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Technical Report

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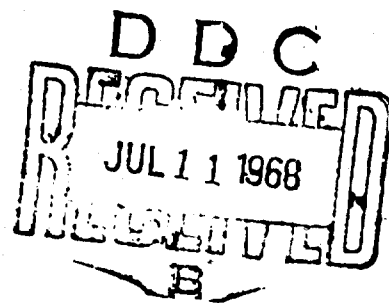
ERL 65-ITS 58

Tabulations of Propagation Data over Irregular Terrain in the 230- to 9200-MHz Frequency Range

Part I: Gunbarrel Hill Receiver Site

MARCH 1968

Boulder, Colorado





U. S. DEPARTMENT OF COMMERCE

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ESSA TECHNICAL REPORT ERL 65-ITS 58

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Part I: Gunbarrel Hill Receiver Site

P. L. McQUATE

J. M. HARMAN

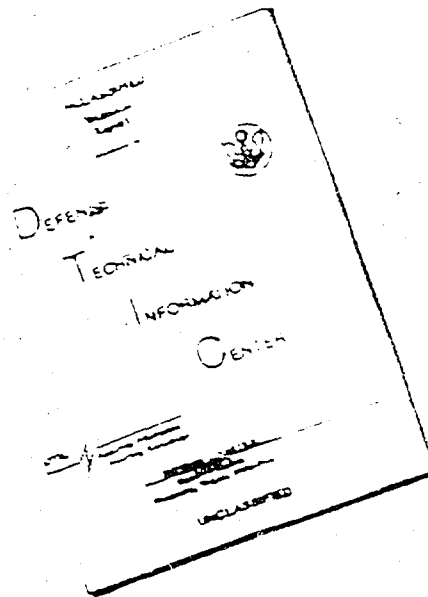
A. P. BARSIS

INSTITUTE FOR TELECOMMUNICATION SCIENCES
BOULDER, COLORADO
March 1968

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TABLE OF CONTENTS

	Page
Abstract	1
1. Introduction	1
2. Measurement Program and Equipment	3
2.1 Receiving Equipment	9
2.2 Transmitting Equipment	17
3. Measurement Procedures	21
4. Antenna Measurements	22
5. Presentation of Data	24
6. Acknowledgments	28
7. References	28
8. Data Tabulations	
Site Number	
R1-0.5-T1	29
R1-0.5-T2	32
R1-3-T1	35
R1-3-T2	40
R1-3-T3	43
R1-3-T4	48
R1-3-T5	55
R1-5-T1	62

Table of Contents (Continued)

Site Number -	Page
R1-5-T2	65
R1-5-T3	72
R1-5-T4	79
P1-5-T5	84
R1-5-T5A	87
R1-5-T6	90
R1-5-T6A	93
R1-10-T1	98
R1-10-T2	105
R1-10-T2A	108
R1-10-T3	113
R1-10-T4	120
R1-10-T5	123
R1-10-T6	131
R1-10-T7	139
R1-20-T1	144
R1-20-T2	152
R1-20-T3	157
R1-20-T4	166
R1-20-T5	173

Table of Contents (Continued)

Site Number -	Page
R1-20-T6	178
R1-20-T7	181
R1-20-T8	188
R1-20-T9	196
R1-20-T10	203
R1-20-T10A	206
R1-50-T1	209
R1-50-T2	214
R1-50-T3	222
R1-50-T4	227
R1-50-T5	232
R1-50-T5A	235
R1-50-T6	238
R1-50-T7	245
R1-50-T8	252
R1-50-T9	255
R1-80-T1	262
R1-80-T2	265
R1-80-T3	268
R1-80-T4	271

Table of Contents (Continued)

Site Number -	Page
R1-120-T1	274
R1-120-T2	277
R1-120-T3	280
R1-120-T4	283
R1-120-T5	286
Meteorological Information	289
USGS Quadrangle Information	314

Tabulations of Propagation Data Over Irregular Terrain in the
230- to 9200- MHz Frequency Range

Part I: Gunbarrel Hill Receiver Site

by

P. L. McQuate, J. M. Harman, and A. P. Barsis

This four-part report contains tabulations and graphs of transmission loss data resulting from propagation experiments in the 230- to 9200-MHz range conducted over irregular terrain in Colorado. Each part of the report deals with data obtained at a single common receiver site over a large number of propagation paths varying in length from 0.5 to 120 km.

