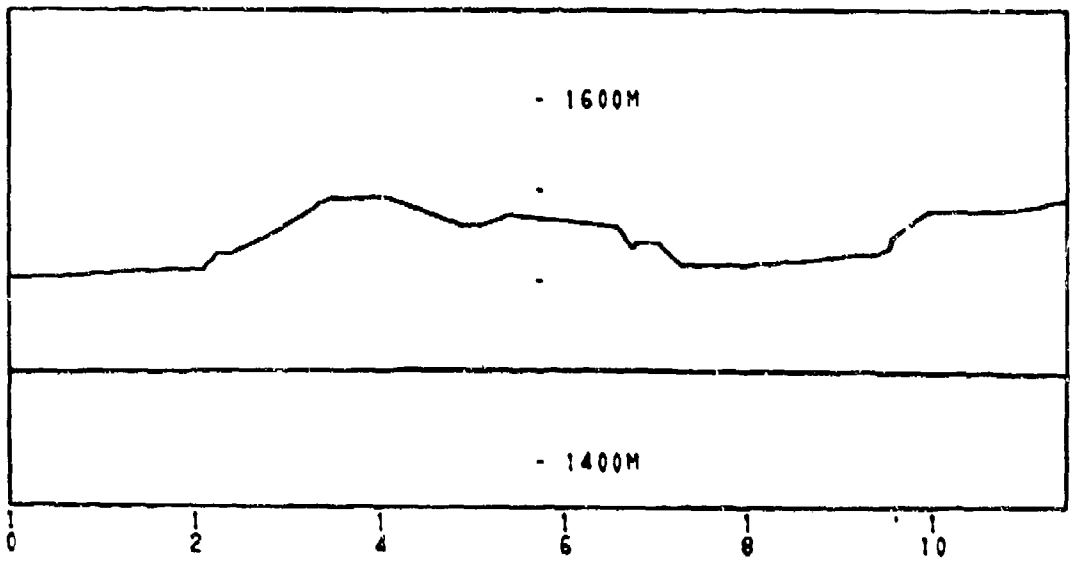
R4-10-T3
ERIE NE 1



PATH VIEW FROM TRANSMITTER
Bearing from common receiver site to transmitter site is
155° 18' 45"


230 MHZ 8/19/66
410 MHZ
910 MHZ 9/ 7/66
1846 MHZ
4595 MHZ
9190 MHZ
R4-10-T3
ERIE NE1
100
110
120
130
140
150
160
170
180
190
200
210
Basic Transmission Loss in Decibels
Free Space Loss
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
Antenna Height Above Ground in Meters

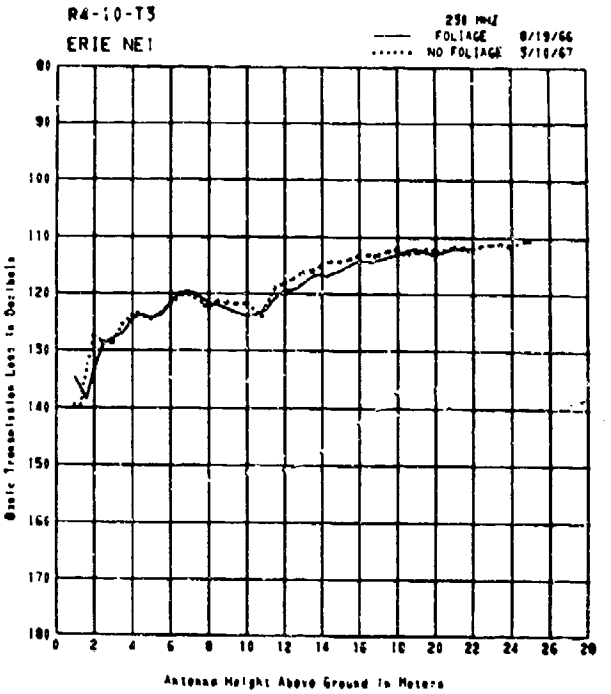
RCVR. ELEV. 1503 M | R4-10-T3 PATH LENGTH 11.445 km | XMTR. ELEV. 1546 M

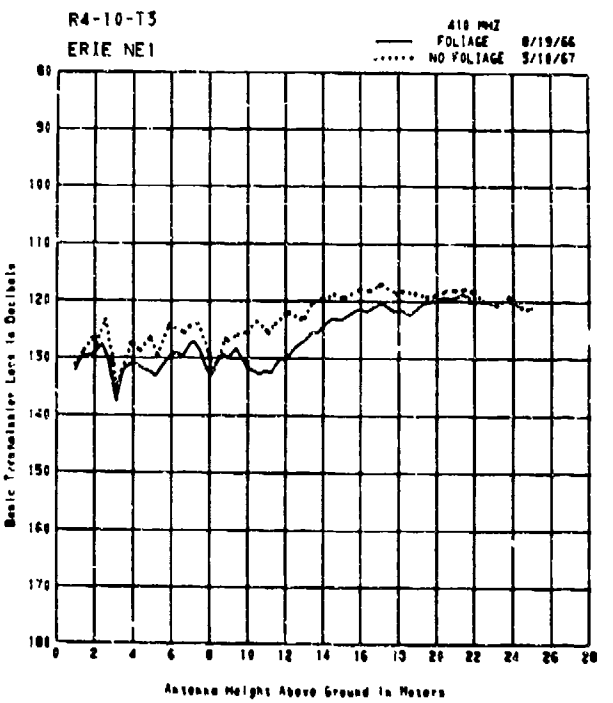


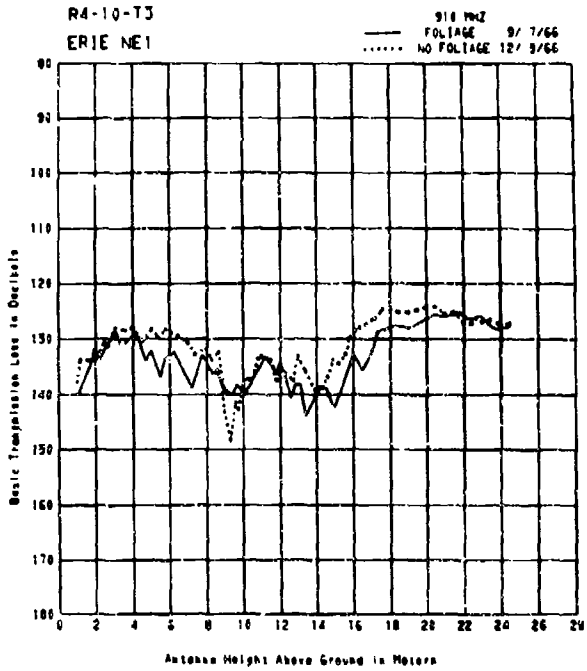
L_b (dB) SHORT TERM SIGNAL VARIABILITY

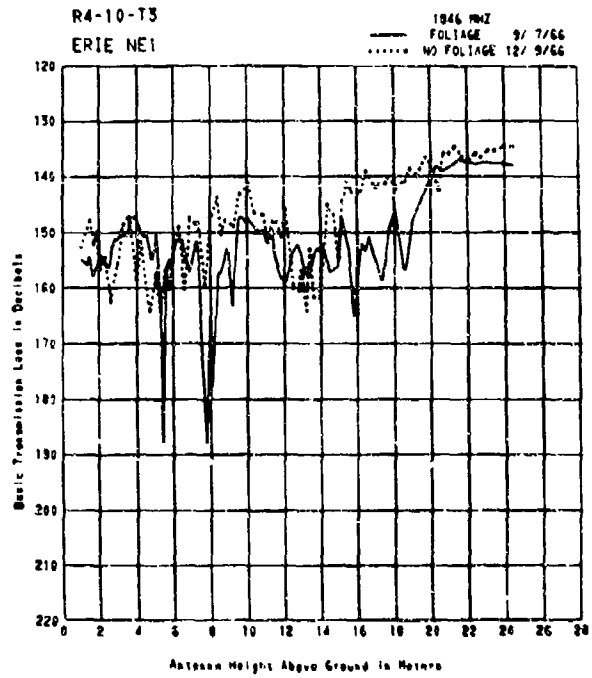
Freq(MHz)	230	410	910	1846	4595	9190
	8-19-66 at 22M			9-7-66 at 1M		
50%	111.4	121.3	142.3	155.7	166.8	174.8
Δ10%-90%	<3	<3	<3	<3	6.2	10.2
				9-7-66 at 7.3M		
50%			138.8	160.7	181.8	186.7
Δ10%-90%			<3	<3	4.9	4.5
				9-7-66 at 24.5M		
50%			127.4	138.2	150.2	164.3
Δ10%-90%			<3	<3	3.9	4.5

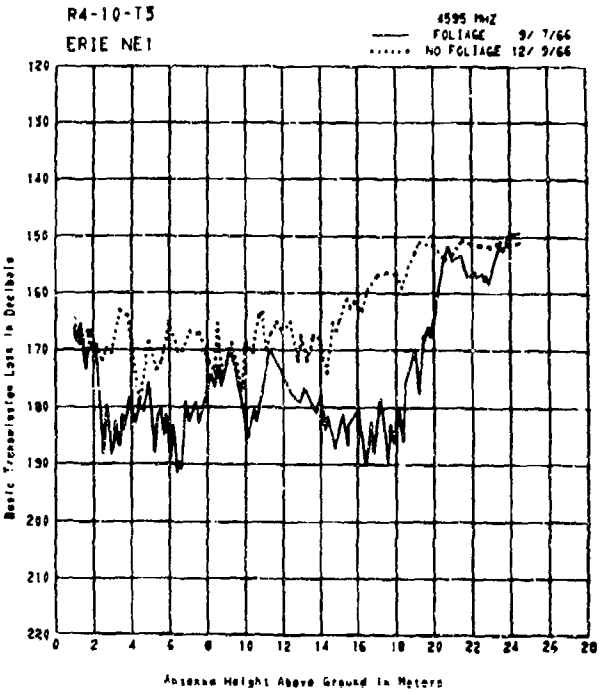
The foreground is comprised of flat farmland for about 2 km. The only apparent obstructions are telephone lines, which cross the path at about 60, 300, and 800 m away from the transmitter. Railroad tracks cross the path about 50 m in front of the antennas.

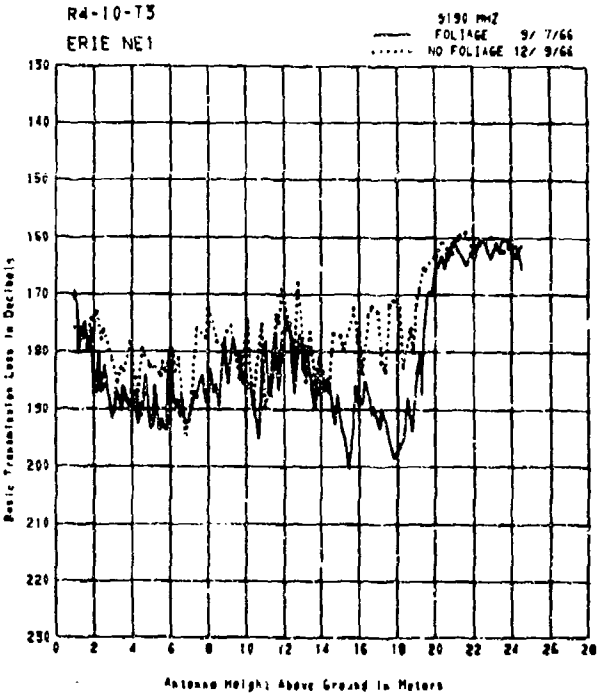

R4-10-T3
ERIE NE1
250 MHZ
FOLIAGE 8/19/66
NO FOLIAGE 5/10/67
Basic Transmission Loss in Decibels
80
90
100
110
120
130
140
150
160
170
180
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-10-T3
ERIE NE1
410 MHZ
FOLIAGE 8/19/66
NO FOLIAGE 5/10/67
Basic Transmission Loss in Decibels
80
90
100
110
120
130
140
150
160
170
180
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-10-T3
ERIE NE1
918 MHZ
FOLIAGE 9/ 7/66
NO FOLIAGE 12/ 9/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-10-T3
ERIE NE1
1846 MHZ
FOLIAGE 9/ 7/66
NO FOLIAGE 12/ 9/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-10-T5
ERIE NE1
4595 MHZ
FOLIAGE 9/ 7/66
NO FOLIAGE 12/ 9/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-10-T5
ERIE NE1
9190 MHZ
FOLIAGE 9/ 7/66
NO FOLIAGE 12/ 9/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters

R4-10-T3

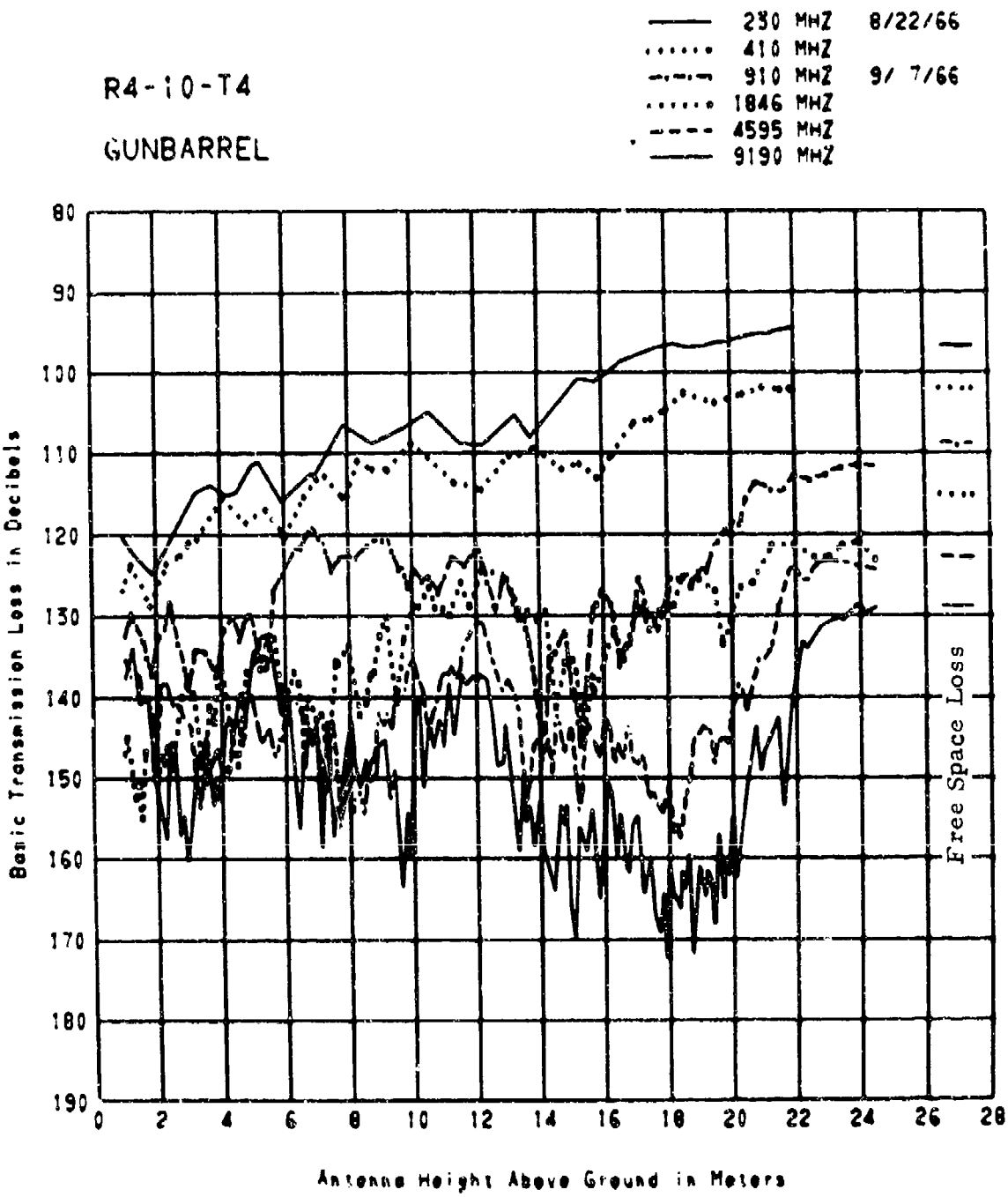
L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
	3-10-67 at 25 M			12-9-66 at 7.3 M		
50%	110.7	118.6	133.6	147.2	166.1	175.4
Δ10% - 90%	< 3	< 3	< 3	< 3	< 3	< 3

R4-10-T4
GUNBARREL HILL



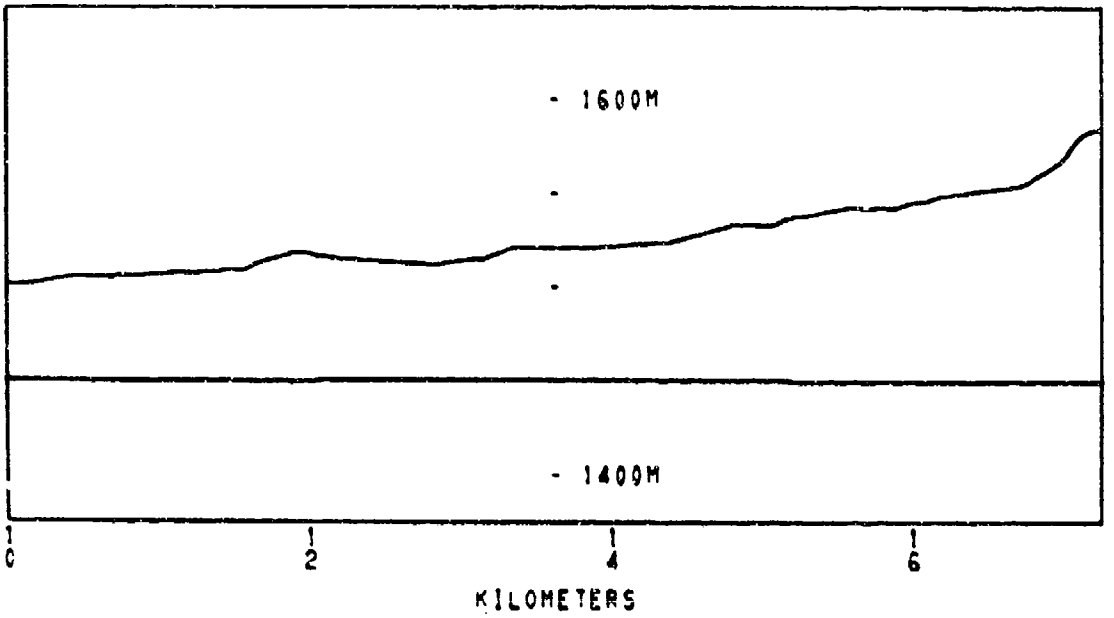
PATH VIEW FROM TRANSMITTER
Bearing from common receiver site to transmitter site is
201° 48' 25"


230 MHZ 8/22/66
410 MHZ
910 MHZ 9/ 7/66
1846 MHZ
4595 MHZ
9190 MHZ
R4-10-T4
GUNBARREL
Basic Transmission Loss in Decibels
80
90
100
110
120
130
140
150
160
170
180
190
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
Antenna Height Above Ground in Meters
Free Space Loss

RCVR. ELEV. 1503 M

R4-10-T4
PATH LENGTH 7.232 km

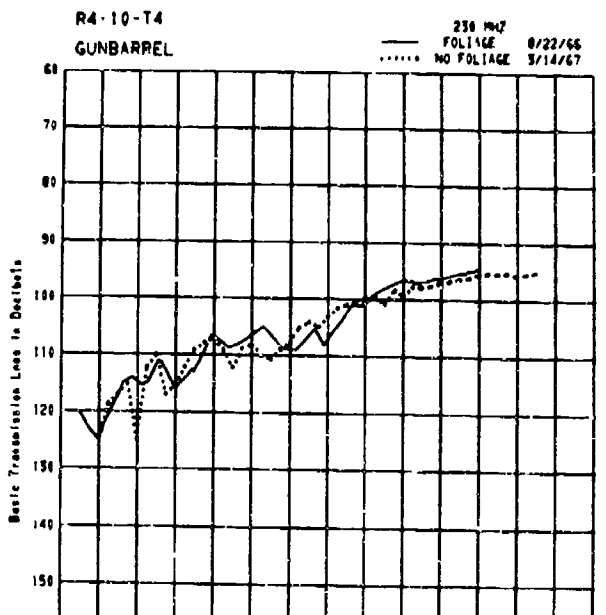
XMTR. ELEV. 1586 M

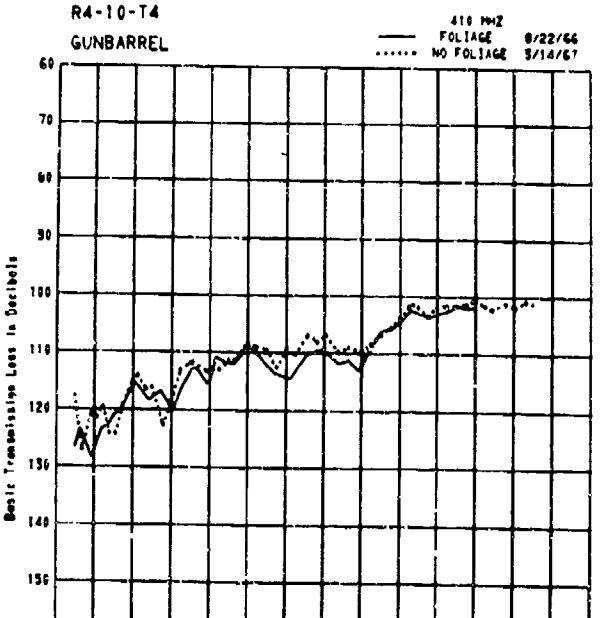


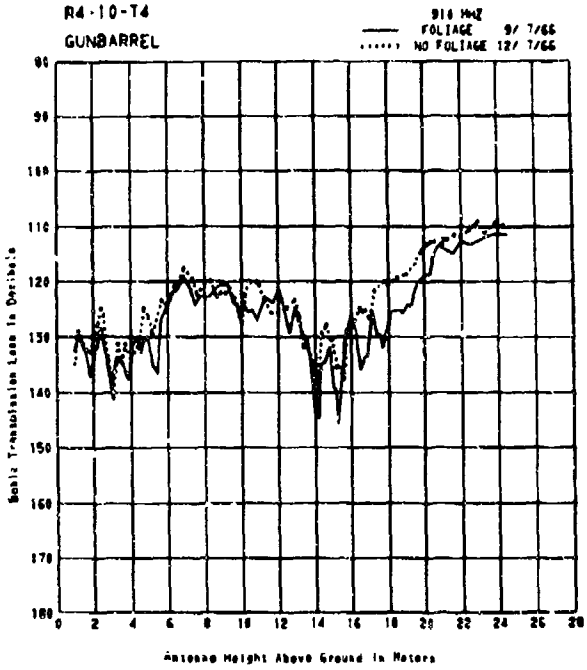
L_b (dB) SHORT TERM SIGNAL VARIABILITY

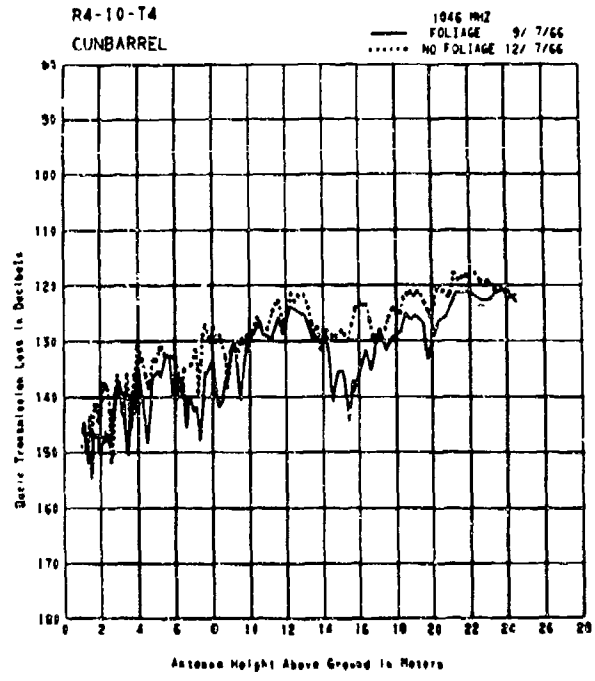
Freq(MHz)	230	410	910	1846	4595	9190
	8-22-66 at 3M			9-7-66 at 1M		
50%	115.3	118.3	131.8	147.3	144.7	138.1
Δ10%-90%	<3	<3	<3	<3	<3	<3
	8-22-66 at 22M			9-7-66 at 7.3M		
50%	93.9	99.5	121.8	145.7	145.7	150.6
Δ10%-90%	<3	<3	<3	5.7	<3	4.2
				9-7-66 at 24.5M		
50%			111.8	125.3	124.7	131.1
Δ10%-90%			<3	<3	<3	<3

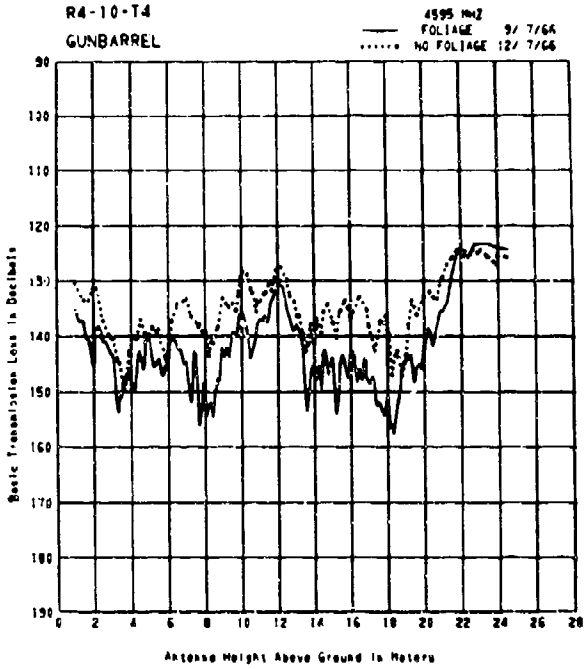
The path extends over open farmland with scattered trees. The land is rolling and slopes downward and away from the transmitter. A small lake lies across the path about 2 km away from this site.

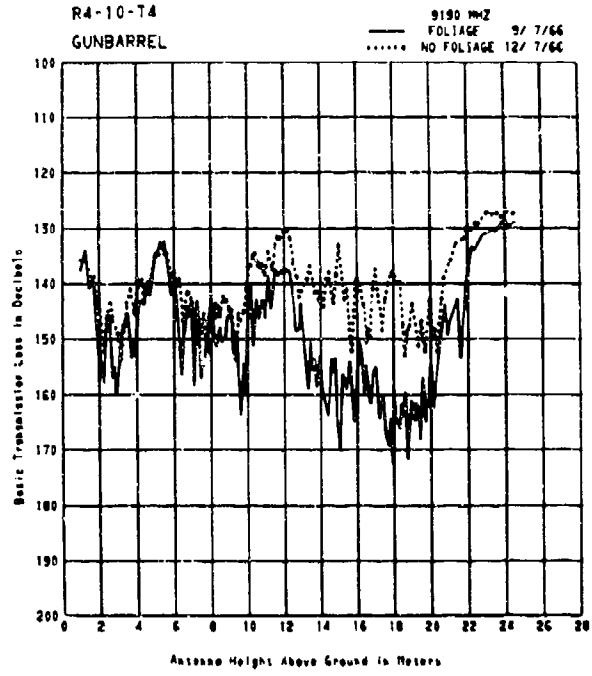

R4-10-T4
GUNBARREL
230 MHZ
FOLIAGE 8/22/66
NO FOLIAGE 5/14/67
Basic Transmission Loss in Decibels
60
70
80
90
100
110
120
130
140
150
160
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-10-T4
GUNBARREL
410 MHZ
FOLIAGE 8/22/66
NO FOLIAGE 5/14/67
Basic Transmission Loss in Decibels
60
70
80
90
100
110
120
130
140
150
160
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-10-T4
GUNBARREL
916 MHZ
FOLIAGE 9/ 7/66
NO FOLIAGE 12/ 7/66
Basic Transmission Loss In Decibels
Antenna Height Above Ground In Meters


R4-10-T4
GUNBARREL
1046 MHZ
FOLIAGE 9/ 7/66
NO FOLIAGE 12/ 7/66
Basic Transmission Loss In Decibels
Antenna Height Above Ground In Meters


R4-10-T4
GUNBARREL
4595 MHZ
FOLIAGE 9/ 7/66
NO FOLIAGE 12/ 7/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters

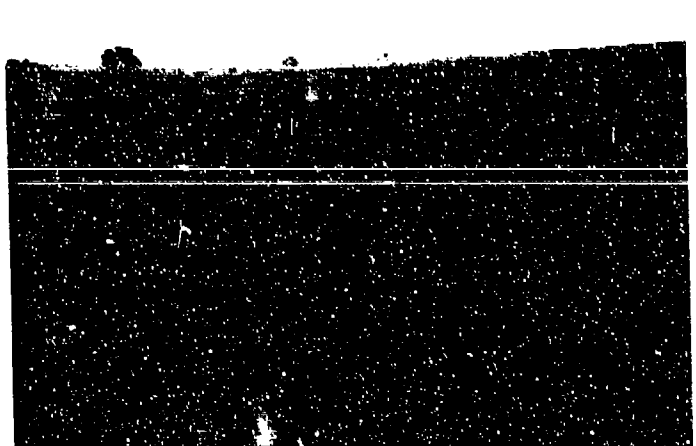

R4-10-T4
GUNBARREL
9190 MHZ
FOLIAGE 9/ 7/66
NO FOLIAGE 12/ 7/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters

R4-10-T4

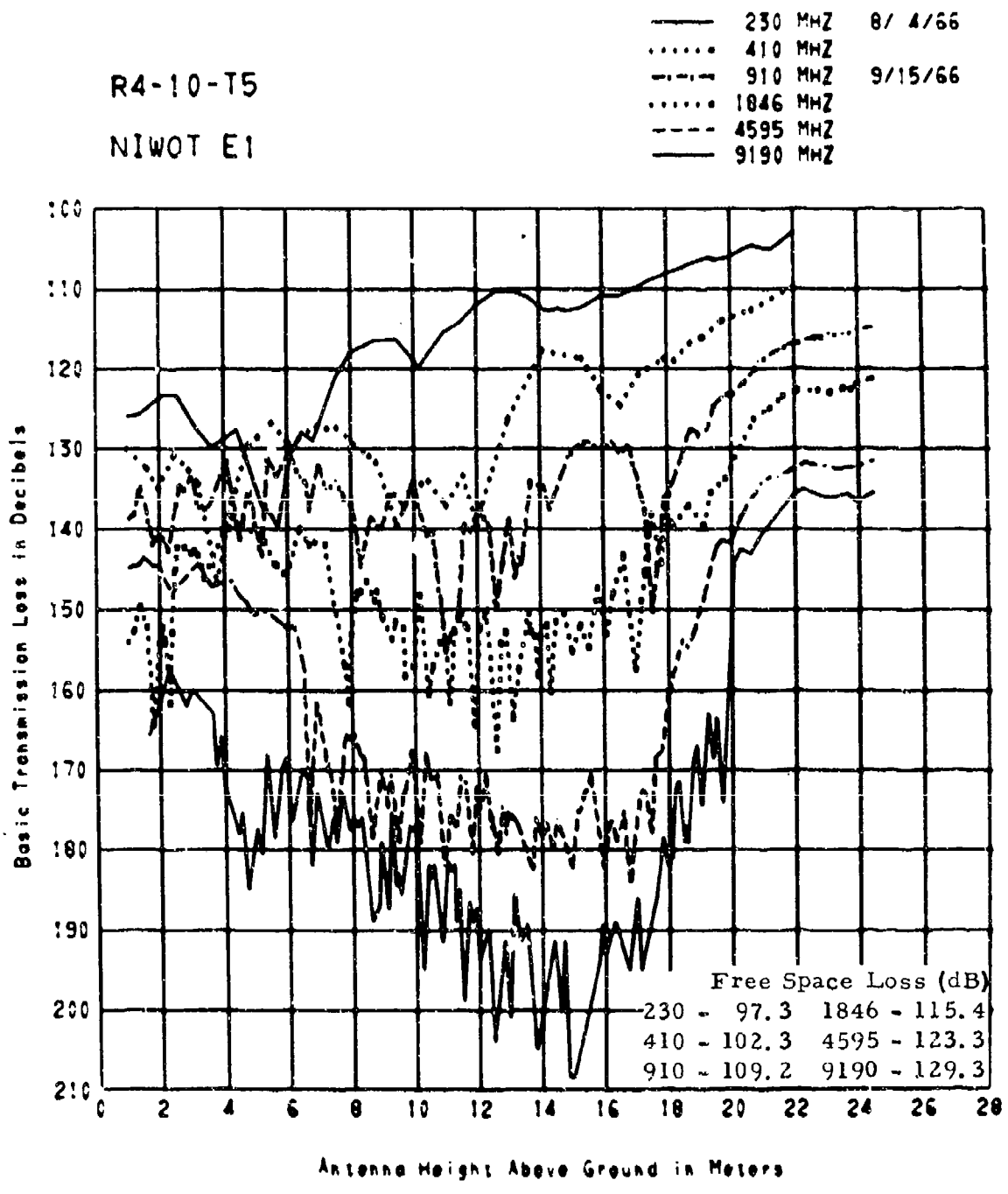
L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
	3-14-67 at 25 M			12-7-66 at 7.3 M		
50%	94.8	101.3	119.0	135.2	137.7	144.8
Δ10% - 90%	< 3	< 3	< 3	< 3	< 3	< 3

R4-10-T5
NIWOT E 1



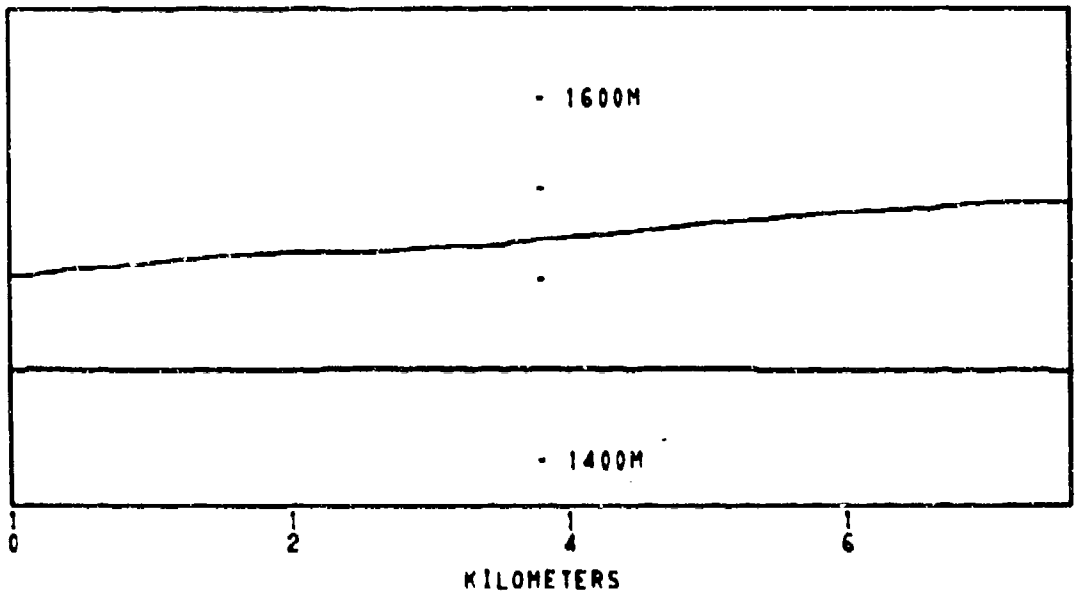
PATH VIEW FROM TRANSMITTER
Bearing from common receiver site to transmitter site is
227° 20' 19"


230 MHZ 8/ 4/66
410 MHZ
910 MHZ 9/15/66
1846 MHZ
4595 MHZ
9190 MHZ
R4-10-T5
NIWOT E1
100
110
120
130
140
150
160
170
180
190
200
210
Basic Transmission Loss in Decibels
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
Antenna Height Above Ground in Meters
Free Space Loss (dB)
230 - 97.3 1846 - 115.4
410 - 102.3 4595 - 123.3
910 - 109.2 9190 - 129.3

RCVR. ELEV. 1503 M

R4-10-T5
PATH LENGTH 7.582 km

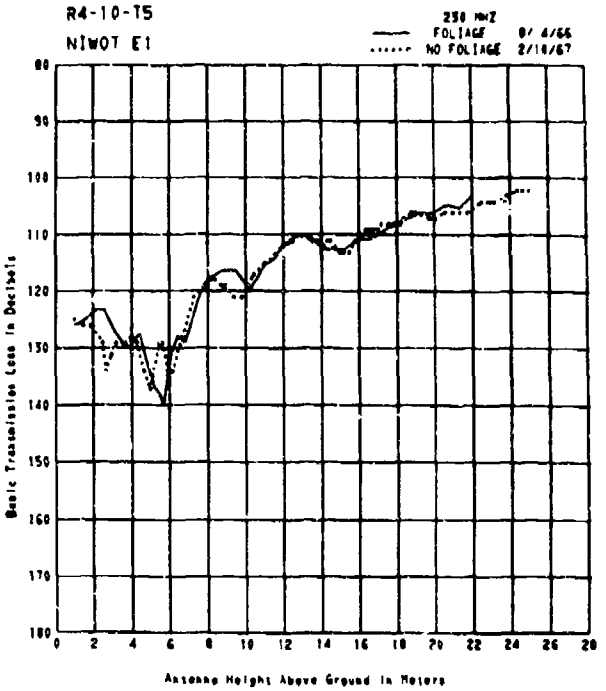
XMTR. ELEV. 1543 M

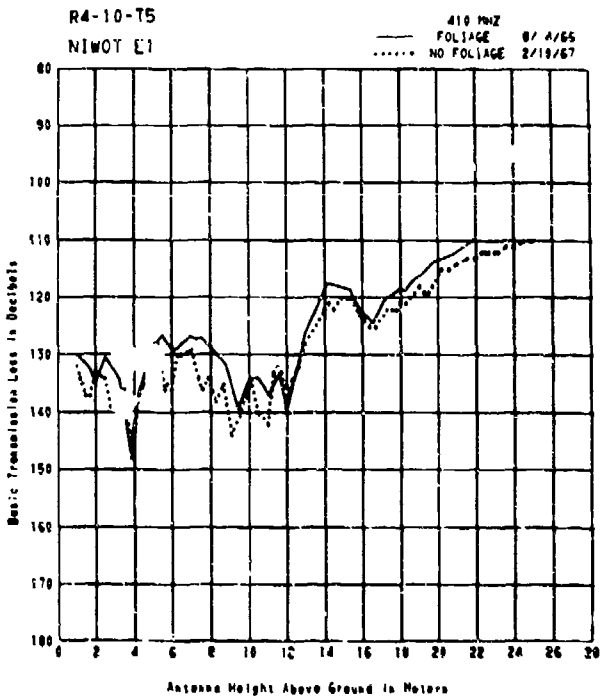


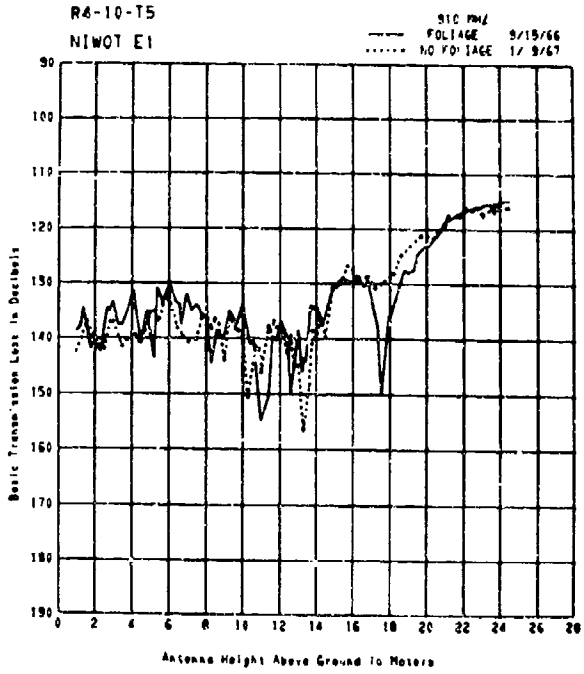
L_b (dB) SHORT TERM SIGNAL VARIABILITY

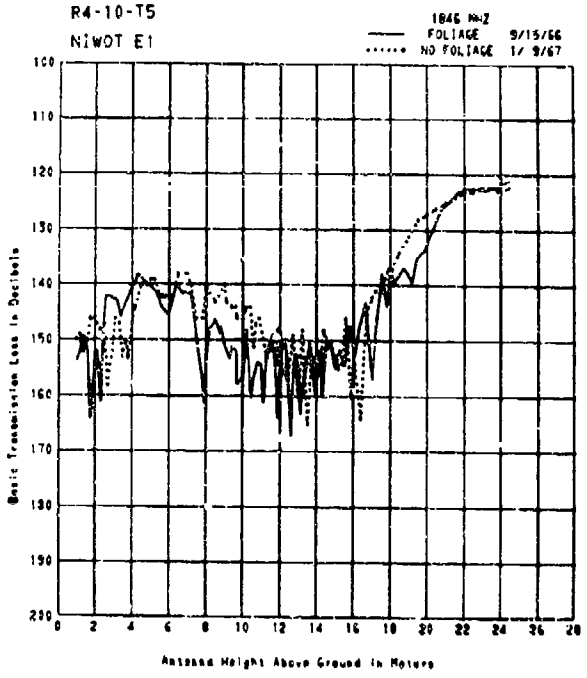
Freq(MHz)	230	410	910	1846	4595	9190
	8-4-66 at 1M			9-15-66 at 1M		
50%	127.6	129.2	137.6	155.3	146.2	159.7
Δ10%-90%	<3	<3	<3	<3	<3	<3
	8-4-66 at 11M			9-15-66 at 7.3M		
50%	111.6	129.3	133.2	145.4	167.3	179.4
Δ10%-90%	<3	<3	<3	<3	9.0	11.6
	8-4-66 at 22M			9-15-66 at 14M		
50%	103.0	109.0	133.5	151.6	170.5	188.2
Δ10%-90%	<3	<3	<3	<3	9.0	11.6
				9-15-66 at 24.5M		
50%			113.9	120.0	131.2	135.1
Δ10%-90%			<3	<3	<3	<3

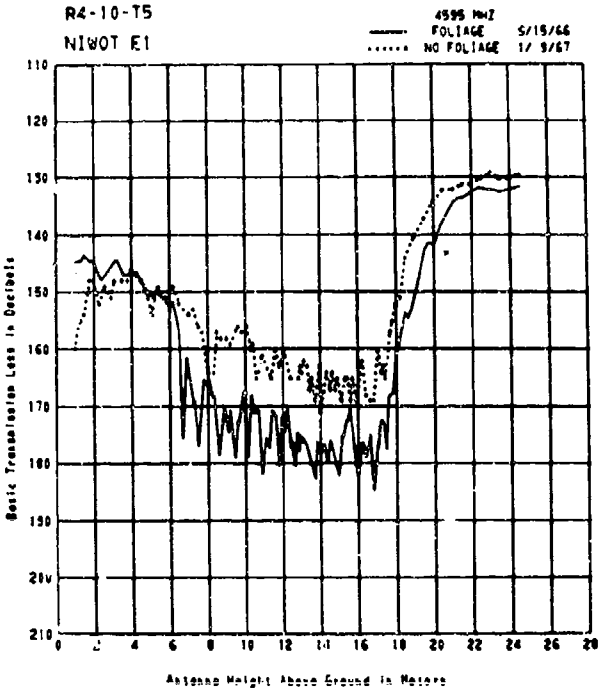
The terrain slopes away from the transmitter over alfalfa fields. Scattered trees are the only apparent obstructions.

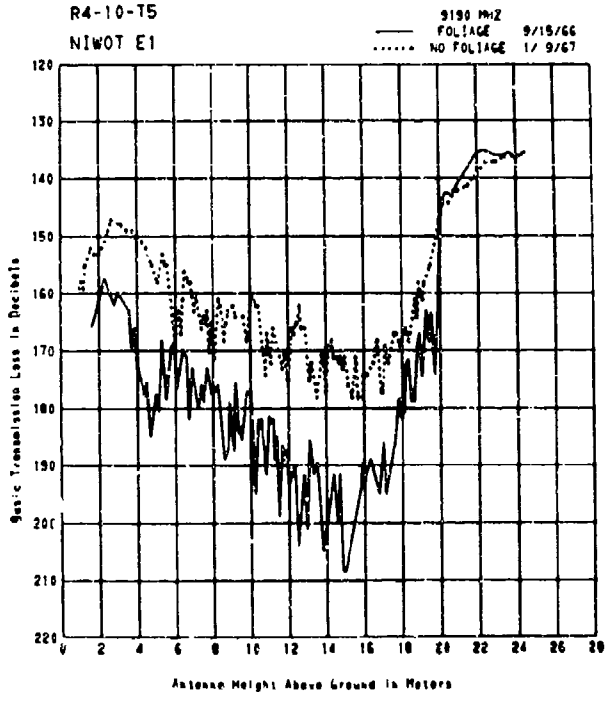

R4-10-T5
NIWOT E1
230 MHZ
FOLIAGE 8/ 4/66
NO FOLIAGE 2/16/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-10-T5
NIWOT E1
410 MHZ
FOLIAGE 8/ 4/66
NO FOLIAGE 2/16/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-10-T5
NIWOT E1
910 MHz
FOLIAGE 9/15/66
NO FOLIAGE 1/ 9/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-10-T5
NIWOT E1
1846 MHz
FOLIAGE 9/15/66
NO FOLIAGE 1/ 9/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-10-T5
NIWOT E1
4595 MHZ
FOLIAGE 5/15/66
NO FOLIAGE 1/ 9/67
Basic Transmission Loss in Decibels
110
120
130
140
150
160
170
180
190
200
210
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
Antenna Height Above Ground in Meters


R4-10-T5
NIWOT E1
9190 MHZ
FOLIAGE 9/15/66
NO FOLIAGE 1/ 9/67
Basic Transmission Loss in Decibels
120
130
140
150
160
170
180
190
200
210
220
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
Antenna Height Above Ground in Meters

R4-10-T5

L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
	2-10-67 at 25 M			1-9-67 at 7.3 M		
50%	103.0	110.0	136.8	142.0	153.7	166.6
Δ10% - 90%	< 3	< 3	< 3	< 3	< 3	< 3

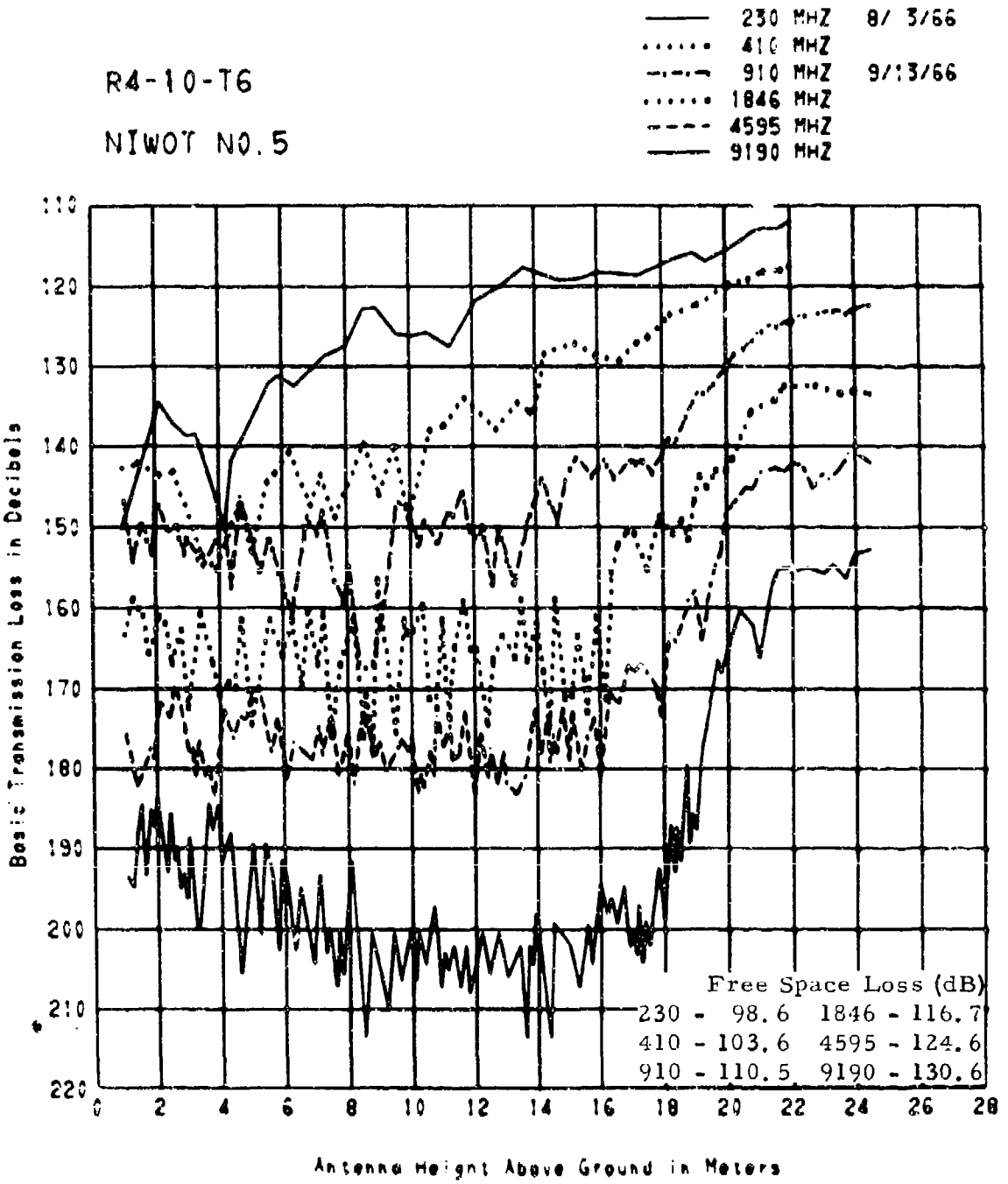
R4-10-T6
NIWOT N 0.5



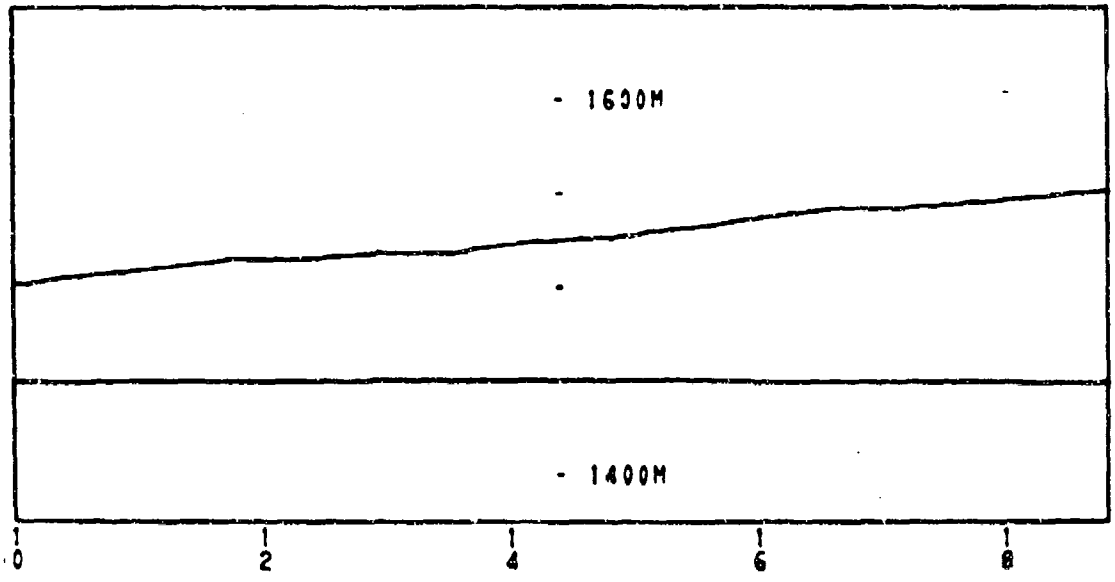
PATH VIEW FROM TRANSMITTER

Bearing from common receiver site to transmitter site is

230° 04' 31"


230 MHZ 8/ 3/66
410 MHZ
910 MHZ 9/13/66
1846 MHZ
4595 MHZ
9190 MHZ
R4-10-T6
NIWOT NO.5
Basic Transmission Loss in Decibels
110
120
130
140
150
160
170
180
190
200
210
220
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
Antenna Height Above Ground in Meters
Free Space Loss (dB)
230 - 98.6 1846 - 116.7
410 - 103.6 4595 - 124.6
910 - 110.5 9190 - 130.6

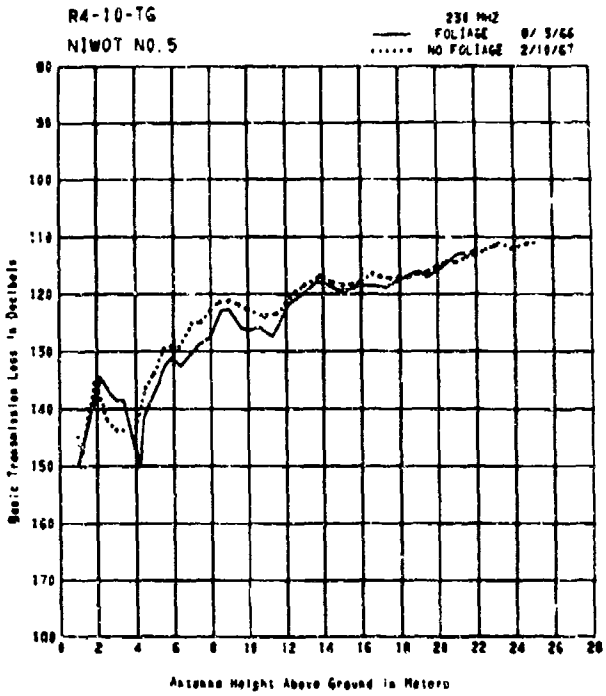
RCVR. ELEV. 1503 M | R4-10-T6 PATH LENGTH 8.808 km | XMTR. ELEV. 1552 M

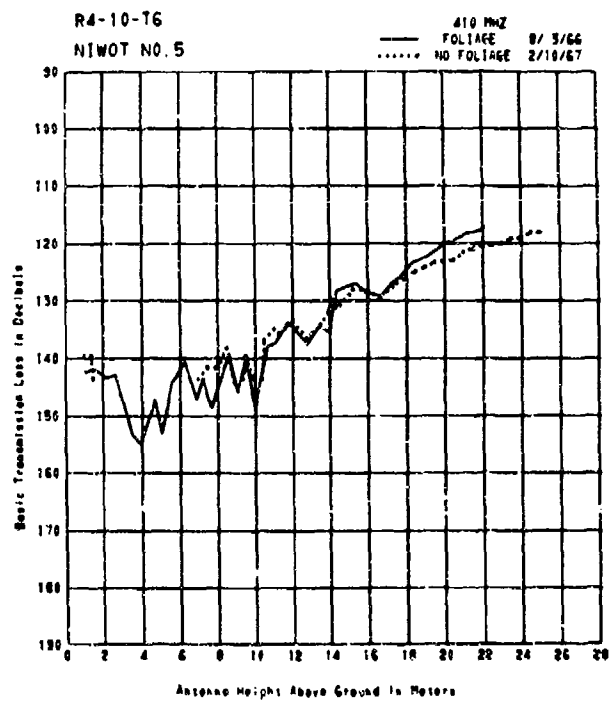


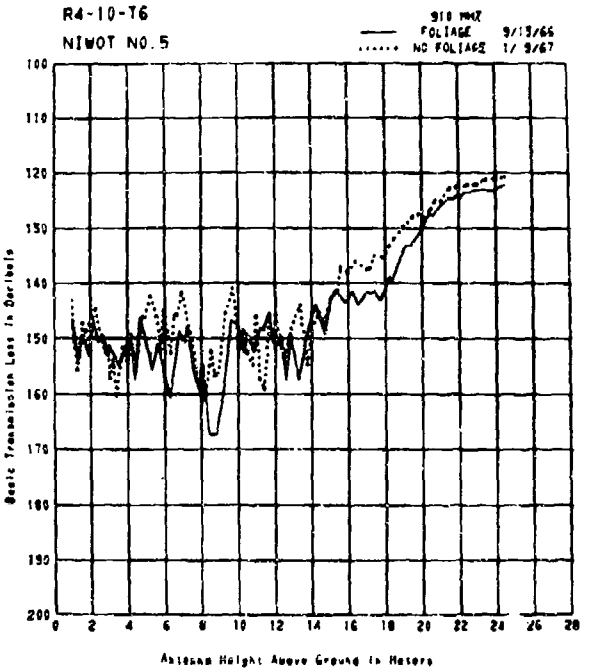
L_b (dB) SHORT TERM SIGNAL VARIABILITY

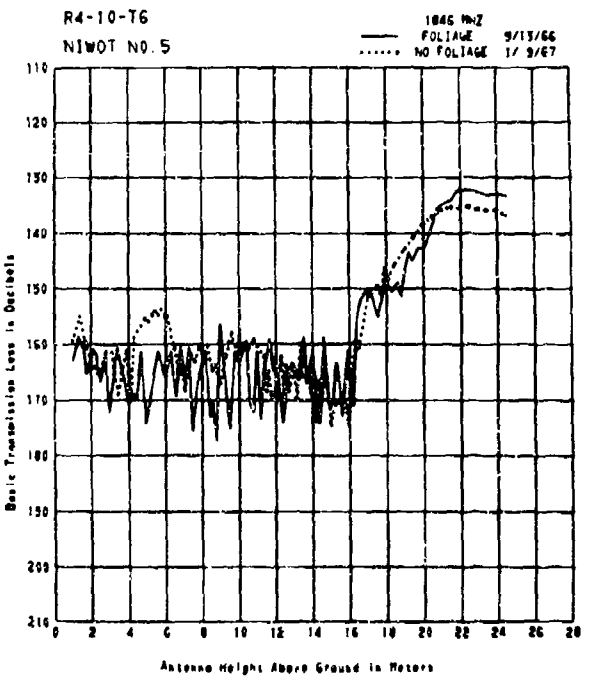
Freq(MHz)	230	410	910	1846	4595	9190
	8-8-66 at 1M			9-13-66 at 1M		
50%	151.6	144.1	146.3	168.3	179.7	195.6
Δ10%-90%	<3	<3	<3	6.8	16.0	18.5
	8-8-66 at 11M			9-13-66 at 7.3M		
50%	123.6	136.1	147.3	176.3	177.2	197.6
Δ10%-90%	<3	<3	<3	13.5	9.0	17.0
	8-8-66 at 22M			9-13-66 at 24.5M		
50%	110.0	117.2	122.8	134.1	143.2	153.6
Δ10%-90%	<3	<3	<3	<3	<3	<3

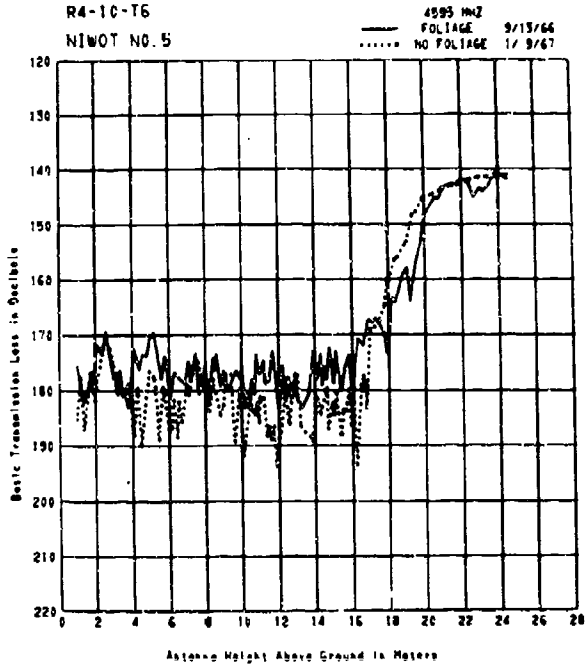
The path slopes downward toward the receiver. There are no obstructions until scattered trees appear about 1.5 km in the distance.

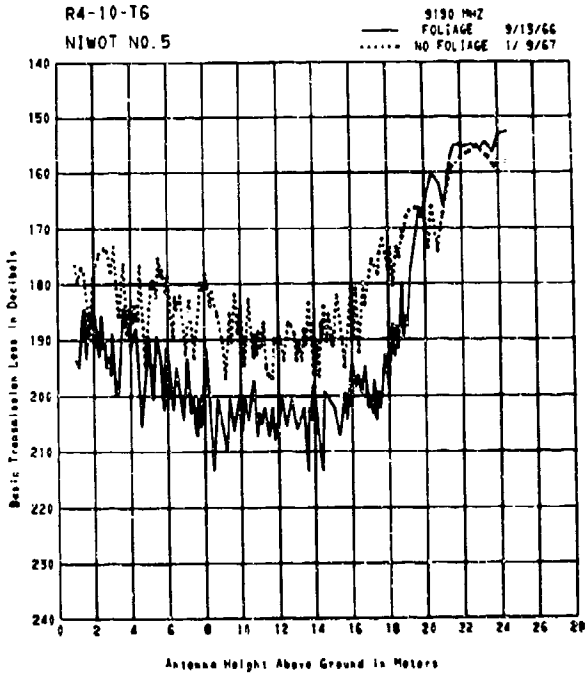

R4-10-TG
NIWOT NO.5
238 MHZ
FOLIAGE 8/ 3/66
NO FOLIAGE 2/10/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-10-T6
NIWOT NO.5
410 MHZ
FOLIAGE 8/ 3/66
NO FOLIAGE 2/10/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-10-T6
NIWOT NO. 5
918 MHZ
FOLIAGE 9/13/66
NO FOLIAGE 1/ 9/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-10-T6
NIWOT NO. 5
1846 MHZ
FOLIAGE 9/13/66
NO FOLIAGE 1/ 9/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-10-T6
NIWOT NO. 5
4595 MHZ
FOLIAGE 9/13/66
NO FOLIAGE 1/ 9/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters

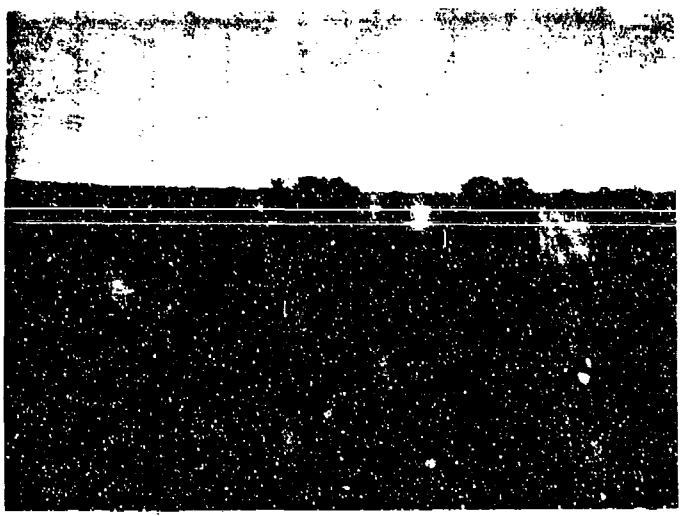

R4-10-T6
NIWOT NO. 5
9190 MHZ
FOLIAGE 9/13/66
NO FOLIAGE 1/ 9/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters

R4-10-T6

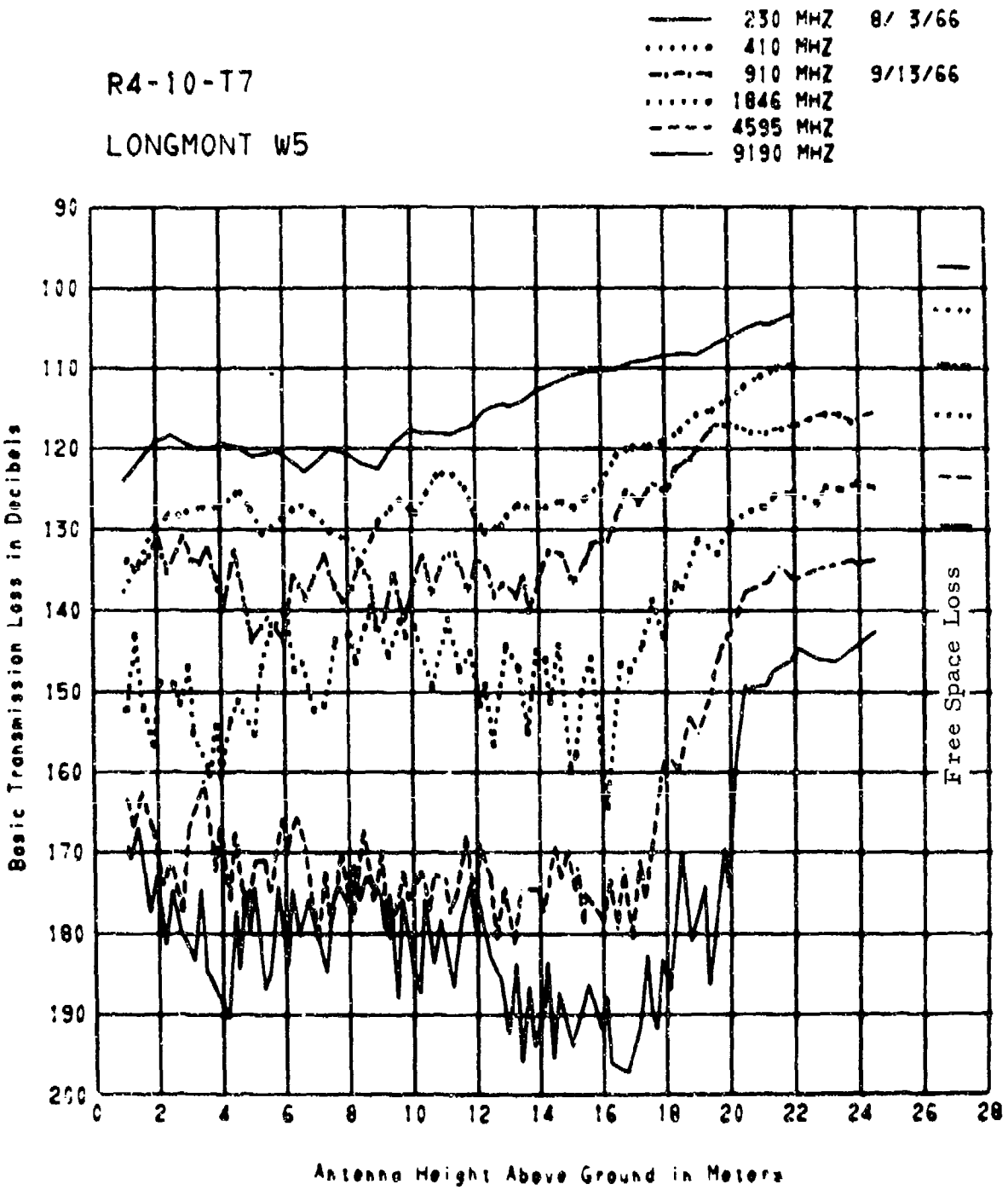
L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
	2-10-67 at 25 M			1-9-67 at 1 M		
50%	110.8	118.6	142.1	158.7	188.5	177.0
Δ10% - 90%	< 3	< 3	< 3	< 3	5.2	3.3
				1-9-67 at 7.3 M		
50%			145.5	159.7	177.1	186.4
Δ10% - 90%			< 3	< 3	< 3	< 3
				1-9-67 at 14 M		
50%			147.0	169.7	183.4	189.2
Δ10% - 90%			< 3	< 3	5.3	5.9
				1-9-67 at 24.5 M		
50%			120.0	135.7	140.7	156.6
Δ10% - 90%			< 3	< 3	< 3	< 3

R4-10-T7
LONGMONT W 5



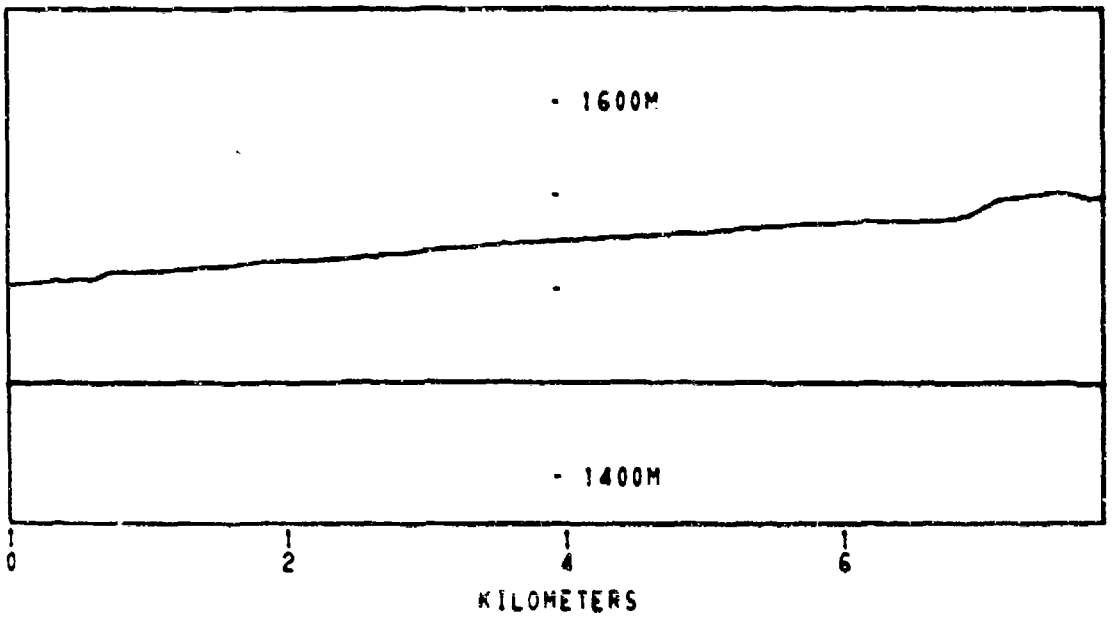
PATH VIEW FROM TRANSMITTER
Bearing from common receiver site to transmitter site is
261° 52' 30"


230 MHZ 8/ 3/66
410 MHZ
910 MHZ 9/13/66
1846 MHZ
4595 MHZ
9190 MHZ
R4-10-T7
LONGMONT W5
Basic Transmission Loss in Decibels
90
100
110
120
130
140
150
160
170
180
190
200
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
Antenna Height Above Ground in Meters
Free Space Loss

RCVR. ELEV. 1503 M

R4-10-T7
PATH LENGTH 7.861 km

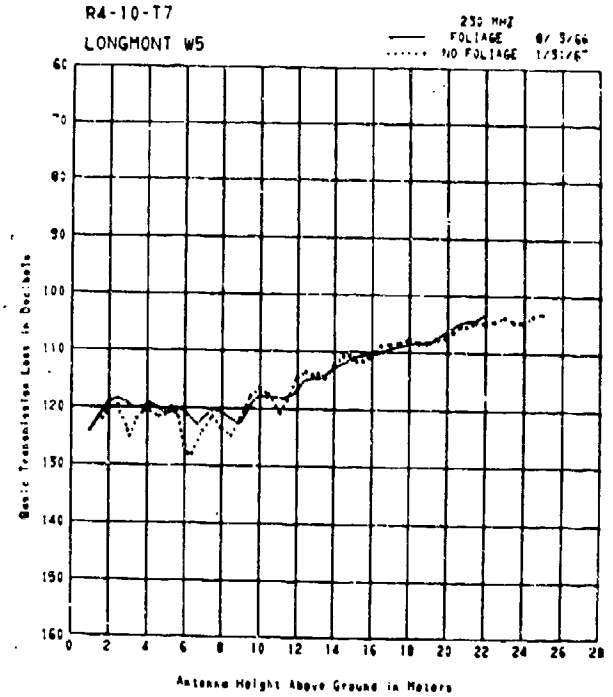
XMTR. ELEV. 1549 M

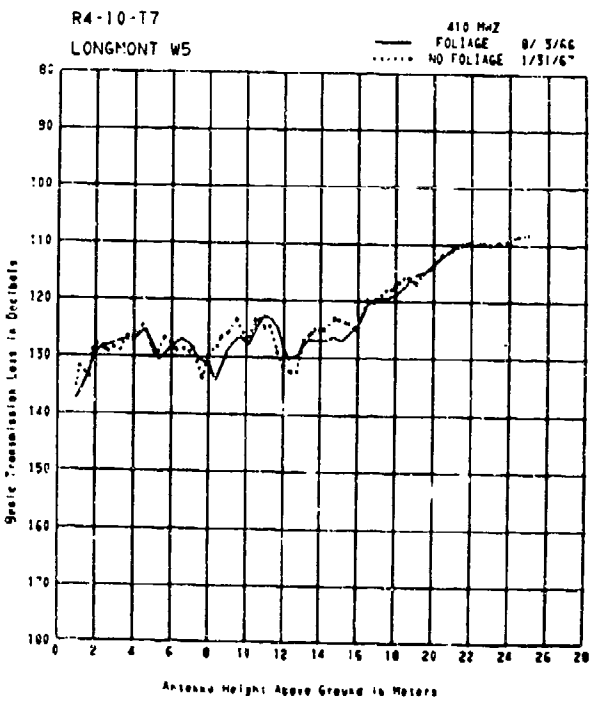


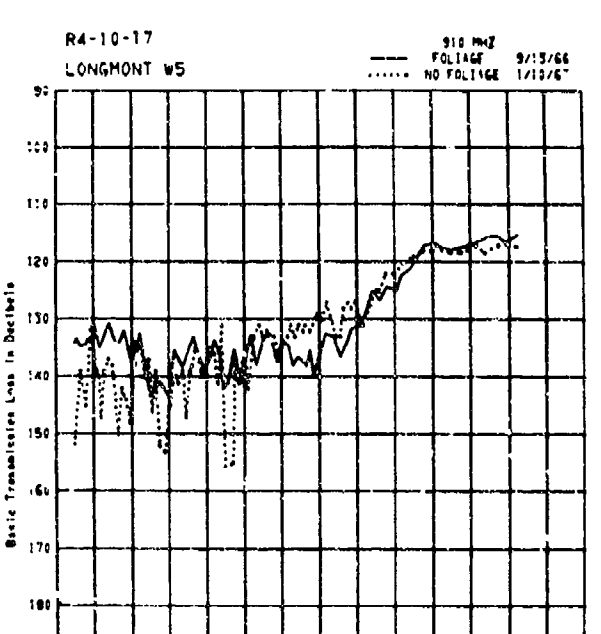
L_b (dB) SHORT TERM SIGNAL VARIABILITY

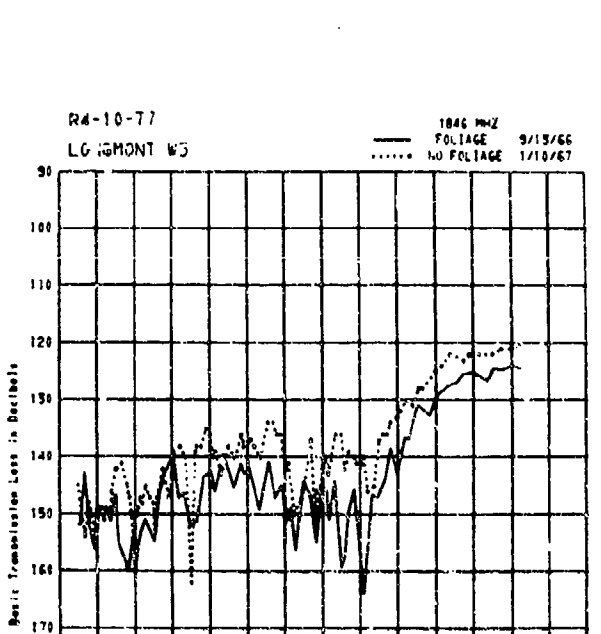
Freq(MHz)	230	410	910	1846	4595	9190
	8-3-66 at 1M			9-13-66 at 1M		
50%	124.7	138.3	136.8	152.4	170.5	176.6
Δ10%-90%	<3	<3	<3	<3	6.7	8.8
	8-3-66 at 11M			9-13-66 at 7.3M		
50%	121.9	128.2	135.3	151.9	176.7	175.4
Δ10%-90%	<3	<3	<3	<3	10.1	3.0
	8-3-66 at 22M			9-13-66 at 24.5M		
50%	103.8	107.9	115.3	123.4	133.9	142.1
Δ10%-90%	<3	<3	<3	<3	<3	<3

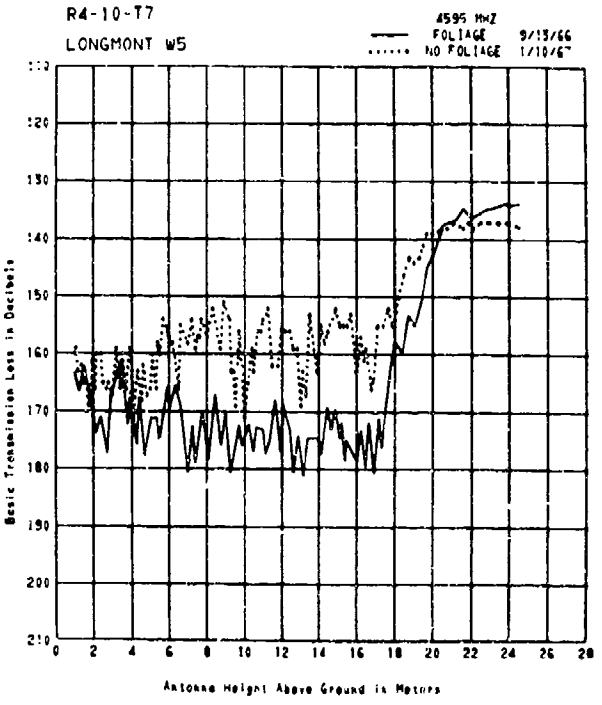
The path extends over level, open grass land for about 3 km. Large trees, 20 m tall, are growing just to the right of the path, about 500 m away. A 2-wire telephone line runs obliquely across the path about 45 m from the antennas. Running parallel to the telephone line, but behind the antennas, is a 2-wire power line.

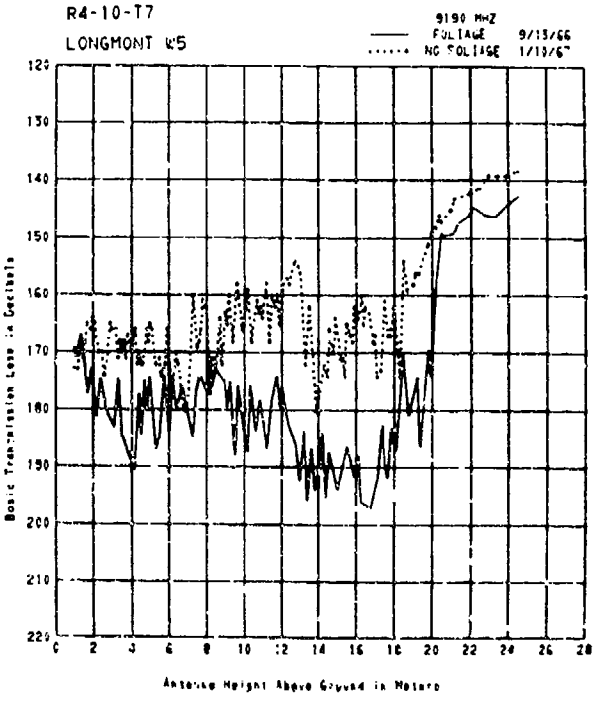

R4-10-T7
LONGMONT W5
230 MHZ
FOLIAGE
NO FOLIAGE
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-10-T7
LONGMONT W5
410 MHZ
FOLIAGE
NO FOLIAGE
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-10-17
LONGMONT W5
910 MHZ
FOLIAGE 9/15/66
NO FOLIAGE 1/10/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-10-77
LONGMONT W5
1846 MHZ
FOLIAGE 9/15/66
NO FOLIAGE 1/10/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-10-T7
LONGMONT W5
4595 MHZ
FOLIAGE 9/13/66
NO FOLIAGE 1/10/67
Basic Transmission Loss in Decibels
120
130
140
150
160
170
180
190
200
210
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-10-T7
LONGMONT W5
9190 MHZ
FOLIAGE 9/13/66
NO FOLIAGE 1/10/67
Basic Transmission Loss in Decibels
130
140
150
160
170
180
190
200
210
220
0 2 3 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters

R4-10-T7

L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
	1-31-67 at 25 M			10-10-67 at 7.3 M		
50%	103.2	108.0	135.9	138.4	153.7	164.8
Δ10% - 90%	< 3	< 3	< 3	< 3	< 3	< 3

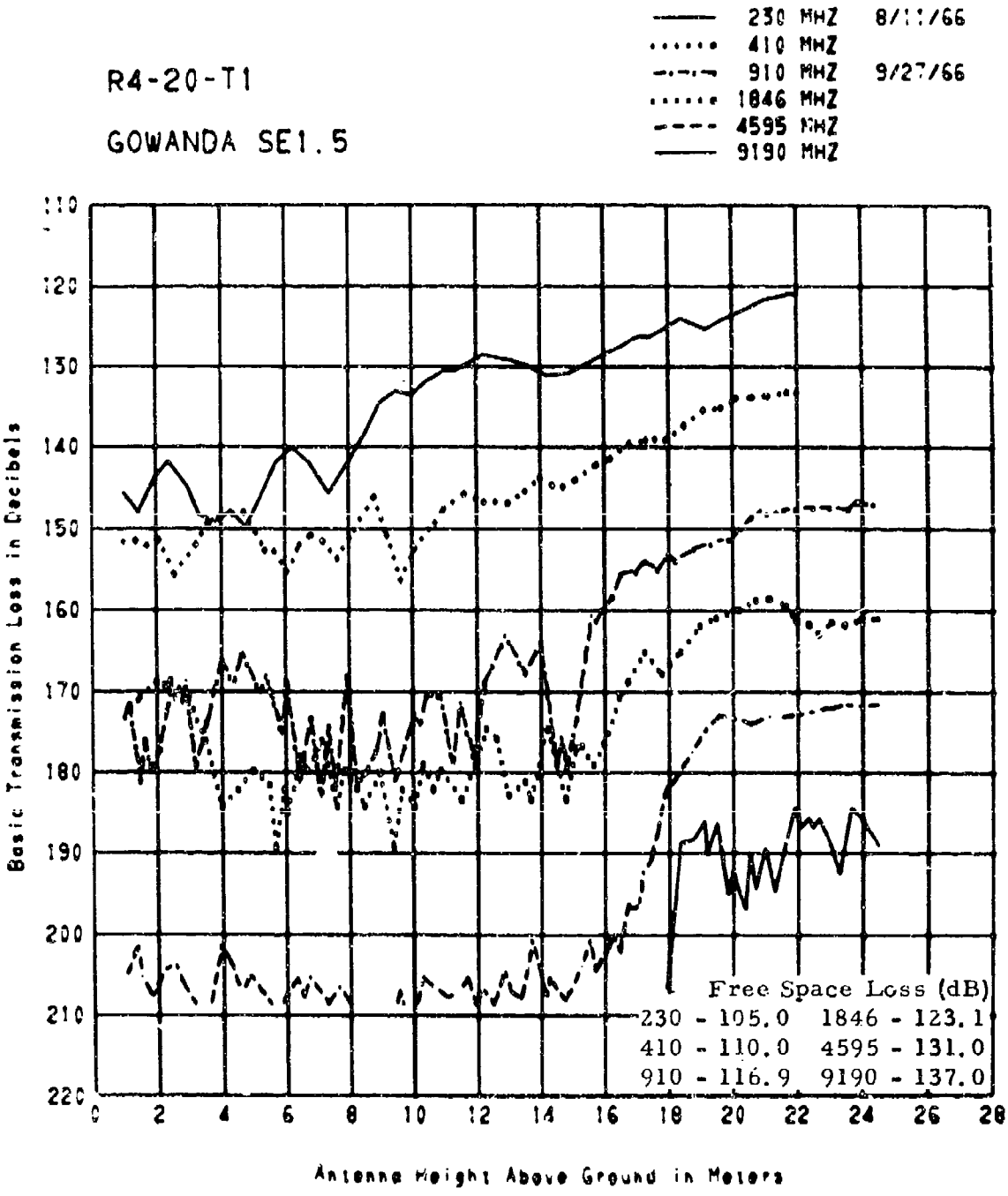
R4-20-T1
GOWANDA SE 1.5



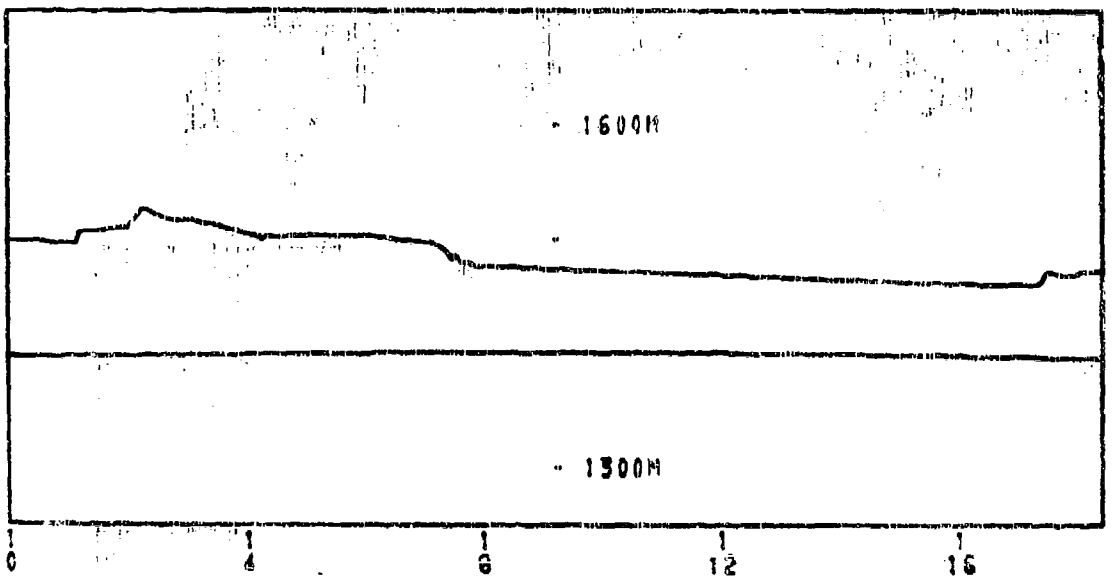
PATH VIEW FROM TRANSMITTER
Bearing from common receiver site to transmitter site is
78° 46' 07"

R4-20-T1

GOWANDA SE1.5



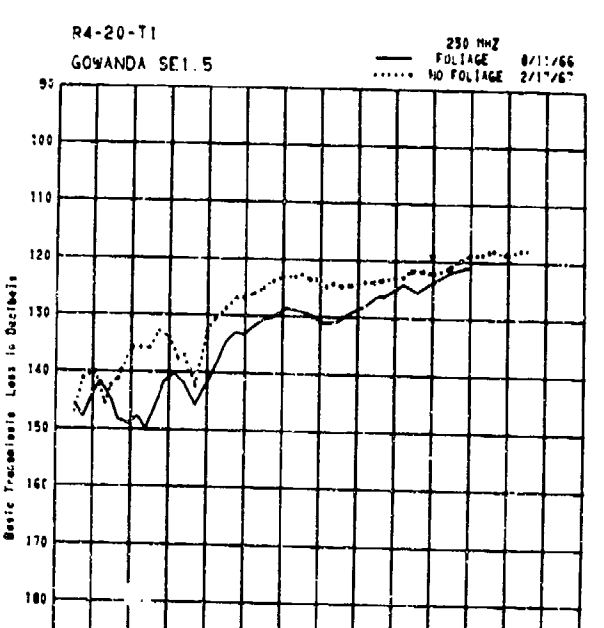
RCVR. ELEV. 1503 M | R4-20-T1 PATH LENGTH 18.380 km | XMTR. ELEV. 1477 M

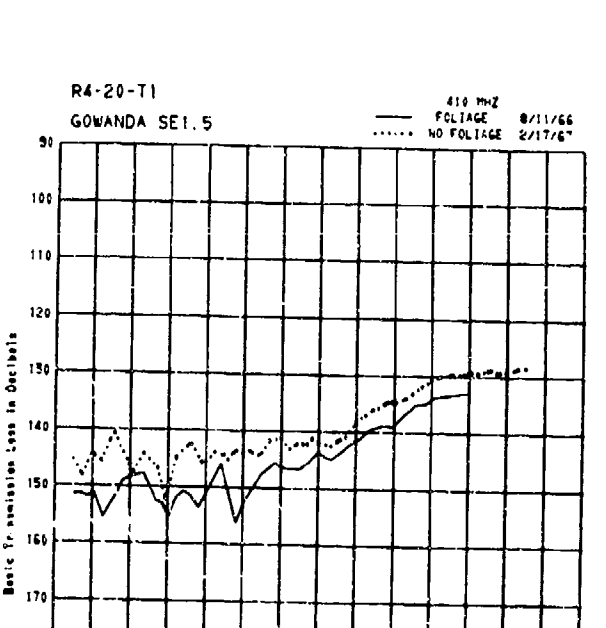


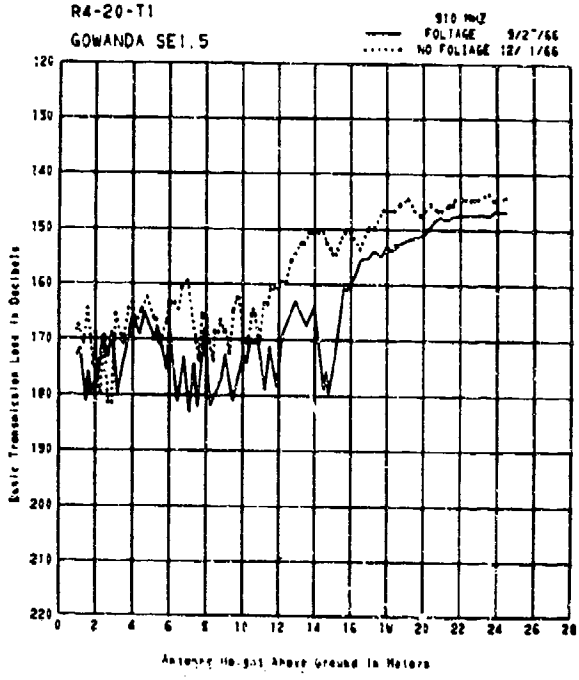
L_b (dB) SHORT TERM SIGNAL VARIABILITY

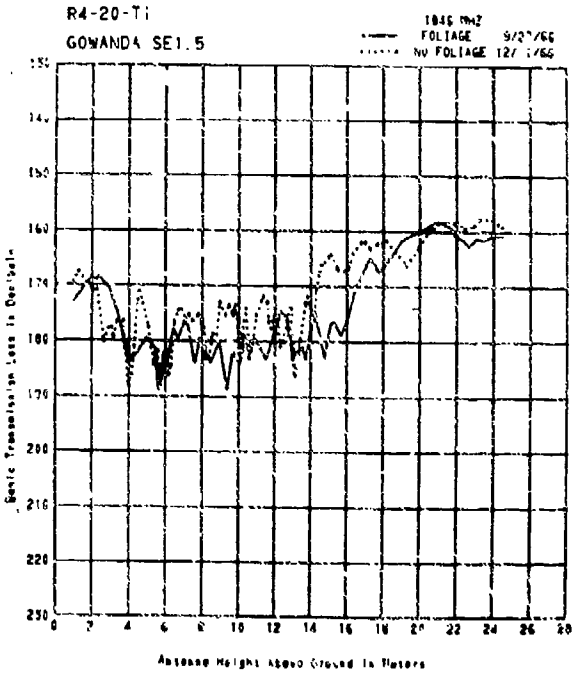
Freq (MHz)	230	410	910	1846	4595	9190
	8-11-66 at 1M			9-27-66 at 1M		
50%	145.6	153.1	171.2	173.9	206.0	
Δ10%-90%	<3	<3	<3	<3	4.5	
	8-11-66 at 11M			9-27-66 at 7.3M		
50%	128.7	146.6	170.2	184.7	210.1	
Δ10%-90%	<3	<3	<3	<3	<3	
	8-11-66 at 22M			9-27-66 at 14M		
50%	120.7	132.2	162.0	175.7	205.1	
Δ10%-90%	<3	<3	<3	<3	<3	
				9-27-66 at 24.5M		
50%			146.2	160.8	171.8	190.1
Δ10%-90%			<3	<3	<3	7.4

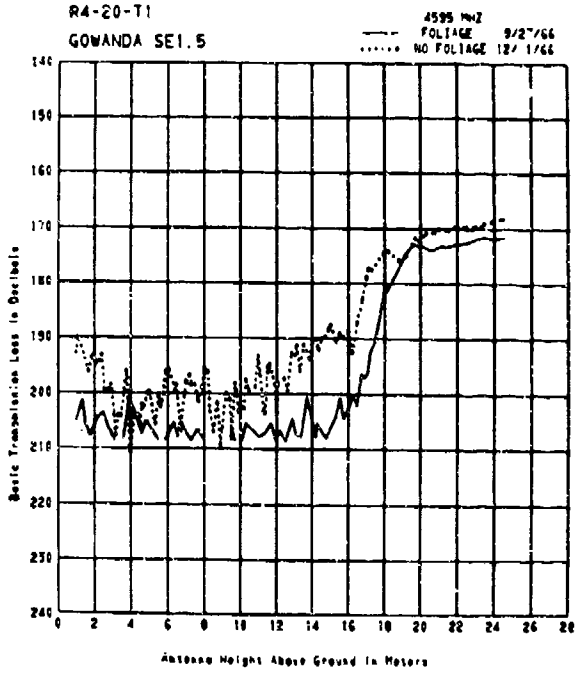
The immediate foreground of this path is dirt road for about 30 m. Beyond is marshland with low trees to the left and a pond to the right of the path. Trees, about 1 km away, obscure the horizon. A 4-wire power line, to the right of the antennas, parallels the path for about 30 m, and then angles away at about 20° to the path.

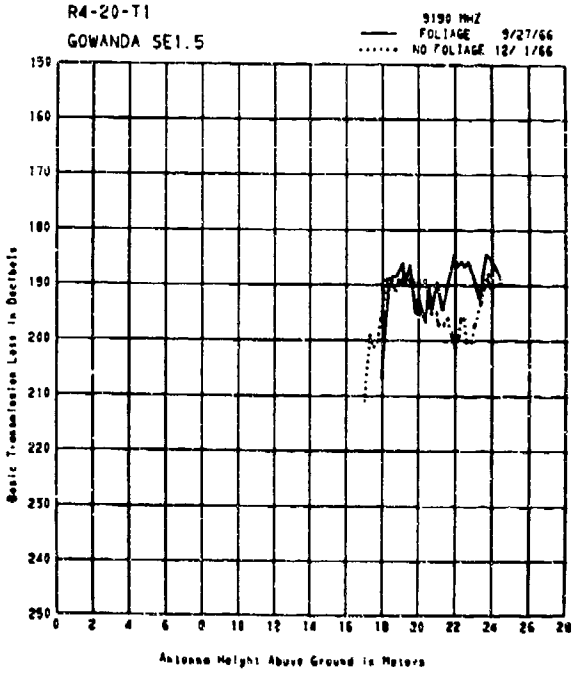

R4-20-TI
GOWANDA SE1.5
230 MHZ
FOLIAGE 8/11/66
NO FOLIAGE 2/17/67
90
100
110
120
130
140
150
160
170
180
190
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-20-TI
GOWANDA SE1.5
410 MHZ
FOLIAGE 8/11/66
NO FOLIAGE 2/17/67
90
100
110
120
130
140
150
160
170
180
190
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-20-T1
GOWANDA SE1.5
910 MHZ
FOLIAGE 9/27/66
NO FOLIAGE 12/ 1/66
Basic Transmission Loss in Decibels
120
130
140
150
160
170
180
190
200
210
220
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-20-T1
GOWANDA SE1.5
1846 MHZ
FOLIAGE 9/27/66
NO FOLIAGE 12/ 1/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-20-T1
GOWANDA SE1.5
4595 MHZ
FOLIAGE 9/27/66
NO FOLIAGE 12/ 1/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters

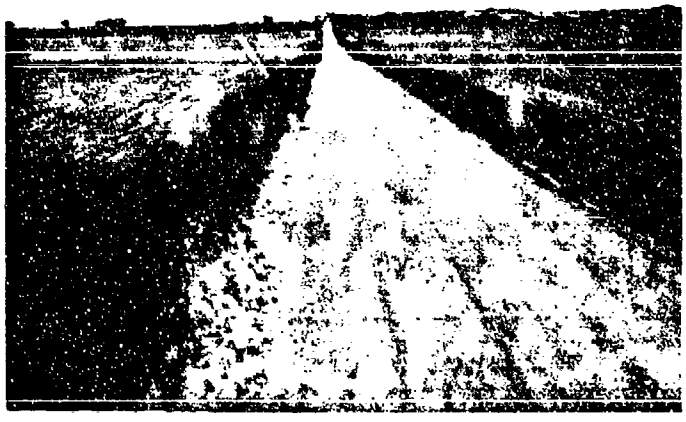

R4-20-T1
GOWANDA SE1.5
9190 MHZ
FOLIAGE 9/27/66
NO FOLIAGE 12/ 1/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters

R4-20-T1

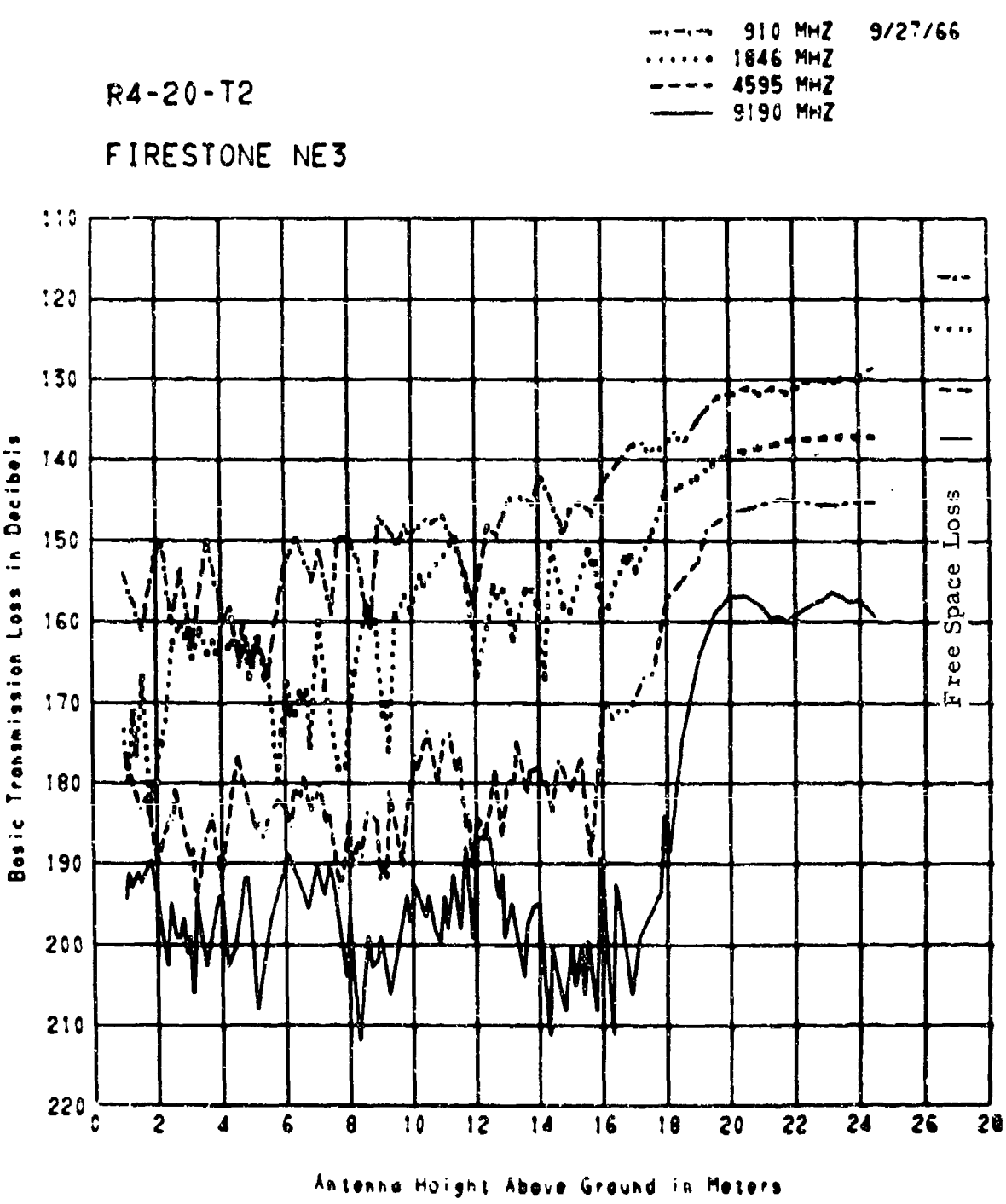
L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
	2-17-67 at 25 M			12-1-66 at 1 M		
50%	117.7	128.3	169.0	170.6	190.5	
Δ10% - 90%	< 3	< 3	< 3	< 3	< 3	
				12-1-66 at 7.3 M		
50%			167.7	175.6	197.5	
Δ10% - 90%			< 3	< 3	< 3	
				12-1-66 at 14 M		
50%			152.9	175.8	189.9	
Δ10% - 90%			< 3	< 3	< 3	
				12-1-66 at 24.5 M		
50%			144.4	158.6	164.5	189.0
Δ10% - 90%			< 3	< 3	< 3	< 3

R4-20-T2
FIRESTONE NE3



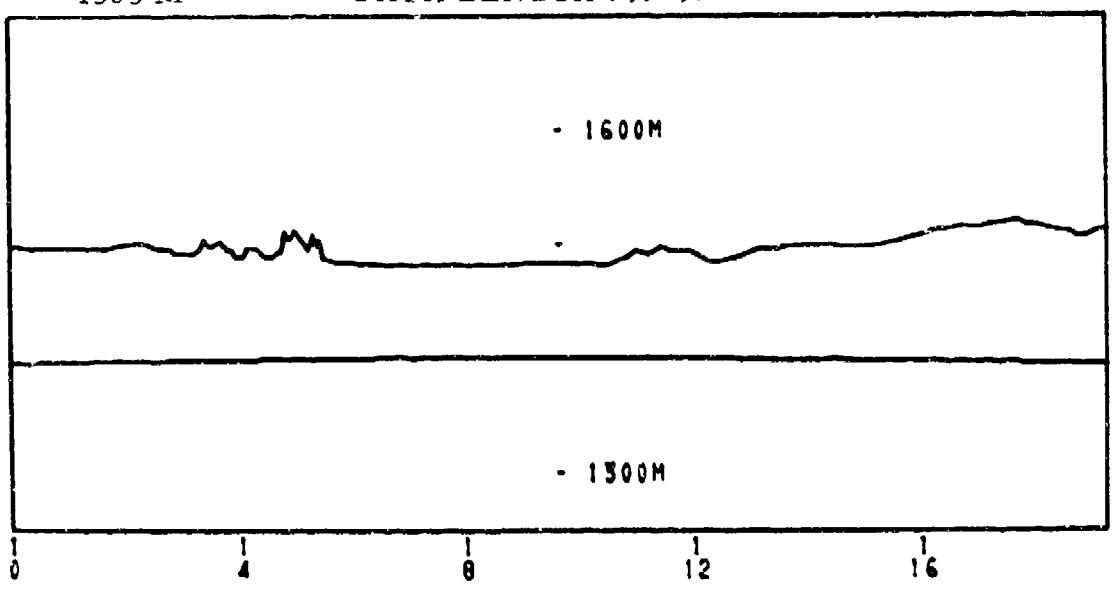
PATH VIEW FROM TRANSMITTER
Bearing from common receiver site to transmitter site is
93° 12' 07"


910 MHZ 9/27/66
1846 MHZ
4595 MHZ
9190 MHZ
R4-20-T2
FIRESTONE NE3
110
120
130
140
150
160
170
180
190
200
210
220
Basic Transmission Loss in Decibels
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
Antenna Height Above Ground in Meters
Free Space Loss

RCVR. ELEV. 1503 M

R4-20-T2
PATH LENGTH 19.195 km

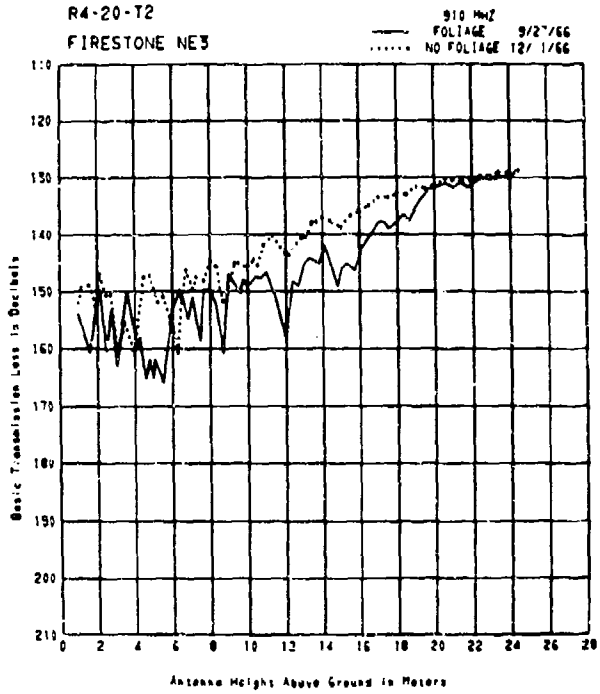
XMTR. ELEV. 1518 M

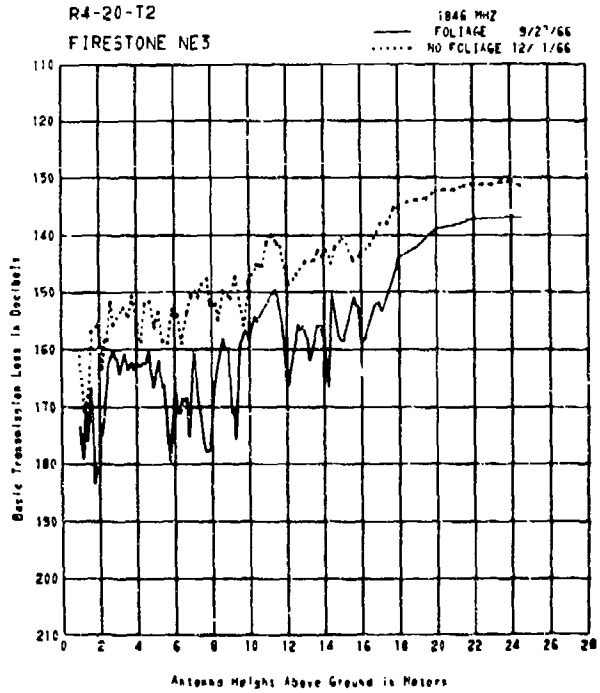


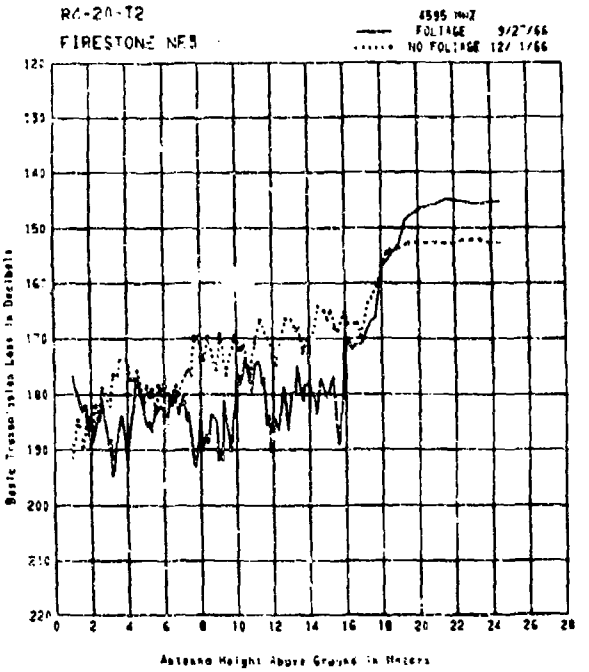
L_b (dB) SHORT TERM SIGNAL VARIABILITY

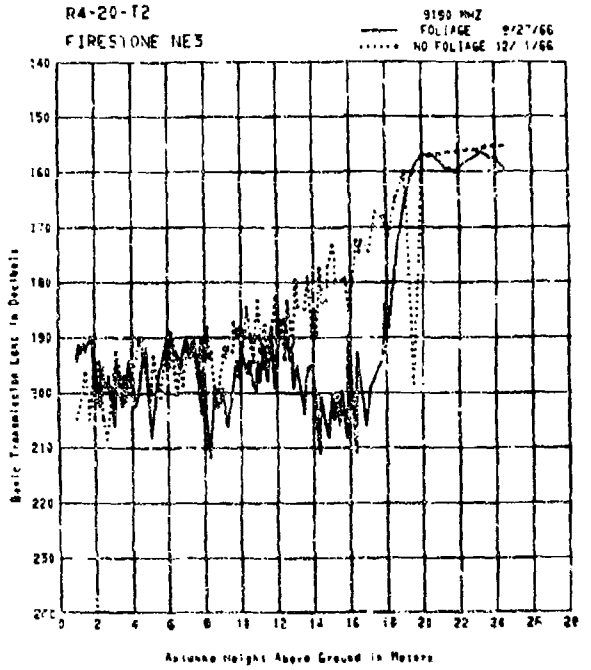
Freq(MHz)	230	410	910	1846	4595	9190
			9-27-66 at 1M			
50%			151.2	173.2	177.5	192.1
Δ10%-90%			<3	<3	<3	4.4
			9-27-66 at 7.3M			
50%			153.7	167.8	181.0	190.8
Δ10%-90%			<3	<3	<3	3.6
			9-27-66 at 14M			
50%			141.7	161.5	172.5	201.4
Δ10%-90%			<3	<3	<3	7.1
			9-27-66 at 24.5M			
50%			128.2	136.6	145.0	159.6
Δ10%-90%			<3	<3	<3	4.1

The antennas are aimed down a dirt road . The apparent horizon is 2 km away, where large trees cross the path. Open farmland exists to the right and left of the path. There are no telephone nor power lines nor fences in the vicinity.