1. Introduction

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

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

All measurements were conducted using mobile transmitters and four fixed receiving sites in order to obtain as many different propagation paths as possible within practical operational limits. Since the primary intention was to simulate radio relay operations between semi-permanent terminals at "favorable" locations, a majority of the transmitting sites were selected to provide a clear, unobstructed foreground in the direction of the receiver. The remaining sites were selected so that the transmitting antennas would be at least partially obstructed by the surrounding vegetation to represent operations from a concealed location. This method of site selection produced somewhat different results regarding transmission loss variations with height and distance from those observed in a previous measurement program at 20, 50, and 100 MHz (Johnson et al., 1967 ; Miles and Barsis, 1966).

Each part of the current report series deals with data from one of the four common receiver sites as follows:

Part I: Gunbarrel Hill (designated R 1)

This site is near the summit of a hill in the open plains 15 km east of the Rocky Mountains foothills north of Boulder. Ten of the 55 transmitter sites associated with this receiver site are located in the mountains and only one of these results in a line-of-sight path.

Part II: Fritz Peak (designated R 2)

This site is located in the mountains west of Boulder at the foot of Fritz Peak, which shields the site from the plains - about 20 km to the east. Only 8 of the 44 transmitter sites associated with this receiver site are located in the plains.

Part III: North Table Mountain (designated R 3)

This site is near Golden, Colorado, on a high mesa at the juncture between the mountains and plains and is visible to most of its associated 59 transmitting sites. It was selected to represent propagation from low-flying aircraft to the ground.

Part IV: Longmont (designated R 4)

This site is located in a grove of trees in a broad river valley near Longmont, Colorado. Since the receiving antenna can assume various positions from near the ground to a point well above the top of the trees, the received signal levels reflect the effects of foliage and branches to a varying degree. There are 45 transmitter sites associated with this receiver site.

Part I, in addition to the data, contains descriptions of the equipment (sec. 2), the method used in making the measurements (sec. 3), and the data reduction procedures (sec. 5). Details regarding measurements of the antenna parameters are given in section 4. The reduced data presented in section 8 consist primarily of graphs showing



FIGURE 1 LAYOUT OF MEASUREMENT POINTS

basic transmission loss vs. receiving antenna height derived from the measurements for each path. Pertinent information on path profiles and photographs are included, available meteorological data are tabulated separately. For reference purposes, section 8 also contains a listing of topographic quadrangles used for each path profile.

All measurements described in this report series were performed by personnel of the Institute of Telecommunication Sciences of the Environmental Science Services Administration.

2. Measurement Program and Equipment

The data presented in this part 1 of the report were obtained between March 1965 and March 1967 from a central receiver site located near the summit of a hill northeast of Boulder, Colorado, and hereafter referred to as Gun Barrel Hill, or site R1. Figure 1 is a map of the area showing most of the measurement locations, which were arranged in concentric circles around the receiving site. Obstructions near the site limited the measurements to the sectors 5° to 135° and 205° to 340° east of true north. Transmitter sites in the 205° to 340° sector and located more than 10 km from the receiver site lie in heavily wooded mountainous terrain; all the others are in the relatively open and rolling plains area. Figure 2 is a panoramic view of the sector 5° to 135° ; figures 3 and 4 are panoramic views of the sector 205° to 340° . All bearings given are measured clockwise from true north.

The transmitter sites were selected at nominal distances of 0.5, 1, 5, 10, 20, 50, 80, and 120 km from the receiver location. Seven of the transmitting sites were selected so that the installation was concealed from the propagation path by vegetation. A concealed site may be located behind a single row of trees, as seen in the photograph of transmitter site R1-20-T1 - Concealed, found on page 145, or in a cluster of trees as seen in the photograph of transmitter site R1-20-T3 - Concealed, found on page 158. Each concealed site has a "companion" open site, i.e., a site with a clear, unobstructed foreground in the direction of the receiver, with the pairs selected so that they are not more than 100 m apart and have essentially a common terrain profile.

All transmissions were continuous wave and frequencies of 230, 910, 751, 910, 1846, 4595, and 9190 MHz were used with horizontal polarization only.