R4-20-T2
FIRESTONE NE3
910 MHZ
FOLIAGE 9/27/66
NO FOLIAGE 12/ 1/66
Basic Transmission Loss in Decibels
110
120
130
140
150
160
170
180
190
200
210
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Heights Above Ground in Meters


R4-20-T2
FIRESTONE NE3
1846 MHZ
FOLIAGE 9/27/66
NO FOLIAGE 12/ 1/66
Basic Transmission Loss in Decibels
110
120
130
140
150
160
170
180
190
200
210
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Heights Above Ground in Meters


R4-20-T2
FIRESTONE NE3
4595 MHZ
FOLIAGE 9/27/66
NO FOLIAGE 12/ 1/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-20-T2
FIRESTONE NE3
9150 MHZ
FOLIAGE 9/27/66
NO FOLIAGE 12/ 1/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters

R4-20-T2

L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
				12-1-66 at 7.3 M		
50%			146.8	149.8	179.1	193.4
Δ10% - 90%			< 3	< 3	< 3	< 3

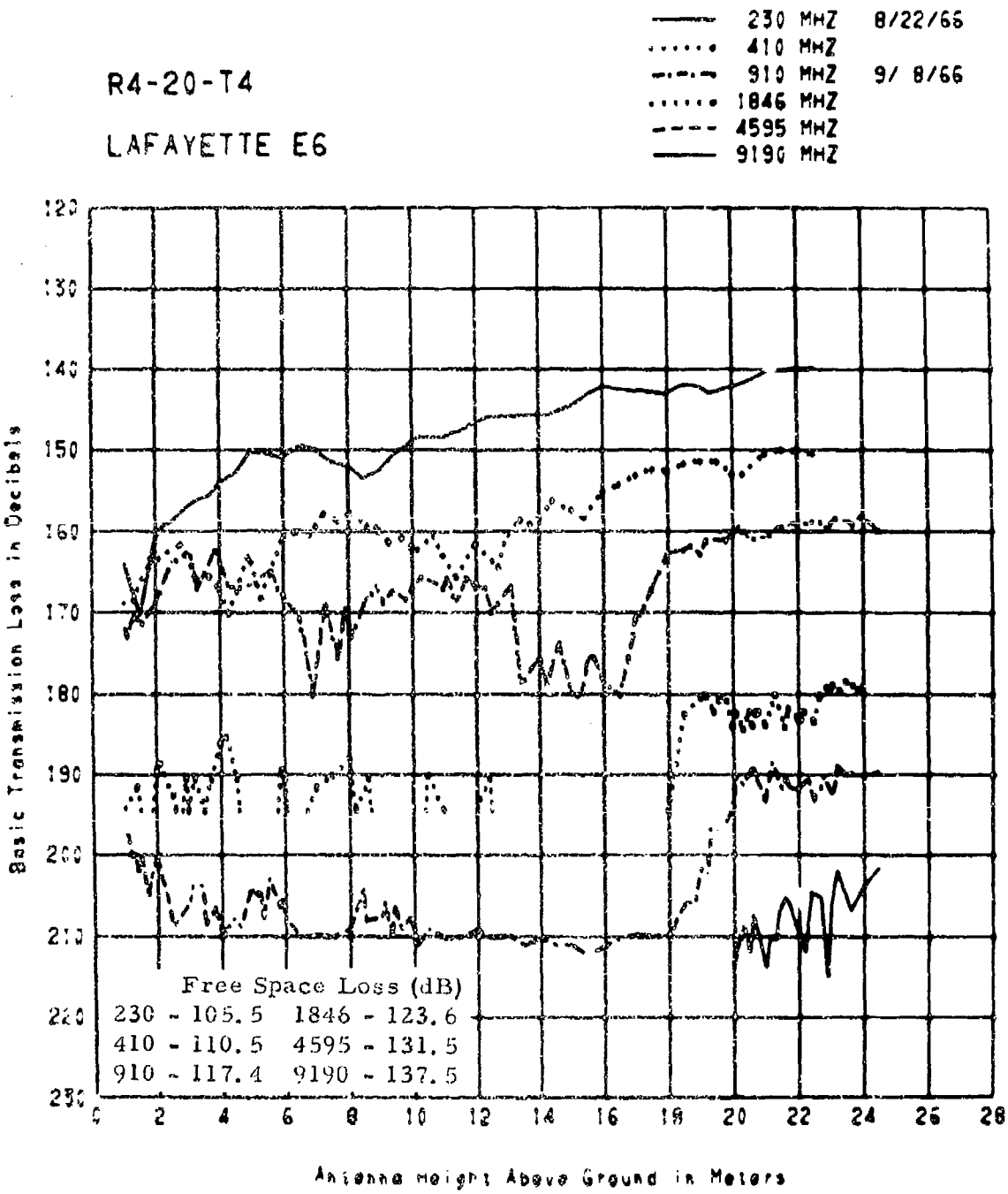
R4-20-T4
LAFAYETTE E 6



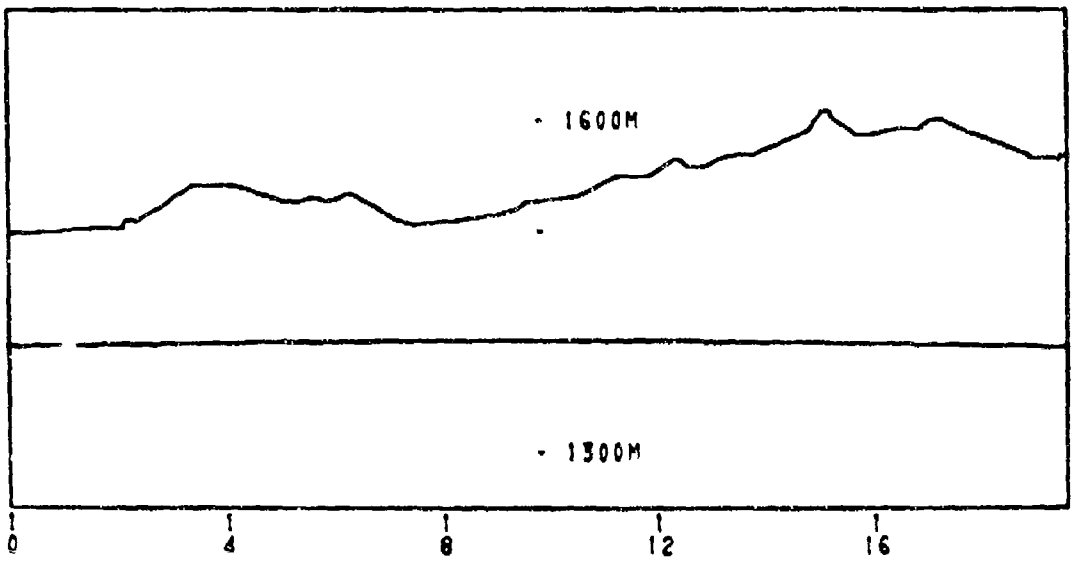
PATH VIEW FROM TRANSMITTER
Bearing from common receiver site to transmitter site is
151° 40' 48"

R4-20-T4

LAFAYETTE E6



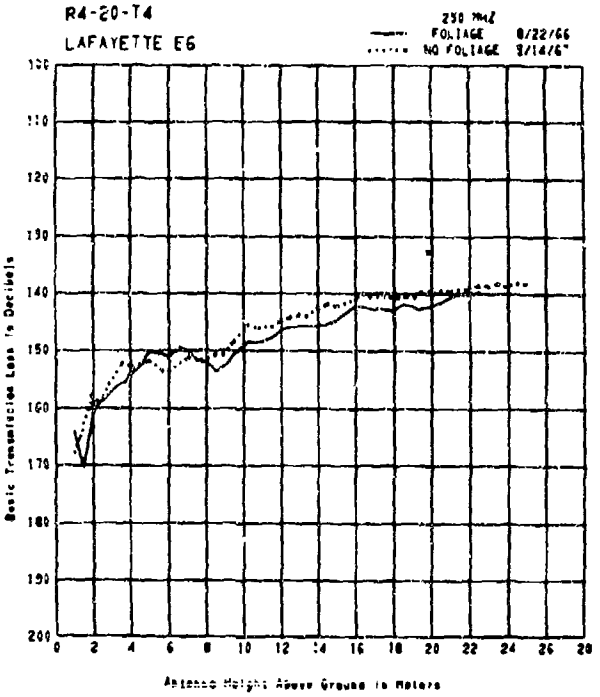
RCVR. ELEV. 1503 M | R4-20-T4 PATH LENGTH 19.527 km | XMTR. ELEV. 1573 M

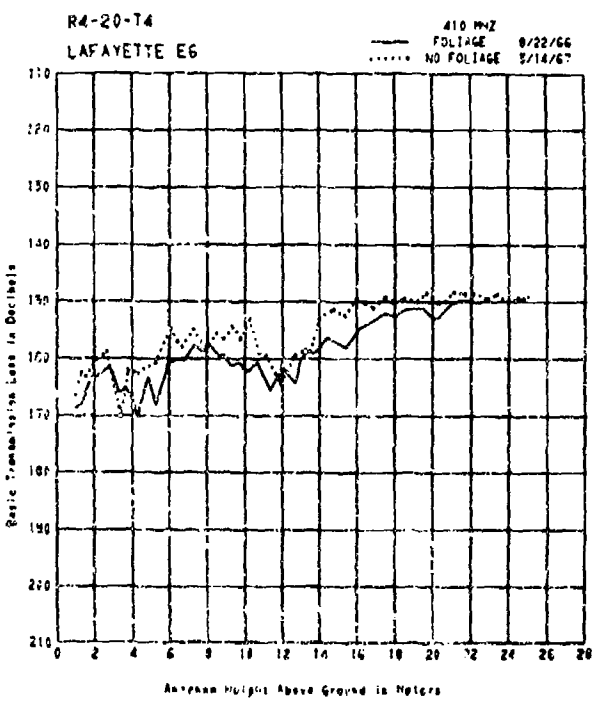


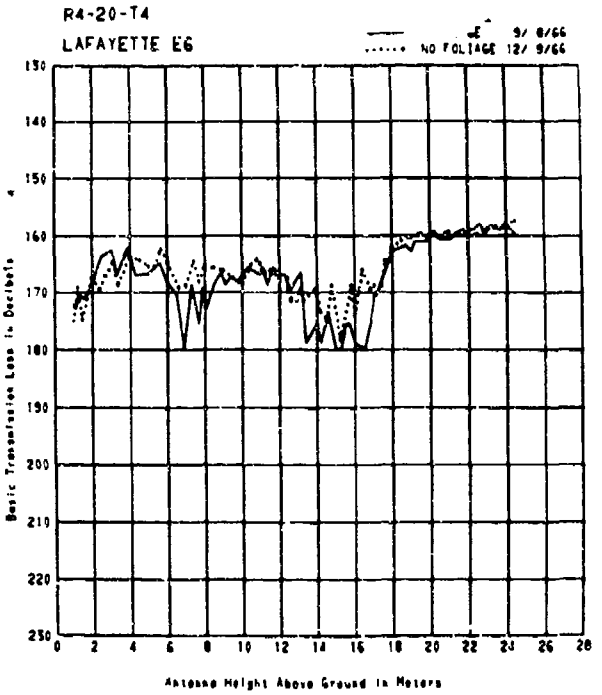
L_b (dB) SHORT TERM SIGNAL VARIABILITY

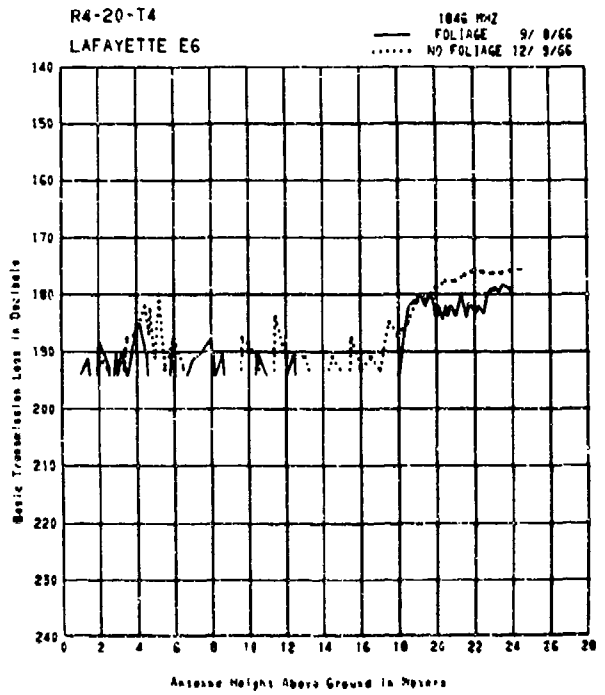
Freq(MHz)	230	410	910	1846	4595	9190
	8-22-66 at 3M			9-8-66 at 1M		
50%	156.6	166.7	172.7	192.3	200.0	
Δ10%-90%	<3	<3	<3	<3	5.0	
	8-22-66 at 22M			9-8-66 at 7.3M		
50%	140.3	149.6	168.7	187.3	209.2	
Δ10%-90%	<3	<3	<3	<3	<3	
				9-8-66 at 24.5M		
50%			159.7	179.3	188.2	
Δ10%-90%			<3	<3	<3	

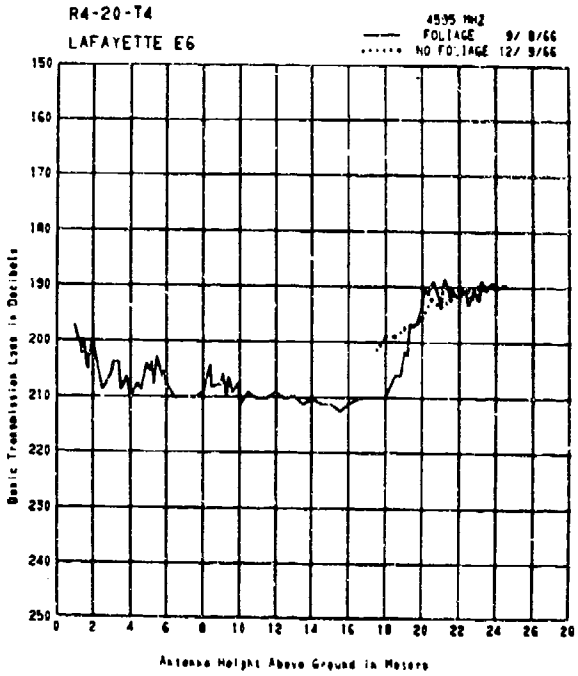
The terrain, in the direction of the receiver, is generally flat and slopes upward to an apparent horizon about 3 km away. About 50 m in front of the antennas is a low, barbed-wire fence. Scattered buildings are in the path at the horizon.

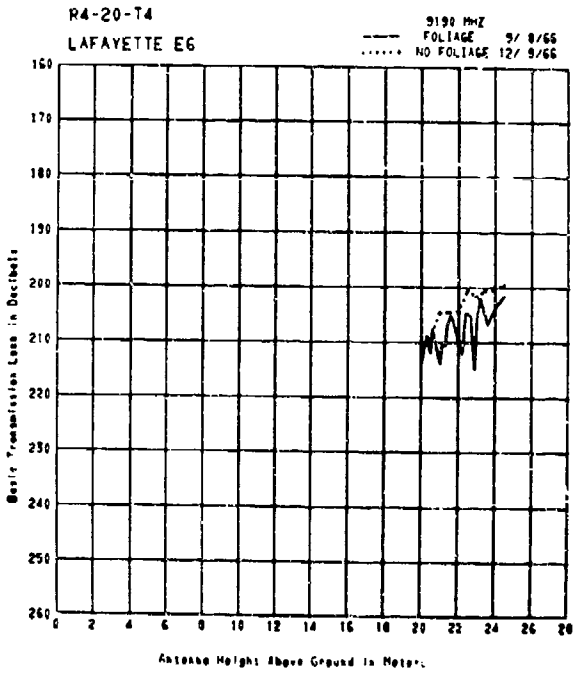

R4-20-T4
LAFAYETTE E6
250 MHZ
FOLIAGE 8/22/66
NO FOLIAGE 3/14/67
Basic Transmission Loss in Decibels
100
110
120
130
140
150
160
170
180
190
200
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-20-T4
LAFAYETTE E6
410 MHZ
FOLIAGE 8/22/66
NO FOLIAGE 3/14/67
Basic Transmission Loss in Decibels
110
120
130
140
150
160
170
180
190
200
210
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-20-T4
LAFAYETTE E6
FOLIAGE 9/ 8/66
NO FOLIAGE 12/ 9/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-20-T4
LAFAYETTE E6
1046 MHZ
FOLIAGE 9/ 8/66
NO FOLIAGE 12/ 9/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-20-T4
LAFAYETTE E6
4595 MHZ
FOLIAGE 9/ 8/66
NO FOLIAGE 12/ 9/66
Basic Transmission Loss in Decibels
150
160
170
180
190
200
210
220
230
240
250
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters

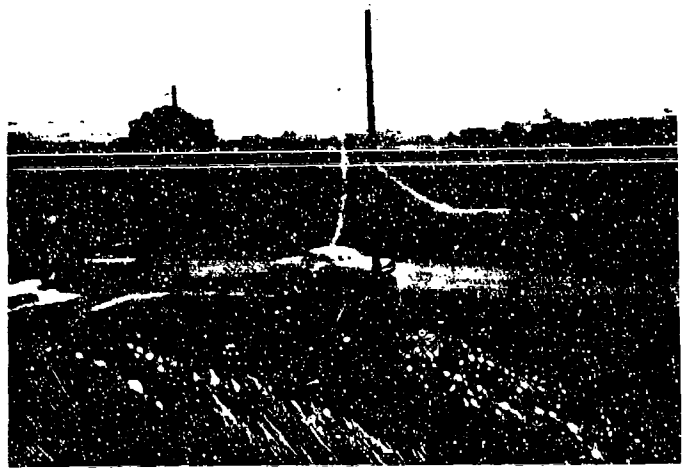

R4-20-T4
LAFAYETTE E6
9190 MHZ
FOLIAGE 9/ 8/66
NO FOLIAGE 12/ 9/66
Basic Transmission Loss in Decibels
160
170
180
190
200
210
220
230
240
250
260
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters

R4-20-T4

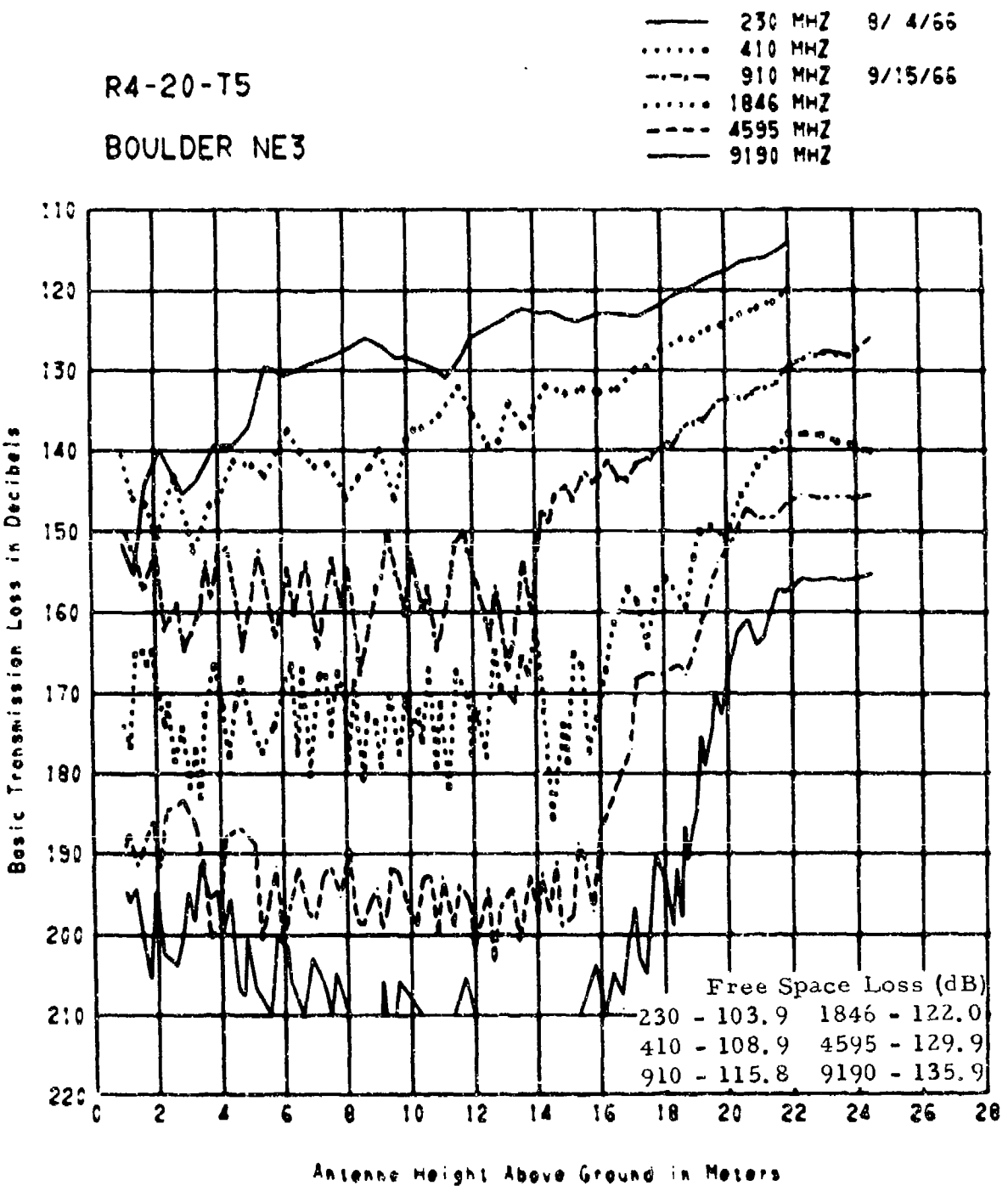
L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
	3-14-67 at 25 M			12-9-66 at 7.3 M		
50%	137.9	147.8	164.3			
Δ10% - 90%	< 3	< 3	< 3			
				12-9-66 at 24.5 M		
50%			157.8	174.0	189.9	202.4
Δ10% - 90%			< 3	< 3	< 3	< 3

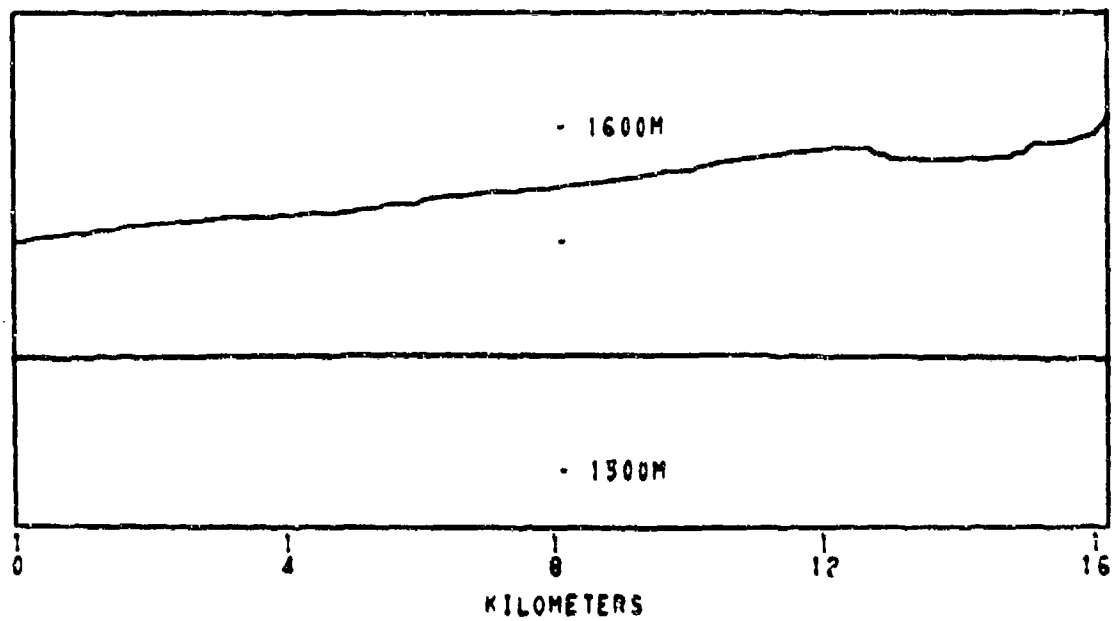
R4-20-T5
BOULDER NE 3



PATH VIEW FROM TRANSMITTER
Bearing from common receiver site to transmitter site is
232° 05' 37"


230 MHZ 8/ 4/66
410 MHZ
910 MHZ 9/15/66
1846 MHZ
4595 MHZ
9190 MHZ
R4-20-T5
BOULDER NE3
Basic Transmission Loss in Decibels
110
120
130
140
150
160
170
180
190
200
210
220
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
Antenna Height Above Ground in Meters
Free Space Loss (dB)
230 - 103.9 1846 - 122.0
410 - 108.9 4595 - 129.9
910 - 115.8 9190 - 135.9

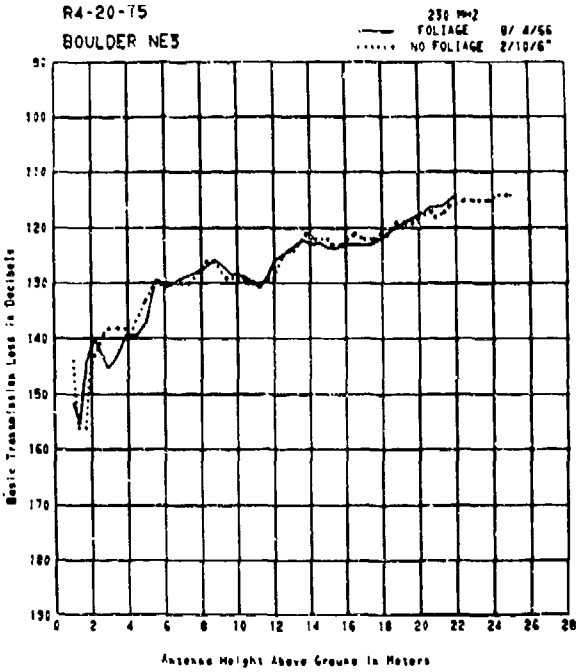
RCVR. ELEV. 1503 M | R4-20-T5 PATH LENGTH 16.196 km | XMTR. ELEV. 1612 M

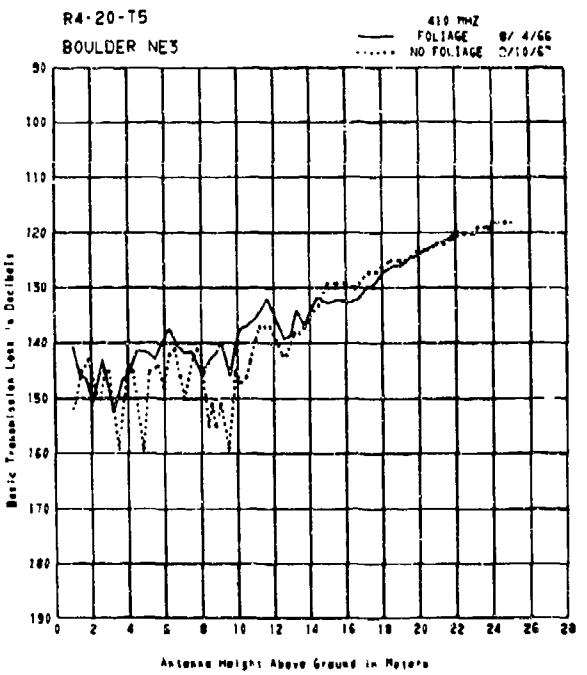


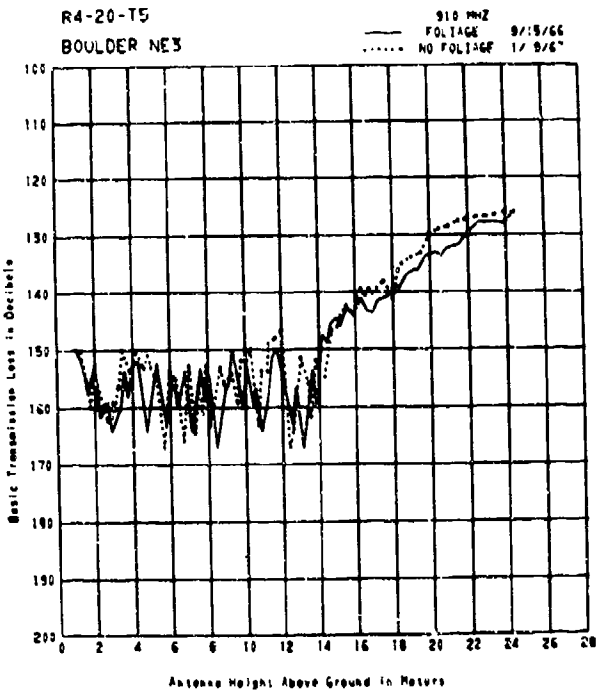
L_b (dB) SHORT TERM SIGNAL VARIABILITY

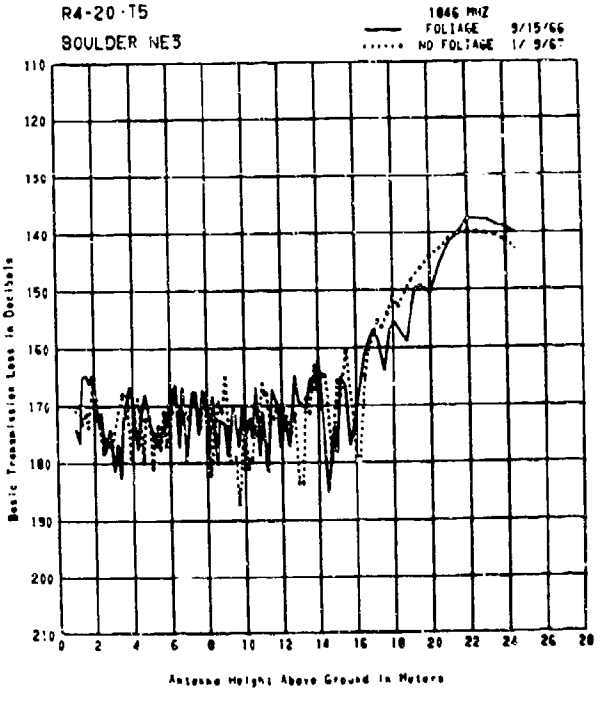
Freq(MHz)	230	410	910	1846	4595	9190
	8-4-66 at 1M			9-15-66 at 1M		
50%	153.5	146.8	149.3	175.3	187.2	197.9
Δ10%-90%	<3	<3	<3	<3	<3	<3
	8-4-66 at 11M			9-15-66 at 7.3M		
50%	128.6	142.5	156.8	168.3	192.7	
Δ10%-90%	<3	<3	<3	<3	<3	
	8-4-66 at 22M			9-15-66 at 14M		
50%	114.6	119.2	155.3	163.3	195.4	
Δ10%-90%	<3	<3	<3	<3	4.7	
				9-15-66 at 24.5M		
50%				138.9	148.2	154.9
Δ10%-90%				<3	<3	<3

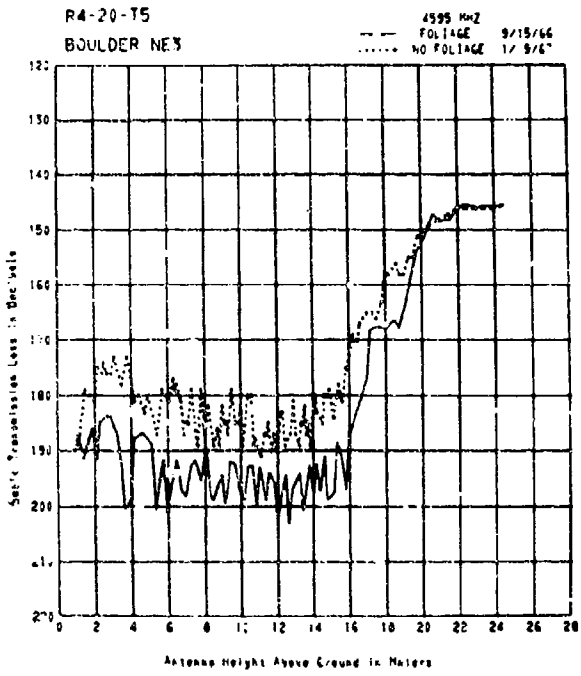
Immediately in front of the antennas, about 25 m away, a 3-wire power line crosses the path. About 1 km away, the path crosses Boulder, Reservoir. The terrain slopes gently downward toward the receiver. The horizon appears to be formed by scattered trees and buildings on the far shore of the reservoir.

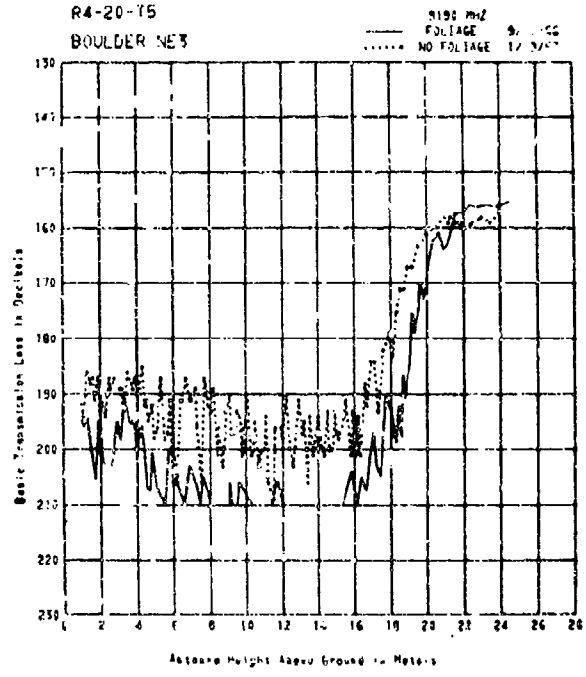

R4-20-T5
BOULDER NE3
238 MHZ
FOLIAGE
NO FOLIAGE
Basic Transmission Loss in Decibels
90
100
110
120
130
140
150
160
170
180
190
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
Antenna Height Above Ground in Meters


R4-20-T5
BOULDER NE3
410 MHZ
FOLIAGE
NO FOLIAGE
Basic Transmission Loss in Decibels
90
100
110
120
130
140
150
160
170
180
190
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
Antenna Height Above Ground in Meters


R4-20-T5
BOULDER NE3
910 MHZ
FOLIAGE 9/15/66
NO FOLIAGE 1/ 9/67
Basic Transmission Loss in Decibels
100
110
120
130
140
150
160
170
180
190
200
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-20-T5
BOULDER NE3
1846 MHZ
FOLIAGE 9/15/66
NO FOLIAGE 1/ 9/67
Basic Transmission Loss in Decibels
110
120
130
140
150
160
170
180
190
200
210
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-20-T5
BOULDER NE3
4595 MHZ
FOLIAGE
NO FOLIAGE
9/15/66
130
140
150
160
180
190
200
0
2
4
6
8
12
14
16
18
20
22
24
26
28
Antenna Height Above Ground in Meters

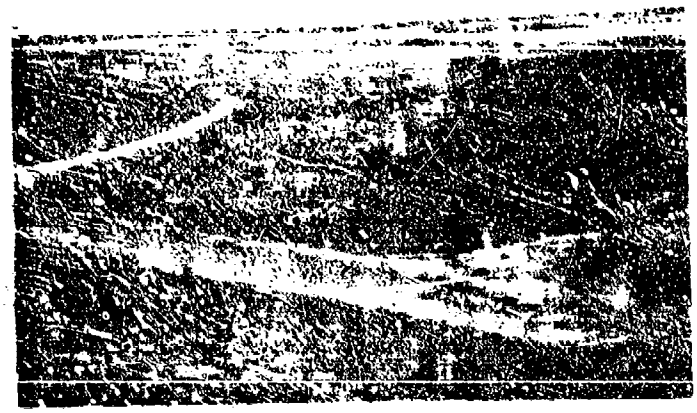

R4-20-T5
BOULDER NE3
FOLIAGE
NO FOLIAGE
130
160
170
180
190
200
220
230
2
4
6
8
10
12
16
18
20
22
24
26
28

R4-20-T5

L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
	2-10-67 at 25 M			1-9-67 at 1 M		
50%	114.2	117.5	148.4	169.5	191.2	192.1
Δ10% - 90%	< 3	< 3	< 3	< 3	< 3	< 3
				1-9-67 at 7.3 M		
50%			162.9	170.0	181.2	
Δ10% - 90%			< 3	< 3	< 3	

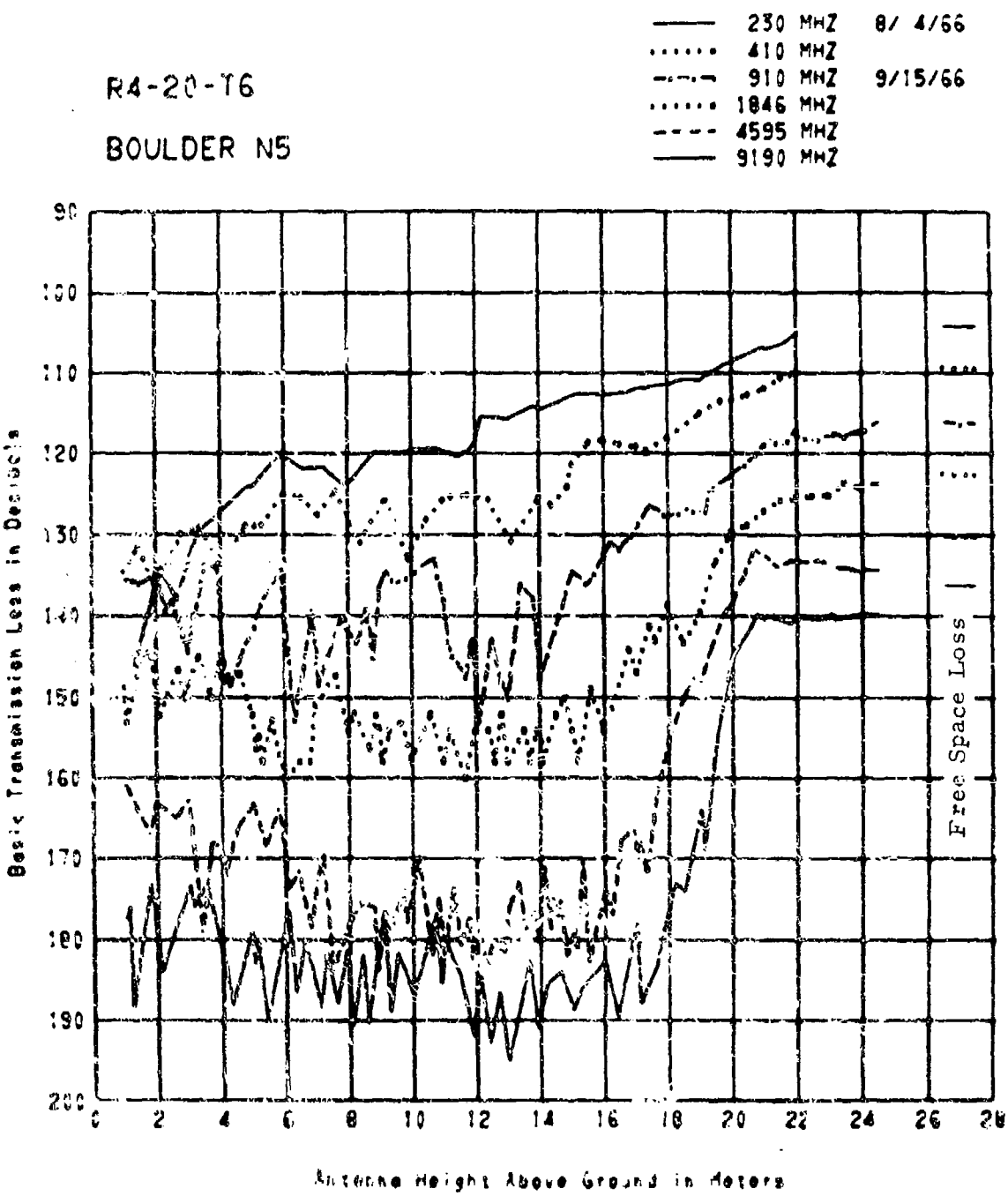
R4-20-T6
BOULDER N 5



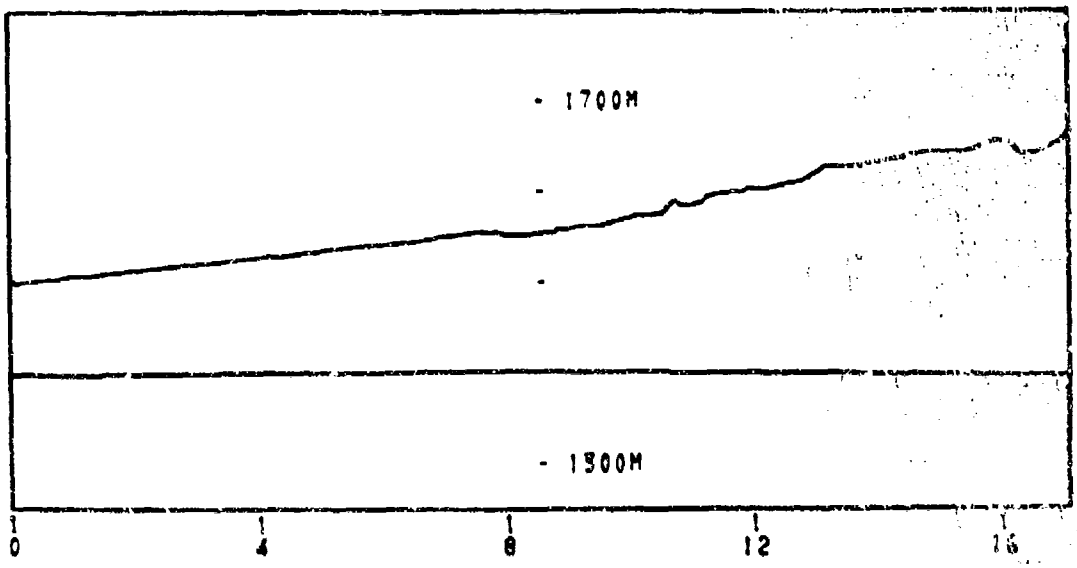
PATH VIEW FROM TRANSMITTER

Bearing from common receiver site to transmitter site is

250° 07' 22"


230 MHZ 8/ 4/66
410 MHZ
910 MHZ 9/15/66
1846 MHZ
4595 MHZ
9190 MHZ
R4-20-T6
BOULDER N5
Basic Transmission Loss in Decibels
90
100
110
120
130
140
150
160
170
180
190
200
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
Antenna Height Above Ground in Meters
Free Space Loss

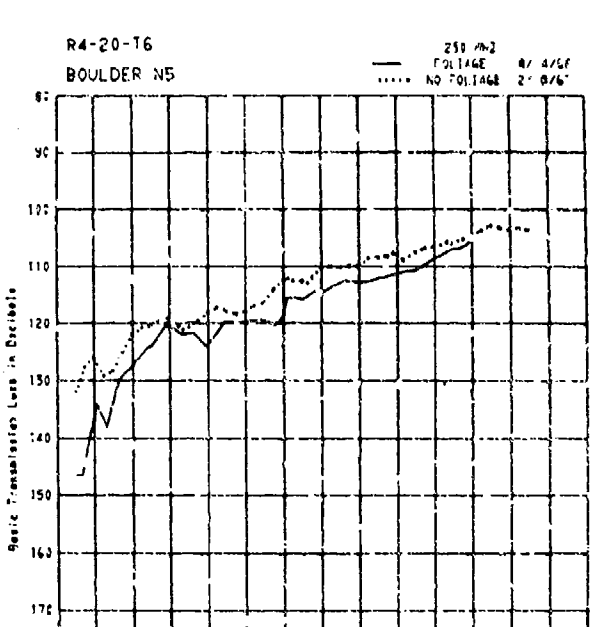
RCVR. ELEV. 1503 M | R4-20-T6 PATH LENGTH 17.038 km | XMTR. ELEV. 1679 M

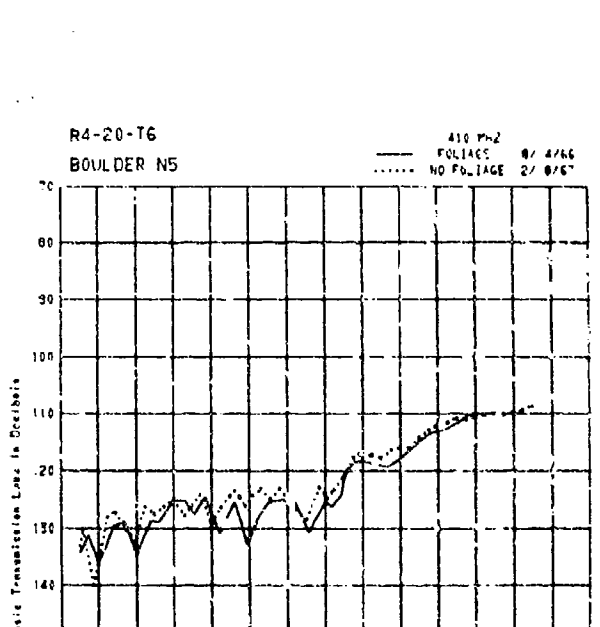


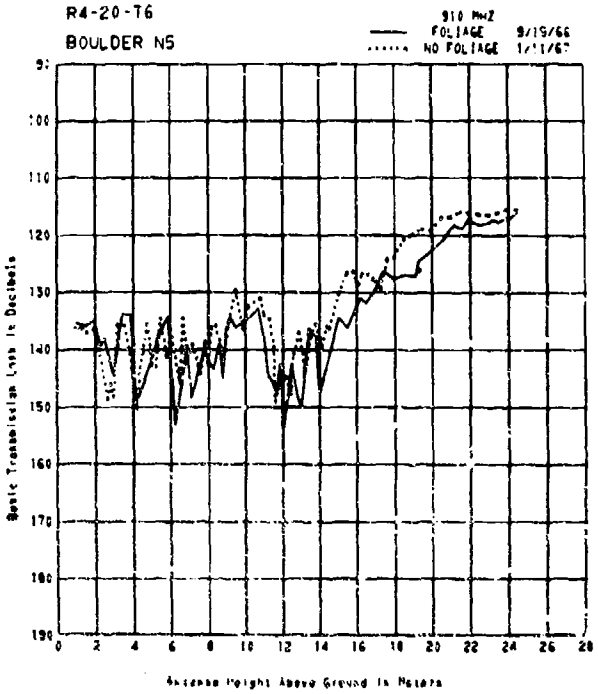
L_b (dB) SHORT TERM SIGNAL VARIABILITY

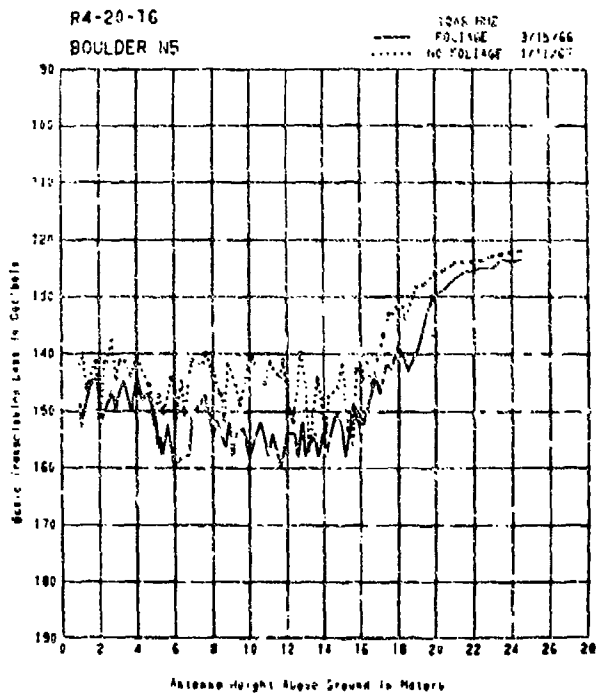
Freq(MHz)	230	410	910	1846	4595	9190
	8-4-66 at 1M			9-15-66 at 1M		
50%	144.6	133.9	135.1	150.3	161.4	178.1
Δ10%-90%	7.6	<3	<3	<3	<3	5.0
	8-4-66 at 11M			9-15-66 at 7.3M		
50%	115.6	125.0	151.3	147.1	172.2	182.0
Δ10%-90%	<3	<3	<3	<3	4.9	4.6
	8-4-66 at 22M			9-15-66 at 14M		
50%	104.6	109.8	145.3	157.3	181.3	187.4
Δ10%-90%	<3	<3	<3	<3	5.4	7.2
				9-15-66 at 24.5M		
50%			161.1	123.4	139.4	139.7
Δ10%-90%			<3	<3	<3	<3

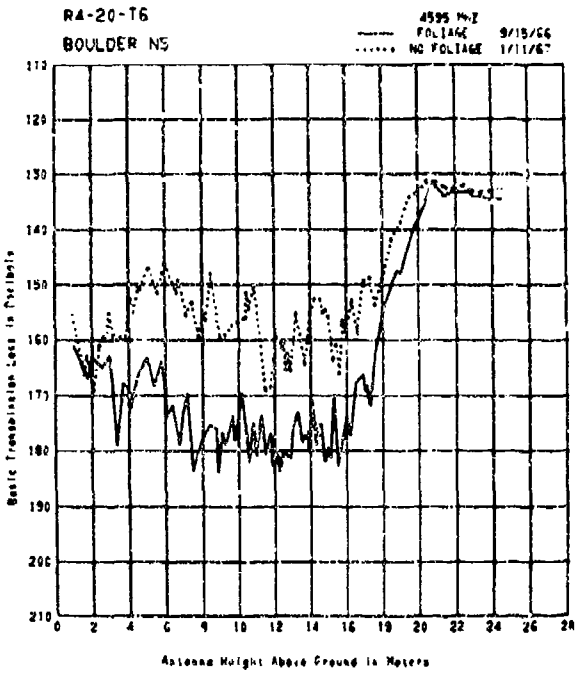
The foreground of this path drops off rapidly for about 450 m. Immediately to the right of the path, about 2 km away, is Haystack Mountain, and to the left is Table Mountain, both of which rise above the apparent line-of-sight path to the receiver. The apparent horizon is formed by a line of trees about 2.5 km away.

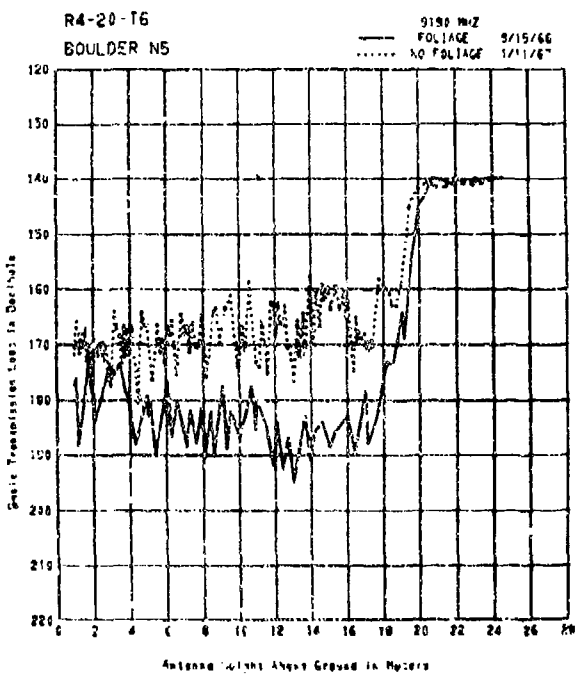

R4-20-T6
BOULDER N5
250 Mhz
FOLIAGE
NO FOLIAGE
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-20-T6
BOULDER N5
410 Mhz
FOLIAGE
NO FOLIAGE
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-20-16
BOULDER N5
910 MHZ
FOLIAGE 9/15/66
NO FOLIAGE 1/11/67
90
100
110
120
130
140
150
160
170
180
190
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-20-16
BOULDER N5
1046 MHZ
FOLIAGE 9/15/66
NO FOLIAGE 1/11/67
90
100
110
120
130
140
150
160
170
180
190
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-20-T6
BOULDER N5
4595 MHZ
FOLIAGE 9/15/66
NO FOLIAGE 1/11/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters

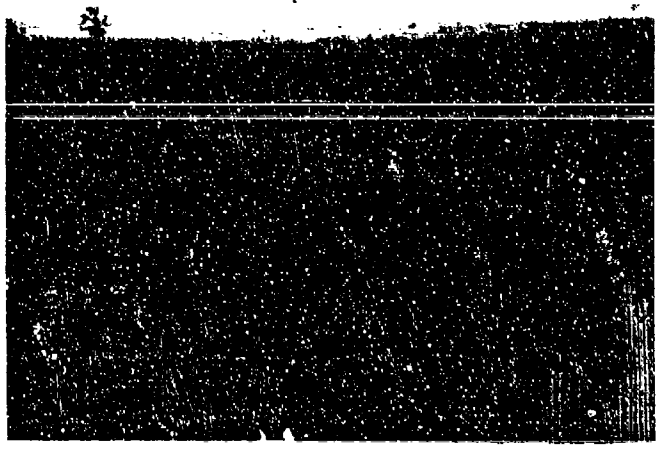

R4-20-T6
BOULDER N5
9190 MHZ
FOLIAGE 9/15/66
NO FOLIAGE 1/11/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters

R4-20-T6

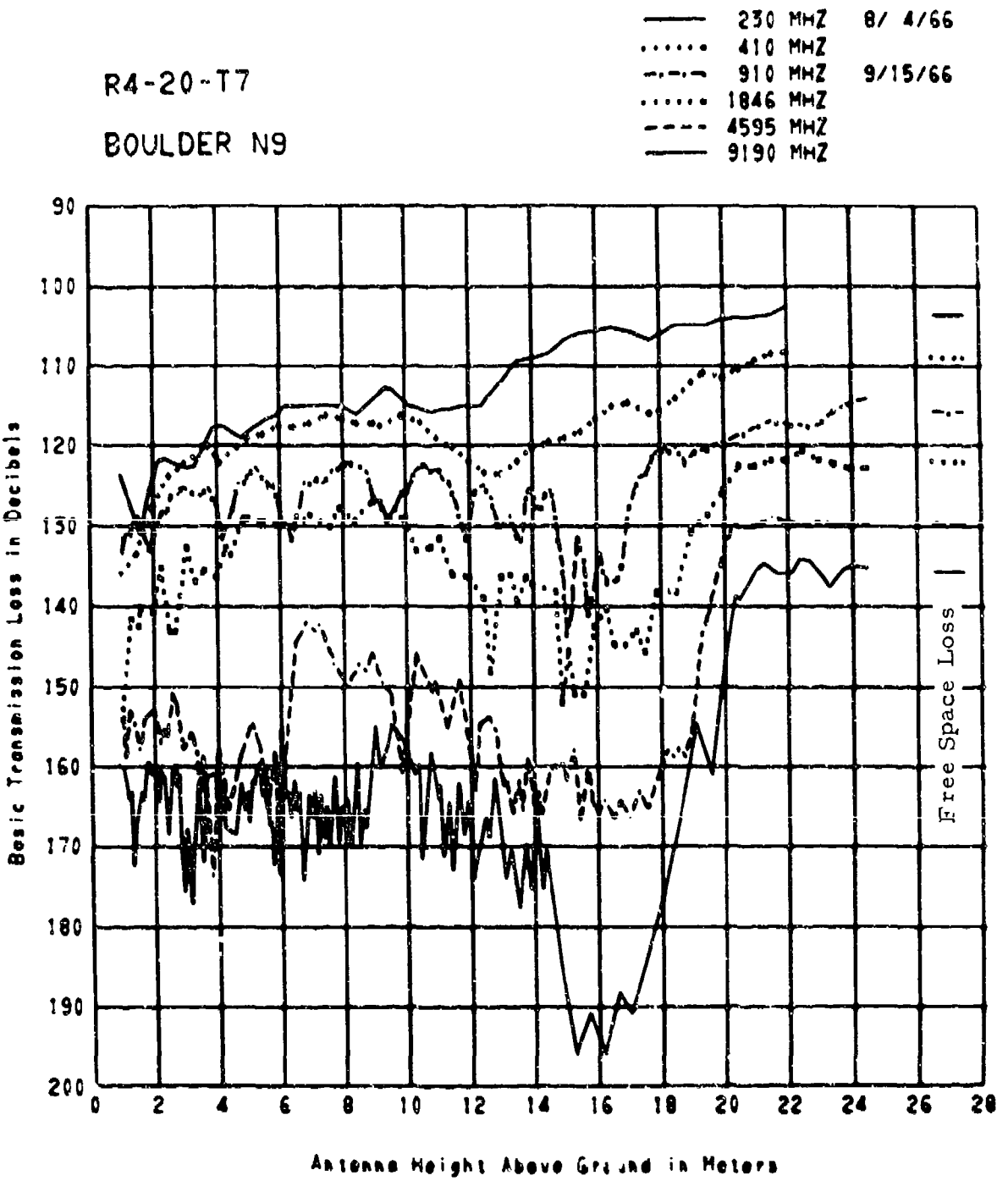
L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
	2-8-67 at 230 M			1-11-67 at 1 M		
50%	103.3	108.6	135.2	140.1	154.4	167.5
Δ10% - 90%	< 3	< 3	< 3	< 3	< 3	< 3
				1-11-67 at 7.3 M		
50%			135.9	138.1	154.9	168.6
Δ10% - 90%			< 3	< 3	< 3	4.2
				1-11-67 at 14 M		
50%			135.5	150.1	154.3	152.5
Δ10% - 90%			< 3	< 3	< 3	< 3
				1-11-67 at 24.5 M		
50%			114.7	122.5	131.9	134.5
Δ10% - 90%			< 3	< 3	< 3	< 3

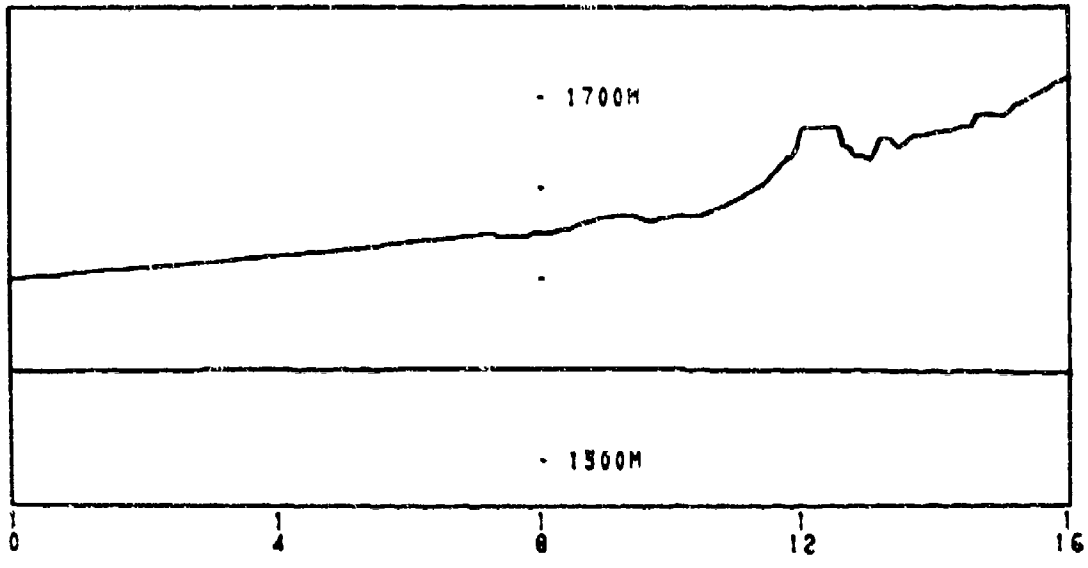
R4-20-T7
BOULDER N 9



PATH VIEW FROM TRANSMITTER
Bearing from common receiver site to transmitter site is
267° 09' 16"


230 MHZ 8/ 4/66
410 MHZ
910 MHZ 9/15/66
1846 MHZ
4595 MHZ
9190 MHZ
R4-20-T7
BOULDER N9
Basic Transmission Loss in Decibels
90
100
110
120
130
140
150
160
170
180
190
200
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
Antenna Height Above Ground in Meters
Free Space Loss

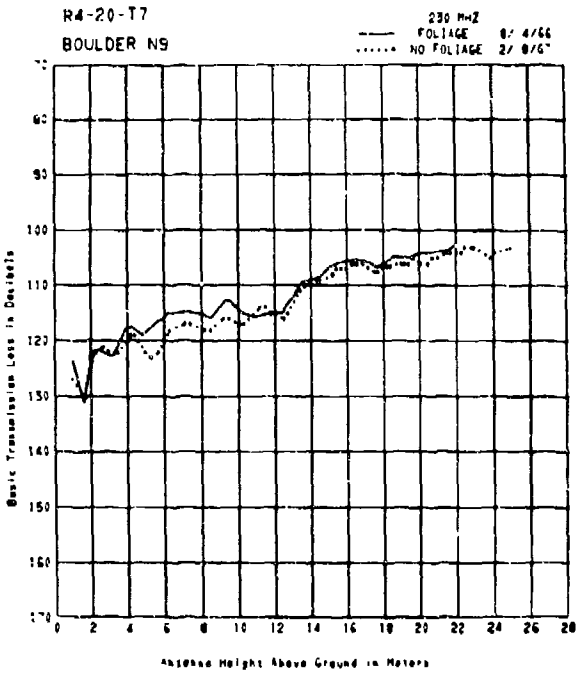
RCVR. ELEV. 1503 M | R4-20-T7 PATH LENGTH 16.023 km | XMTR. ELEV. 1725 M

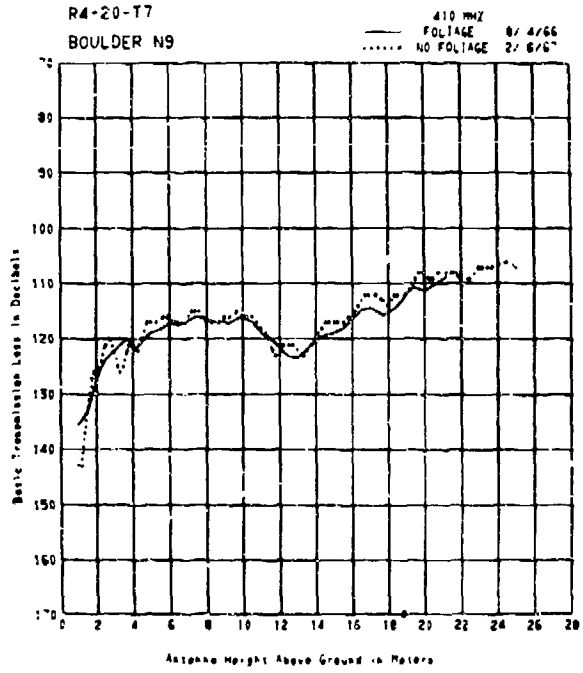


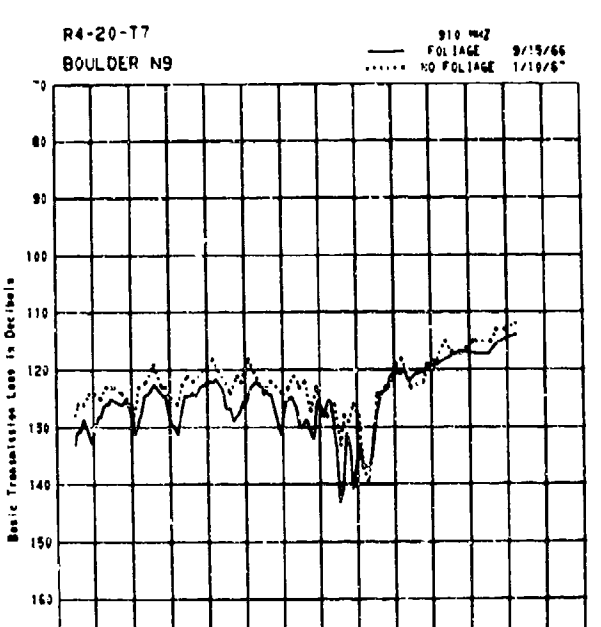
L_b (dB) SHORT TERM SIGNAL VARIABILITY

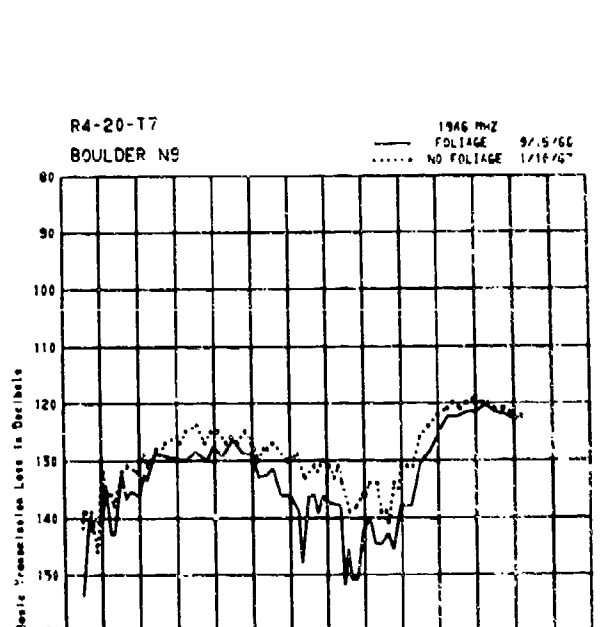
Freq(MHz)	230	410	910	1846	4595	9190
	8-4-66 at 1M			9-15-66 at 1M		
50%	122.2	141.0	135.3	153.8	153.7	158.4
Δ10%-90%	<3	<3	<3	<3	<3	<3
	8-4-66 at 11M			9-15-66 at 7.3M		
50%	113.9	124.0	125.8	129.9	142.2	165.9
Δ10%-90%	<3	<3	<3	<3	<3	4.5
	8-4-66 at 22M			9-15-66 at 14M		
50%	101.8	108.5	124.3	136.9	163.2	165.9
Δ10%-90%	<3	<3	<3	<3	<3	<3
				9-15-66 at 24.5M		
50%			114.3	122.9	129.7	135.9
Δ10%-90%			<3	<3	<3	<3

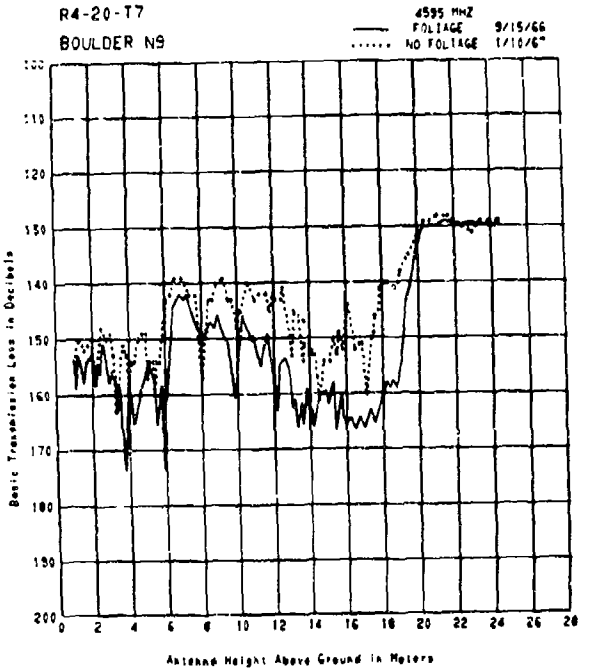
The immediate foreground is grassy pasture. The ground slopes downward and away from the transmitter. A 4-wire power line is about 6 m from the antennas, with the lowest wire at the same height as the antennas.

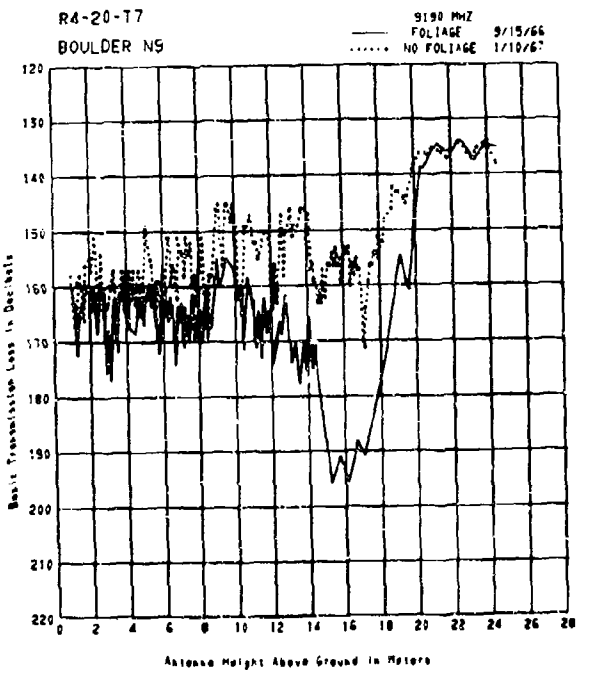

R4-20-T7
BOULDER N9
230 MHZ
FOLIAGE
NO FOLIAGE
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-20-T7
BOULDER N9
410 MHZ
FOLIAGE
NO FOLIAGE
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-20-T7
BOULDER N9
910 MHZ
FOLIAGE 9/15/66
NO FOLIAGE 1/10/67
Basic Transmission Loss in Decibels
80
90
100
110
120
130
140
150
160
170
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-20-T7
BOULDER N9
1946 MHZ
FOLIAGE 9/15/66
NO FOLIAGE 1/10/67
Basic Transmission Loss in Decibels
80
90
100
110
120
130
140
150
160
170
180
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-20-T7
BOULDER N9
4595 MHZ
FOLIAGE 9/15/66
NO FOLIAGE 1/10/67
Basic Transmission Loss in Decibels
110
120
130
140
150
160
170
180
190
200
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters

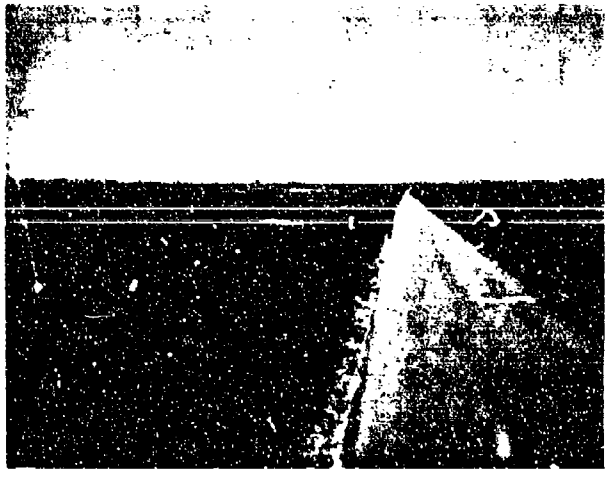

R4-20-T7
BOULDER N9
9190 MHZ
FOLIAGE 9/15/66
NO FOLIAGE 1/10/67
Basic Transmission Loss in Decibels
120
130
140
150
160
170
180
190
200
210
220
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters

R4-20-[illegible]7

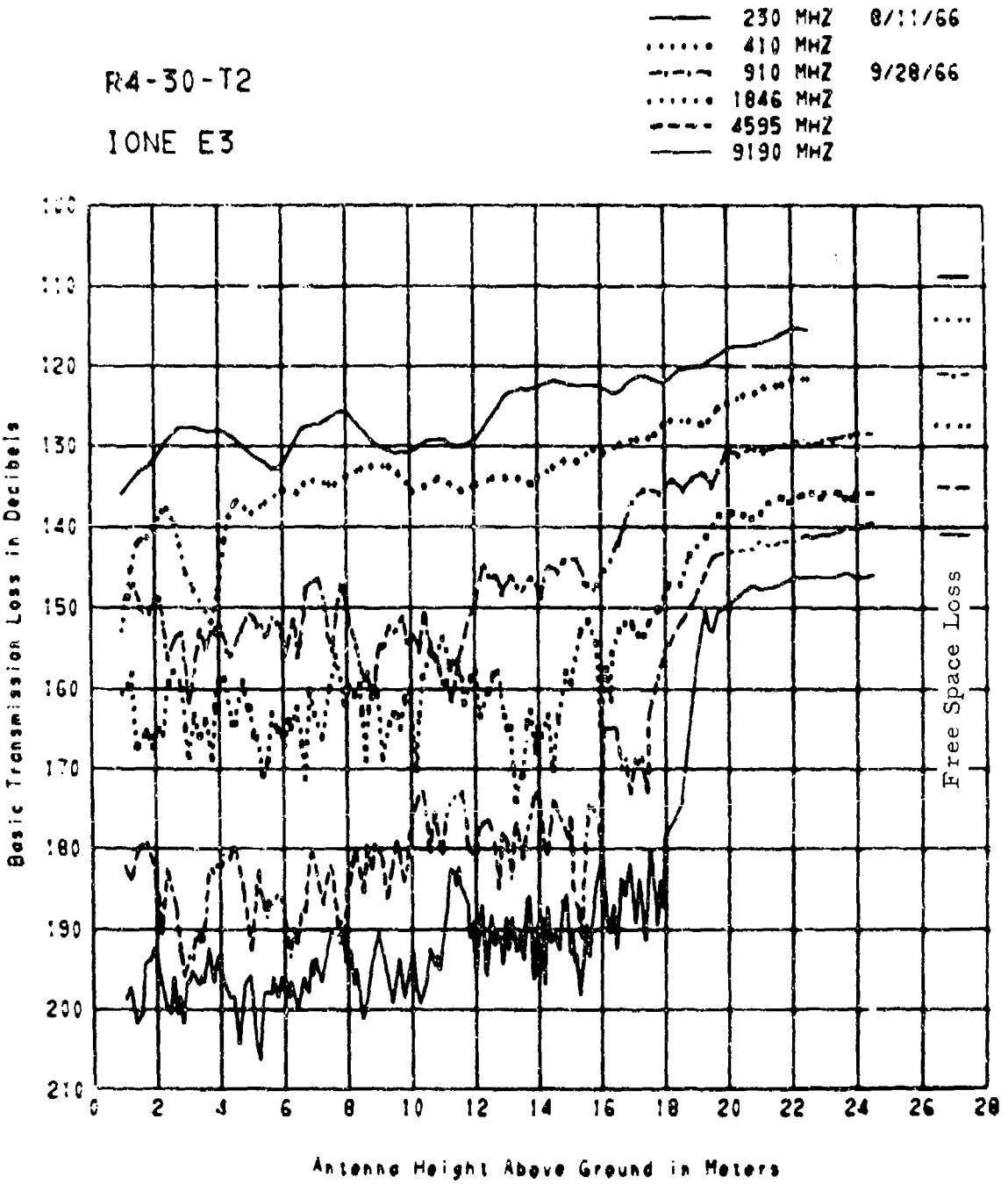
L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
	2-8-67 at 25 M			1-10-67 at 7.3 M		
50%	103.5	106.8	121.2	126.1	141.3	150.4
Δ 10% - 90%	< 3	< 3	< 3	< 3	< 3	< 3

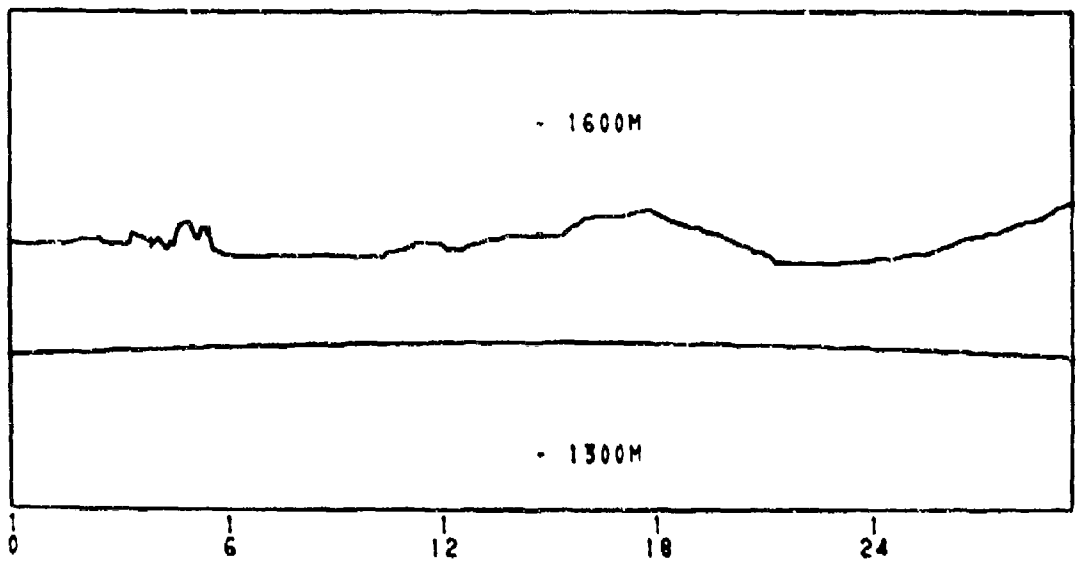
R4-30-T2
IONE E 3



PATH VIEW FROM TRANSMITTER
Bearing from common receiver site to transmitter site is
92° 04' 56"


230 MHZ 8/11/66
410 MHZ
910 MHZ 9/28/66
1846 MHZ
4595 MHZ
9190 MHZ
R4-30-T2
IONE E3
Basic Transmission Loss in Decibels
Free Space Loss
Antenna Height Above Ground in Meters
110
120
130
140
150
160
170
180
190
200
210
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28

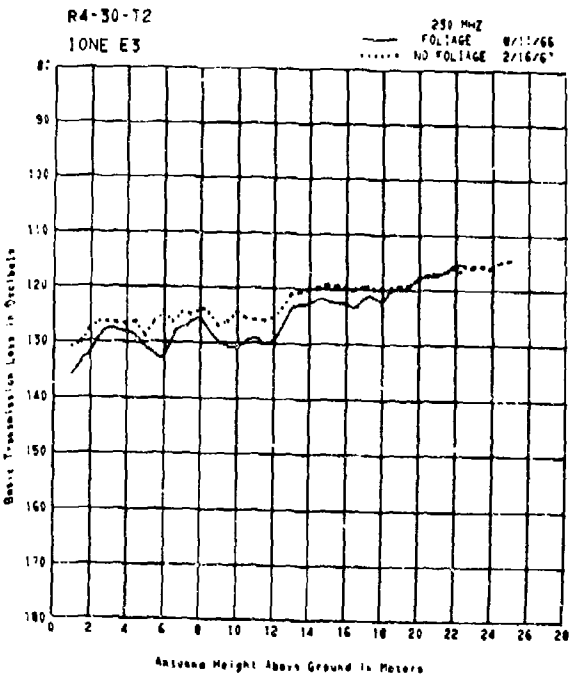
RCVR. ELEV. 1503 M | R4-30-T2 PATH LENGTH 29.451 km | XMTR. ELEV. 1540 M

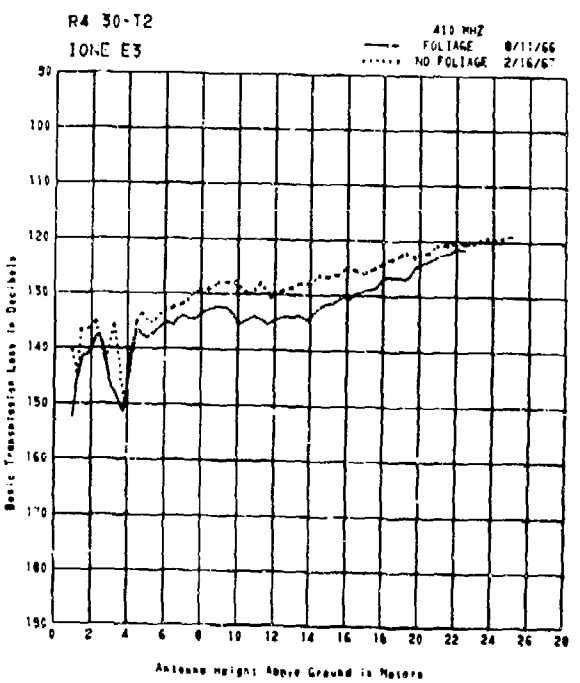


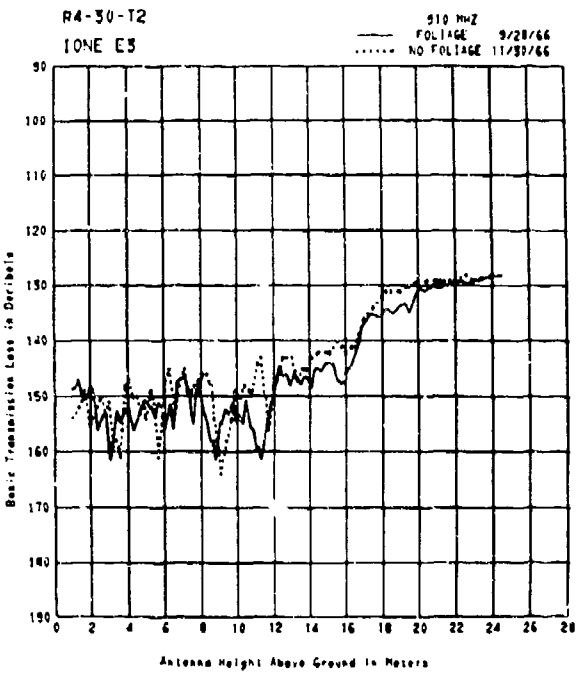
L_b (dB) SHORT TERM SIGNAL VARIABILITY

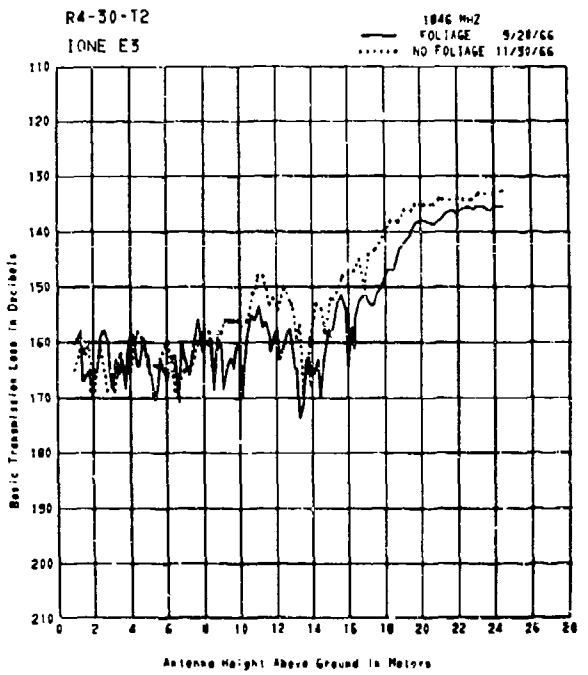
Freq(MHz)	230	410	910	1846	4595	9190
	8-11-66 at 1M			9-28-66 at 1M		
50%	135.8	151.4	150.5	157.8	186.4	197.1
Δ10%-90%	<3	3.1	<3	3.0	9.2	8.3
	8-11-66 at 11M			9-28-66 at 7.3M		
50%	131.2	132.9	145.1	159.2	189.0	189.5
Δ10%-90%	<3	<3	<3	<3	<3	3.5
	8-11-66 at 22M			9-28-66 at 14M		
50%	115.8	119.2	143.6	170.3	173.6	188.1
Δ10%-90%	<3	<3	<3	12.8	<3	4.5
				9-28-66 at 24.5M		
50%			126.6	134.1	140.1	145.6
Δ10%-90%			<3	<3	<3	<3

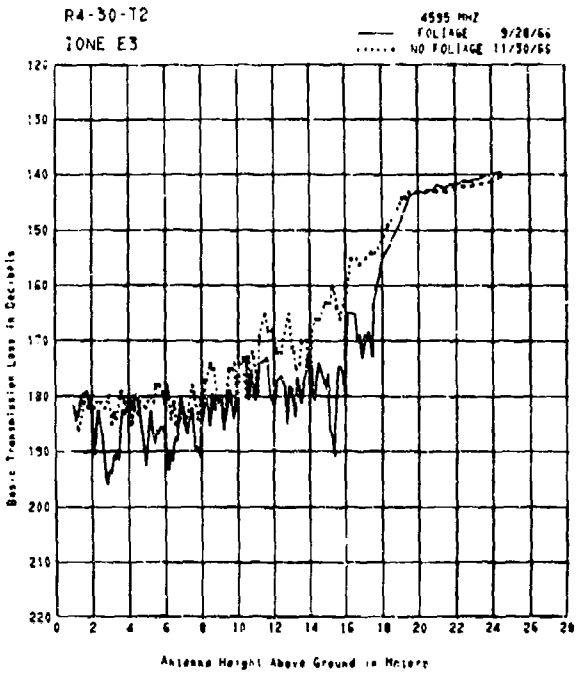
The apparent horizon is about 10 km from the transmitter. Scattered trees grow in a valley about 3 km away. Freshly plowed fields are in the immediate foreground.

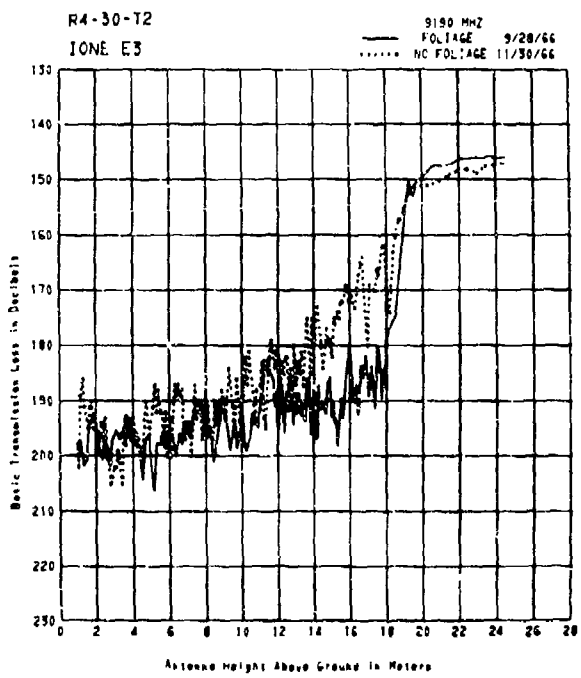

R4-30-T2
IONE E3
250 MHZ
FOLIAGE
NO FOLIAGE
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4 30-T2
IONE E3
410 MHZ
FOLIAGE
NO FOLIAGE
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-30-T2
IONE E3
910 MHZ
FOLIAGE 9/28/66
NO FOLIAGE 11/30/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-30-T2
IONE E3
1846 MHZ
FOLIAGE 9/28/66
NO FOLIAGE 11/30/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-30-T2
ZONE E3
4595 MHZ
FOLIAGE 9/28/66
NO FOLIAGE 11/30/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-30-T2
ZONE E3
9190 MHZ
FOLIAGE 9/28/66
NO FOLIAGE 11/30/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters

R4-30-T2

L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
	2-10-67 at 25 M			11-30-66 at 1 M		
50%	11[illegible].1	119.0	152.9	163.6	182.8	200.0
Δ10% - 90%	< 3	< 3	< 3	< 3	< 3	< 3
				11-30-66 at 7.3 M		
50%			151.9	166.6	182.3	185.0
Δ10% - 90%			< 3	< 3	< 3	< 3
				11-30-66 at 14 M		
50%			142.4	159.4	172.3	181.3
Δ10% - 90%			< 3	< 3	< 3	6.3
				11-30-66 at 24.5 M		
50%			126.5	133.1	141.3	136.0
Δ10% - 90%			< 3	< 3	< 3	< 3

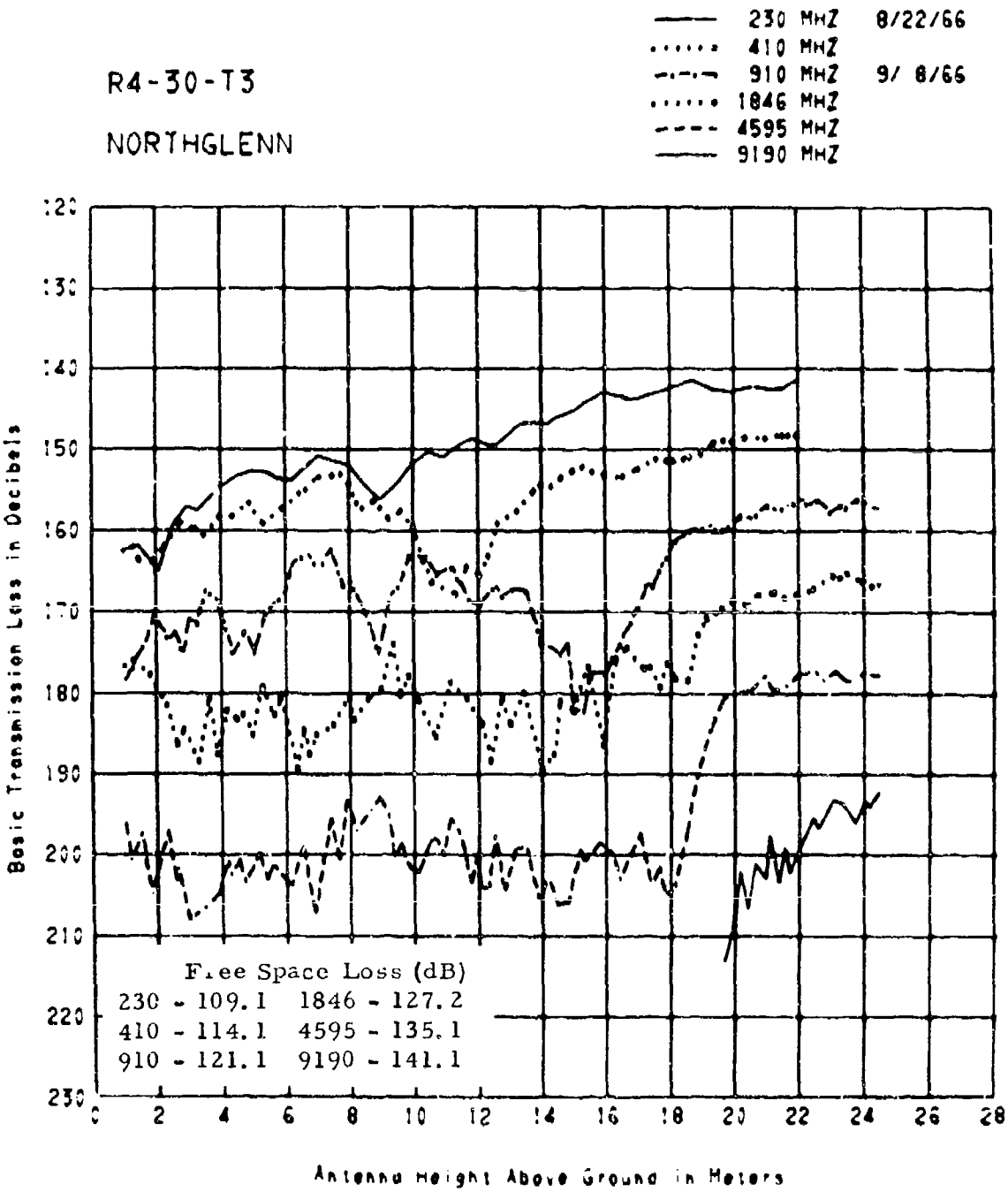
R4-30-T3
NORTHGLENN



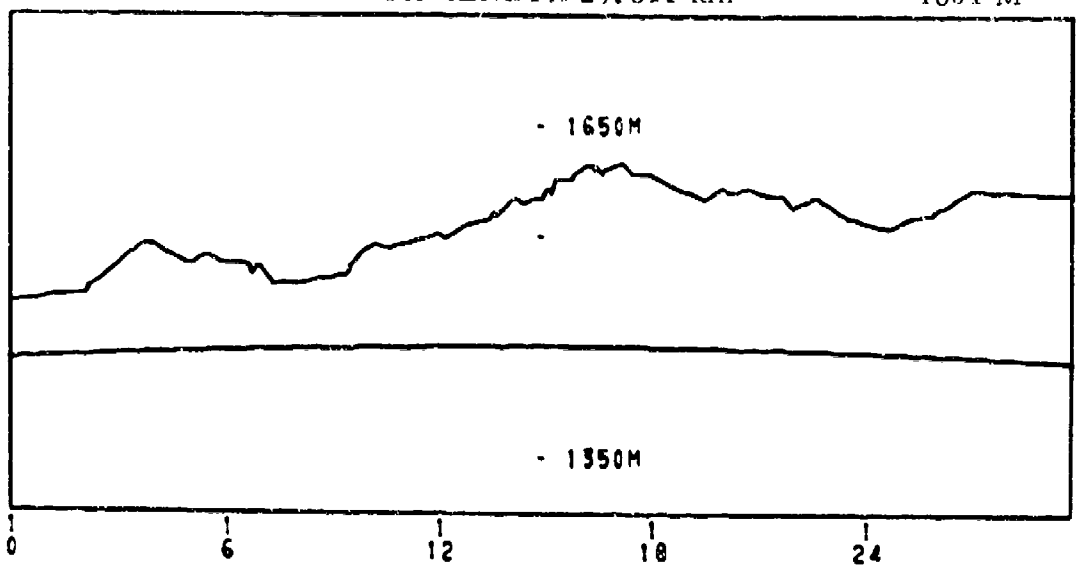
PATH VIEW FROM TRANSMITTER
Bearing from common receiver site to transmitter site is
155° 33' 01"

R4-30-T3

NORTHGLENN



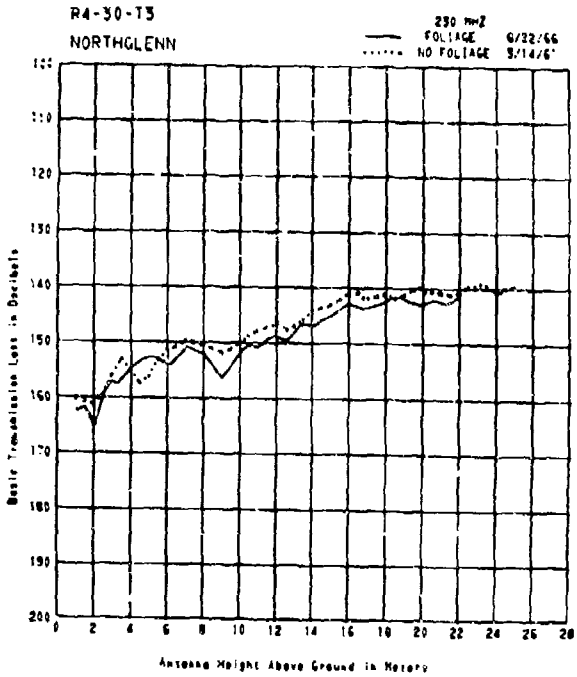
RCVR. ELEV. 1503 M | R4-30-T3 PATH LENGTH 29.611 km | XMTR. ELEV. 1601 M

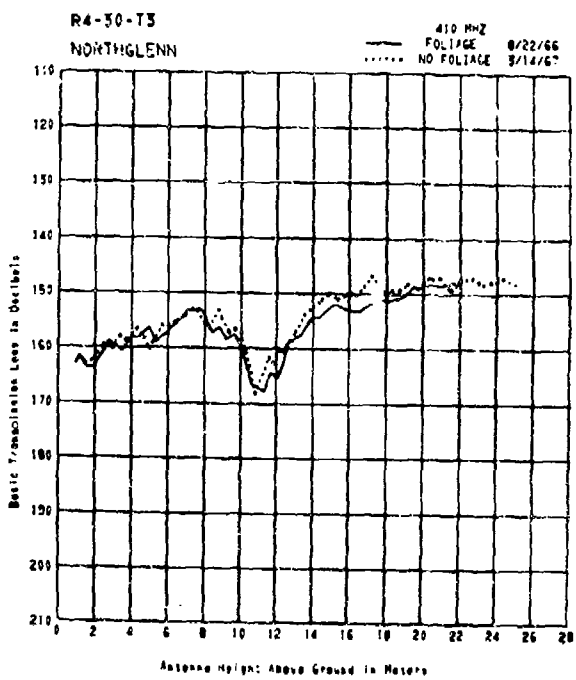


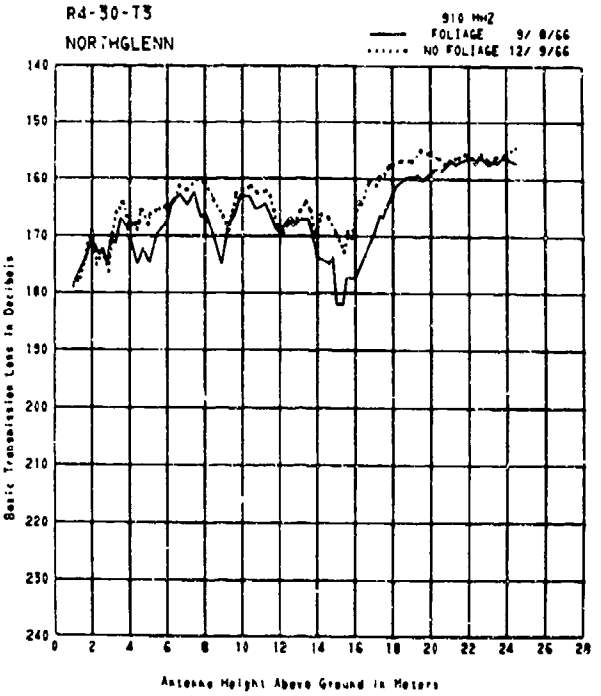
L_b (dB) SHORT TERM SIGNAL VARIABILITY

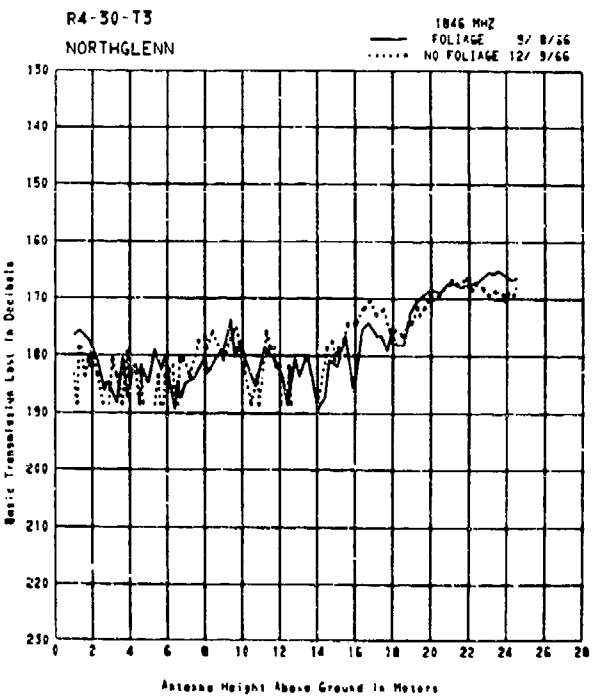
Freq(MHz)	230	410	910	1846	4595	9190
	8-22-66 at 1M			9-8-66 at 1M		
50%		165.7	178.8	178.3	199.0	
Δ10%-90%		<3	<3	3.0	6.5	
				9-8-66 at 7.3M		
50%			163.8	180.3	196.4	
Δ10%-90%			<3	6.0	7.0	
				9-8-66 at 24.5M		
50%			156.3	166.3	176.9	194.2
Δ10%-90%			<3	<3	4.5	9.5

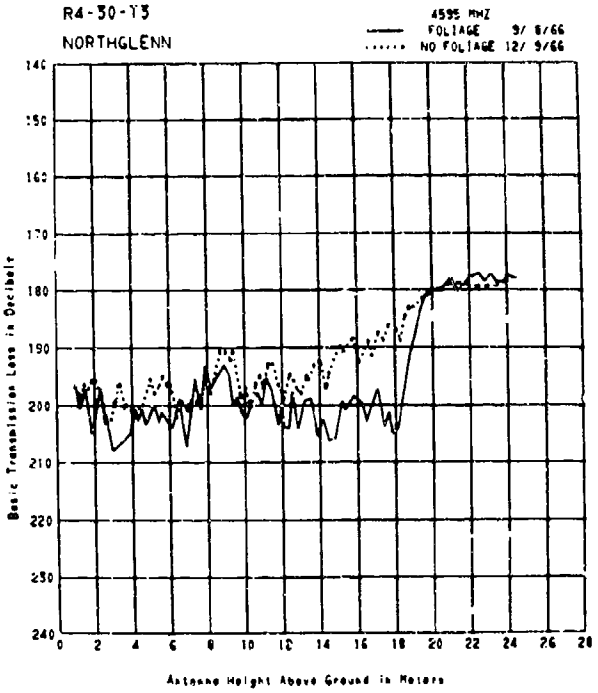
This transmitter site is on the edge of a housing development in which two houses, 75 m away, form the apparent horizon. Large trees are on either side of the path.

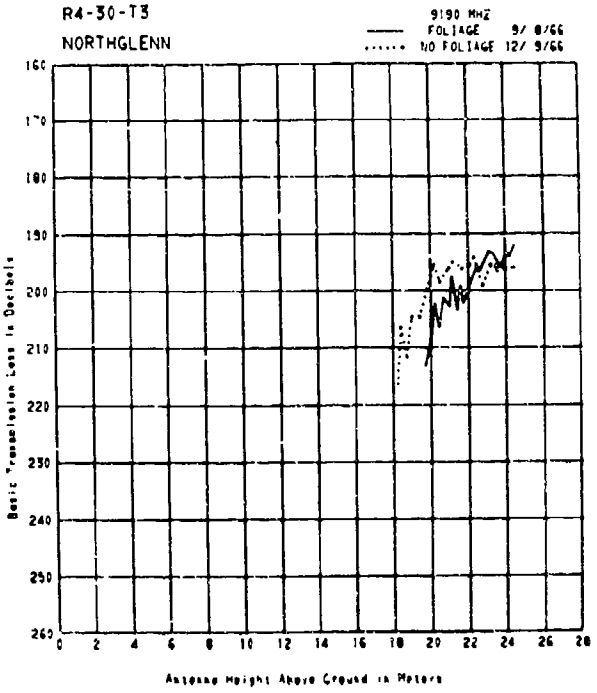

R4-30-T3
NORTHGLENN
230 MHZ
FOLIAGE 6/22/66
NO FOLIAGE 9/14/6
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-30-T3
NORTHGLENN
410 MHZ
FOLIAGE 8/22/66
NO FOLIAGE 9/14/6
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-30-T3
NORTHGLENN
910 MHZ
FOLIAGE 9/ 8/66
NO FOLIAGE 12/ 9/66
Basic Transmission Loss In Decibels
Antenna Height Above Ground In Meters


R4-30-T3
NORTHGLENN
1846 MHZ
FOLIAGE 9/ 8/66
NO FOLIAGE 12/ 9/66
Basic Transmission Loss In Decibels
Antenna Height Above Ground In Meters


R4-30-T3
NORTHGLENN
4595 MHZ
FOLIAGE 9/ 8/66
NO FOLIAGE 12/ 9/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-30-T3
NORTHGLENN
9190 MHZ
FOLIAGE 9/ 8/66
NO FOLIAGE 12/ 9/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters

R4-30-T3

L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
	3-14-67 at 25 M			12-9-66 at 1 M		
50%	139.4	148.4	173.5	183.4	196.3	
Δ10% - 90%	< 3	< 3	< 3	< 3	< 3	
				12-9-66 at 7.3 M		
50%			160.5	182.4	198.3	
Δ10% - 90%			< 3	< 3	< 3	
				12-9-66 at 14 M		
50%			169.0	183.4	192.3	
Δ10% - 90%			< 3	< 3	< 3	
				12-9-66 at 24.5 M		
50%			153.5	165.9	178.0	195.4
Δ10% - 90%			< 3	< 3	< 3	< 3

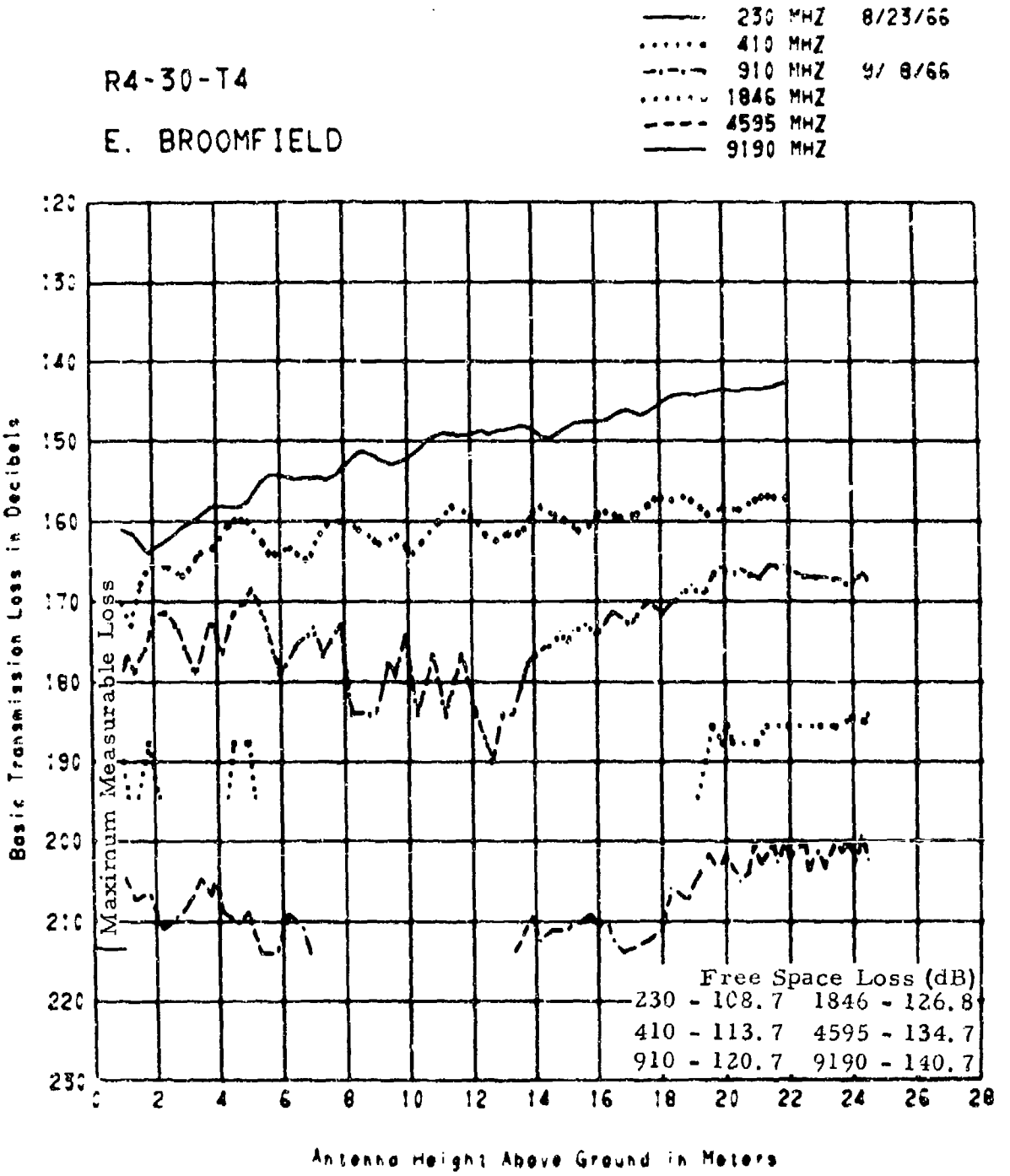
R4-30-T4
EAST BROOMFIELD



PATH VIEW FROM TRANSMITTER
Bearing from common receiver site to transmitter site is
176° 07' 40"

R4-30-T4

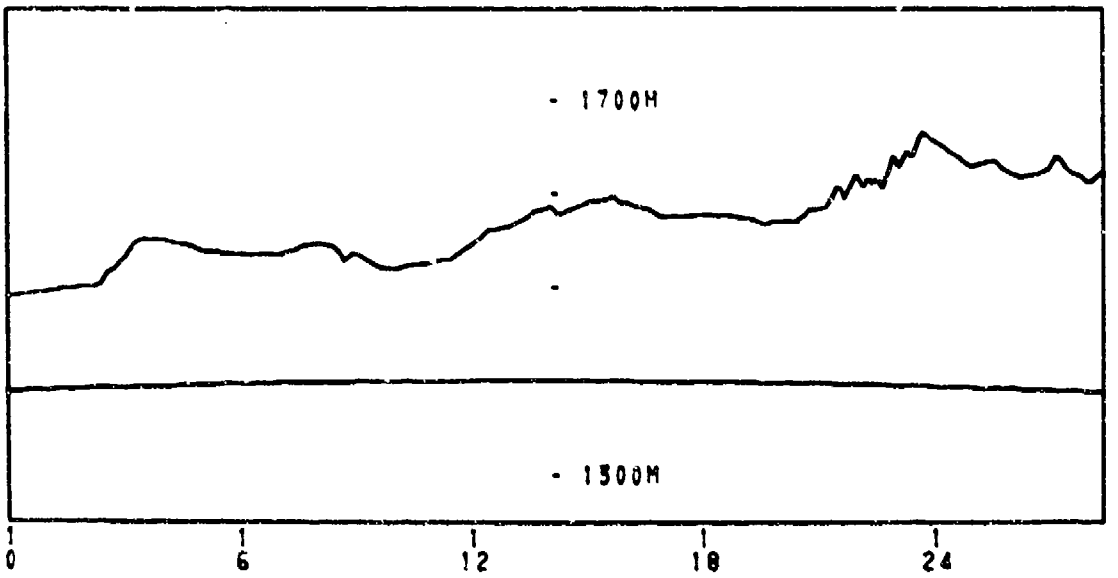
E. BROOMFIELD



RCVR. ELEV. 1503 M

R4-30-T4
PATH LENGTH 28.281 km

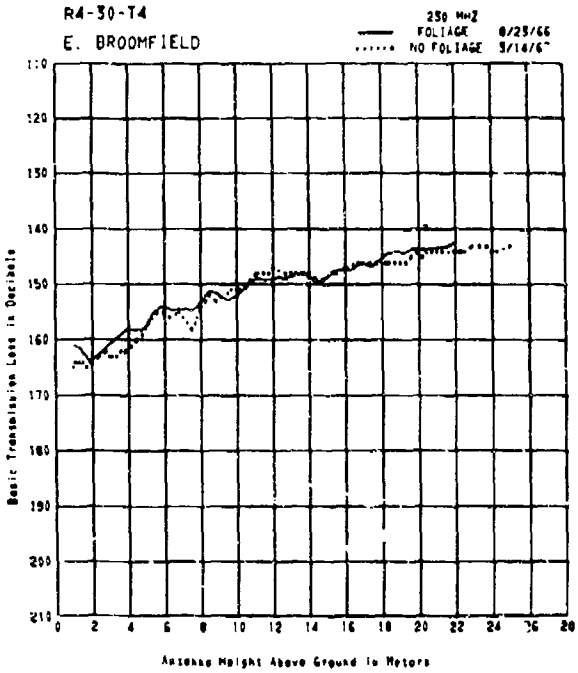
XMTR. ELEV. 1634 M

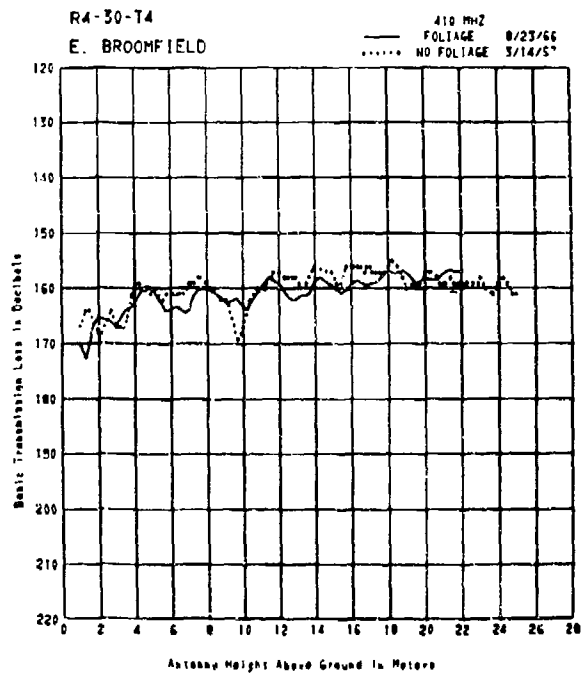


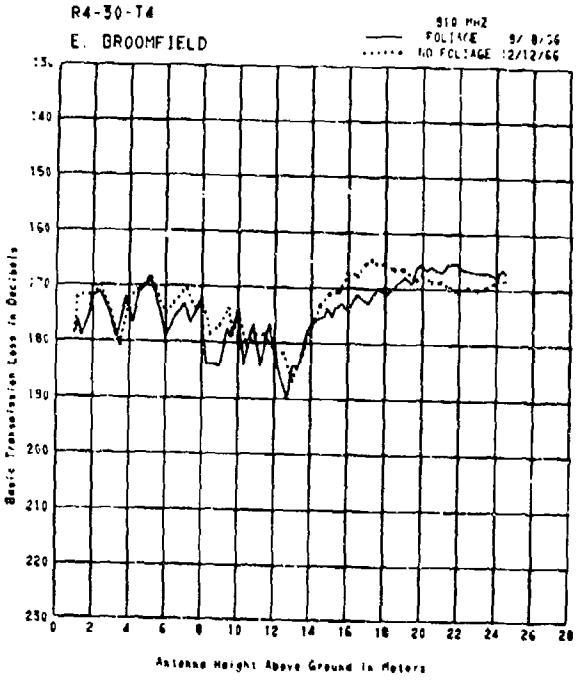
L_b (dB) SHORT TERM SIGNAL VARIABILITY

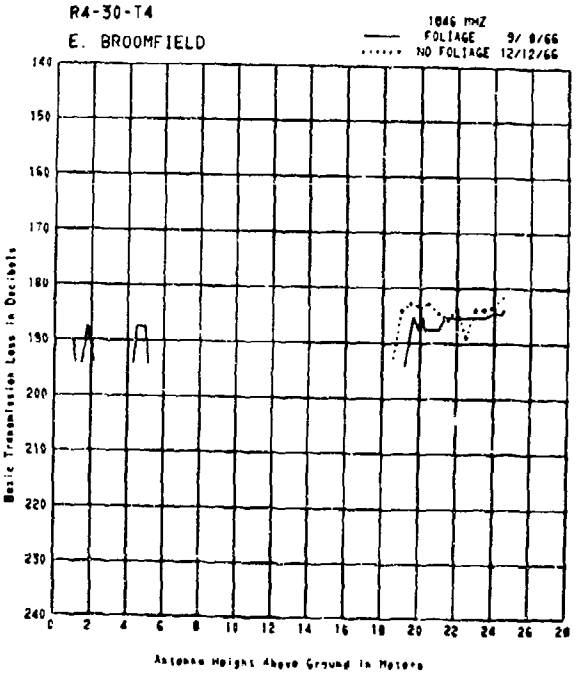
Freq(MHz)	230	410	910	1846	4595	9190
	8-23-66 at 22M			9-8-66 at 1M		
50%	142.6	158.9		189.3	206.2	
Δ10%-90%	<3	<3		<3	5.0	
				9-8-66 at 7.3M		
50%			175.1	192.3		
Δ10%-90%			<3	<3		
				9-8-66 at 24.5M		
50%			167.1	184.3	201.2	
Δ10%-90%			<3	<3	6.5	

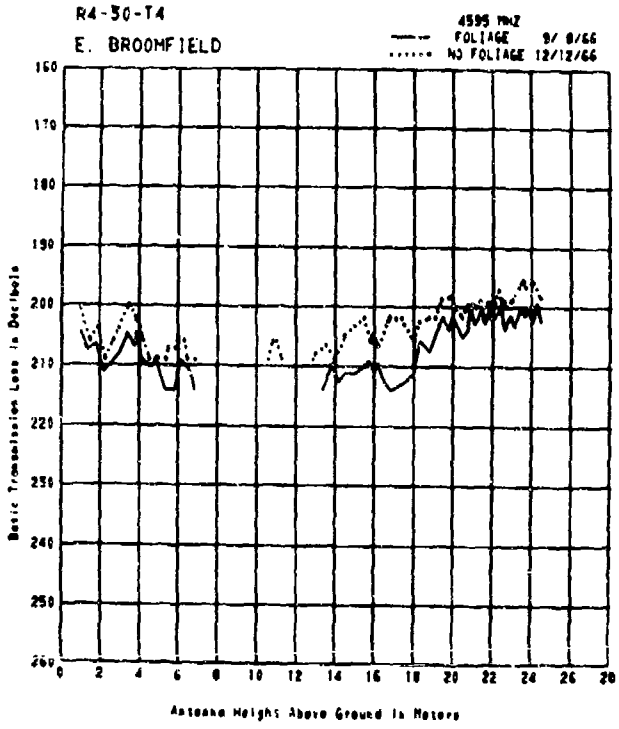
The path lies over a gravel road which runs off to the right of the path at an angle of about 10°. A 4-wire power line parallels the road and crosses the path, about 75 m away, at antenna height. A hill about 3 km away forms the horizon.


R4-30-T4
E. BROOMFIELD
250 MHZ
FOLIAGE 8/23/66
NO FOLIAGE 5/14/6
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-30-T4
E. BROOMFIELD
410 MHZ
FOLIAGE 8/23/66
NO FOLIAGE 5/14/5
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-30-T4
E. BROOMFIELD
910 MHZ
FOLIAGE 9/ 8/66
NO FOLIAGE 12/12/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-30-T4
E. BROOMFIELD
1846 MHZ
FOLIAGE 9/ 8/66
NO FOLIAGE 12/12/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters



R4-30-T4

L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
	3-14-67 at 25 M			12-12-66 at 1 M		
50%	143.0	160.2	179.7		202.7	
Δ10% - 90%	< 3	< 3	< 3		< 3	
				12-12-66 at 7.3 M		
50%			168.7			
Δ10% - 90%			< 3			
				12-12-66 at 24.5 M		
50%			164.2	181.0	197.7	
Δ10% - 90%			< 3	< 3	< 3	

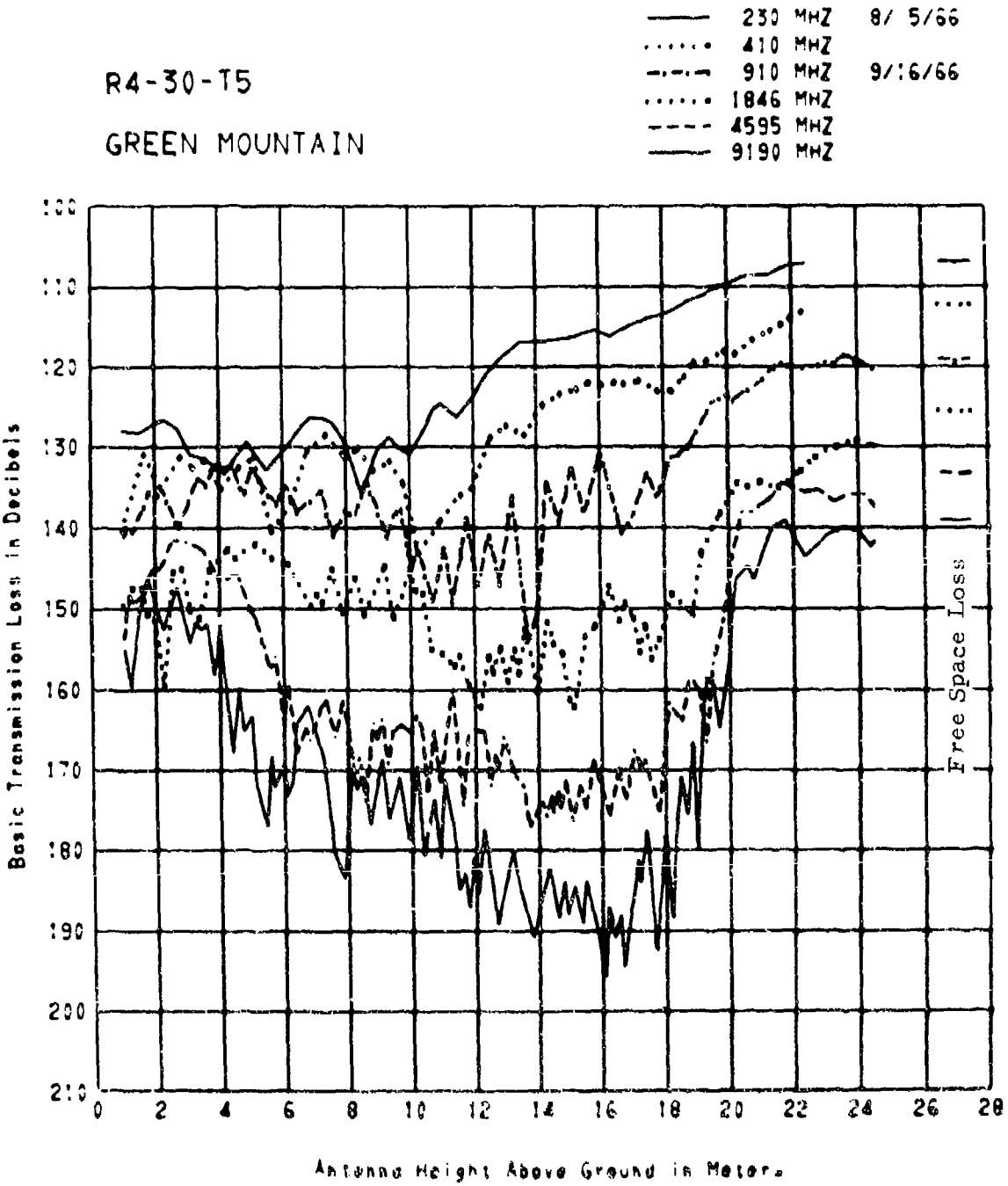
R4-30-T5
GREEN MOUNTAIN



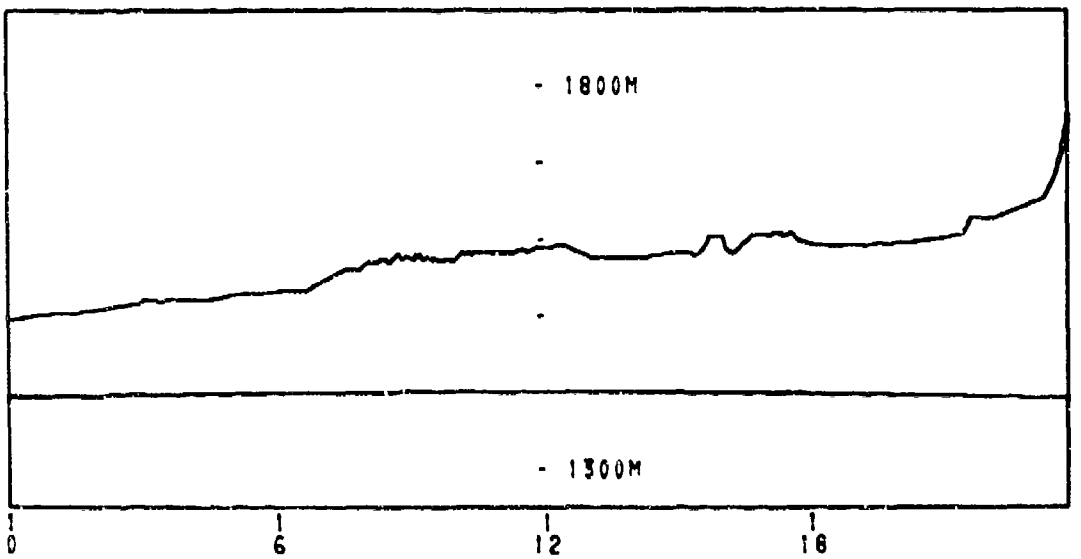
PATH VIEW FROM TRANSMITTER
Bearing from common receiver site to transmitter site is
220° 02' 09"

R4-30-T5

GREEN MOUNTAIN



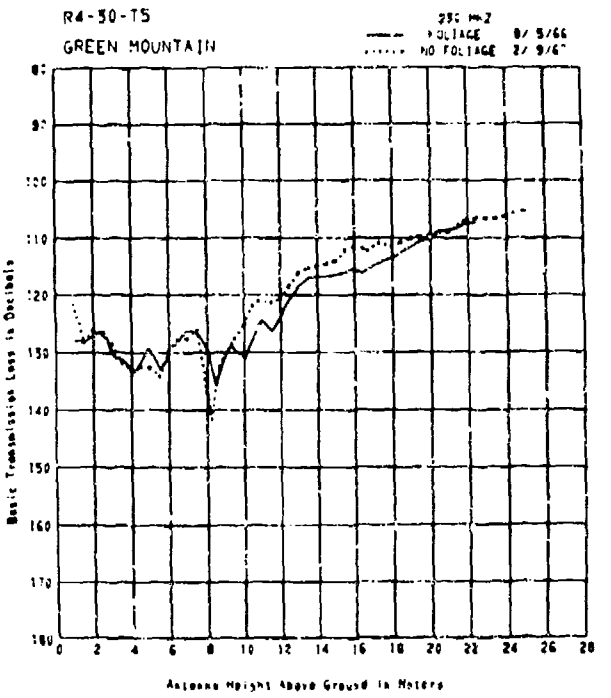
RCVR. ELEV. 1503 M | R4-30-T5 PATH LENGTH 23.714 km | XMTR. ELEV. 1796 M

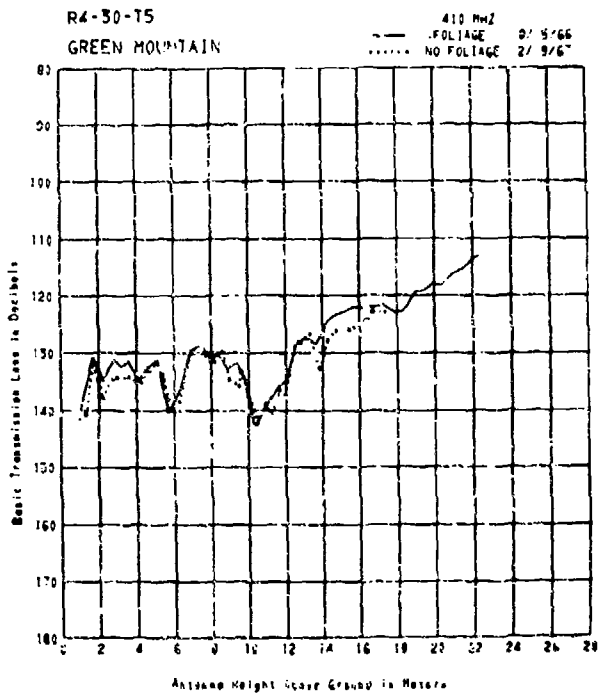


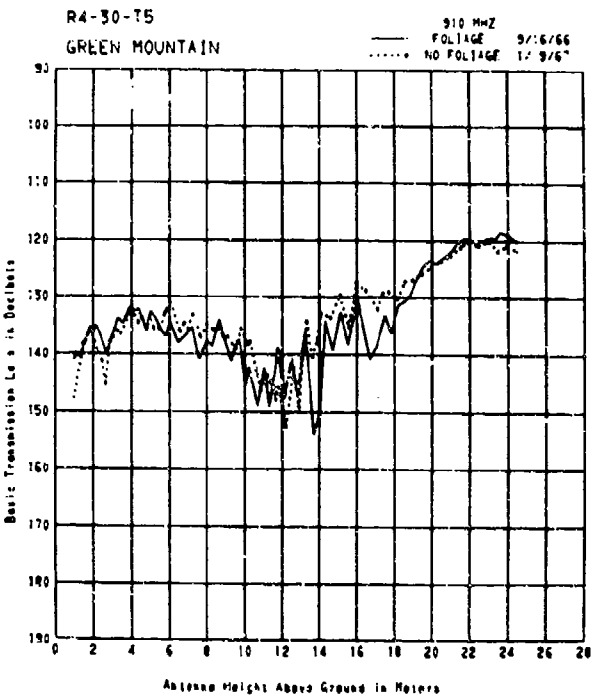
L_b (dB) SHORT TERM SIGNAL VARIABILITY

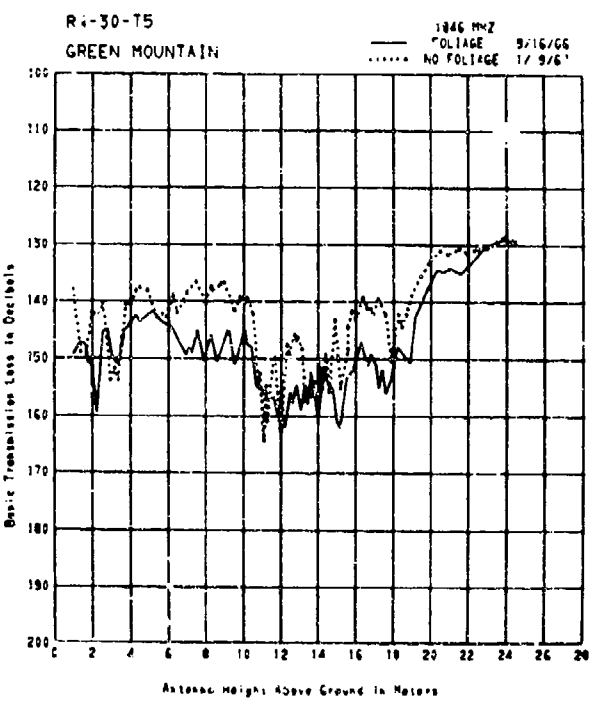
Freq(MHz)	230	410	910	1846	4595	9190
	8-5-66 at 1M			9-16-66 at 1M		
50%	128.0	141.7	144.0	148.8	156.0	155.1
Δ10%-90%	<3	<3	<3	<3	<3	<3
	8-5-66 at 22M			9-16-66 at 7.3M		
50%	107.3	112.2	133.5	147.3	162.7	171.1
Δ10%-90%	<3	<3	<3	<3	<3	<3
				9-16-66 at 14M		
50%			153.0	158.3	183.2	187.7
Δ10%-90%			6.0	<3	8.7	8.5
				9-16-66 at 24.5M		
50%			120.0	128.9	137.2	141.1
Δ10%-90%			<3	<3	<3	<3

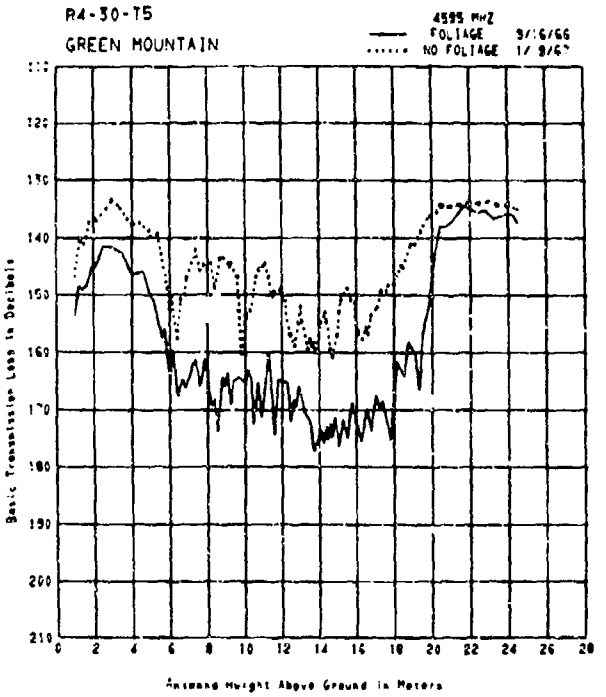
The transmitter site is at the edge of Green Mountain, a mesa overlooking the city of Boulder. The path to the receiver is line-of-sight, as far as one can see.

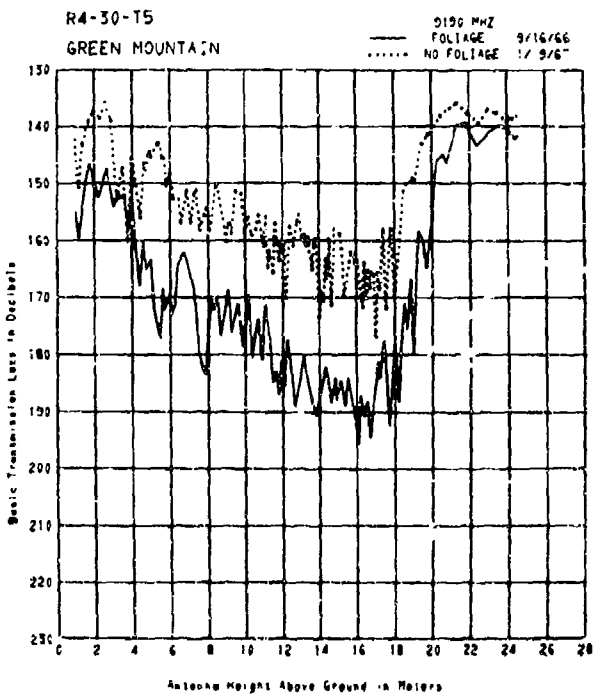

R4-30-T5
GREEN MOUNTAIN
FOLIAGE
NO FOLIAGE
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-30-T5
GREEN MOUNTAIN
410 MHZ
FOLIAGE
NO FOLIAGE
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-30-T5
GREEN MOUNTAIN
910 MHZ
FOLIAGE
NO FOLIAGE
Basic Transmission Loss in Decibels
90
100
110
120
130
140
150
160
170
180
190
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-30-T5
GREEN MOUNTAIN
1846 MHZ
FOLIAGE
NO FOLIAGE
Basic Transmission Loss in Decibels
100
110
120
130
140
150
160
170
180
190
200
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-30-T5
GREEN MOUNTAIN
4595 MHZ
FOLIAGE 9/16/66
NO FOLIAGE 1/ 9/6
Basic Transmission Loss in Decibels
120
130
140
150
160
170
180
190
200
210
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters

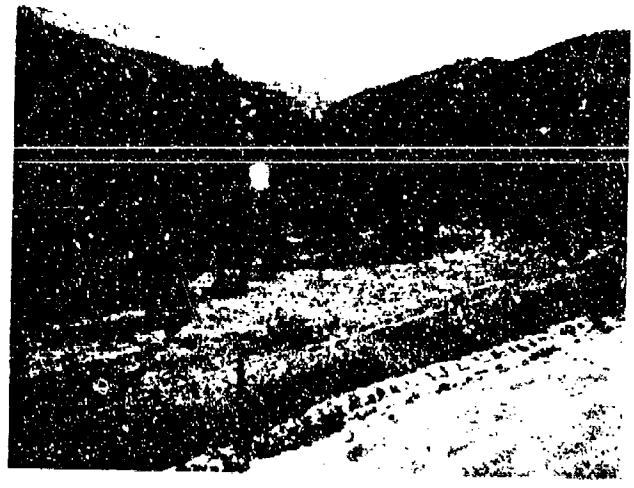

R4-30-T5
GREEN MOUNTAIN
9190 MHZ
FOLIAGE 9/16/66
NO FOLIAGE 1/ 9/6
Basic Transmission Loss in Decibels
130
140
150
160
170
180
190
200
210
220
230
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters

R4-30-T5

L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
	2-9-67 at 25 M			1-9-67 at 7.3 M		
50%	105.0		131.1	134.3	141.2	151.4
Δ10% - 90%	< 3		< 3	< 3	< 3	< 3

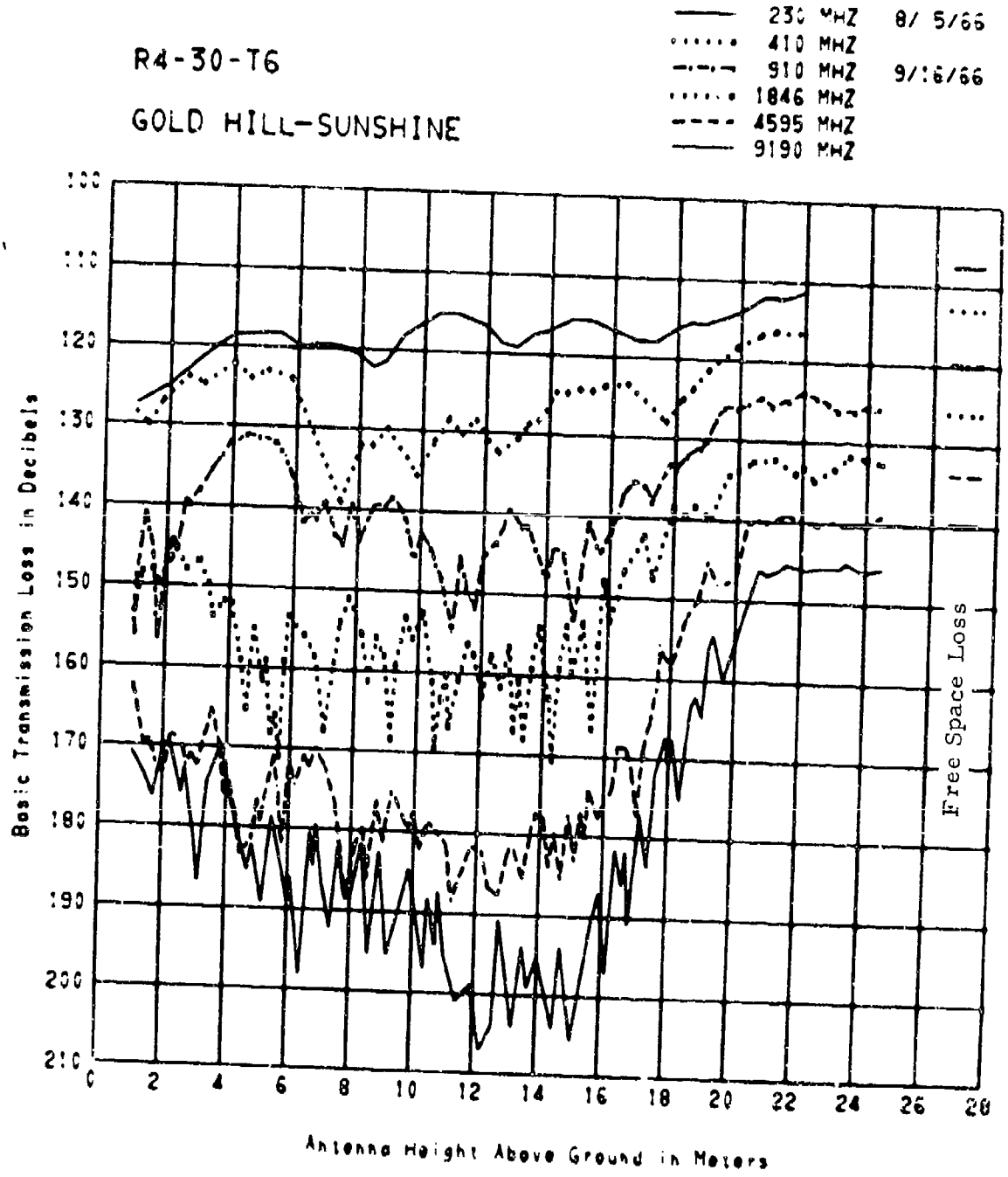
R4-30-T6
GOLD HILL - SUNSHINE



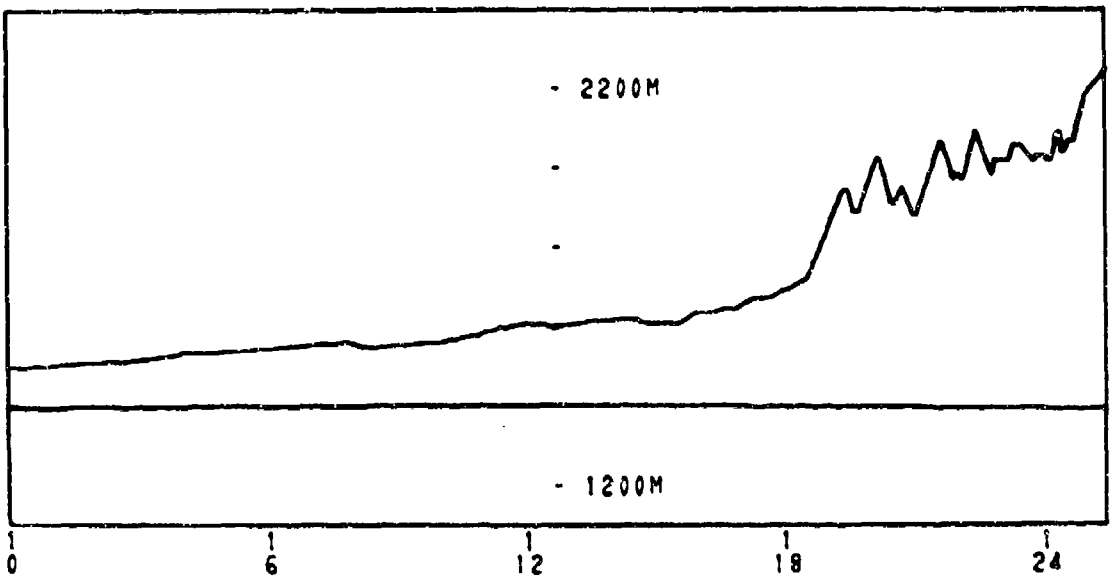
PATH VIEW FROM TRANSMITTER
Bearing from common receiver site to transmitter site is
243° 50' 13"

R4-30-T6

GOLD HILL-SUNSHINE



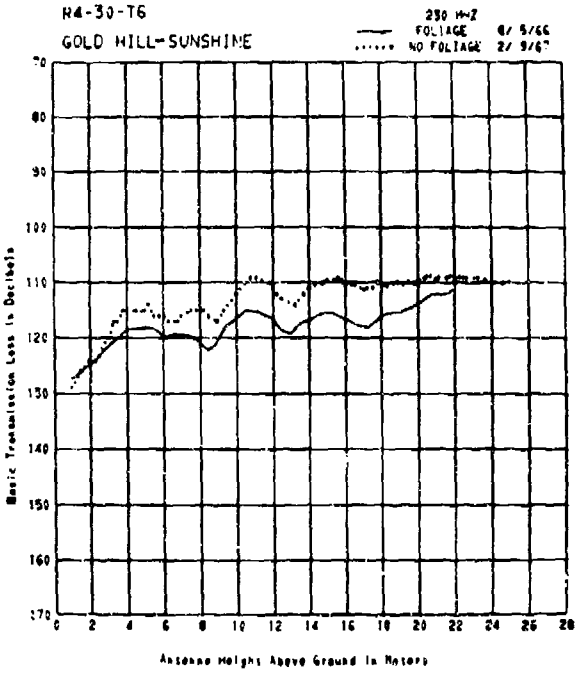
RCVR. ELEV. 1503 M | R4-30-T6 PATH LENGTH 25.373 km | XMTR. ELEV. 2256 M

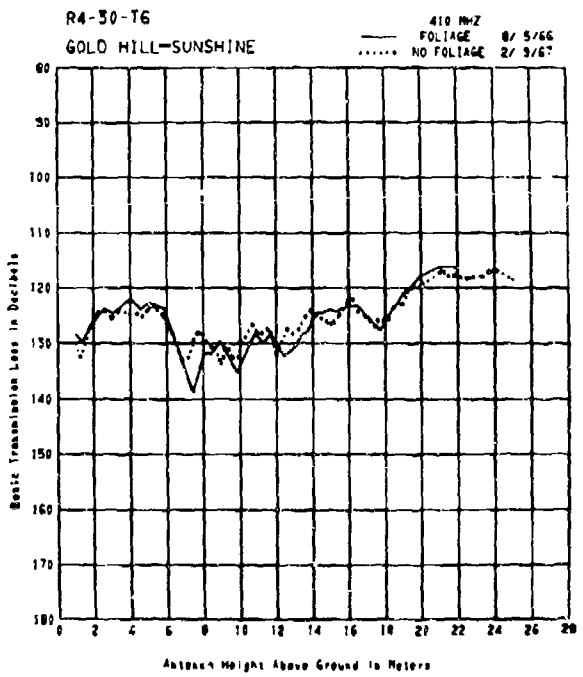


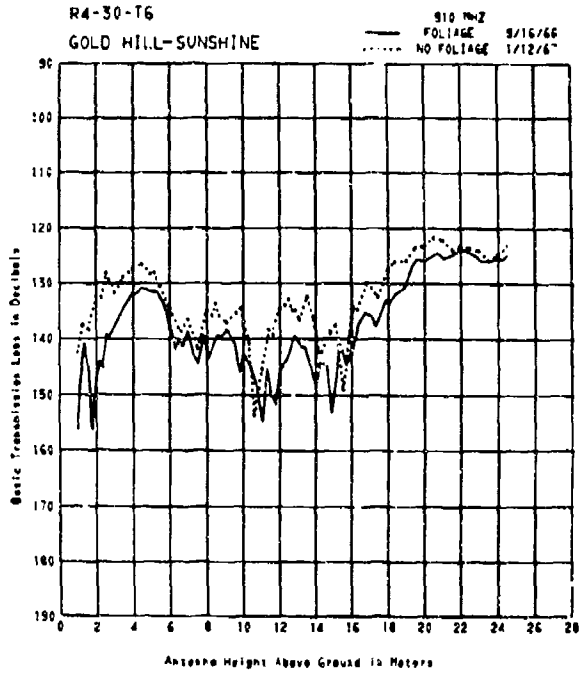
L_b (dB) SHORT TERM SIGNAL VARIABILITY

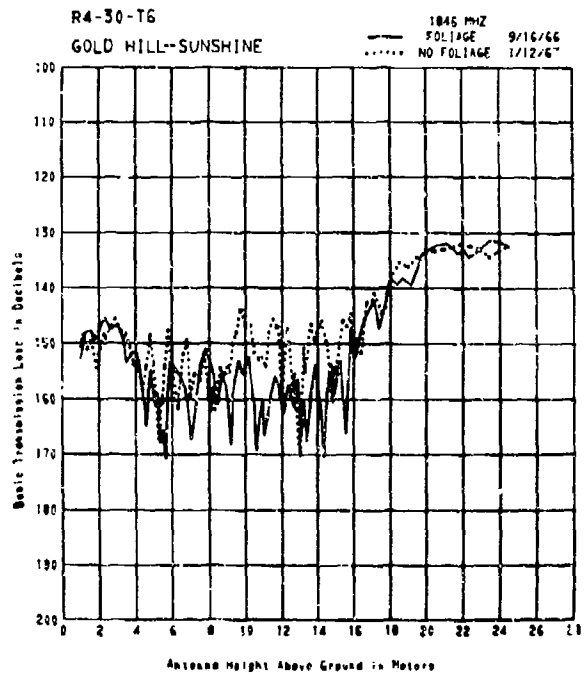
Freq(MHz)	230	410	910	1846	4595	9190
	8-5-66 at 3M			9-15-66 at 1M		
50%	122.3	124.6	149.7	153.6	161.1	171.3
Δ10%-90%	<3	<3	4.7	<3	<3	<3
	8-5-66 at 22M			9-15-66 at 7.3M		
50%	110.8	115.0	142.4	157.0	171.3	185.6
Δ10%-90%	<3	<3	<3	<3	<3	12.6
				9-15-66 at 14M		
50%			145.6	156.4	180.7	195.5
Δ10%-90%			<3	3.8	7.5	9.3
				9-15-66 at 24.5M		
50%			124.7	131.4	139.0	146.0
Δ10%-90%			<3	<3	<3	<3

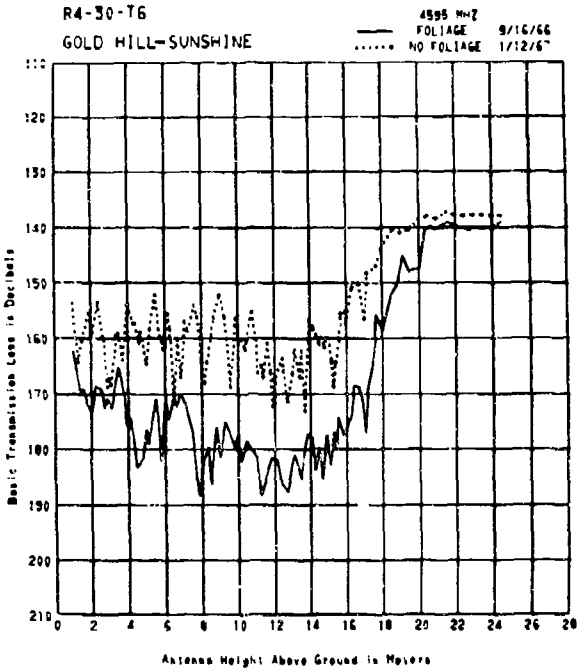
The path, as far as one can see, is line-of-sight. However, the foreground is rough and covered with coniferous trees. A hill about 4 km away hides most of the valley beyond. About 12 m in front of the antennas, but about 3 m below them, many telephone lines cross the path.

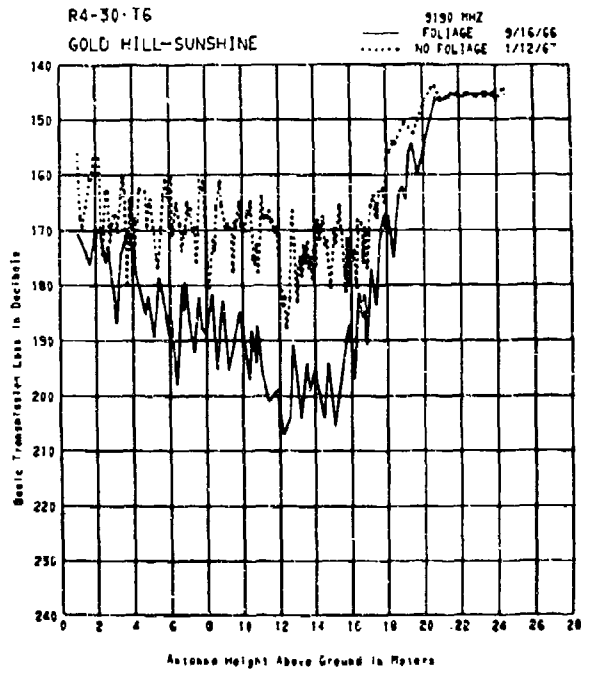

R4-30-T6
GOLD HILL-SUNSHINE
250 MHZ
FOLIAGE 8/ 5/66
NO FOLIAGE 2/ 9/67
Basic Transmission Loss in Decibels
70
80
90
100
110
120
130
140
150
160
170
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Heights Above Ground in Meters


R4-30-T6
GOLD HILL-SUNSHINE
410 MHZ
FOLIAGE 8/ 5/66
NO FOLIAGE 2/ 9/67
Basic Transmission Loss in Decibels
80
90
100
110
120
130
140
150
160
170
180
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Heights Above Ground in Meters


R4-30-T6
GOLD HILL-SUNSHINE
910 MHZ
FOLIAGE 9/16/66
NO FOLIAGE 1/12/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-30-T6
GOLD HILL--SUNSHINE
1845 MHZ
FOLIAGE 9/16/66
NO FOLIAGE 1/12/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-30-T6
GOLD HILL-SUNSHINE
4595 MHZ
FOLIAGE 9/16/66
NO FOLIAGE 1/12/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters

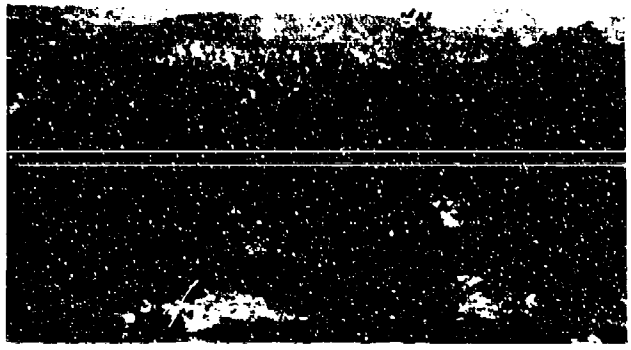

R4-30-T6
GOLD HILL-SUNSHINE
9190 MHZ
FOLIAGE 9/16/66
NO FOLIAGE 1/12/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters

R4-30-T6

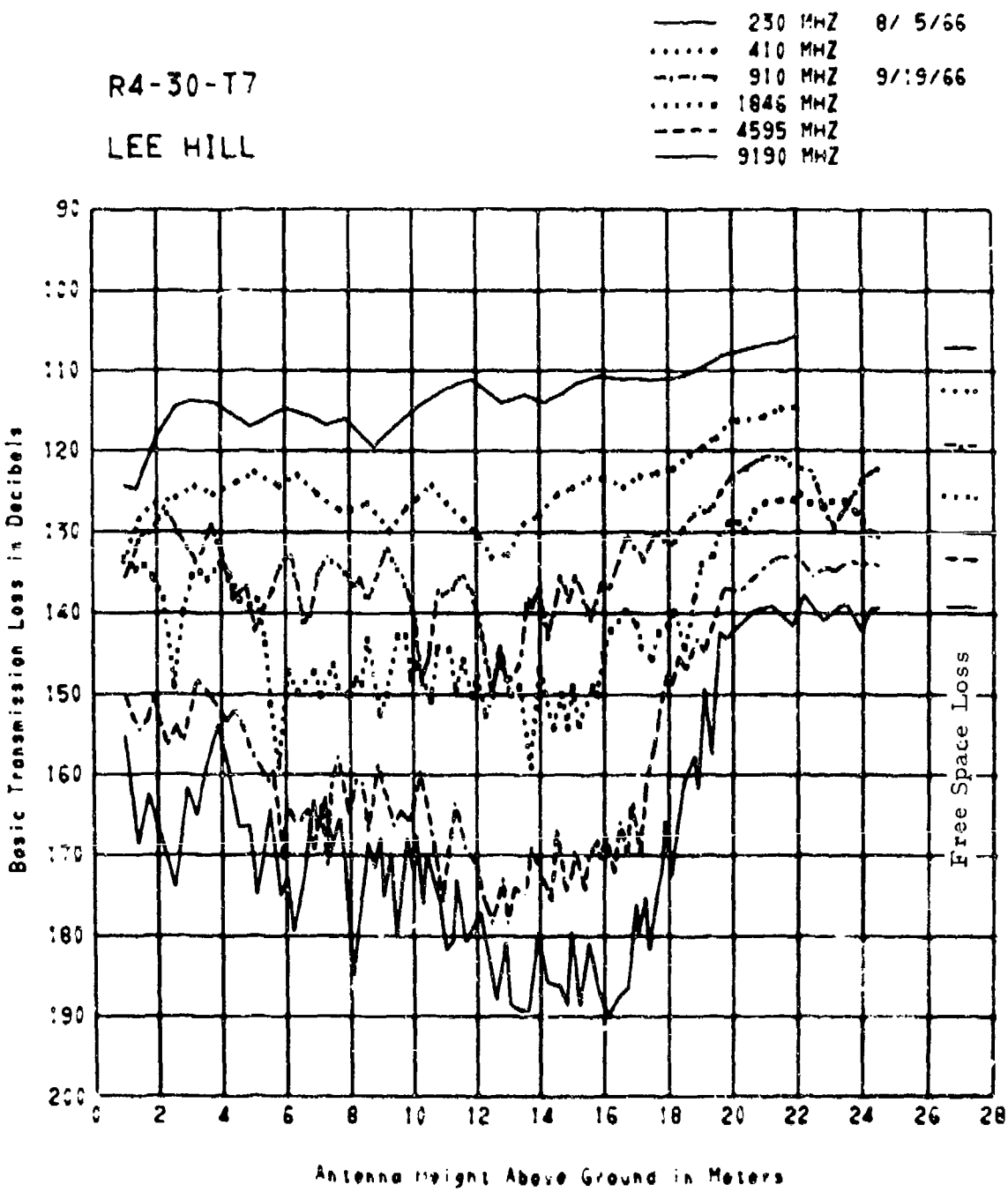
L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

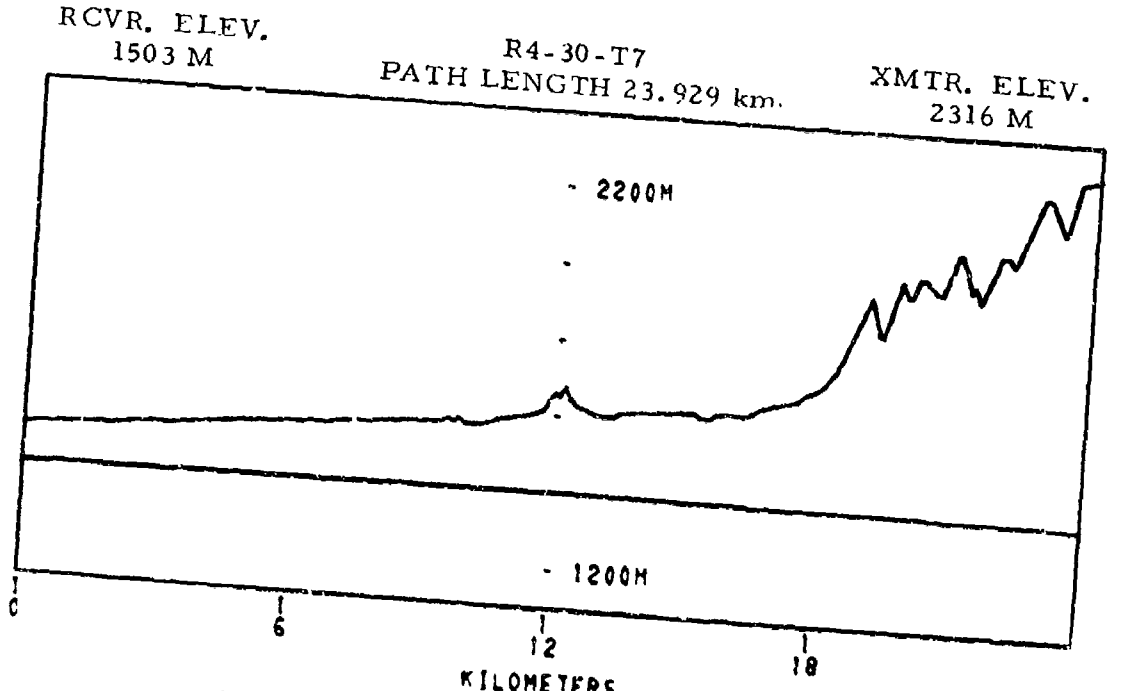
Freq (MHz)	230	410	910	1846	4595	9190
	2-9-67 at 25 M			1-12-67 at 1 M		
50%	109.7	120.2	148.0	151.8	151.8	155.0
Δ10% - 90%	< 3	< 3	< 3	< 3	< 3	< 3
				1-12-67 at 7.3 M		
50%			137.8	155.3	155.3	166.5
Δ10% - 90%			< 3	< 3	< 3	< 3
				1-12-67 at 14 M		
50%			137.0	146.3	156.4	174.5
Δ10% - 90%			< 3	< 3	< 3	< 3
				1-12-67 at 24.5 M		
50%			123.0	131.4	137.0	142.5
Δ10% - 90%			< 3	< 3	< 3	< 3

R4-30-T7
LEE HILL



PATH VIEW FROM TRANSMITTER
Bearing from common receiver site to transmitter site is
246° 08' 23"

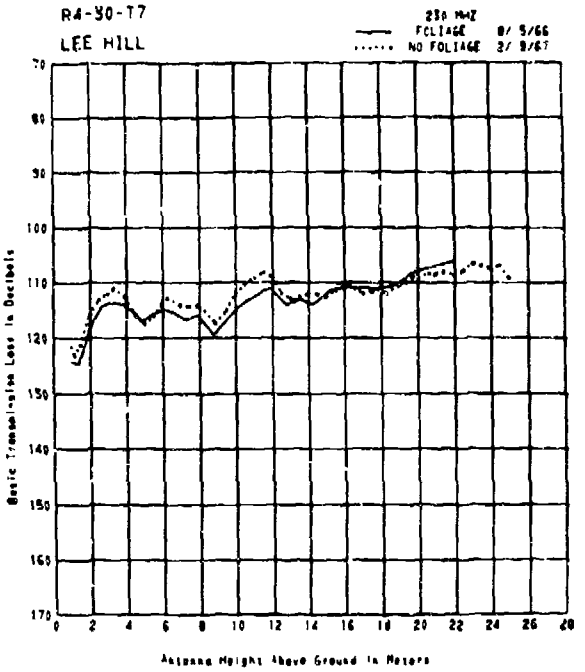

230 MHZ 8/ 5/66
410 MHZ
910 MHZ 9/19/66
1846 MHZ
4595 MHZ
9190 MHZ
R4-30-T7
LEE HILL
Basic Transmission Loss in Decibels
90
100
110
120
130
140
150
160
170
180
190
200
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
Antenna Height Above Ground in Meters
Free Space Loss

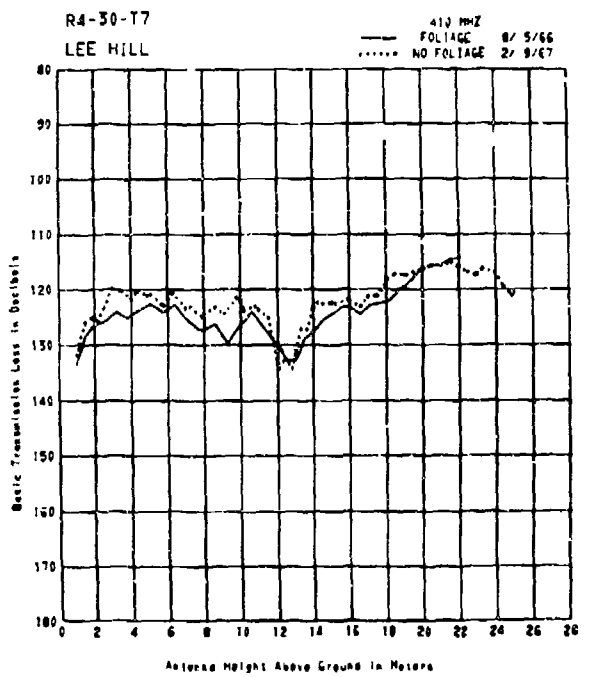


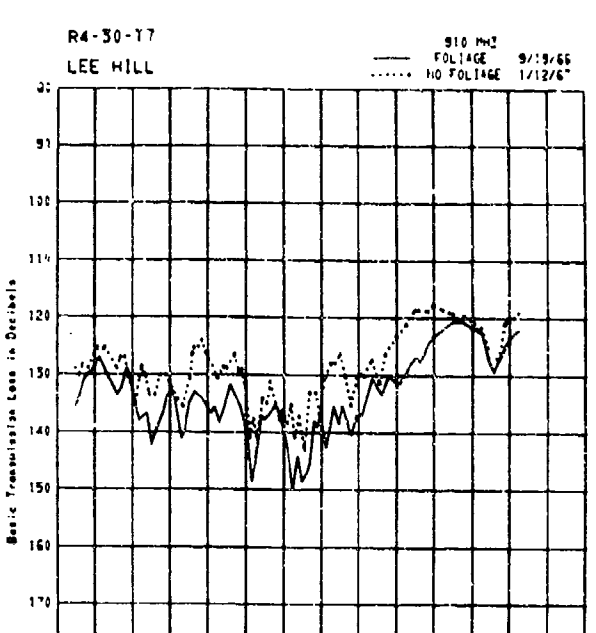
L_b (dB) SHORT TERM SIGNAL VARIABILITY

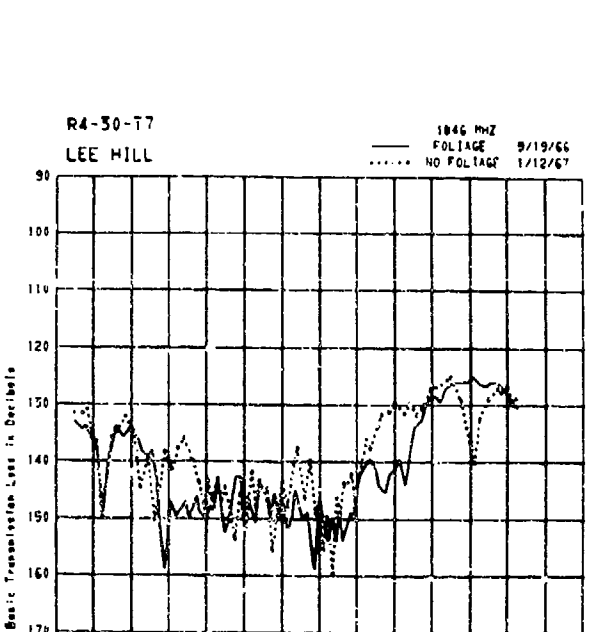
Freq(MHz)	230	410	910	1846	4595	9190
	8-5-66 at 3M			9-19-66 at 1M		
50%	113.9	122.4	136.9	132.4	151.2	153.5
Δ10%-90%	<3	<3	<3	<3	<3	<3
	8-5-66 at 22M			9-19-66 at 7.3M		
50%	106.1	112.4	133.9	145.3	175.8	169.0
Δ10%-90%	<3	<3	<3	<3	9.2	6.0
				9-19-66 at 14M		
50%			134.9	149.3	175.4	183.5
Δ10%-90%			<3	<3	9.8	9.8
				9-19-66 at 24.5M		
50%			122.9	129.4	133.2	142.0
Δ10%-90%			<3	<3	<3	<3

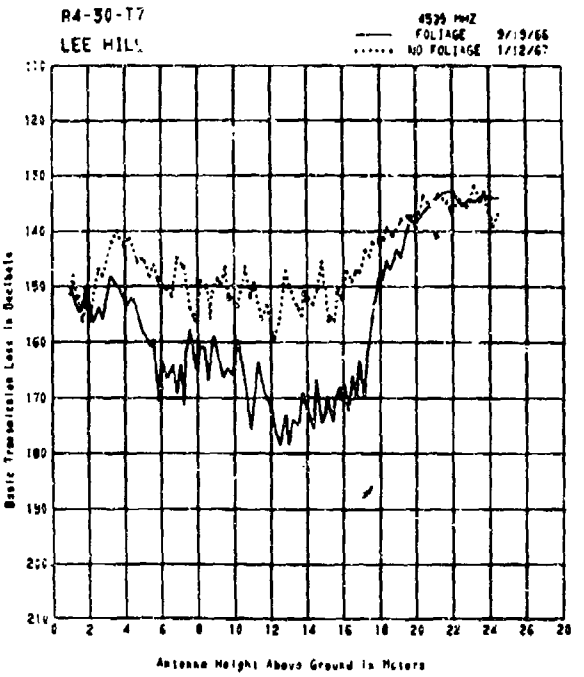
This is a line-of-sight path which crosses rough, mountainous terrain for 4 km, then part of the Boulder valley. There are no obstructions.

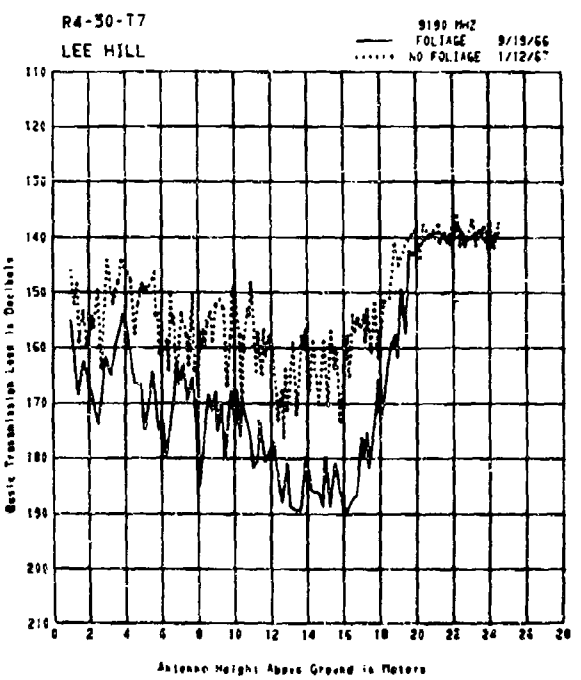

R4-30-T7
LEE HILL
236 MHZ
FOLIAGE 8/ 5/66
NO FOLIAGE 2/ 9/67
Basic Transmission Loss in Decibels
70
80
90
100
110
120
130
140
150
160
170
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-30-T7
LEE HILL
410 MHZ
FOLIAGE 8/ 5/66
NO FOLIAGE 2/ 9/67
Basic Transmission Loss in Decibels
80
90
100
110
120
130
140
150
160
170
180
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-30-T7
LEE HILL
910 MHZ
FOLIAGE 9/19/66
NO FOLIAGE 1/12/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-30-T7
LEE HILL
1846 MHZ
FOLIAGE 9/19/66
NO FOLIAGE 1/12/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-30-T7
LEE HILL
4529 MHZ
FOLIAGE 9/19/66
NO FOLIAGE 1/12/67
Basic Transmission Loss in Decibels
120
130
140
150
160
170
180
190
200
210
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-30-T7
LEE HILL
9190 MHZ
FOLIAGE 9/19/66
NO FOLIAGE 1/12/67
Basic Transmission Loss in Decibels
110
120
130
140
150
160
170
180
190
200
210
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters

R4-30-T7

L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
	2-9-67 at 25 M			1-12-67 at 1 M		
50%	108.9	121.4	129.2	130.6	156.0	145.8
Δ10% - 90%	< 3	< 3	< 3	< 3	< 3	< 3
				1-12-67 at 7.3 M		
50%			126.3	140.0	146.5	155.8
Δ10% - 90%			< 3	< 3	< 3	< 3
				1-12-67 at 14 M		
50%			136.2	151.0	153.5	173.9
Δ10% - 90%			< 3 /	< 3	< 3	9.4
				1-12-67 at 24.5 M		
50%			118.2	126.6	134.5	135.8
Δ10% - 90%			< 3	< 3	< 3	< 3

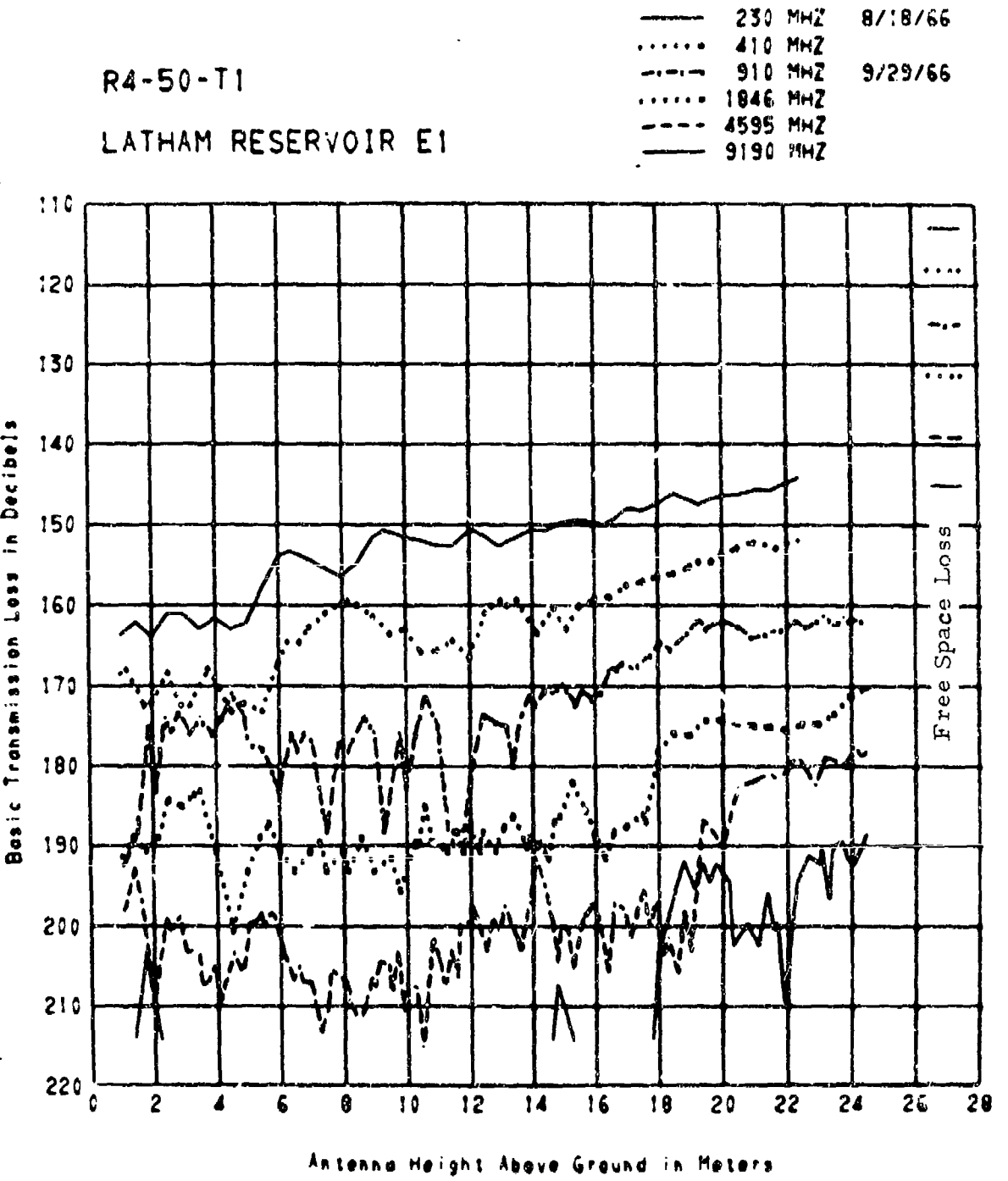
R4-50-T1
LATHAM RESERVOIR E 1



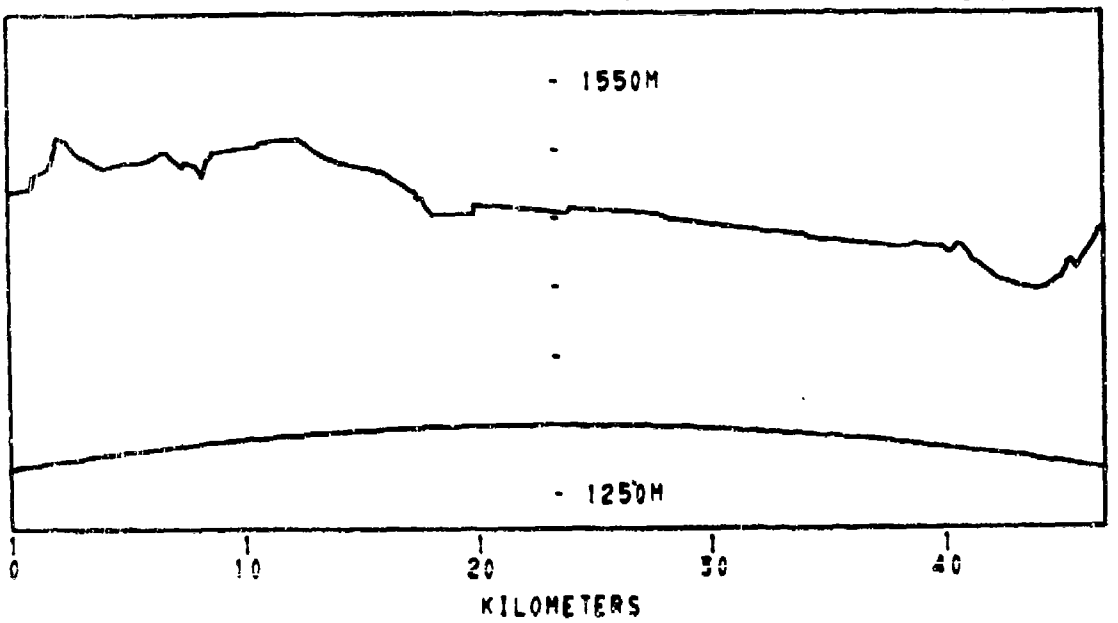
PATH VIEW FROM TRANSMITTER
Bearing from common receiver site to transmitter site is
63° 01' 05"

R4-50-T1

LATHAM RESERVOIR E1



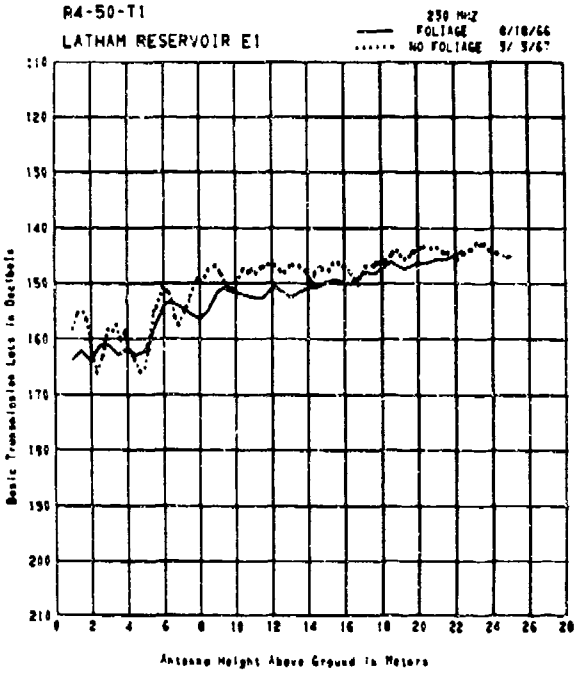
RCVR. ELEV. 1503 M | R4-50-T1 PATH LENGTH 46.732 km | XMTR. ELEV. 1503 M

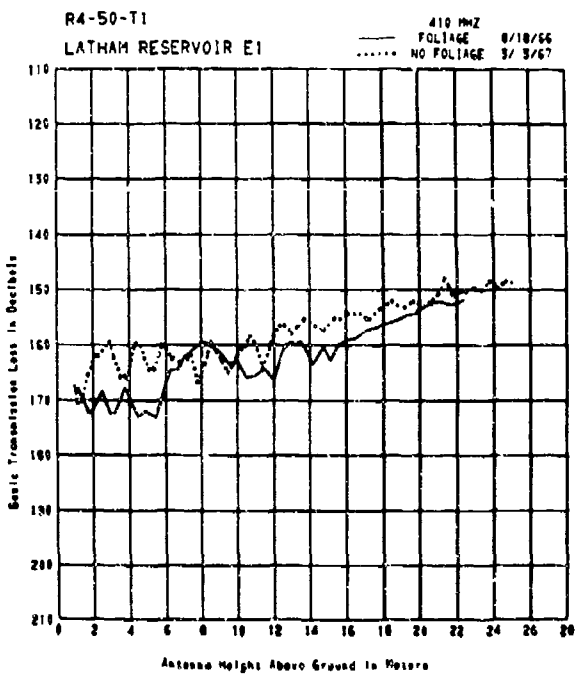


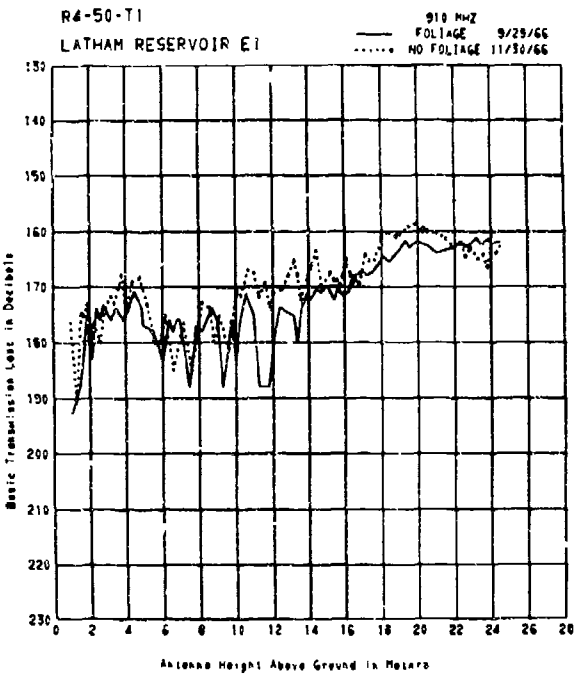
L_b (dB) SHORT TERM SIGNAL VARIABILITY

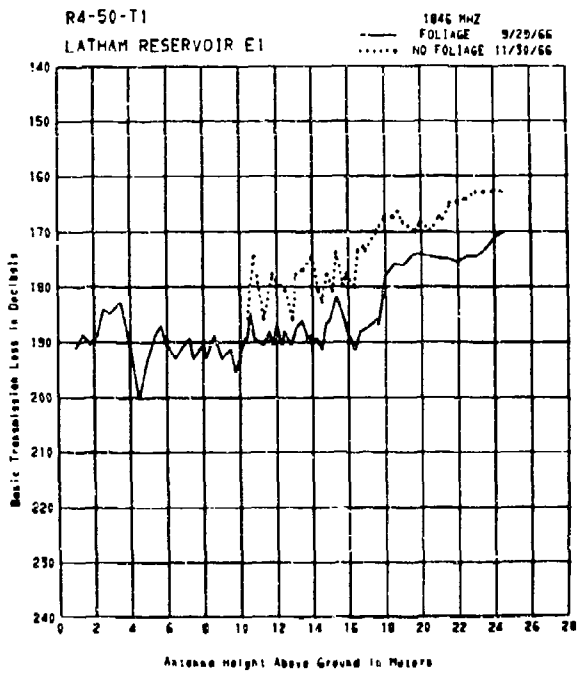
Freq(MHz)	230	410	910	1846	4595	9190
	8-18-66 at 1M			9-29-66 at 1M		
50%	162.8	170.6	188.0	195.4	197.0	203.6
Δ10%-90%	<3	5.2	<3	<3	7.1	8.0
	8-18-66 at 11M			9-29-66 at 7.3M		
50%	150.1	162.8	180	188.4	211.5	
Δ10%-90%	<3	<3	<3		5.5	
	8-18-66 at 22M			9-29-66 at 14M		
50%	143.6	151.0	172.0	189.4	194.5	
Δ10%-90%	<3	3.0	<3		3.6	
				9-29-66 at 24.5M		
50%			162.5	169.9	178.1	193.8
Δ10%-90%			<3	<3	4.3	12.0

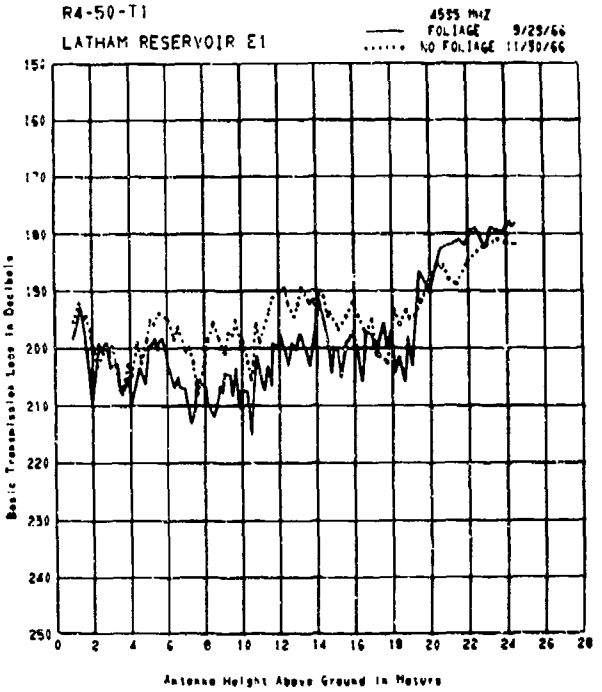
The path extends over rolling farmland to an apparent horizon about 30 or 40 km away. There are scattered trees and buildings along the path.

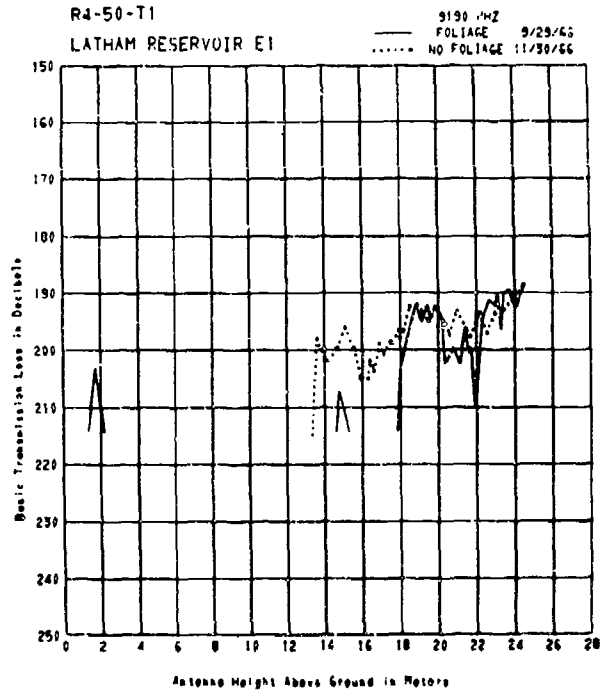

R4-50-T1
LATHAM RESERVOIR E1
250 MHZ
FOLIAGE 8/18/66
NO FOLIAGE 3/ 3/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-50-T1
LATHAM RESERVOIR E1
410 MHZ
FOLIAGE 8/18/66
NO FOLIAGE 3/ 3/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-50-T1
LATHAM RESERVOIR E1
910 MHZ
FOLIAGE 9/29/66
NO FOLIAGE 11/30/66
130
140
150
160
170
180
190
200
210
220
230
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-50-T1
LATHAM RESERVOIR E1
1846 MHZ
FOLIAGE 9/29/66
NO FOLIAGE 11/30/66
140
150
160
170
180
190
200
210
220
230
240
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-50-T1
LATHAM RESERVOIR E1
4555 MHZ
FOLIAGE 9/29/66
NO FOLIAGE 11/30/66
150
160
170
180
190
200
210
220
230
240
250
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters

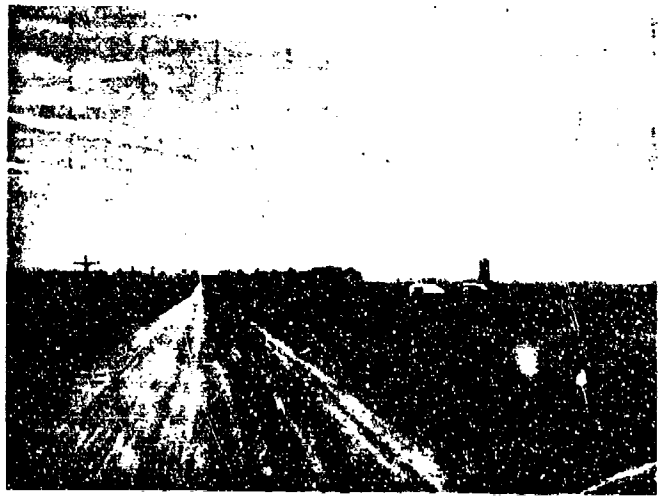

R4-50-T1
LATHAM RESERVOIR E1
9190 MHZ
FOLIAGE 9/29/66
NO FOLIAGE 11/30/66
150
160
170
180
190
200
210
220
230
240
250
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters

R4-50-T1

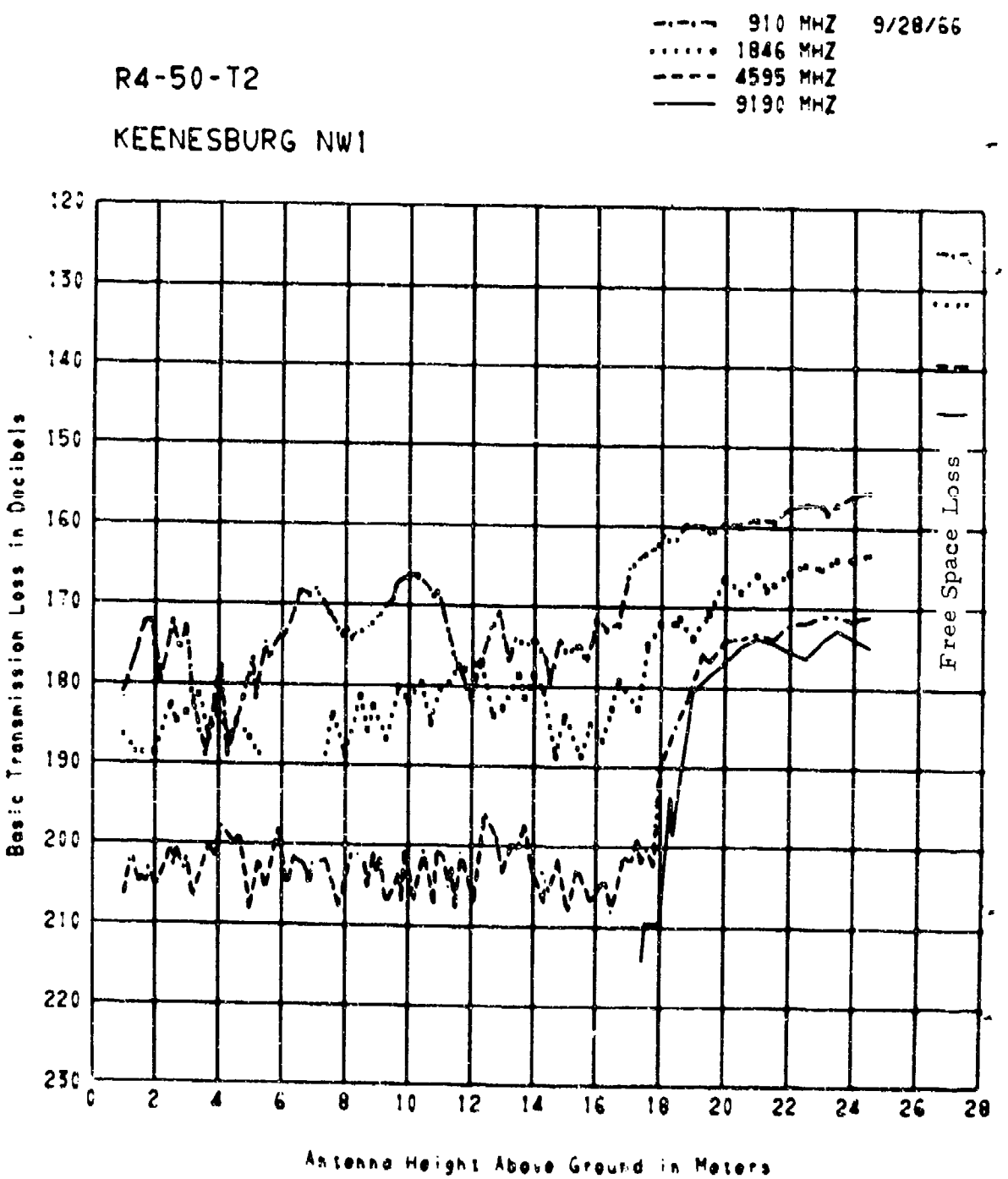
L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
	3-3-67 at 25 M			11-30-66 at 1 M		
50%	145.0	149.8	175.7		197.3	
Δ10% - 90%	< 3	< 3	< 3		< 3	
				11-30-66 at 7.3 M		
50%			174.7		203.0	
Δ10% - 90%			< 3		< 3	
				11-30-66 at 14 M		
50%			164.2	180.7	191.8	200.9
Δ10% - 90%			< 3	< 3	< 3	< 3
				11-30-66 at 24.5 M		
50%			160.2	167.7	171.3	187.9
Δ10% - 90%			< 3	< 3	< 3	< 3

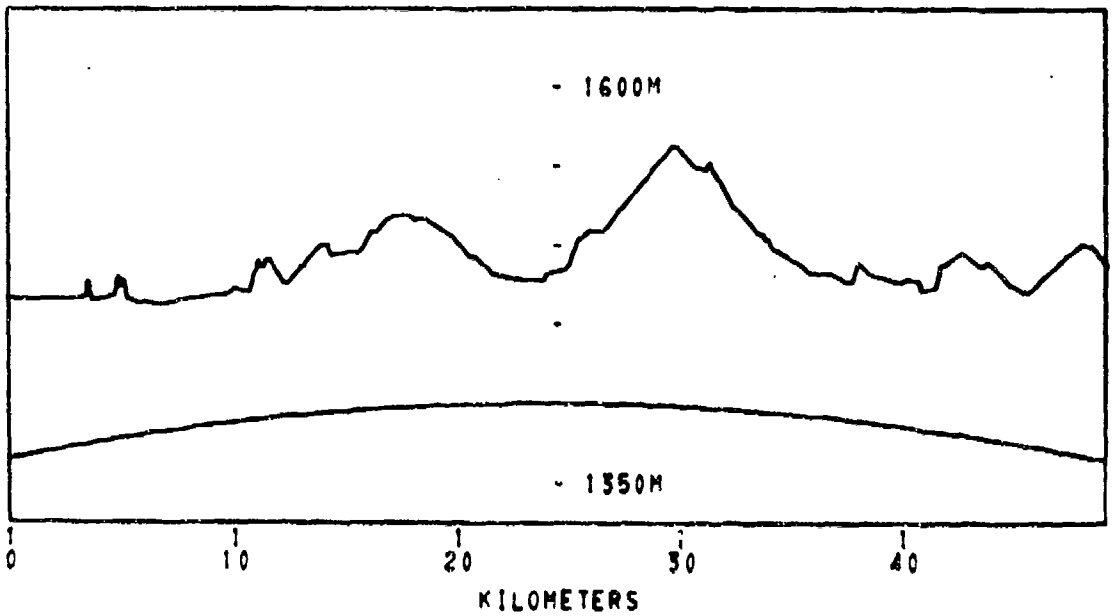
R4-50-T2
KEENESBURG NW 1



PATH VIEW FROM TRANSMITTER
Bearing from common receiver site to transmitter site is
94° 45' 25"


910 MHZ 9/28/66
1846 MHZ
4595 MHZ
9190 MHZ
R4-50-T2
KEENESBURG NW1
120
130
140
150
160
170
180
190
200
210
220
230
Basic Transmission Loss in Decibels
Free Space Loss
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
Antenna Height Above Ground in Meters

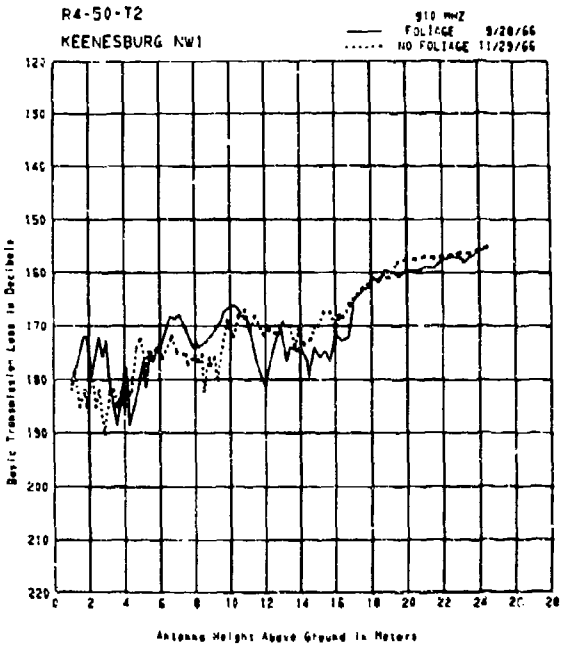
RCVR. ELEV. 1503 M | R4-50-T2 PATH LENGTH 48.910 km | XMTR. ELEV. 1523 M

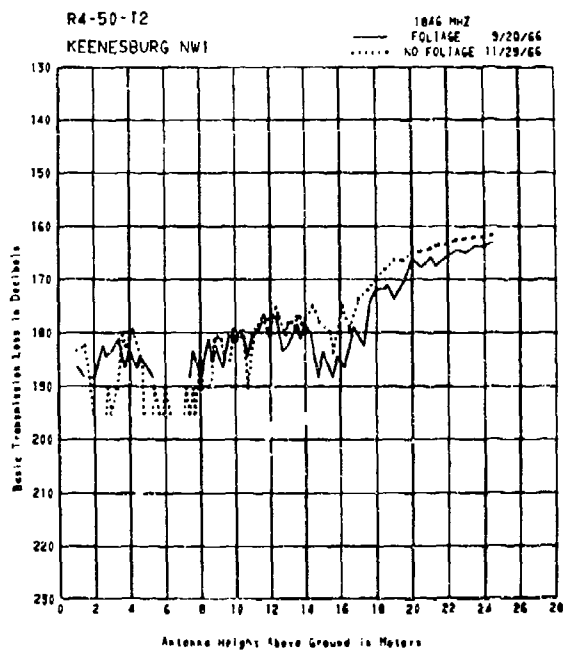


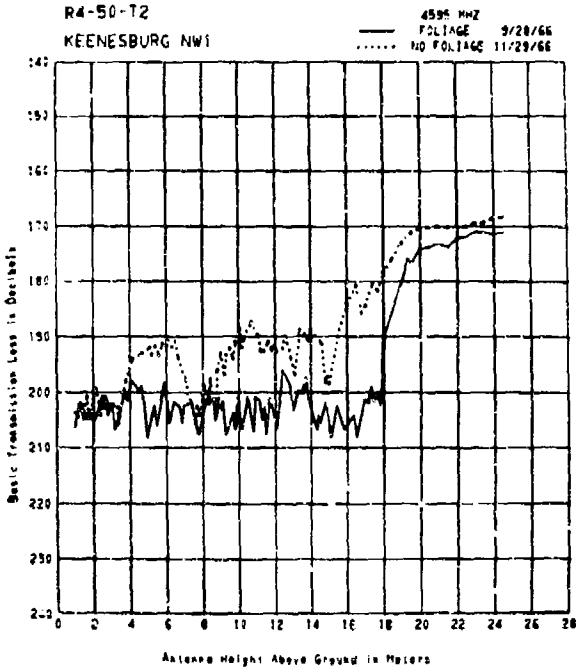
L_b (dB) SHORT TERM SIGNAL VARIABILITY

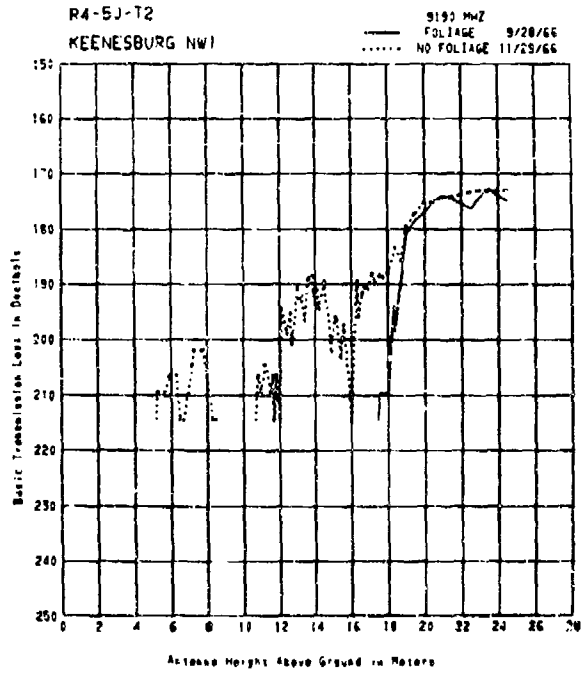
Freq(MHz)	230	410	910	1846	4595	9190
				9-29-66 at 1M		
50%			183.7	188.5	204.8	
Δ10%-90%			<3	<3	7.0	
				9-29-66 at 7.3M		
50%			172.7	186.5	201.3	
Δ10%-90%			8.0	<3	9.5	
				9-29-66 at 14M		
50%			172.2	178.5	200.8	
Δ10%-90%			5.0	8.0	9.2	
				9-29-66 at 24.5M		
50%			155.7	163.0	171.3	173.8
Δ10%-90%			<3	4.0	4.2	4.0

The path lies over a dirt road which runs to the left of the path at an angle of 5°. A 3-wire power line parallels the road to the left of the antennas, and a 6-wire telephone line parallels the road to the right. The telephone line crosses the path about 60 m away. The path crosses a grove of trees about 400 m away, and the apparent horizon is about 20 km in the distance.


R4-50-T2
KEENESBURG NW1
910 MHZ
FOLIAGE 9/20/66
NO FOLIAGE 11/29/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-50-T2
KEENESBURG NW1
1846 MHZ
FOLIAGE 9/20/66
NO FOLIAGE 11/29/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-5D-T2
KEENESBURG NW1
4595 MHZ
FOLIAGE 9/28/66
NO FOLIAGE 11/29/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-5J-T2
KEENESBURG NW1
9190 MHZ
FOLIAGE 9/28/66
NO FOLIAGE 11/29/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters

R4-50-T2

L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
			11-29-66 at 1 M			
50%			183.9	184.1	202.8	
Δ10% - 90%			< 3	< 3	< 3	
			11-29-66 at 7.3 M			
50%			174.4	195.1	201.8	196.3
Δ10% - 90%			< 3	< 3	< 3	< 3
			11-29-66 at 14 M			
50%			171.4	175.1	189.8	186.3
Δ10% - 90%			< 3	< 3	< 3	< 3
			11-29-66 at 24.5 M			
50%			152.9	163.1	168.8	167.3
Δ10% - 90%			< 3	< 3	< 3	< 3

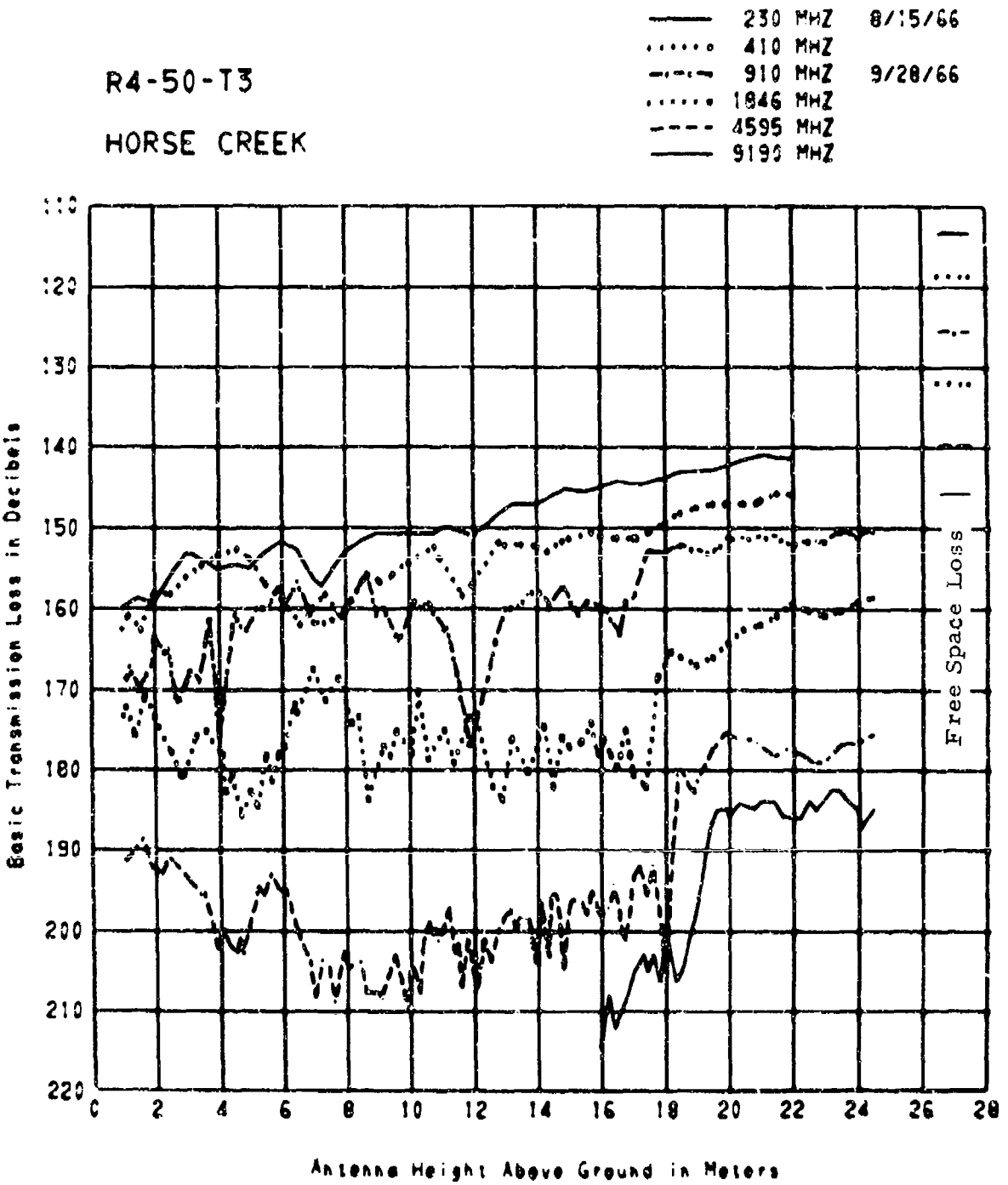
R4-50-T3
HORSE CREEK E 1



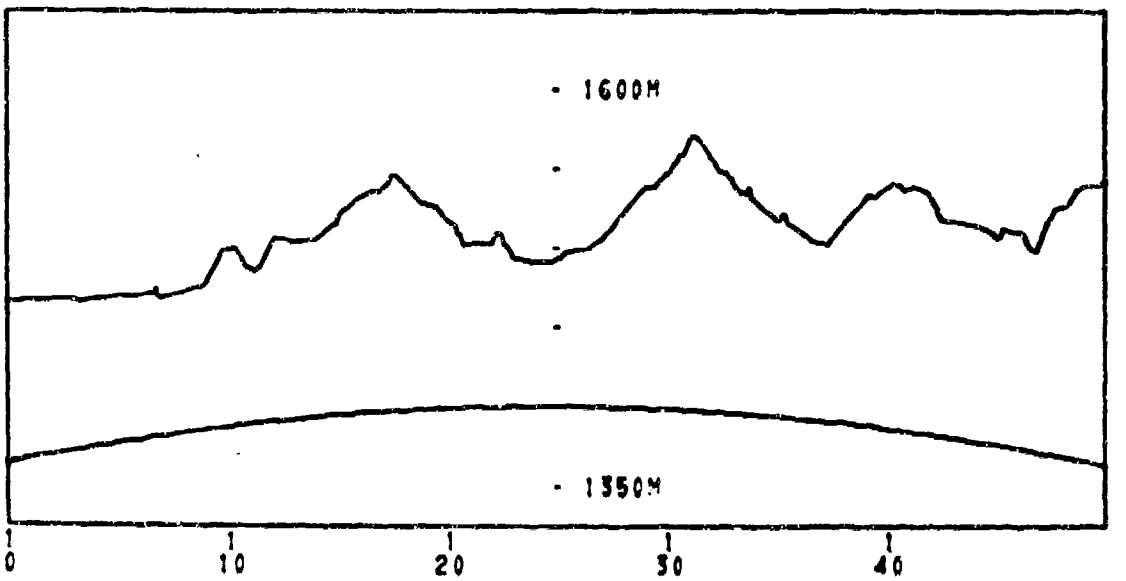
PATH VIEW FROM TRANSMITTER
Bearing from common receiver site to transmitter site is
110° 03' 35"

R4-50-T3

HORSE CREEK



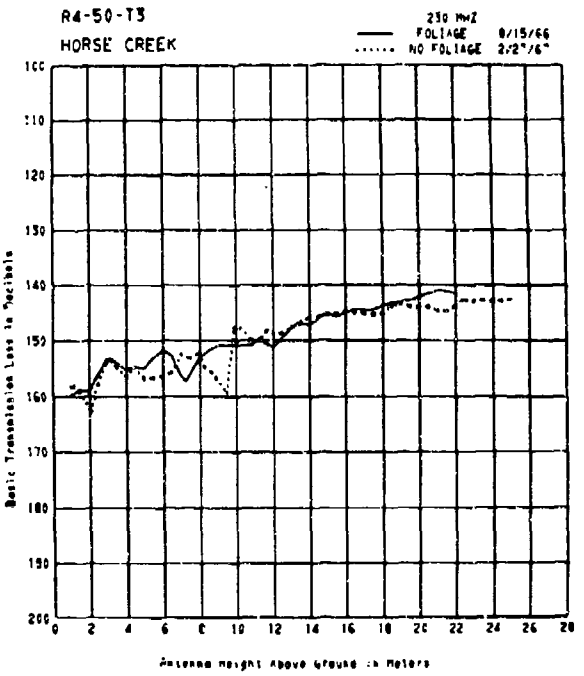
RCVR. ELEV. 1503 M | R4-50-T3 PATH LENGTH 49.699 km | XMTR. ELEV. 1579 M

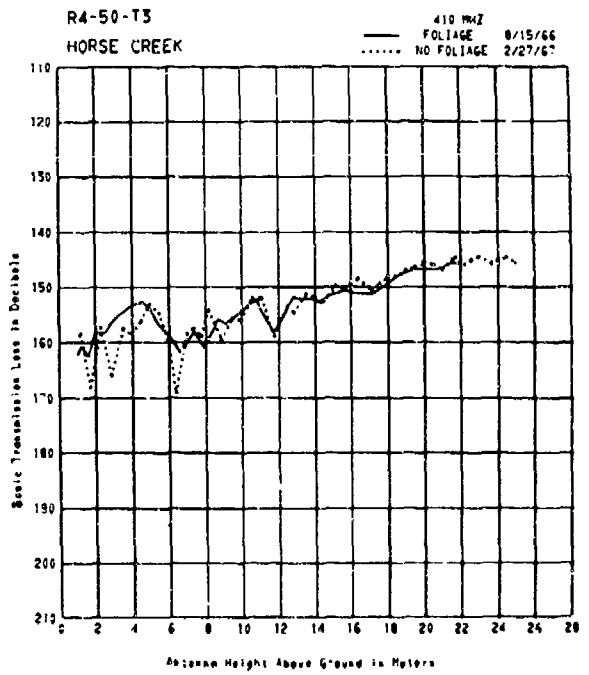


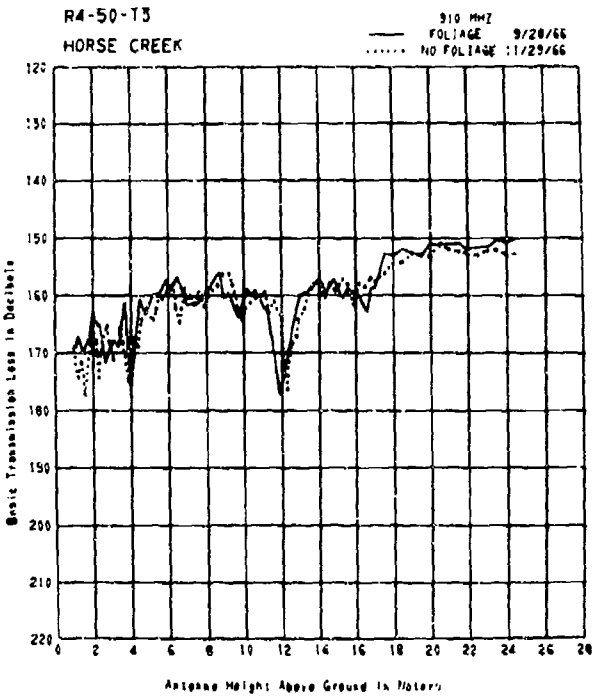
L_b(dB) SHORT TERM SIGNAL VARIABILITY

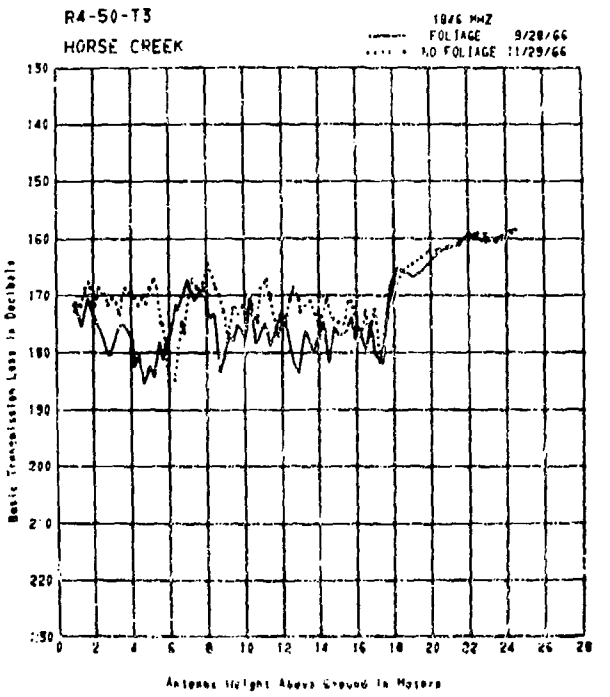
Freq(MHz)	230	410	910	1846	4595	9190
	8-15-66 at 11M			9-28-66 at 1M		
50%	150.6	153.8	168.1	173.7	191.6	
Δ10%-90%	<3	<3	3.5	<3	<3	
				9-28-66 at 7.3M		
50%			162.1	171.2	201.6	
Δ10%-90%			<3	<3	4.0	
				9-28-66 at 14M		
50%			158.1	175.2	197.6	
Δ10%-90%			<3	4.5	6.2	
				9-28-66 at 24.5M		
50%			150.1	158.2	175.6	185.0
Δ10%-90%			<3	<3	<3	6.0

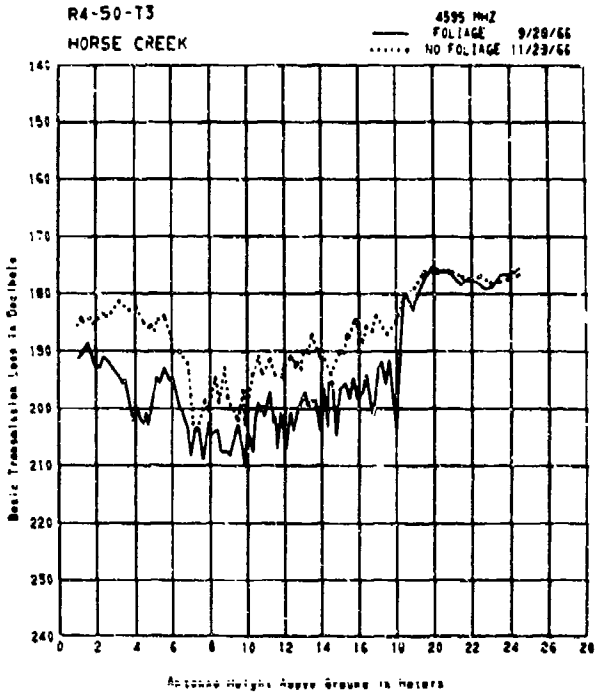
The path extends over cultivated fields for about 3 km, then over grassy land to the apparent horizon about 20 km in the distance.

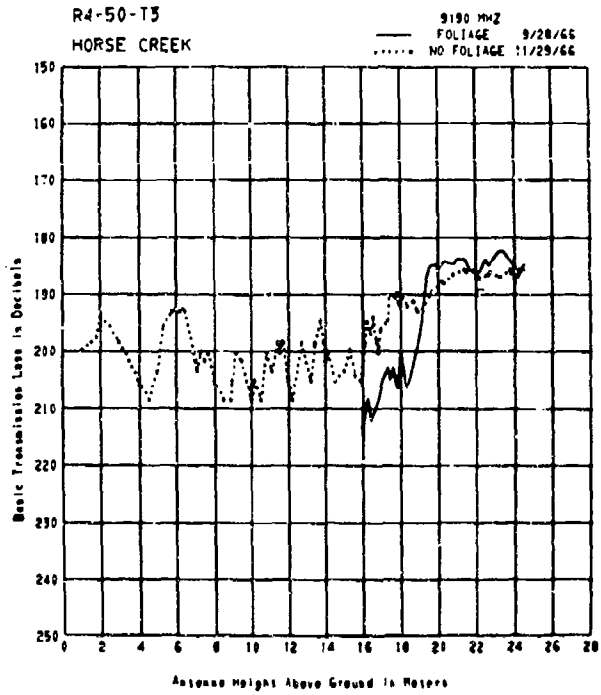

R4-50-T3
HORSE CREEK
230 MHZ
FOLIAGE 8/15/66
NO FOLIAGE 2/27/67
100
110
120
130
140
150
160
170
180
190
200
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-50-T3
HORSE CREEK
410 MHZ
FOLIAGE 8/15/66
NO FOLIAGE 2/27/67
110
120
130
140
150
160
170
180
190
200
210
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-50-T3
HORSE CREEK
910 MHZ
FOLIAGE 9/28/66
NO FOLIAGE 11/29/66
Basic Transmission Loss in Decibels
120
130
140
150
160
170
180
190
200
210
220
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-50-T3
HORSE CREEK
1846 MHZ
FOLIAGE 9/28/66
NO FOLIAGE 11/29/66
Basic Transmission Loss in Decibels
130
140
150
160
170
180
190
200
210
220
230
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-50-T3
HORSE CREEK
4595 MHZ
FOLIAGE 9/28/66
NO FOLIAGE 11/29/66
Basic Transmission Loss in Decibels
Antenna Heights Above Ground in Meters

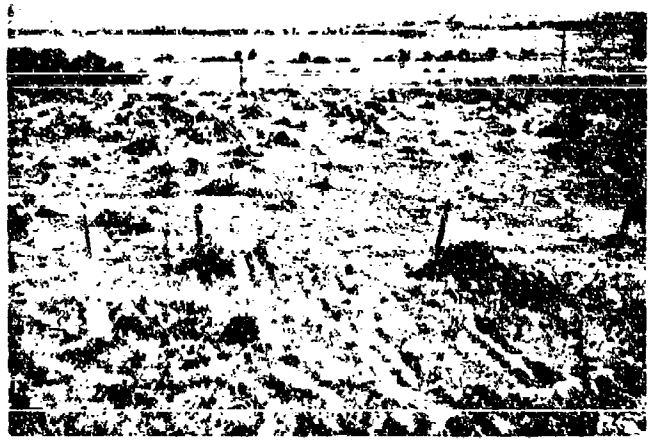

R4-50-T3
HORSE CREEK
9190 MHZ
FOLIAGE 9/28/66
NO FOLIAGE 11/29/66
Basic Transmission Loss in Decibels
Antenna Heights Above Ground in Meters

R4-50-T3

L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
	2-27-67 at 25 M			11-29-66 at 1 M		
50%	141.9	146.8	170.1	171.6	186.8	200.3
Δ10% - 90%	< 3	< 3	< 3	< 3	< 3	< 3
				11-29-66 at 7.3 M		
50%			159.6	168.6	207.0	200.3
Δ10% - 90%			< 3	< 3	< 3	< 3
				11-29-66 at 14 M		
50%			160.1	171.6	190.8	199.3
Δ10% - 90%			< 3	< 3	< 3	< 3
				11-29-66 at 24.5 M		
50%			152.1	159.6	177.8	183.8
Δ10% - 90%			< 3	< 3	< 3	< 3

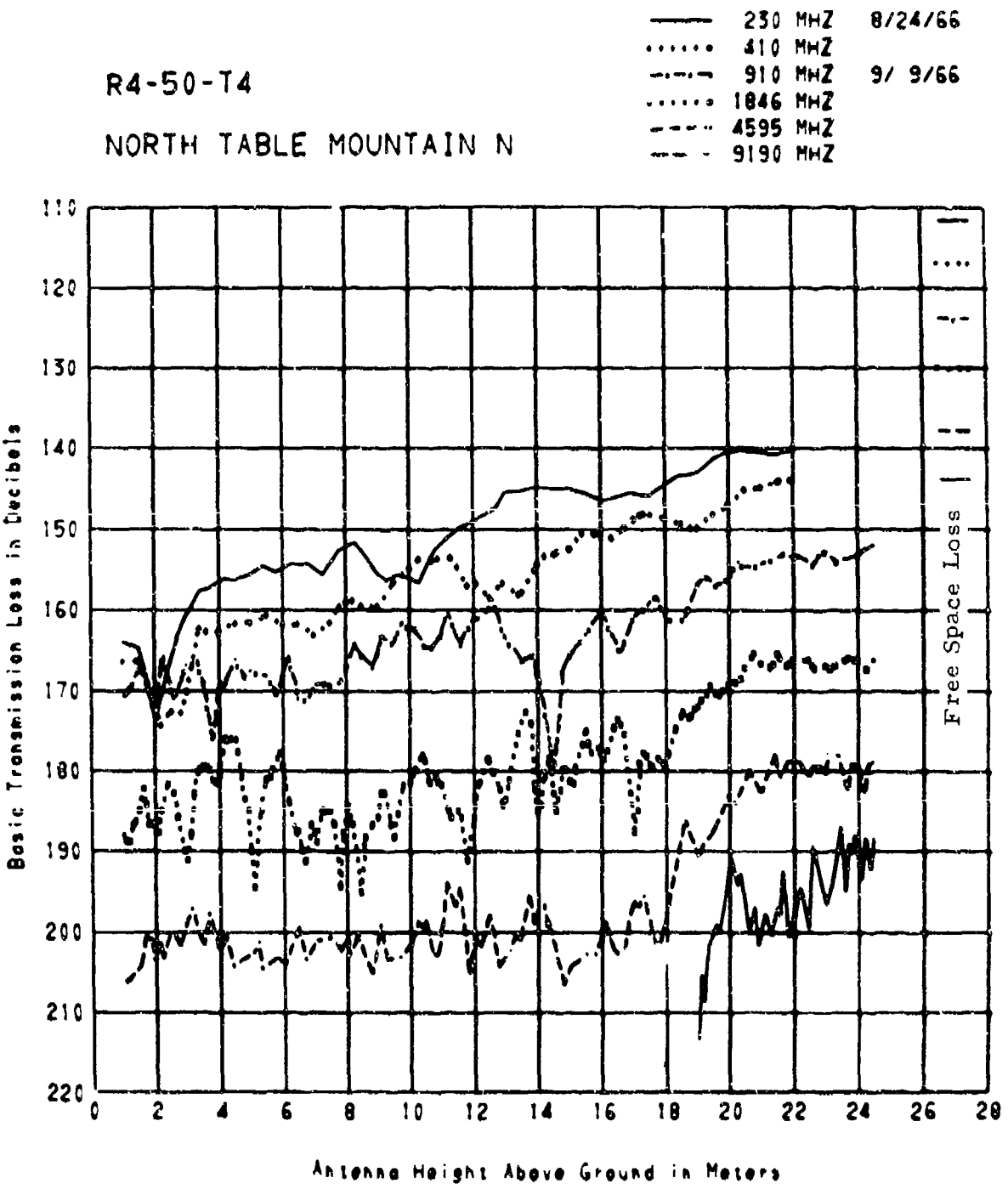
R4-50-T4
NORTH TABLE MOUNTAIN N



PATH VIEW FROM TRANSMITTER
Bearing from common receiver site to transmitter site is
190° 44' 04"

R4-50-T4

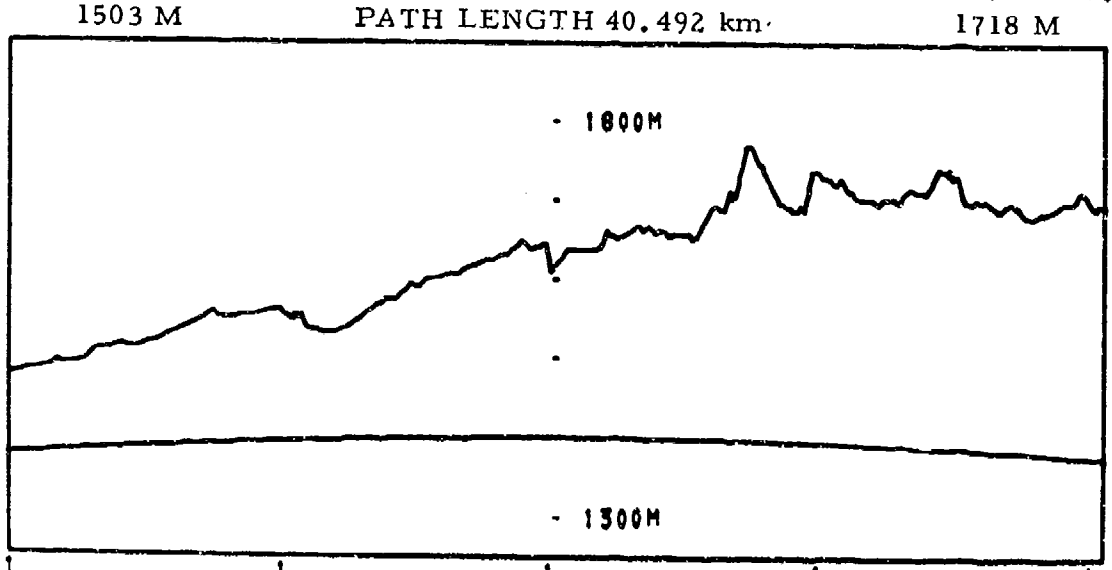
NORTH TABLE MOUNTAIN N



RCVR. ELEV. 1503 M

R4-50-T4
PATH LENGTH 40.492 km

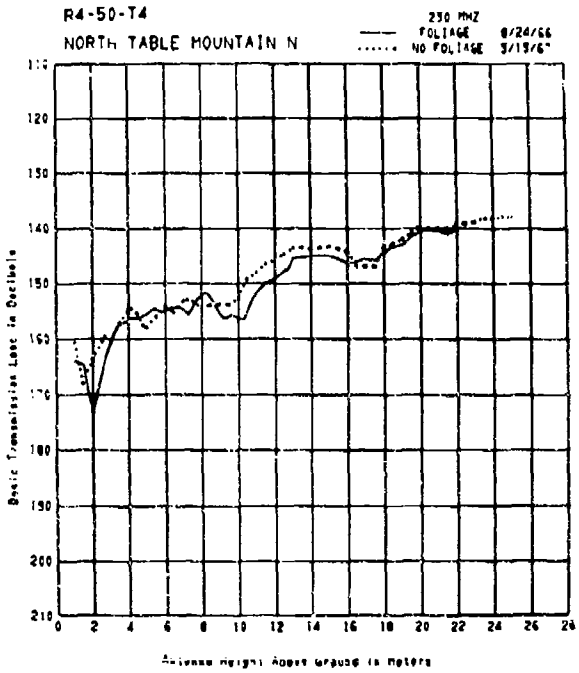
XMTR. ELEV. 1718 M

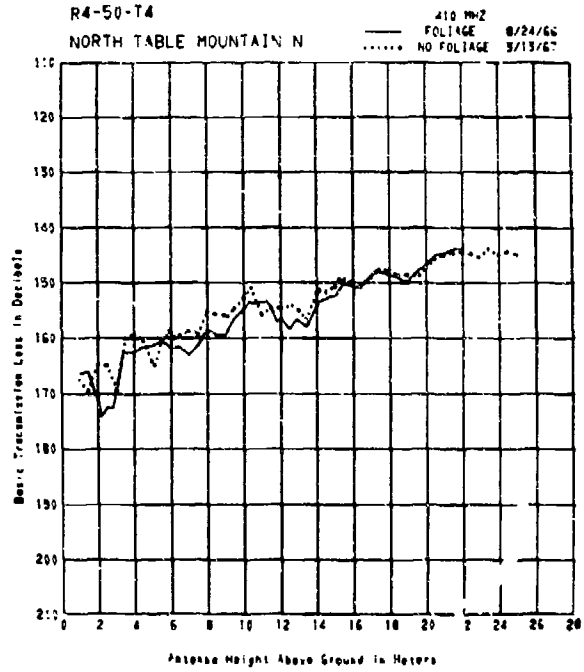


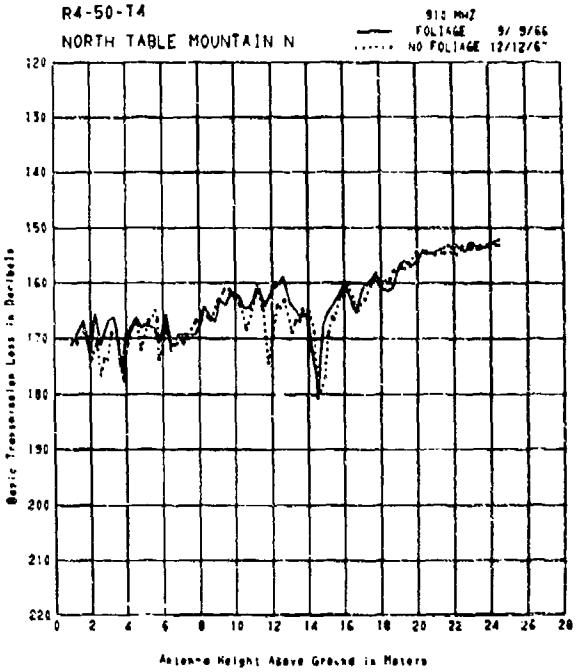
L_b (dB) SHORT TERM SIGNAL VARIABILITY

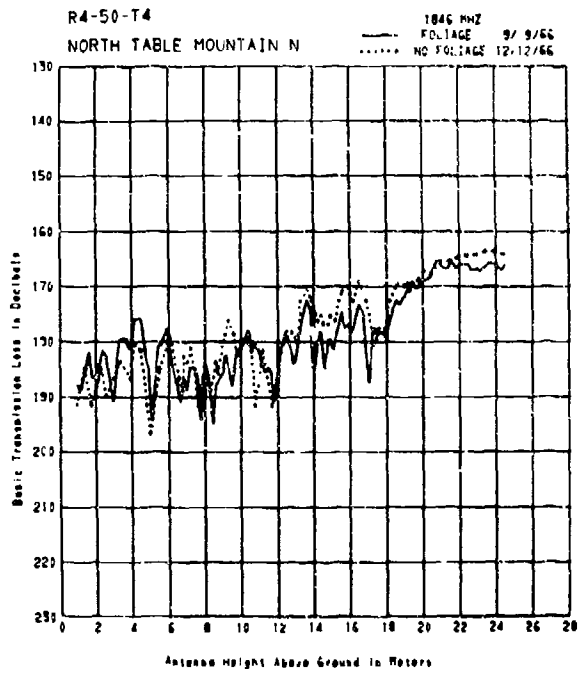
Freq(MHz)	230	410	910	1846	4595	9190
	8-24-66 at 22M			9-9-66 at 1M		
50%	140.0	143.7	168.1	189.3	206.7	
Δ10%-90%	<3	<3	<3	<3	6.0	
				9-9-66 at 7.3M		
50%			164.1	187.3	204.7	
Δ10%-90%			<3	<3	6.5	
				9-9-66 at 24.5M		
50%			149.6	167.3	179.5	188.9
Δ10%-90%			<3	3.0	5.0	13.6

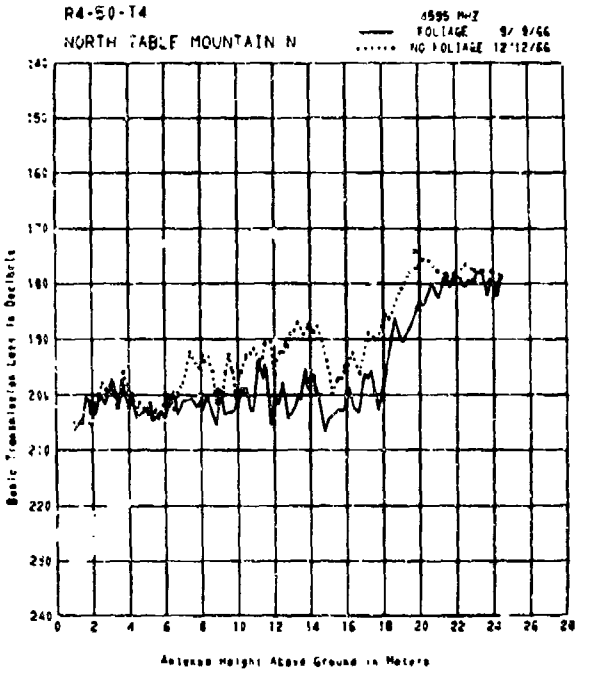
The foreground of the path, consisting of rocky grass land, extends for 90 m. The terrain the drops off for 60 m to a valley below. The radio horizon is about 5 km beyond the valley, and is formed by a rounded, grassy ridge. There are scattered trees throughout the valley.

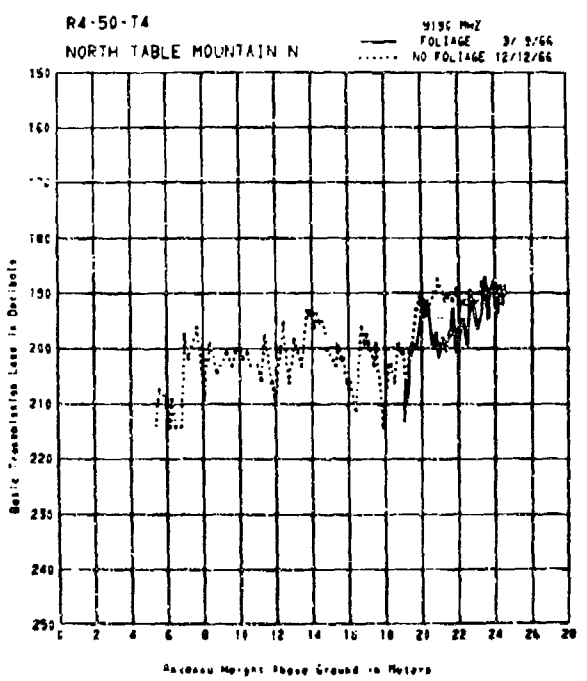

R4-50-T4
NORTH TABLE MOUNTAIN N
230 MHZ
FOLIAGE 8/24/66
NO FOLIAGE 9/13/67
Basic Transmission Loss in Decibels
110
120
130
140
150
160
170
180
190
200
210
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-50-T4
NORTH TABLE MOUNTAIN N
410 MHZ
FOLIAGE 8/24/66
NO FOLIAGE 9/13/67
Basic Transmission Loss in Decibels
110
120
130
140
150
160
170
180
190
200
210
0 2 4 6 8 10 12 14 16 18 20 2 24 26 28
Antenna Height Above Ground in Meters


R4-50-T4
NORTH TABLE MOUNTAIN N
915 MHZ
FOLIAGE 9/ 9/66
NO FOLIAGE 12/12/6
Basic Transmission Loss in Decibels
120
130
140
150
160
170
180
190
200
210
220
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-50-T4
NORTH TABLE MOUNTAIN N
1846 MHZ
FOLIAGE 9/ 9/66
NO FOLIAGE 12/12/66
Basic Transmission Loss in Decibels
130
140
150
160
170
180
190
200
210
220
230
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-50-T4
NORTH TABLE MOUNTAIN N
4595 MHZ
FOLIAGE 9/ 9/66
NO FOLIAGE 12/12/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters

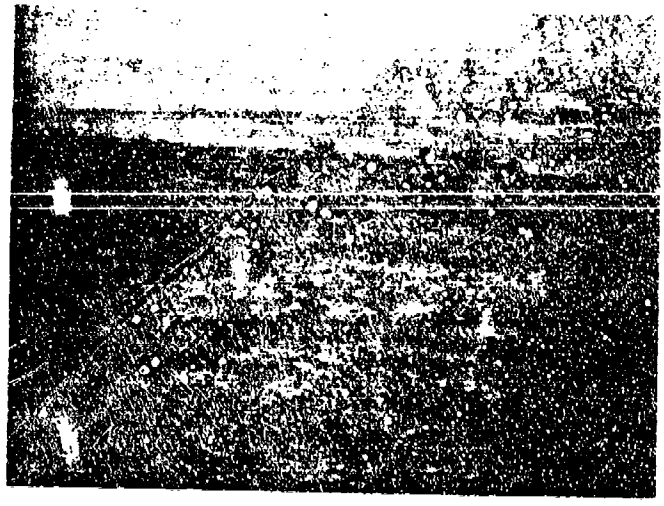

R4-50-T4
NORTH TABLE MOUNTAIN N
9195 MHZ
FOLIAGE 9/ 9/66
NO FOLIAGE 12/12/66
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters

R4-50-T4

L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
	3-13-67 at 25 M			12-12-66 at 1 M		
50%	137.9	145.3	168.7	191.5	203.2	
Δ10% - 90%	< 3	< 3	< 3	< 3	< 3	
				12-12-66 at 7.3 M		
50%			169.7	181.0	193.7	199.1
Δ10% - 90%			< 3	< 3	< 3	< 3
				12-12-66 at 14 M		
50%				174.0	187.2	192.1
Δ10% - 90%				< 3	< 3	< 3
				12-12-66 at 24.5 M		
50%			152.2	162.5	178.2	186.6
Δ10% - 90%			< 3	< 3	< 3	< 3

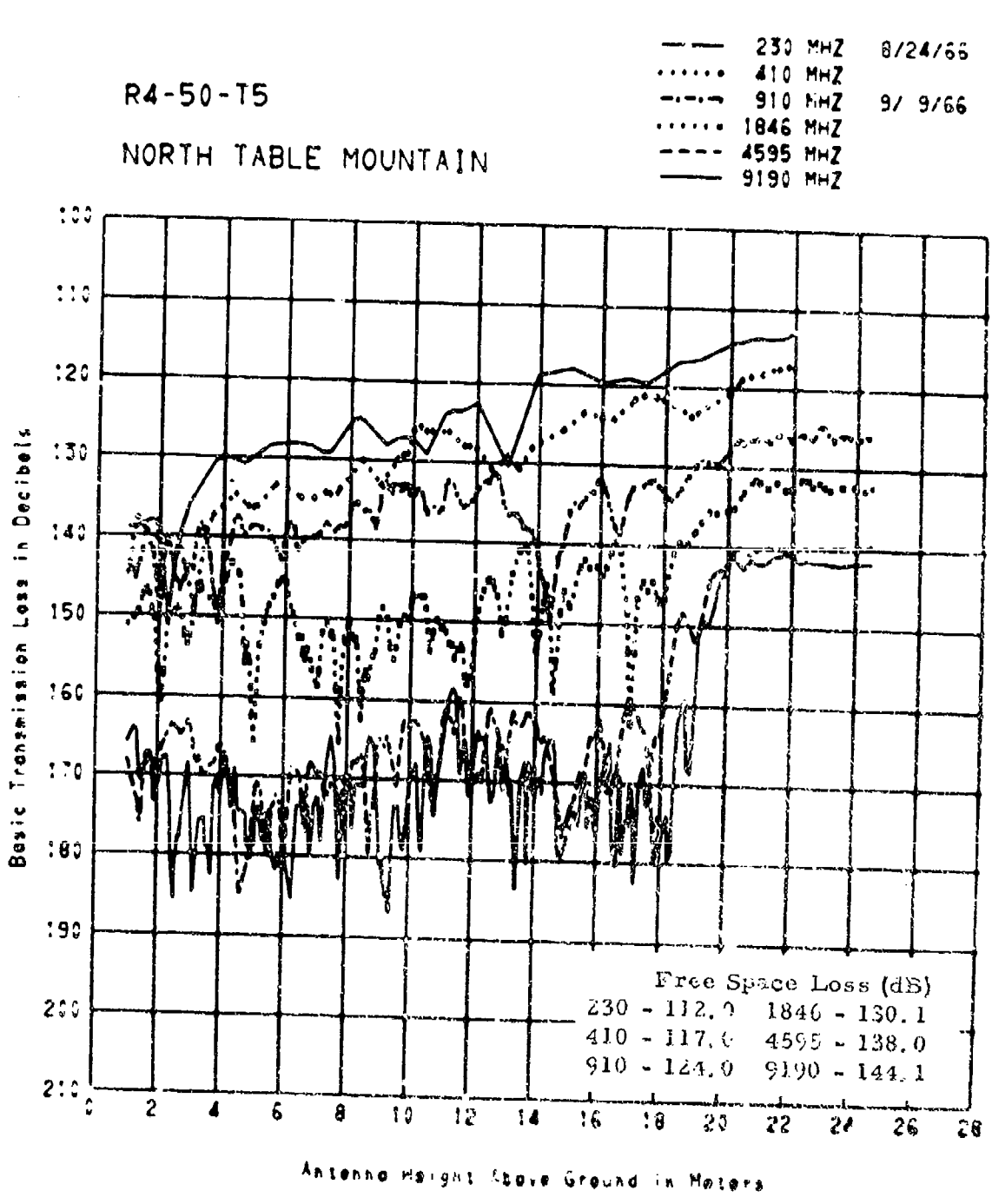
R4-50-T5
NORTH TABLE MOUNTAIN



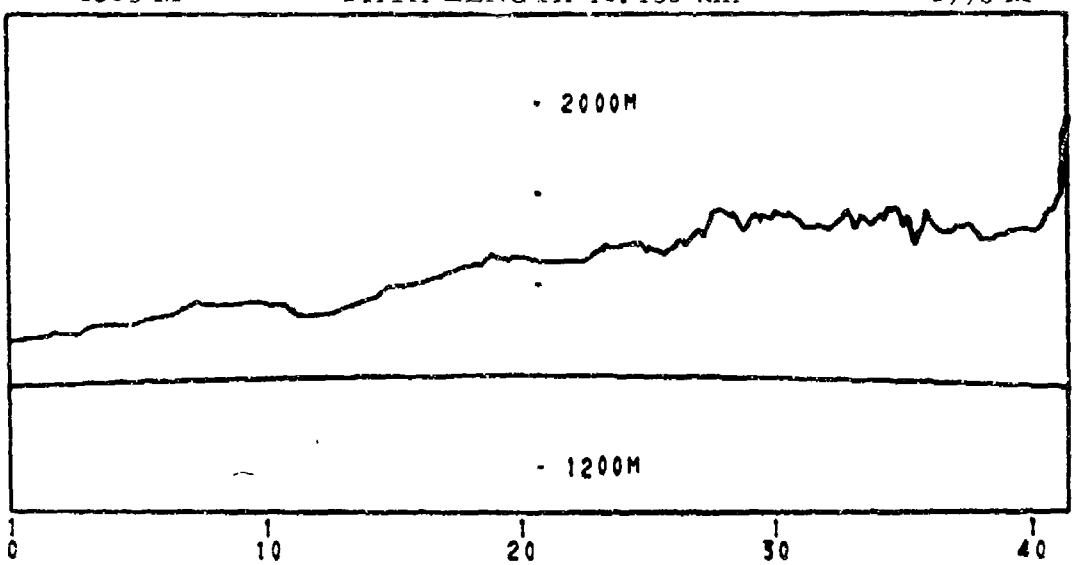
PATH VIEW FROM TRANSMITTER
Bearing from common receiver site to transmitter site is
192° 45' 37"

R4-50-T5

NORTH TABLE MOUNTAIN



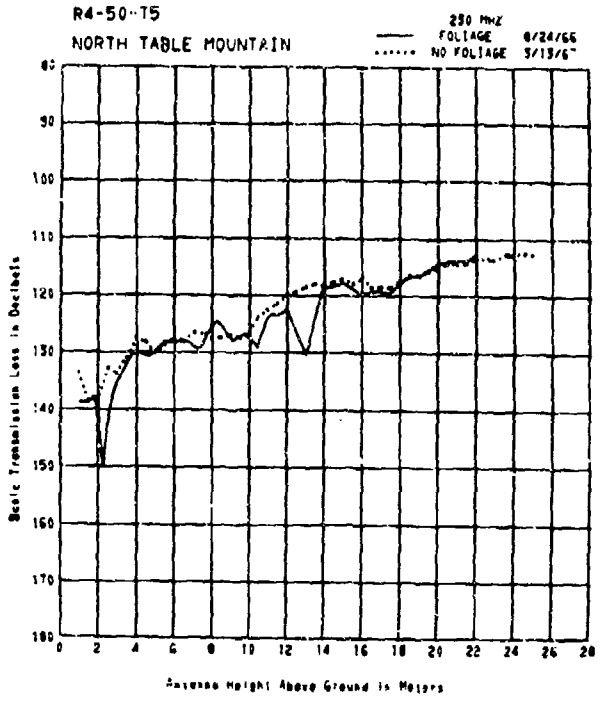
RCVR. ELEV. 1503 M | R4-50-T5 PATH LENGTH 41.435 km | XMTR. ELEV. 1996 M

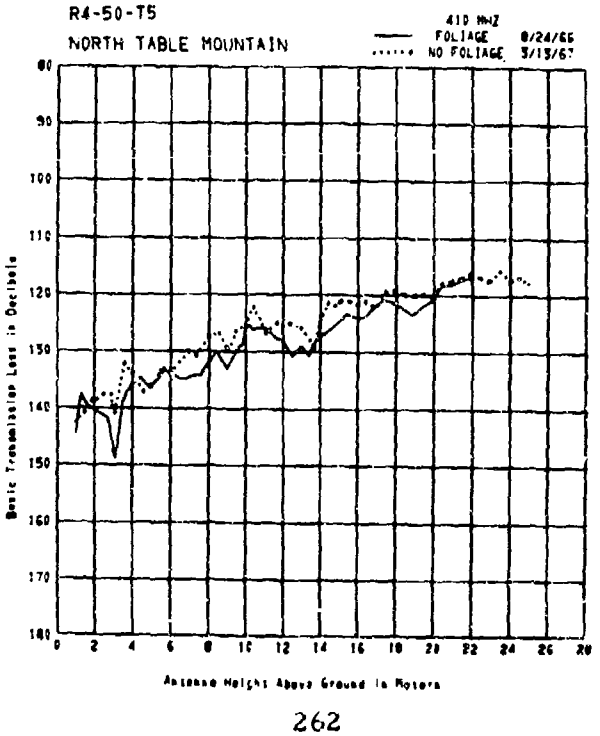


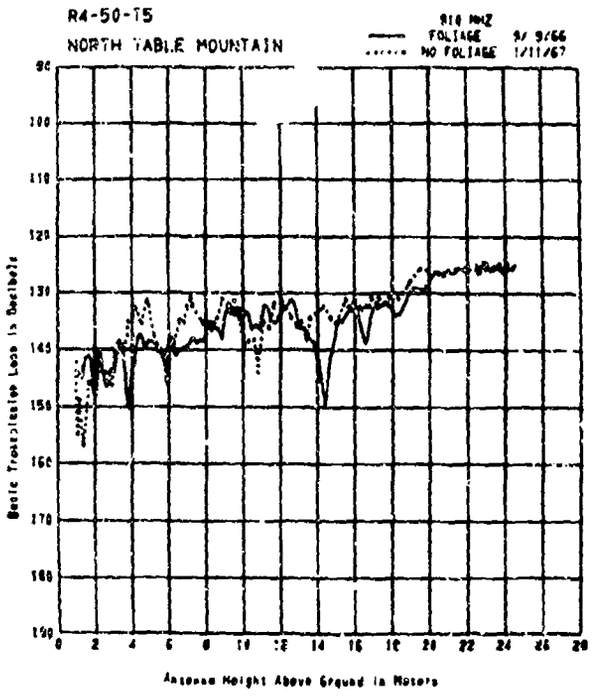
L_b (dB) SHORT TERM SIGNAL VARIABILITY

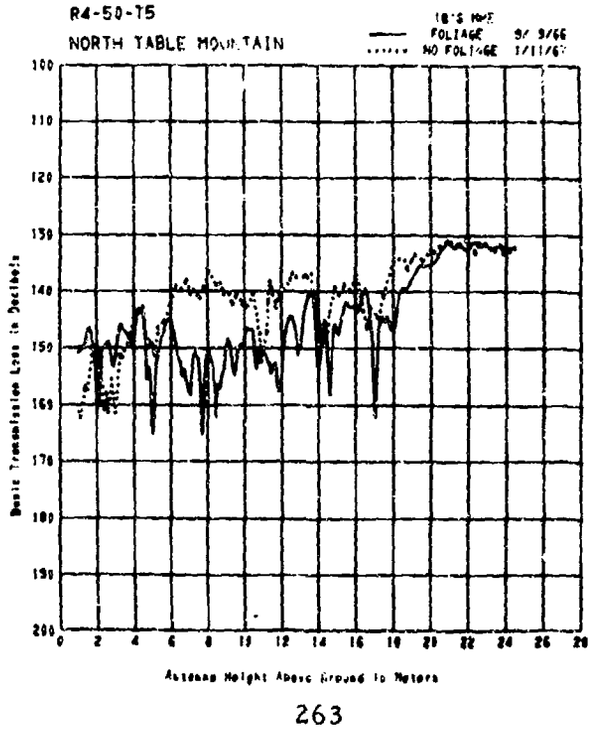
Freq(MHz)	230	410	910	1846	4595	9190
	8-24-66 at 22M			9-9-66 at 1M		
50%	112.9	117.4	144.2	150.8	167.9	165.3
Δ10%-90%	<3	<3	<3	<3	<3	3.5
				9-9-66 at 7.3M		
50%			136.2	150.3	168.9	168.8
Δ10%-90%			<3	<3	5.0	3.0
				9-9-66 at 24.5M		
50%			124.7	132.3	139.4	141.3
Δ10%-90%			<3	<3	<3	<3

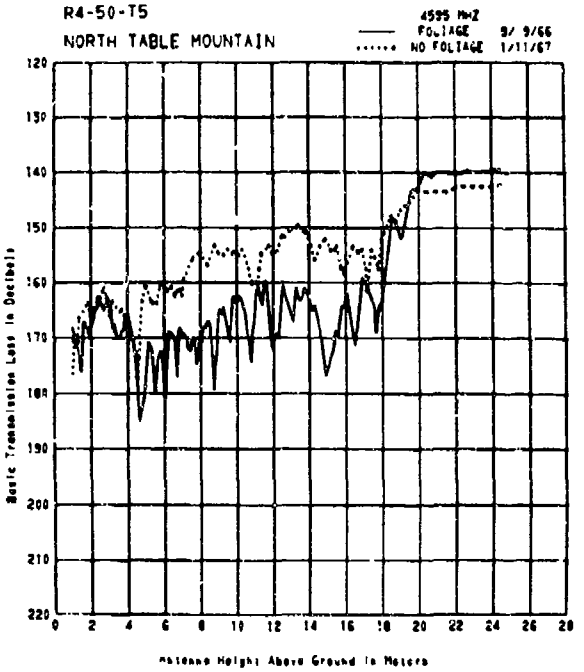
The foreground of the radio path consists of rocky terrain with sparse grass, and extends for 30 m. At this point, the mountain drops off for about 200 m to the valley below. The remainder of the path is cultivated farm land.

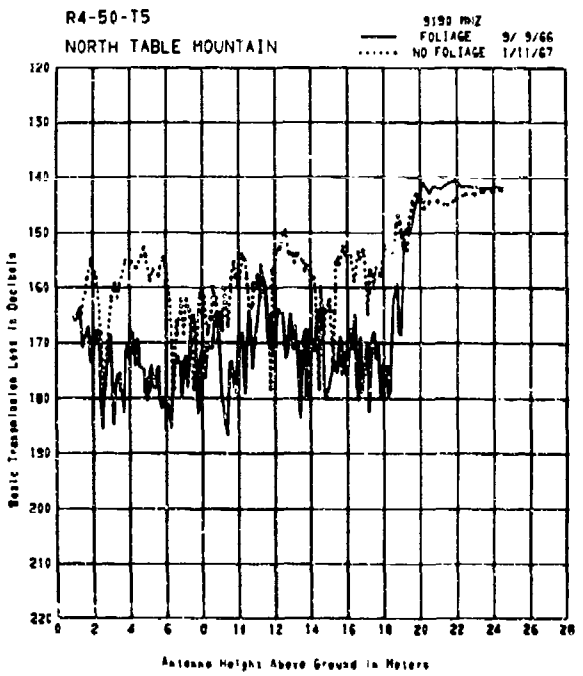

R4-50-T5
NORTH TABLE MOUNTAIN
230 MHZ
FOLIAGE 8/24/66
NO FOLIAGE 5/13/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-50-T5
NORTH TABLE MOUNTAIN
410 MHZ
FOLIAGE 8/24/66
NO FOLIAGE 5/13/67
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-50-T5
NORTH TABLE MOUNTAIN
FOLIAGE
NO FOLIAGE
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-50-T5
NORTH TABLE MOUNTAIN
FOLIAGE
NO FOLIAGE
Basic Transmission Loss in Decibels
Antenna Height Above Ground in Meters


R4-50-T5
NORTH TABLE MOUNTAIN
4595 MHZ
FOLIAGE 9/ 9/66
NO FOLIAGE 1/11/67
Basic Transmission Loss in Decibels
120
130
140
150
160
170
180
190
200
210
220
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters


R4-50-T5
NORTH TABLE MOUNTAIN
9190 MHZ
FOLIAGE 9/ 9/66
NO FOLIAGE 1/11/67
Basic Transmission Loss in Decibels
120
130
140
150
160
170
180
190
200
210
220
0 2 4 6 8 10 12 14 16 18 20 22 24 26 28
Antenna Height Above Ground in Meters

R4-50-T5

L_b (dB) SHORT TERM SIGNAL VARIABILITY (Without Foliage)

Freq (MHz)	230	410	910	1846	4595	9190
	3-13-67 at 25 M			1-11-66 at 1 M		
50%	113.4	117.0	142.3	160.0	179.8	161.1
Δ10% - 90%	< 3	< 3	< 3	< 3	< 3	< 3
				1-11-66 at 7.3 M		
50%			130.3	139.6	159.3	161.6
Δ10% - 90%			< 3	< 3	< 3	< 3
				1-11-66 at 14 M		
50%			132.3	147.6	151.3	156.1
Δ10% - 90%			< 3	< 3	< 3	< 3
				1-11-67 at 24.5 M		
50%			124.8	132.1	142.0	141.6
Δ10% - 90%			< 3	< 3	< 3	< 3

9. METEOROLOGICAL INFORMATION

This section of the report presents a comprehensive listing of meteorological parameters for each path that were obtained simultaneously with the path loss measurements. Wet and dry bulb temperatures were obtained by reading electrically operated psychrometers; atmospheric pressures were indicated on high-grade aneroid barometers; percent relative humidity was calculated from data obtained at the site. Cloud types were based on the National Weather Service cloud code classification, and percent cloud cover, wind speed, and wind direction were estimated.

Type of Site	Dry Bulb Temp C	Wet Bulb Temp C	Atmos. Press. mb	% Rel. Humid.	Cloud Type	% Cloud Cover	Wind Speed & Dir.	Terminal
			R4-0.5-T1 Longmont S1					
UHF	August 8, 1966							
OPEN	18.3	14.4	870.0	67	L2, M6	100	5	Rcvr
	16.7	13.9	851.3	75	L5	100	0-5NE	Xmtr
SHF	September 13, 1966							
OPEN	16.4	11.6	847.9	59	L1, M4	30	1-2E	Rcvr
	15.0	10.6	850.3	60	L1, L2	20	0-5W	Xmtr
SHF	January 10, 1967							
OPEN	1.0	-2.7	858.5	42	H6	50	0-2	Rcvr
	-1.1	-3.9	862.2	50	H9	60	3W	Xmtr
UHF	February 8, 1967							
OPEN	4.5	1.3	845.9	58	H7	5	Calm	Rcvr
	2.5	-2.5	855.5	29	- -	0	Calm	Xmtr
			R4-3-T1 Longmont E1					
UHF	August 9, 1966							
OPEN	23.3	16.7	846.0	53	L2, M6	10	Calm	Rcvr
	26.7	17.7	840.5	43	L1, L2	30	5 W	Xmtr

Type of Site	Dry Bulb Temp C	Wet Bulb Temp C	Atmos. Press. mb	% Rel. Humid.	Cloud Type	% Cloud Cover	Wind Speed & Dir.	Terminal
			R4-3-T1 (continued)					
SHF	September 26, 1966							
OPEN	18.4	15.1	844.6	72	L1	10	5-10NE	Rcvr
	21.4	15.6	842.5	57	L2, M3	30	5NE	Xmtr
SHF	December 5, 1966							
OPEN	-1.6	-1.8	832.0	95	Fog	100	Calm	Rcvr
	0.0	-0.3	829.3	95	Fog	100	Calm	Xmtr
UHF	February 24, 1967							
OPEN	0.2	-0.4	849.3	90	- -	- -	- -	Rcvr
	-1.1	-3.9	854.3	50	H2	5	Calm	Xmtr
			R4-3-T2 Longmont SE 1.5					
UHF	August 9, 1966							
OPEN	22.8	16.7	847.5	56	L2, M6	90	5 NW	Rcvr
	24.4	18.3	847.3	57	L1	20	0-5 E	Xmtr
SHF	September 6, 1966							
OPEN	24.5	15.0	852.0	38	L2, M2	75	Calm	Rcvr
	27.2	15.6	852.0	30	L2	40	Calm	Xmtr
SHF	December 7, 1966							
OPEN	3.4	2.7	829.7	90	M3	75	Calm	Rcvr
	3.6	2.2	831.7	81	H6	65	Calm	Xmtr
UHF	February 24, 1967							
OPEN	1.8	0.0	848.0	73	- -	- -	Calm	Rcvr
	1.1	-2.8	859.0	40	H1	20	0-5 SE	Xmtr
			R4-3-T3 Longmont ESE 3					
UHF	August 19, 1966							
OPEN	25.0	16.7	848.0	45	L2, M2	70	Calm	Rcvr
	27.1	17.2	831.7	36	H2, H9, L9	60	Calm	Xmtr

Type of Site	Dry Bulb Temp C	Wet Bulb Temp C	Atmos. Press. mb	% Rel. Humid.	Cloud Type	% Cloud Cover	Wind Speed & Dir.	Terminal
			R4-3-T2 (continued)					
SHF	September 2, 1966							
OPEN	16.8	14.6	852.1	80	L1, M3	40	Calm	Rcvr
	17.8	15.6	851.3	81	L1, M3	75	0-5 E	Xmtr
SHF	December 7, 1966							
OPEN	3.9	2.2	829.3	77	L5, M1	85	Calm	Rcvr
	7.1	5.0	831.0	75	H6	65	Calm	Xmtr
UHF	March 10, 1967							
OPEN	16.5	16.2	835.1	- -	H2	30	Calm	Rcvr
	15.0	5.0	845.1	- -	H9	30	Calm	Xmtr
			R4-3-T4 Longmont SSE2					
UHF	August 18, 1967							
OPEN	26.7	15.6	849.5	32	L6	70	0-5-NW	Rcvr
	32.2	20.0	843.2	34	H2, L5	50	5 NW	Xmtr
SHF	September 2, 1966							
OPEN	21.6	16.2	849.8	59	L1, M3	30	Calm	Rcvr
	21.7	17.8	847.3	70	L1, L2	30	0-5 S	Xmtr
SHF	December 7, 1966							
OPEN	5.2	3.3	829.7	76	M3	75	0-4SE	Rcvr
	5.6	3.1	829.3	69	H6	70	Calm	Xmtr
UHF	March 10, 1967							
OPEN	16.5	16.2	835.1	- -	H2	30	- -	Rcvr
	16.1	3.9	841.6	- -	H6	40	5 W	Xmtr
			R4-3-T5 Longmont SW1.5					
UHF	August 8, 1966							
OPEN	16.1	12.8	854.0	70	L2, M6	100	Calm	Rcvr
	14.4	12.2	851.3	79	L5	100	0-5NE	Xmtr

Type of Site	Dry Bulb Temp C	Wet Bulb Temp C	Atmos. Press. mb	% Rel. Humid.	Cloud Type	% Cloud Cover	Wind Speed & Dir.	Terminal
			R4-3-T5 (continued)					
SHF	September 12, 1966							
OPEN	22.0	13.7	845.9	41	L1	80	2 SE	Rcvr
	25.6	15.6	846.6	36	L1, L2	50	0-5 E	Xmtr
SHF	January 10, 1967							
OPEN	4.9	-0.2	857.4	36	H6	30	0-2	Rcvr
	4.7	0.3	860.1	44	H9	30	3 SE	Xmtr
			R4-3-T6 Longmont SW1.2					
UHF	August 8, 1966							
OPEN	15.6	12.8	853.5	74	L2, M6	100	Calm	Rcvr
	16.1	13.3	850.7	75	L5	100	0-5NE	Xmtr
SHF	September 12, 1966							
OPEN	23.4	13.1	845.5	32	L1	10	2 E	Rcvr
	25.0	15.0	845.9	36	L1	30	5	Xmtr
SHF	January 10, 1967							
OPEN	7.2	0.8	856.1	28	H6	50	0-2S	Rcvr
	8.9	2.8	858.5	35	H9	70	3 SW	Xmtr
UHF	February 8, 1967							
OPEN	No data available							
			R4-5-T1 Union Reservoir					
UHF	August 10, 1966							
OPEN	17.2	14.4	850.0	75	L2, M6	50	5 E	Rcvr
	18.9	15.0	847.6	68	L1	30	5 NE	Xmtr
SHF	September 23, 1966							
OPEN	22.1	14.8	851.7	45	L1	5	Calm	Rcvr
	21.9	15.0	853.0	50	L1	3	1 W	Xmtr
SHF	November 18, 1966							
OPEN	10.6	6.3	854.1	55	M3	80	0-5S	Rcvr
	11.7	4.4	856.8	30	H9, L1	20	2	Xmtr
UHF	February 21, 1967							
OPEN	No data available							

Type of Site	Dry Bulb Temp C	Wet Bulb Temp C	Atmos. Press. mb	% Rel. Humid.	Cloud Type	% Cloud Cover	Wind Speed & Dir.	Terminal
			R4-5-T2 Union Reservoir S1					
UHF	August 10, 1966							
OPEN	21.7	16.1	849.5	58	H2, L2	10	Calm	Rcvr
	22.8	16.7	846.9	56	L1	40	0-5 E	Xmtr
SHF	September 26, 1966							
OPEN	20.3	16.3	843.9	68	L1, L5	40	5-10NE	Rcvr
	21.9	15.3	844.9	52	H4, L5, M3	75	5-10NE	Xmtr
SHF	December 2, 1966							
OPEN	0.2	0.0	844.2	97	M1	100	Calm	Rcvr
	2.8	0.0	845.9	61	H6	90	Calm	Xmtr
UHF	February 21, 1967							
OPEN	6.6	3.4	833.7	62	L2, M6	10	0-25NW	Rcvr
	7.8	0.6	842.0	22	L9	50	Calm	Xmtr
			R4-5-T3 Longmont SE 3.5					
UHF	August 19, 1966							
OPEN	22.3	16.1	849.5	49	L2, M6	40	Calm	Rcvr
	23.9	16.7	845.2	50	L1, H6	50	Calm	Xmtr
SHF	September 2, 1966							
OPEN	19.6	15.3	851.2	65	L2, M3	32	Calm	Rcvr
	21.1	17.2	848.6	69	L1, L5	75	0-5SE	Xmtr
SHF	December 7, 1966							
OPEN	4.9	3.5	829.3	82	L1, M3	60	Calm	Rcvr
	7.2	4.4	832.7	67	H6	65	Calm	Xmtr
UHF	February 24, 1967							
OPEN	6.6	3.4	833.7	62	L2, M6	20	0-25NW	Rcvr
	2.2	-1.7	858.3	43	H2	20	Calm	Xmtr

Type of Site	Dry Bulb Temp C	Wet Bulb Temp C	Atmos. Press. mb	% Rel. Humid.	Cloud Type	% Cloud Cover	Wind Speed & Dir.	Terminal
			R4-5-T4 Longmont S 3					
UHF	August 19, 1966							
OPEN	27.2	17.2	847.5	38	L2, M9	70	Calm	Rcvr
	27.8	17.8	838.1	39	H9, L2, L9	70	Calm	Xmtr
SHF	September 7, 1966							
OPEN	25.8	13.8	853.3	27	L1	25	5SE	Rcvr
	27.2	15.0	838.1	28	L1, L2	30	5-10	Xmtr
SHF	December 7, 1966							
OPEN	5.1	3.6	830.7	81	M3	40	Calm	Rcvr
	6.1	3.3	827.3	66	H6	60	3 SE	Xmtr
UHF	March 10, 1967							
OPEN	18.2	7.6	834.7	21	H2	10	0-10NW	Rcvr
	17.2	5.0	839.6	9	H6	40	5 W	Xmtr
			R4-5-T5 Longmont SW5					
UHF	August 2, 1966							
OPEN	21.1	15.6	855.0	58	L2, M6	90	Calm	Rcvr
	27.2	21.1	847.3	60	L1, M3	25	0-5 E	Xmtr
SHF	September 12, 1966							
OPEN	21.2	13.9	845.2	47	L5	90	Calm	Rcvr
	23.9	14.4	842.9	37	L1, L5	80	0-5SW	Xmtr
SHF	January 9, 1967							
OPEN	7.3	-0.3	853.0	16	H6	60	0-2	Rcvr
	8.3	1.1	857.8	23	H9	30	0-5NE	Xmtr
UHF	January 31, 1967							
OPEN	6.6	4.0	834.4	69	H2	60	0-5	Rcvr
	4.4	1.1	842.8	57	H9	70	8 NW	Xmtr

Type of Site	Dry Bulb Temp C	Wet Bulb Temp C	Atmos. Press. mb	% Rel. Humid.	Cloud Type	% Cloud Cover	Wind Speed & Dir.	Terminal
			R4-5-T6 Longmont W2.5					
UHF	August 3, 1966							
OPEN	22.2	17.8	851.5	67	L1, H6	30	0-5W	Rcvr
	24.4	18.3	848.6	57	L1, H6	25	0-5W	Xmtr
SHF	September 13, 1966							
OPEN	19.5	12.8	847.3	48	L1	40	5 E	Rcvr
	19.4	13.9	848.0	57	L1	30	0-5NE	Xmtr
SHF	January 10, 1967							
OPEN	9.1	2.2	855.1	28	H6	20	0-2	Rcvr
	11.1	3.9	856.1	30	H9	80	3 SW	Xmtr
UHF	January 31, 1967							
OPEN	No data available							Rcvr
	6.9	2.2	841.0	46	H9, L1	30	0-5NW	Xmtr
			R4-10-T2 Union Reservoir SE 2.5					
UHF	August 10, 1966							
OPEN	23.3	16.7	848.0	53	- -	- -	- -	Rcvr
	24.4	17.2	857.1	50	L1	20	0 5NE	Xmtr
SHF	September 26, 1966							
OPEN	20.5	15.9	844.2	64	L1, L2, L5	75	5-10SE	Rcvr
	24.4	15.5	847.6	41	L2, L5, M3	60	5 NE	Xmtr
SHF	December 2, 1966							
OPEN	-4.2	-4.9	843.9	82	M1	100	Calm	Rcvr
	-2.8	-4.2	848.3	71	H6	100	5-10W	Xmtr
UHF	February 17, 1967							
OPEN	No data available							Rcvr
	4.4	-1.1	844.6	30	L5	100	5-10W	Xmtr

Type of Site	Dry Bulb Temp C	Wet Bulb Temp C	Atmos. Press mb	% Rel. Humid.	Cloud Type	% Cloud Cover	Wind Speed & Dir.	Terminal
			R4-10-T3 Erie NF1					
UHF	August 19, 1966							
OPEN	22.2	17.2	846.5	63	L2, M2	80	- -	Rcvr
	29.4	17.2	837.1	31	L2, L5	90	- -	Xmtr
SHF	September 7, 1966							
OPEN	24.7	12.5	854.3	24	M1	90	10 NW	Rcvr
	27.2	14.4	848.6	25	L1, L2	50	5-10 N	Xmtr
SHF	December 9, 1966							
OPEN	-3.1	-4.5	853.0	70	- -	- -	0-2	Rcvr
	-2.8	-6.1	851.7	36	- -	- -	0-2	Xmtr
UHF	March 10, 1967							
OPEN	18.2	7.6	834.7	21	H2	10	0-10 NW	Rcvr
	20.0	6.1	840.3	7	H9	20	10-15 W	Xmtr
			R4-10-T4 Gunbarrel Hill					
UHF	August 22, 1966							
OPEN	15.0	10.0	857.0	55	- -	- -	Calm	Rcvr
	16.1	11.1	843.9	67	- -	- -	0-5 E	Xmtr
SHF	September 7, 1966							
OPEN	22.6	14.6	854.2	44	L1	10	Calm	Rcvr
	22.8	14.4	845.2	42	L2	20	0-5 S	Xmtr
SHF	December 7, 1966							
OPEN	4.2	2.6	831.7	79	L1	5	0-3 S	Rcvr
	5.0	2.8	825.6	72	L1	20	Calm	Xmtr
UHF	March 14, 1967							
OPEN	8.2	4.2	834.4	55	H2	60	0-5 NW	Rcvr
	10.6	4.2	835.7	37	L2	70	10 E	Xmtr

Type of Site	Dry Bulb Temp C	Wet Bulb Temp C	Atmos. Press. mb	% Rel. Humid.	Cloud Type	% Cloud Cover	Wind Speed & Dir.	Terminal
			R4-10-T5 Niwot E1					
UHF	August 4, 1966							
OPEN	21.1	18.3	850.0	78	L2, M6	90	Calm	Rcvr
	21.1	17.8	843.9	74	L1, L2	75	0-5 E	Xmtr
SHF	September 15, 1966							
OPEN	9.3	8.1	847.6	86	L6	100	Calm	Rcvr
	10.0	8.9	845.9	88	L6	100	1 NE	Xmtr
SHF	January 9, 1967							
OPEN	7.0	-0.5	853.4	16	H6	10	0-3	Rcvr
	7.8	1.7	852.7	33	H9	30	0-5 NE	Xmtr
UHF	February 10, 1967							
OPEN	7.8	3.5	832.4	52	L2, H2	90	0-20 NNW	Rcvr
	8.3	1.7	837.3	29	H9, L2, L5	80	10-15 W	Xmtr
			R4-10-T6 Niwot N 0.5					
UHF	August 3, 1966							
OPEN	28.3	17.8	852.0	50	-	-	Calm	Rcvr
	28.3	18.9	843.9	43	L1, L5	90	5 N	Xmtr
SHF	September 13, 1966							
OPEN	22.6	13.5	845.2	37	L1, L2	20	0-1	Rcvr
	23.3	14.4	843.2	40	L1, L2	30	0-5 S	Xmtr
SHF	January 9, 1967							
OPEN	-1.4	-5.0	853.4	36	H6	95	0-2 S	Rcvr
	8.9	1.7	852.6	25	H9	30	0-5 SE	Xmtr
UHF	February 10, 1967							
OPEN	7.2	3.6	832.4	58	H2, L2	95	0-25 NNW	Rcvr
	6.7	1.7	837.0	42	H6, L5	100	15 W	Xmtr

Type of Site	Dry Bulb Temp C	Wet Bulb Temp C	Atmos. Press. mb	% Rel. Humid.	Cloud Type	% Cloud Cover	Wind Speed & Dir.	Terminal
			R4-10-T7 Longmont W5					
UHF	August 22, 1966							
OPEN	27.8	19.4	851.0	47	-	-	Calm	Rcvr
	27.2	18.3	851.0	44	-	-	Calm	Xmtr
SHF	September 13, 1966							
OPEN	21.5	13.0	846.6	39	L1, L2	20	3 S	Rcvr
	21.7	15.6	844.2	55	L1	30	0-5 NE	Xmtr
SHF	January 10, 1967							
OPEN	11.5	3.4	854.7	23	H6, H7	100	0-2	Rcvr
	11.1	-0.6	853.4	-	H9	90	3 NW	Xmtr
UHF	January 31, 1967							
OPEN	8.6	5.4	854.1	64	H2, L2	80	Calm	Rcvr
	13.3	6.1	836.6	35	H9, L2	40	15 SW	Xmtr
			R4-20-T1 Gowanda SE 1.5					
UHF	August 11, 1966							
OPEN	21.4	17.8	844.0	72	- -	-	Calm	Rcvr
	22.2	17.8	845.2	67	L1	5	0-5 N	Xmtr
SHF	September 27, 1966							
OPEN	13.5	12.2	842.5	87	L9	35	2-8 SSW	Rcvr
	14.7	12.2	854.4	76	L5	100	Calm	Xmtr
SHF	December 1, 1966							
OPEN	-4.8	-5.4	843.6	83	M1	80	Calm	Rcvr
	-1.1	-3.9	849.3	50	H6, L1	80	Calm	Xmtr
UHF	February 17, 1967							
OPEN	2.4	-0.8	834.4	54	L6	100	0-15 NW	Rcvr
	0.3	-4.2	847.3	29	M1, L1, L5	90	10 S	Xmtr

Type of Site	Dry Bulb Temp C	Wet Bulb Temp C	Atmos. Press. mb	% Rel. Humid.	Cloud Type	% Cloud Cover	Wind Speed & Dir.	Terminal
R4-20-T2 Firestone NE3								
UHF	August 10, 1966							
OPEN	25.0	16.7	847.0	45	L2, M6	10	Calm	Rcvr
	26.1	16.1	843.2	37	L1	10	0-5 E	Xmtr
SHF	September 27, 1966							
OPEN	15.7	12.2	848.3	68	L9	95	1 S	Rcvr
	15.6	12.2	849.0	69	L1	50	0-5 SE	Xmtr
SHF	December 1, 1966							
OPEN	-5.3	-6.4	843.2	72	M2	95	0-1	Rcvr
	1.1	-1.4	843.9	61	H6, L1	60	2 NE	Xmtr
UHF	February 17, 1967							
OPEN	2.7	-0.4	838.7	57	L6	100	0-15 NW	Rcvr
	2.8	-2.8	842.2	23	H1, L1, L5	95	5-10 NW	Xmtr
R4-20-T4 Lafayette E6								
UHF	August 22, 1966							
OPEN	21.1	13.3	855.5	43	L1	40	Calm	Rcvr
	21.7	13.9	842.9	44	L1	5	0-5 NE	Xmtr
SHF	September 8, 1966							
OPEN	26.1	13.8	851.0	26	L1	50	Calm	Rcvr
	30.6	15.0	847.3	18	L1	30	5 SE	Xmtr
SHF	December 9, 1966							
OPEN	-1.8	-5.5	851.7	33	L1	-	0-2	Rcvr
	1.7	-3.1	846.9	29	- -	-	3 E	Xmtr
UHF	March 14, 1967							
OPEN	5.6	3.0	835.8	65	H2	70	0-5 NW	Rcvr
	13.3	6.1	837.5	35	L1	25	6-10 ESE	Xmtr

Type of Site	Dry Bulb Temp C	Wet Bulb Temp C	Atmos. Press. mb	% Rel. Humid.	Cloud Type	% Cloud Cover	Wind Speed & Dir.	Terminal
			R4-20-T5 Boulder NE3					
UHF	August 4, 1966							
OPEN	22.8	18.3	835.1	67	H2, L2	40	-	Rcvr
	22.8	17.2	835.1	59	L1, L2	50	0-5 W	Xmtr
SHF	September 15, 1966							
OPEN	10.2	9.0	847.3	87	L6	100	Calm	Rcvr
	12.2	10.0	839.2	78	L6	100	1 NE	Xmtr
SHF	January 9, 1967							
OPEN	2.7	-2.2	853.7	31	H1, H6	5	0-2	Rcvr
	5.0	-0.6	847.3	31	- -	-	0-5 NE	Xmtr
UHF	February 10, 1967							
OPEN	7.8	3.5	832.4	52	L2, H2	90	0-15 NNW	Rcvr
	6.1	0.6	830.9	36	H6	90	10 NW	Xmtr
			R4-20-T6 Boulder N5					
UHF	August 4, 1966							
OPEN	25.6	16.7	849.5	42	L2, H2	40	Calm	Rcvr
	26.7	17.8	831.7	44	L1, L2	50	0-5 E	Xmtr
SHF	September 15, 1966							
OPEN	10.3	9.4	846.6	90	L6	100	1	Rcvr
	10.6	10.0	831.7	93	L6	100	1 E	Xmtr
SHF	January 11, 1967							
OPEN	1.0	-2.1	847.3	52	H4, M4	90	-	Rcvr
	9.4	1.7	832.0	22	H6, L2	80	0-5 NW	Xmtr
UHF	February 8, 1967							
OPEN	no data available							Rcvr
	9.4	0.6	834.3	13	H1	30	0-5 W	Xmtr

Type of Site	Dry Bulb Temp C	Wet Bulb Temp C	Atmos. Press. mb	% Rel. Humid.	Cloud Type	% Cloud Cover	Wind Speed & Dir.	Terminal
			R4-20-T7 Boulder N9					
UHF	August 4, 1966							
OPEN	13.3	16.1	850.5	49	- -	-	5-15	Rcvr
	26.6	16.1	827.0	37	L1, L2	75	0-5 N	Xmtr
SHF	September 15, 1966							
OPEN	12.5	10.5	845.9	80	L6	100	1	Rcvr
	11.7	11.1	825.9	94	L6	100	1 E	Xmtr
SHF	January 10, 1967							
OPEN	10.8	3.4	854.7	28	H7	100	0-2	Rcvr
	11.7	4.4	835.4	31	H7	100	3 SW	Xmtr
UHF	February 8, 1967							
OPEN	no data available							Rcvr
	8.9	0.6	829.8	16	H9	70	0-5 W	Xmtr
			R4-30-T2 Ione E3					
UHF	August 11, 1966							
OPEN	31.7	15.6	836.5	18	L1	20	5 SE	Rcvr
	35.0	16.7	837.1	15	L1, L2	30	0-5 N	Xmtr
SHF	September 28, 1966							
OPEN	16.6	12.4	844.6	64	H4, H6	60	2-8 E	Rcvr
	18.9	12.8	843.2	52	H1, L1, M1	80	5-10 S	Xmtr
SHF	November 30, 1966							
OPEN	4.9	3.0	847.6	75	M1, L1	15	0-2 E	Rcvr
	7.2	3.9	846.6	61	H3, L1	20	3 NE	Xmtr
UHF	February 16, 1967							
OPEN	2.2	-0.1	836.4	67	H2, L2	70	0-5 NW	Rcvr
	2.8	-3.6	842.0	13	L1	50	10 W	Xmtr

Type of Site	Dry Bulb Temp C	Wet Bulb Temp C	Atmos. Press. mb	% Rel. Humid.	Cloud Type	% Cloud Cover	Wind Speed & Dir.	Terminal
			R4-30-T3 Northglenn					
UHF	August 22, 1966							
OPEN	22.8	15.0	854.8	45	L1	30	Calm	Rcvr
	24.4	15.0	837.1	38	L1	10	0-5 E	Xmtr
SHF	September 8, 1966							
OPEN	28.7	14.5	850.3	21	L1	40	2 S	Rcvr
	28.3	15.0	841.9	24	L1	20	5 E	Xmtr
SHF	December 9, 1966							
OPEN	-2.0	-5.5	851.7	36	- -	-	0-2 W	Rcvr
	-2.8	-5.6	842.0	45	- -	-	Calm	Xmtr
UHF	March 14, 1967							
OPEN	5.8	3.0	835.8	65	H2	70	0-5 NW	Rcvr
	8.3	3.3	833.3	43	L1	25	5 NW	Xmtr
			R4-30-T4 East Broomfield					
UHF	August 23, 1966							
OPEN	17.2	13.3	859.0	66	L2, M2	100	Calm	Rcvr
	16.6	12.8	840.5	74	L5	100	0-5 E	Xmtr
SHF	September 8, 1966							
OPEN	27.6	14.3	850.0	23	L1, L2	50	Calm	Rcvr
	29.4	15.0	839.8	21	L1, L2	30	0-5 E	Xmtr
SHF	December 12 1966							
OPEN	-1.8	-3.4	853.4	66	H2	10	0-2	Rcvr
	0.8	-1.4	842.2	57	H6, H4	10	2 S	Xmtr
UHF	March 14, 1967							
OPEN	4.0	-0.4	836.4	43	H2	30	0-5 NW	Rcvr
	7.2	1.9	833.8	40	L1	10	5-10 NE	Xmtr

Type of Site	Dry Bulb Temp C	Wet Bulb Temp C	Atmos. Press. mb	% Rel. Humid.	Cloud Type	% Cloud Cover	Wind Speed & Dir.	Terminal
			R4-30-T5 Green Mountain					
UHF	August 5, 1966							
OPEN	21.7	17.5	851.0	68	L1	5	Calm	Rcvr
	21.1	16.7	825.9	66	- -	-	0-5 NE	Xmtr
SHF	September 16, 1966							
OPEN	11.6	9.8	846.6	81	Fog	100	Calm	Rcvr
	13.6	11.4	821.9	79	L2	20	12 NW	Xmtr
SHF	January 9, 1967							
OPEN	-1.1	-3.0	853.7	65	H1	20	0-2 SE	Rcvr
	2.8	-1.7	829.3	38	H9	20	0-5 W	Xmtr
UHF	February 9, 1967							
OPEN	10.2	5.2	832.4	49	H1	90	-	Rcvr
6	6.1	-1.1	816.5	18	H9, M2	80	10-30	Xmtr
			R4-30-T6 Gold Hill-Sunshine					
UHF	August 5, 1966							
OPEN	26.1	17.8	851.5	46	L1	5	Calm	Rcvr
	23.3	15.6	789.0	48	L2	10	5 E	Xmtr
SHF	September 16, 1966							
OPEN	17.5	13.0	846.6	62	L1	20	5 S	Rcvr
	16.7	7.8	782.6	31	H9, L2	20	10 NW	Xmtr
SHF	January 12, 1967							
OPEN	3.0	-0.1	840.8	57	H6, L1, M3	80	0-2	Rcvr
	3.1	2.8	775.8	96	M3	100	0-5 NW	Xmtr
UHF	February 9, 1967							
OPEN	10.7	5.2	835.8	45	H1	90	0-20	Rcvr
	2.8	-2.8	775.0	26	H9	30	10-25 NW	Xmtr

Type of Site	Dry Bulb Temp C	Wet Bulb Temp C	Atmos. Press. mb	% Rel. Humid.	Cloud Type	% Cloud Cover	Wind Speed & Dir.	Terminal
			R4-30-T7 Lee Hill					
UHF	August 5, 1966							
OPEN	28.9	18.3	850.0	37	L2, M6	30	Calm	Rcvr
	27.8	16.1	774.8	32	L1	10	0-5 E	Xmtr
SHF	September 19, 1966							
OPEN	11.5	10.1	849.3	85	Fog	100	1	Rcvr
	16.4	11.4	768.0	58	H9	2	1	Xmtr
SHF	January 12, 1967							
OPEN	5.0	1.9	839.8	61	L1, M3	60	0-2	Rcvr
	7.5	1.9	759.6	40	L5, M3	80	15 W	Xmtr
UHF	February 9, 1967							
OPEN	10.7	5.2	832.7	45	H7	90	0-25 NW	Rcvr
	2.2	-3.3	760.7	26	H9	75	10-25 NW	Xmtr
			R4-50-T1 Latham Reservoir E1					
UHF	August 18, 1966							
OPEN	18.3	13.3	853.0	59	- -	-	Calm	Rcvr
	20.0	14.4	851.3	56	- -	-	Calm	Xmtr
SHF	September 29, 1966							
OPEN	12.6	9.4	841.5	68	H1	30	2 S	Rcvr
	10.6	8.6	845.9	79	H1	10	0-5 NE	Xmtr
SHF	November 30, 1966							
OPEN	5.5	3.7	851.0	77	L1	2	0-2	Rcvr
	2.8	1.9	858.1	87	L5, L6	100	Calm	Xmtr
UHF	March 3, 1967							
OPEN	1.8	-0.2	837.1	70	L6	100	0-5 NE	Rcvr
	5.0	1.9	850.5	60	L9	50	5 E	Xmtr

Type of Site	Dry Bulb Temp C	Wet Bulb Temp C	Atmos. Press. mb	% Rel. Humid.	Cloud Type	% Cloud Cover	Wind Speed & Dir.	Terminal
			R4-50-T2 Keensburg NW1					
UHF	August 15, 1966							
OPEN	27.2	16.7	850.0	36	- -	-	Calm	Rcvr
	30.0	17.2	841.5	29	L1	5	5 E	Xmtr
SHF	September 28, 1966							
OPEN	20.0	13.4	844.6	50	H6	80	2-10 SE	Rcvr
	21.1	13.6	843.9	45	H4	75	5-10 NE	Xmtr
SHF	November 29, 1966							
OPEN	13.2	6.4	847.3	38	H2	100	0-2	Rcvr
	15.0	8.3	847.3	42	L5	90	5 N	Xmtr
UHF	March 3, 1966							
OPEN	4.8	1.4	834.4	57	M1	100	15 NW	Rcvr
	13.9	5.6	841.4	38	L9	50	5 SE	Xmtr
			R4-50-T3 Horse Creek E1					
UHF	August 15, 1966							
OPEN	30.0	17.2	848.5	29	- -	-	Calm	Rcvr
	34.4	16.7	836.4	16	L1	5	0-5 SE	Xmtr
SHF	September 28, 1966							
OPEN	23.1	13.2	843.2	34	H6	80	2-8 SE	Rcvr
	23.9	12.8	383.1	29	H2	70	5 NE	Xmtr
SHF	Nobember 29, 1966							
OPEN	11.7	5.4	846.6	39	M2	98	0-1	Rcvr
	16.1	8.3	842.5	36	L9, H4	60	10 NNW	Xmtr
UHF	February 27, 1967							
OPEN	12.4	6.8	-	-	H7	15	Calm	Rcvr
	7.8	1.1	852.2	27	- -	-	5-10 NW	Xmtr

Type of Site	Dry Bulb Temp C	Wet Bulb Temp C	Atmos. Press. mb	% Rel. Humid.	Cloud Type	% Cloud Cover	Wind Speed & Dir.	Terminal
			R4-50-T4 North Table Mountain N					
UHF	August 24, 1966							
OPEN	23.6	14.7	857.6	40	L1	10	Calm	Rcvr
	23.3	13.9	823.2	37	- -	-	5 N	Xmtr
SHF	September 9, 1966							
OPEN	22.6	14.8	847.3	45	L1	25	1-2 S	Rcvr
	25.0	12.8	823.6	25	L1, L2	10	0-5 E	Xmtr
SHF	December 12, 1966							
OPEN	4.4	-0.3	830.7	40	H2, H6	30	0-2	Rcvr
	7.8	2.8	823.2	45	H6, H4	10	Calm	Xmtr
UHF	March 13, 1967							
OPEN	18.2	9.2	831.0	32	H2	30	0-10 NW	Rcvr
	18.9	5.6	809.6	8	H9	60	20-35 SW	Xmtr
			R4-50-T5 North Table Mountain					
UHF	August 24, 1966							
OPEN	23.8	14.4	856.0	37	L1	20	Calm	Rcvr
	22.2	11.7	804.3	30	L1	5	10 SSW	Xmtr
SHF	September 9, 1966							
OPEN	27.1	13.9	850.0	23	L1	10	Calm	Rcvr
	26.1	20.0	806.0	59	L1, L2	30	20 W	Xmtr
SHF	January 11, 1967							
OPEN	15.2	4.1	831.7	12	L5	95	0-5 NW	Rcvr
	14.7	3.1	792.5	9	H9, M3	95	15 W	Xmtr
UHF	March 13, 1967							
OPEN	12.8	6.8	831.7	44	H7	30	Calm	Rcvr
	14.4	2.8	792.8	8	H9	30	20-30 SW	Xmtr

APPENDIX

Cross polarization and angle-of-arrival measurements

At the conclusion of the path loss measurement program, additional measurements were made over selected paths (R4-10-T5, R4-20-T6, and R4-30-T6) to evaluate polarization (including cross polarization) losses caused by trees without leaves. Measurements were also made, using a slightly elevated transmitter test site, to investigate the azimuthal angle-of-arrival of the 230- and 410-MHz signals for several receiving antenna elevations at the R4 receiving site.

All the transmitter sites for this series of measurements were selected to provide maximum shielding of the receiving antennas from the transmitting antennas by the cluster of trees at the R4 receiving site. The true bearings of these transmitter sites from the receiver site are: R4-10-T5, 227° 20'; R4-20-T6, 250° 07'; R4-30-T6, 234° 47'; and Test Site, 234° 48' (see figure 1).

The polarization data were collected using the same measurement techniques developed for the original path loss measurement program. However, before any measurements using vertical polarization were attempted, all inactive antenna dipoles in the antenna array were removed from the front of the antenna reflector screen (see figures 9 and 11 for physical appearance of the lower frequency antennas), thus preventing the possibility of interaction between the active and inactive elements.

Cross polarization measurements were made by changing the receiving antenna polarization with respect to the transmitting antenna except for site R4-30-T6, where both antennas were rotated 90 degrees with respect to each other.

The azimuthal angle-of-arrival data were obtained by raising the receiving antenna to the desired height above ground and recording the received signal level as the receiving antenna was turned in azimuth,

in 10-degree steps, from a position 60 degrees counterclockwise to the transmission path to a point 60 degrees clockwise to the path. This procedure was then repeated for all other receiving antenna elevations for both frequencies.

The data for the supplemental polarization measurements are arranged in the following order:

For the polarization measurements, graphs of basic transmission loss versus receiving antenna height derived from the path loss measurements are shown for each of the three paths for both frequencies with site code and designation, frequency, date, and foliage condition indicated on each. The type of polarization used is shown for each graph with the receiving antenna orientation indicated first; i.e., V-H indicates that the receiving antenna was oriented to receive a vertically polarized signal and the transmitting antenna was oriented to transmit a horizontally polarized signal. For conversion of the measured values to basic transmission loss the antenna gain values shown in table 1 (section 4 of the report) were used, although they may not be realistic for cross polarization measurements. The "basic transmission loss values" resulting from this procedure should therefore be used only for relative comparisons. Generalization of these results to other antenna types may not be appropriate.

The free space basic transmission loss is indicated on each graph. Photographs of the terrain taken at the transmitter site in the direction of the common receiver site and the bearing from the receiver site to the transmitter site may be found under the corresponding site in the main body of the report.

Arrangement of the data (see pages 293-296) for the azimuthal angle-of-arrival measurements (designated Test Site) is as follows:

The first page includes the site code, a photograph of the terrain taken at the transmitter site in the direction of the receiver, and the

bearing from the common receiver site to the transmitter site. It also includes the ground elevation of the receiver and transmitter sites, the actual path length, and the path profile drawn as previously described for other paths.

The second page includes the site designation and code, a code for the graph for each frequency, followed by the date that the path loss measurement was undertaken, a graph of the 230 and 410 MHz basic transmission loss versus receiving antenna height (data for these graphs were obtained by measurements techniques previously described), and the free space basic transmission loss for each frequency.

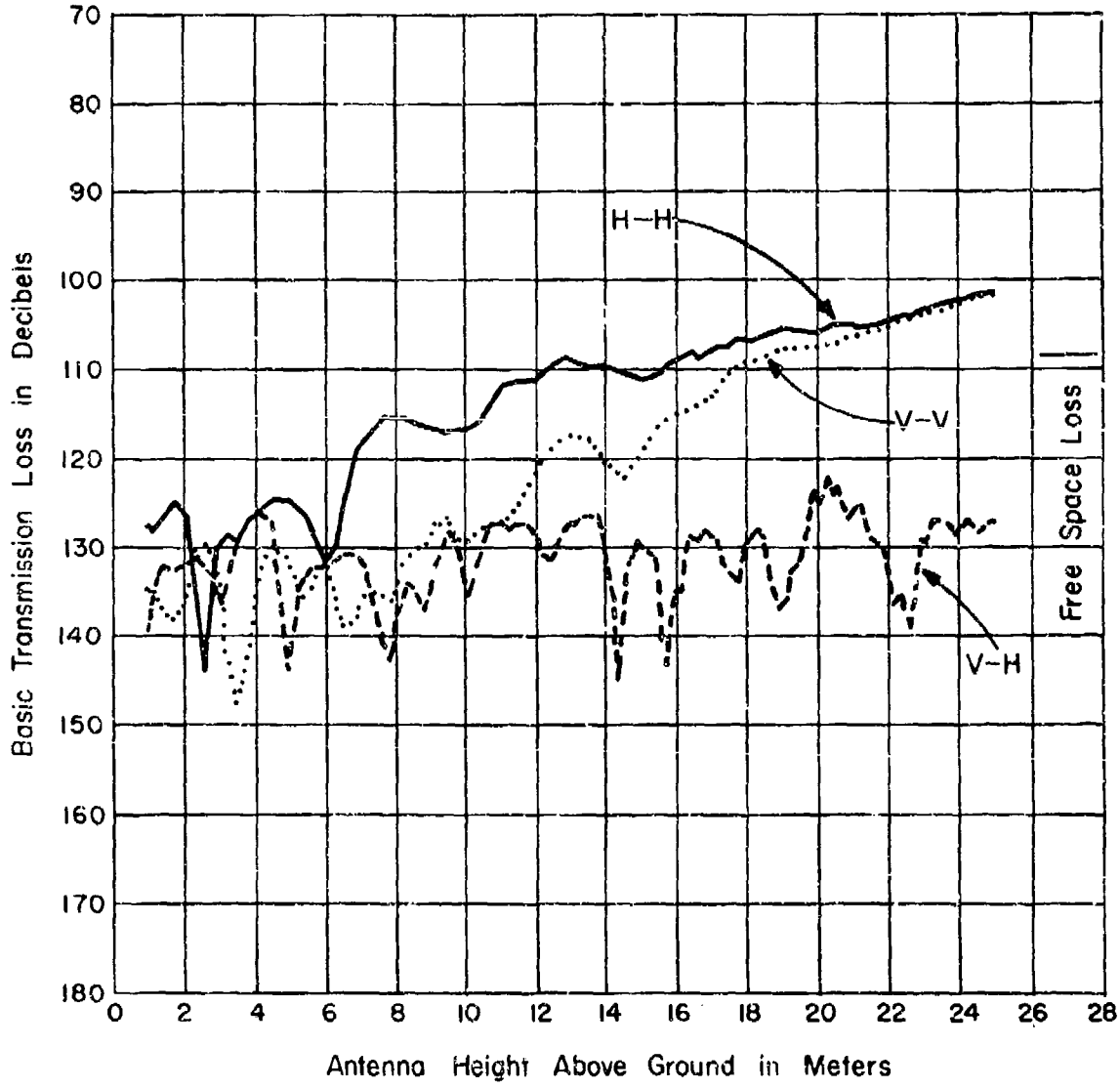
The upper set of graphs on the third page includes plots of basic transmission loss versus receiving antenna orientation with respect to the transmitting path for several receiving antenna elevations. These graphs are for horizontal polarization for 230 MHz. The lower set of graphs were obtained in the same manner for the same frequency as the upper graphs except these graphs are for vertical polarization.

Finally, the fourth page of graphs are the results of the azimuthal angle-of-arrival data for 410 MHz, which were obtained in the same manner as the 230 MHz data.

The shape of the curves for the 230 MHz, horizontally-polarized, azimuthal angle-of-arrival data obtained 25 m above ground and the 410 MHz horizontally-polarized data obtained at 19 m above ground are essentially identical to the antenna patterns obtained over the antenna range for the same antennas.

230 MHZ 3/17/67

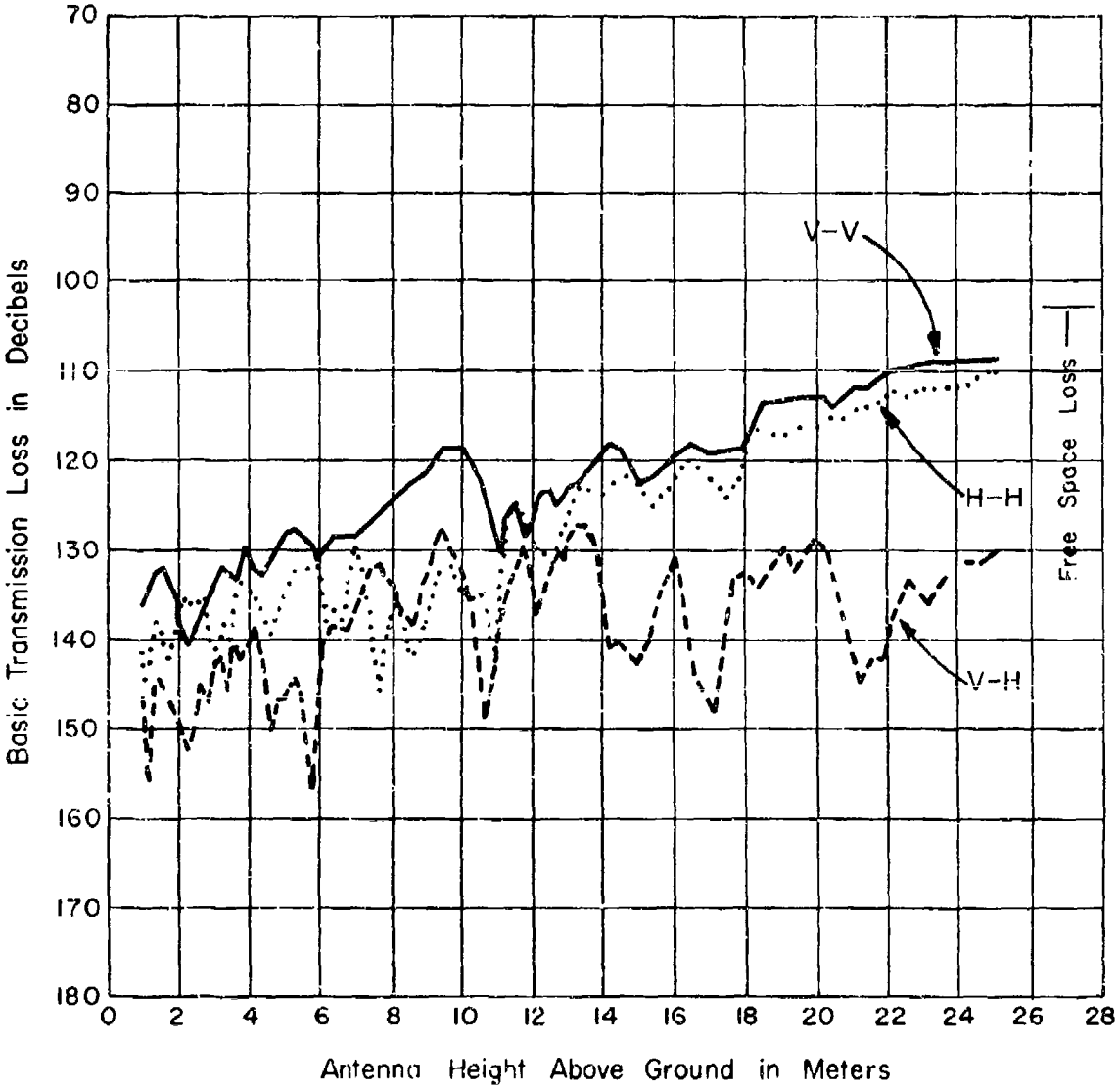
R4-10-T5 POL.
NIWOT E1



410 MHZ 3/17/57

R4-10-T5 POL.

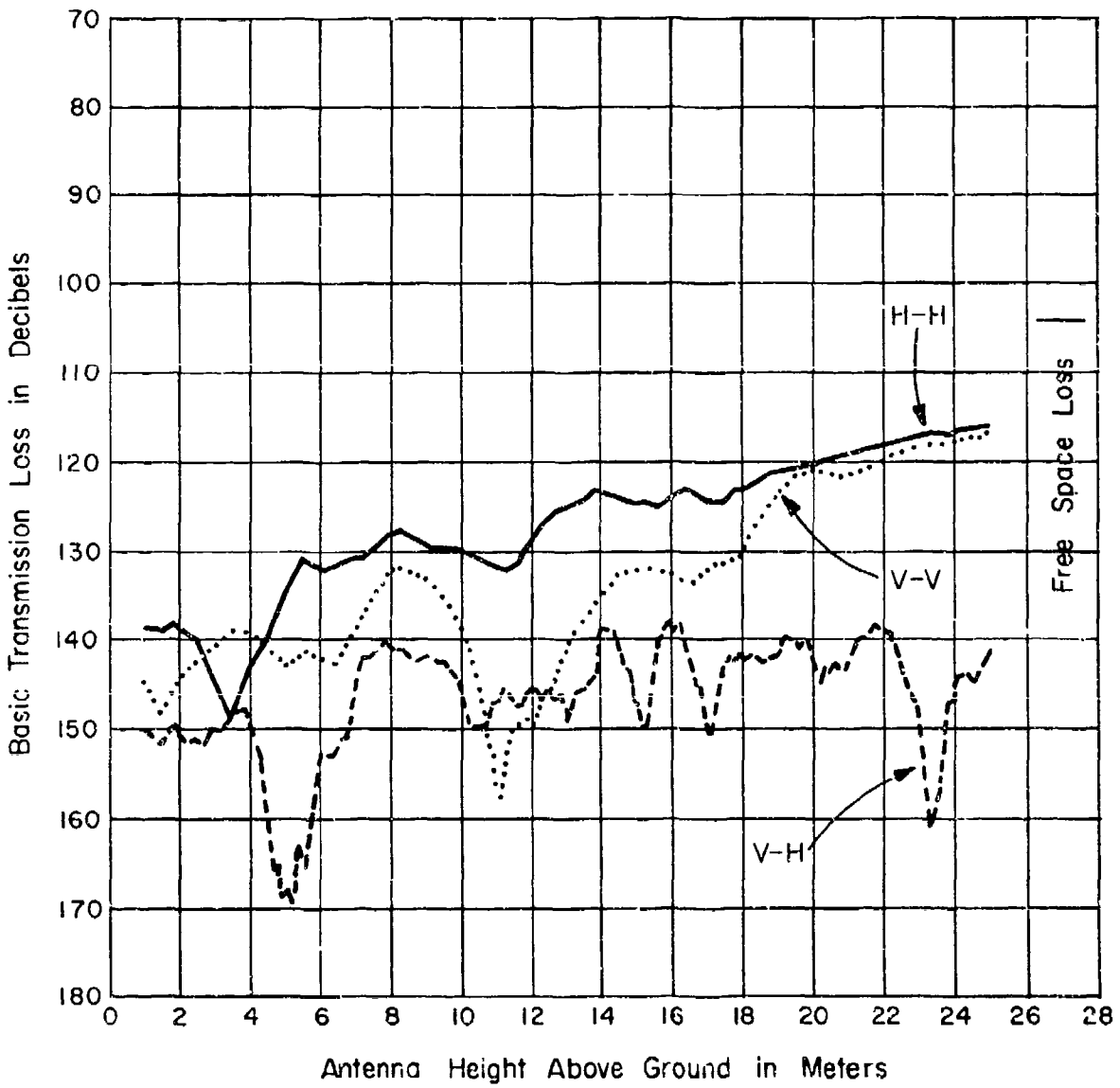
NIWOT E1



230 MHZ 3/17/67

R4-20-T5 POL.

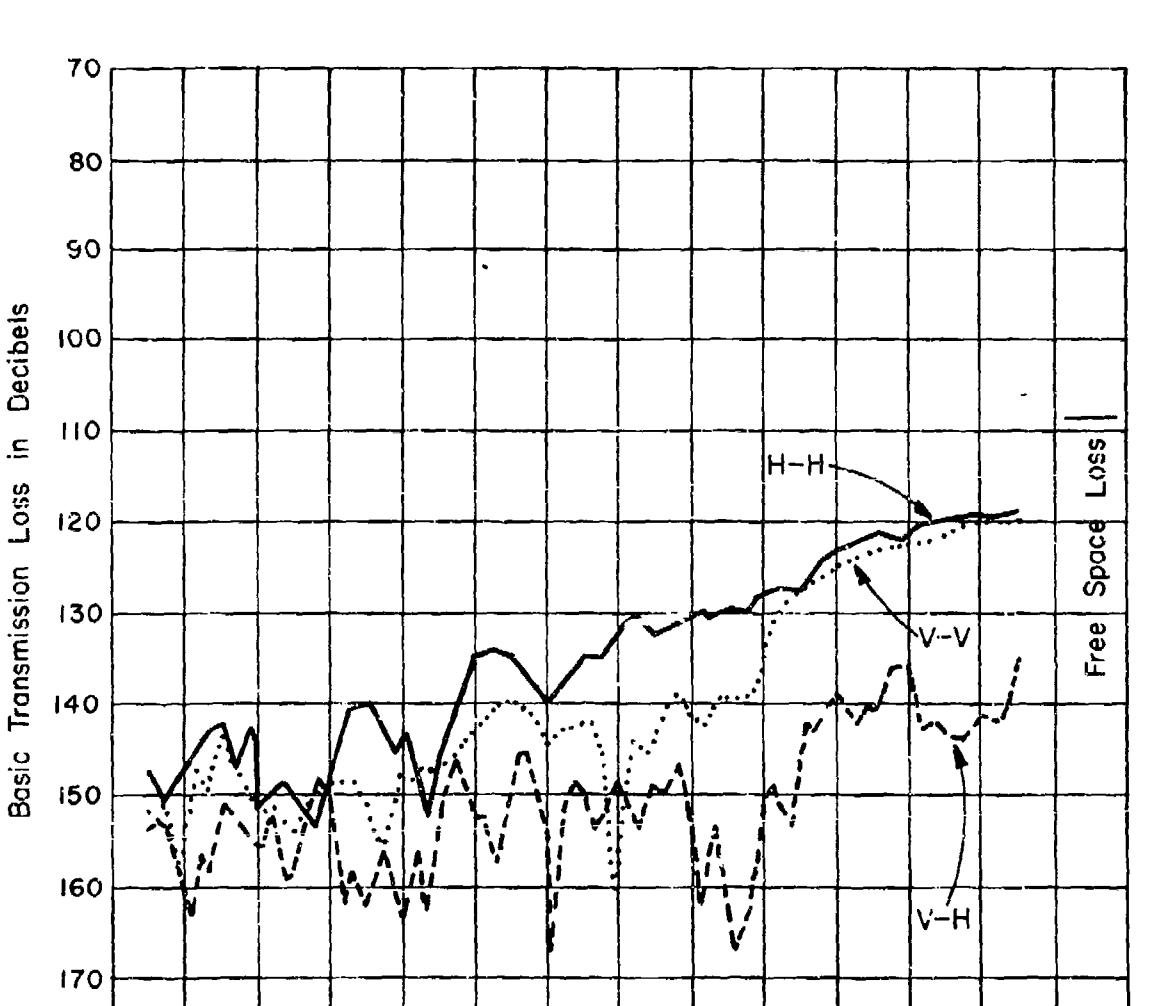
BOULDER NE 3



410 MHZ 3/20/67

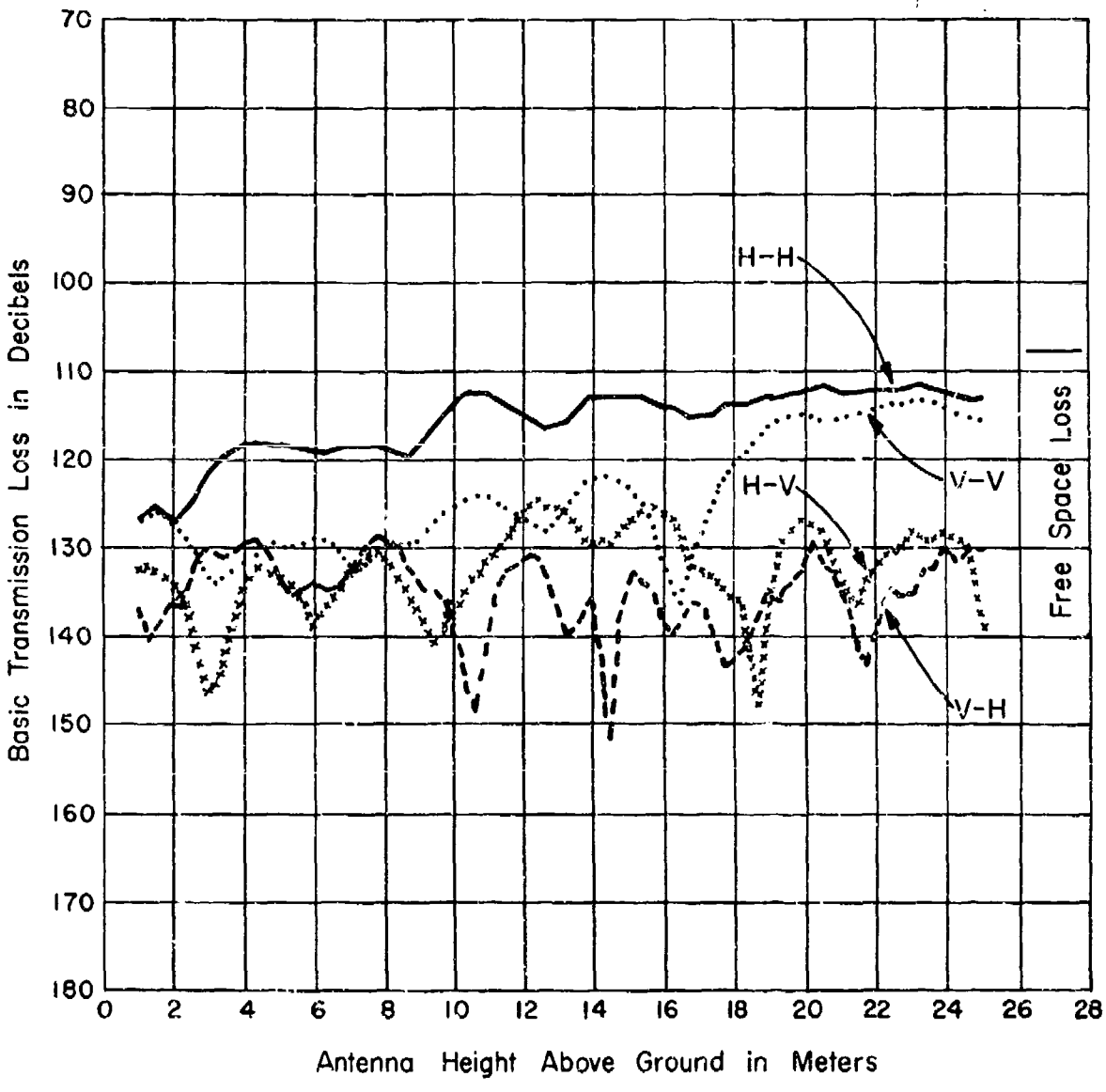
R4-20-T5 POL.

BOULDER NE 3



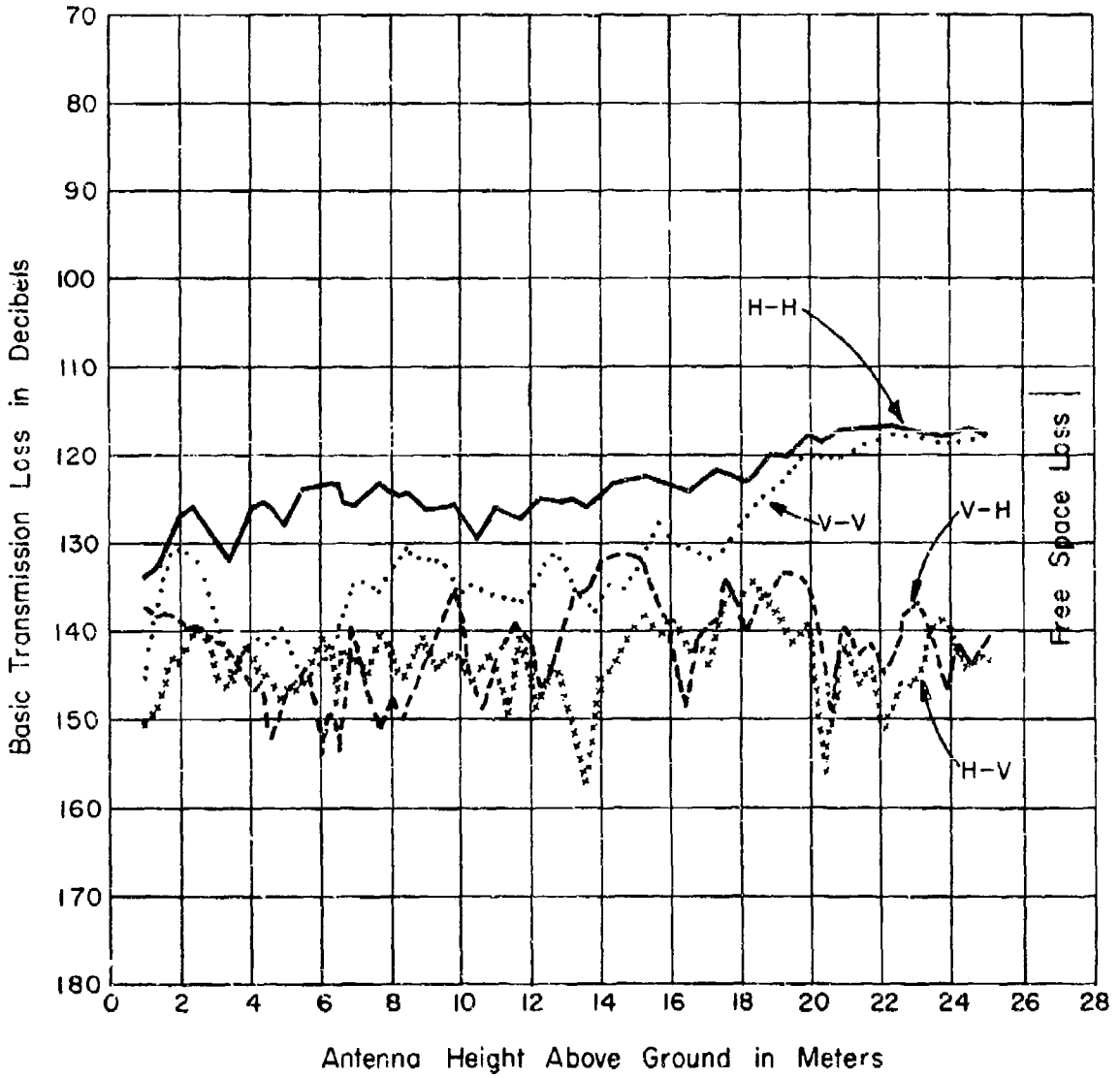
230 MHZ 3/21/67

R4-30-T6 POL.
GOLD HILL SUNSHINE



410 MHZ 3/21/67

R4-30-T6 POL.
GOLD HILL SUNSHINE



TEST SITE

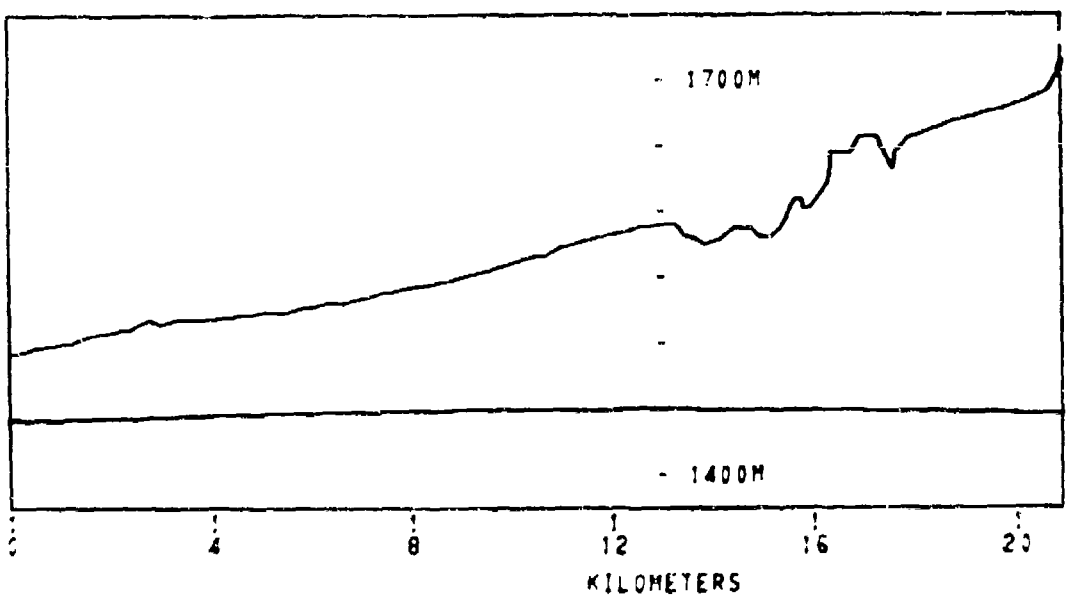


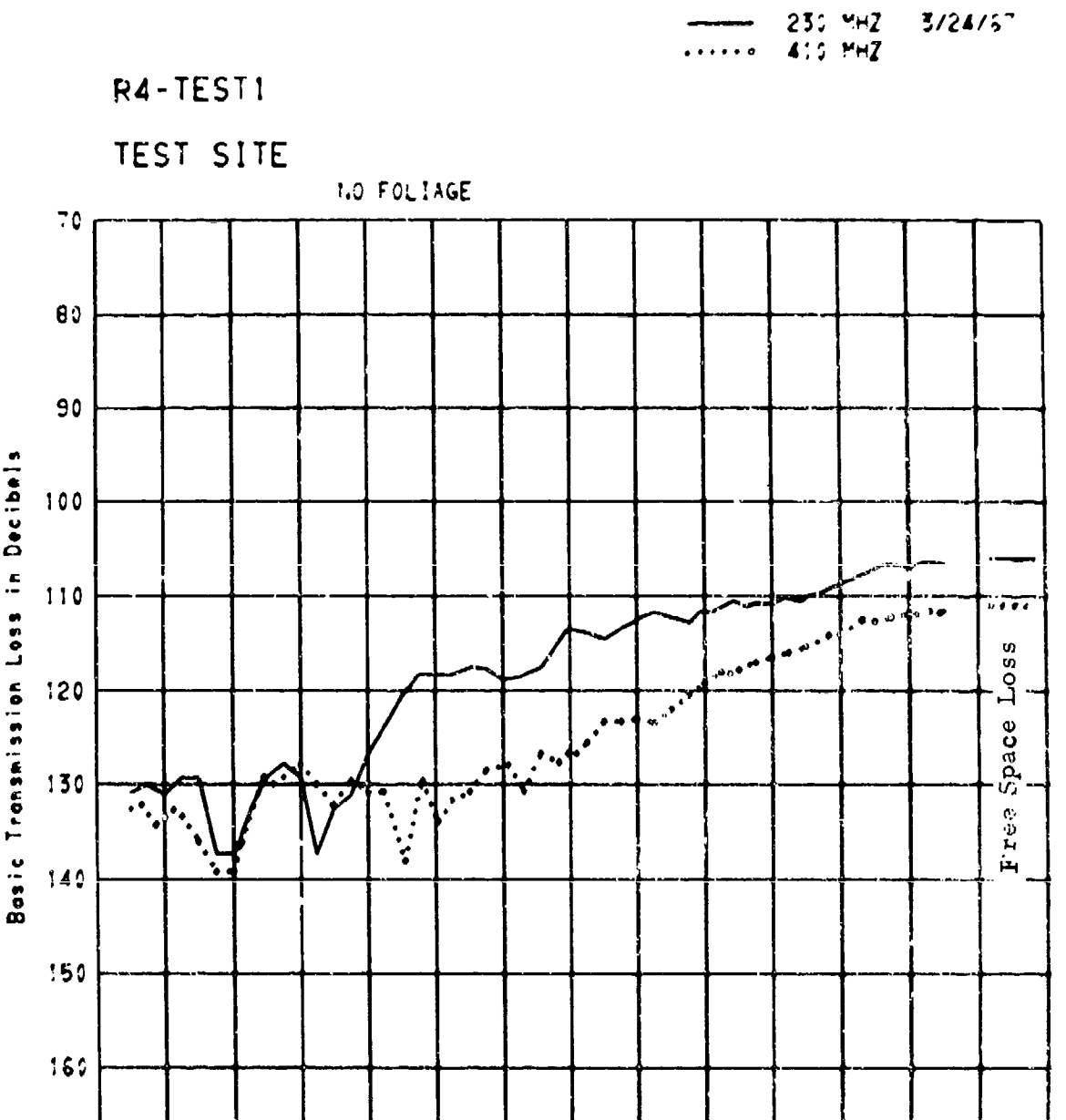
PATH VIEW FROM TEST SITE

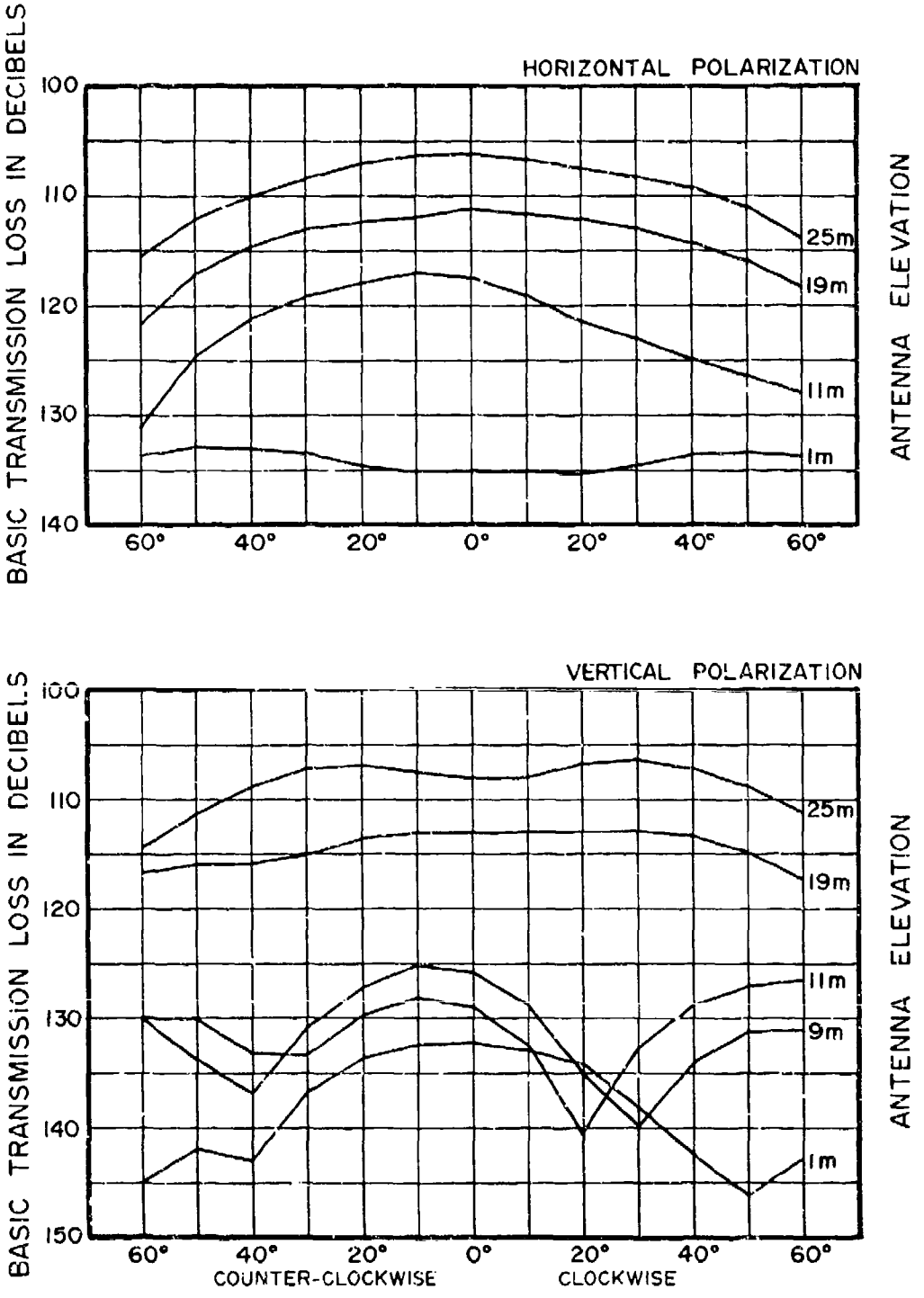
Bearing from common receiver site to test site is

234° 47' 43"

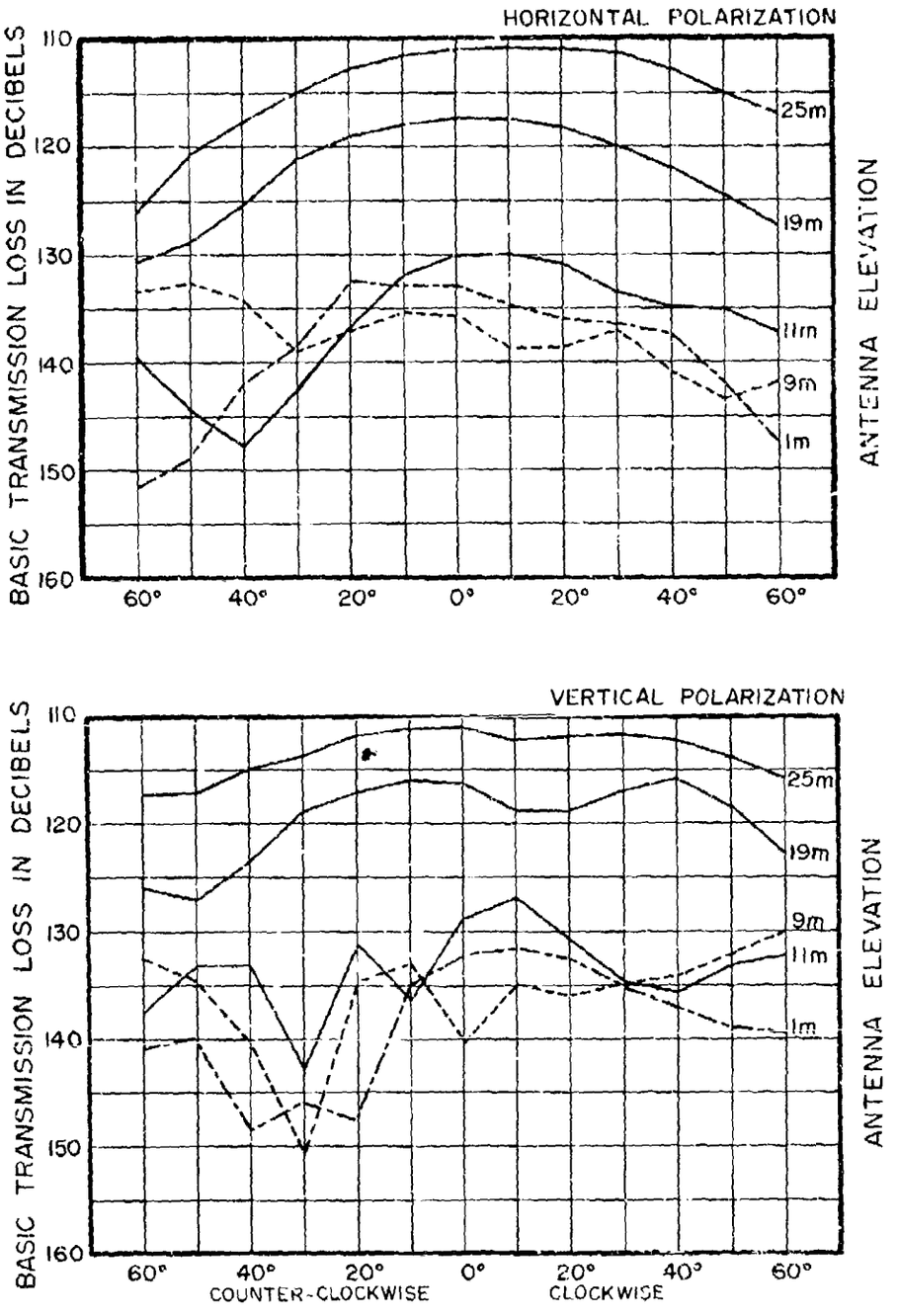
RCVR. ELEV 1503 M | R4-TEST1 PATH LENGTH 20.89 km | XMTR. ELEV. 1719 M




230 MHZ 3/24/67
410 MHZ
R4-TEST1
TEST SITE
NO FOLIAGE
Basic Transmission Loss in Decibels
70
80
90
100
110
120
130
140
150
160
170
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
Free Space Loss
Antenna Height Above Ground in Meters



VARIATION OF THE RECEIVED SIGNAL LEVEL, AT 230 MHz, AS A FUNCTION OF RECEIVING ANTENNA ORIENTATION AT THE R4 RECEIVING SITE



VARIATION OF THE RECEIVED SIGNAL LEVEL, AT 410 MHz, AS A FUNCTION OF RECEIVING ANTENNA ORIENTATION AT THE R4 RECEIVING SITE

GPO 838-517