5
|30
|60
|90
|

FIGURE 2 PANORAMIC VIEW OF SECTOR 5° TO 135°

205
|225
|245
|270
|290
|

FIGURE 3 FOREGROUND VIEW OF SECTOR 205° TO 340°

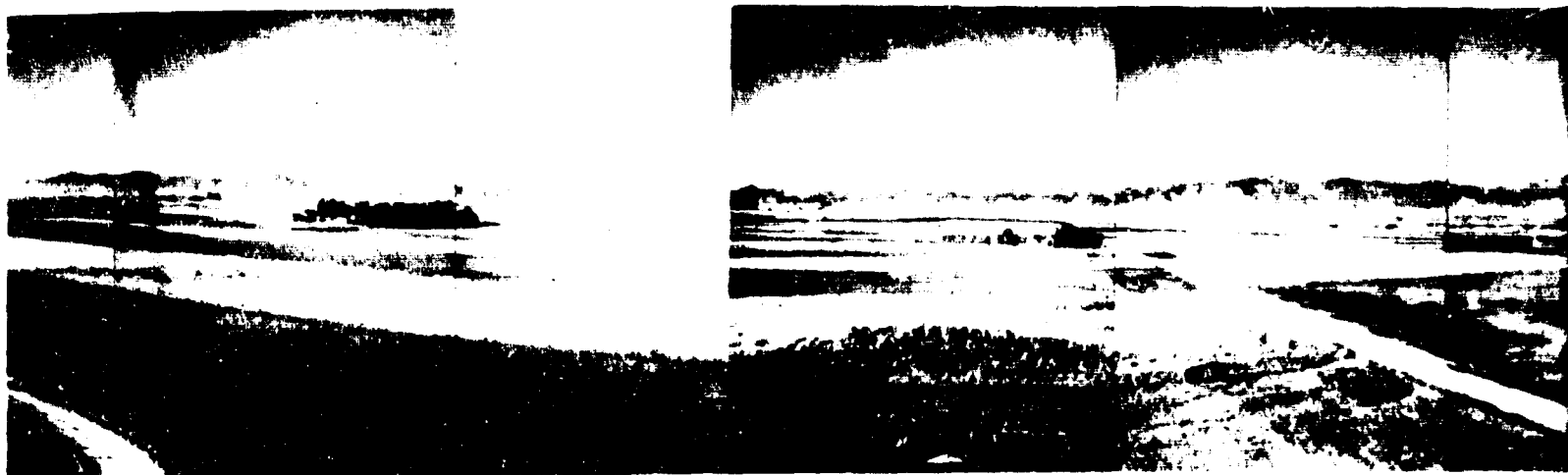
205
|245
|270
|290
|30
|

FIGURE 4 BACKGROUND VIEW OF SECTOR 205° TO 340°

60
|

90
|

120
|

135
|

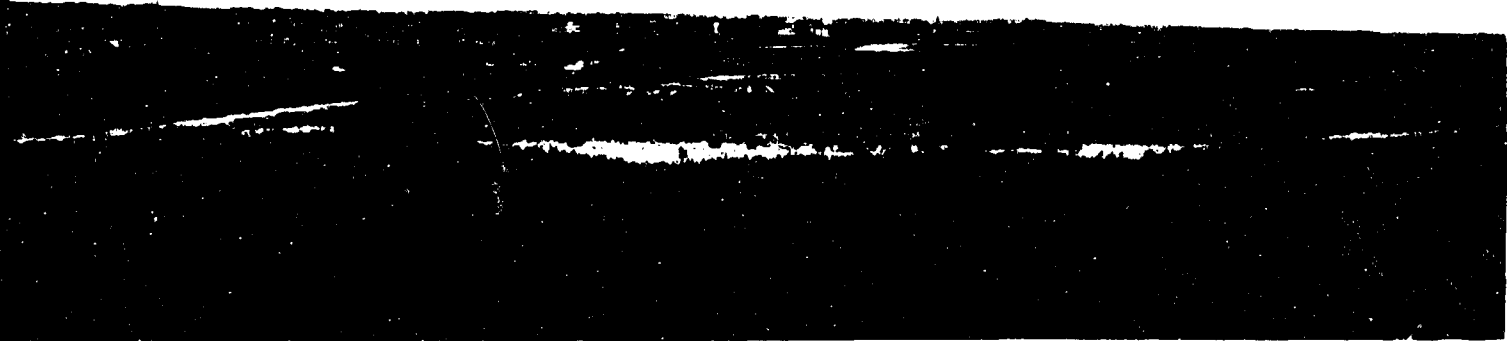


FIGURE 2 PANORAMIC VIEW OF SECTOR 5° TO 135°

270
|

290
|

305
|

330
|



FIGURE 3 FOREGROUND VIEW OF SECTOR 205° TO 340°

270
|

290
|

305
|

340
|



FIGURE 4 BACKGROUND VIEW OF SECTOR 205° TO 340°

2.1 Receiving Equipment

For the receivers, two trailers were used to house equipment for separate frequency groups. Figures 5 and 6 show the trailer and associated antenna system used for the three lower frequencies (230, 410, and 751 MHz) and a view of the rack-mounted receiving equipment. Figures 7, 8, and 9 show the trailer used for the four higher frequencies (910, 1846, 4595, and 9190 MHz), its associated antennas and portions of the receivers. Both of these units are shown in position at the receiver site R1. Figure 10 is a block diagram of the receiving system in the "calibrating" position.

Descriptive antenna parameters are given in table 1. Note that the electrical characteristics of the transmitting and receiving antennas used at each frequency were essentially identical.

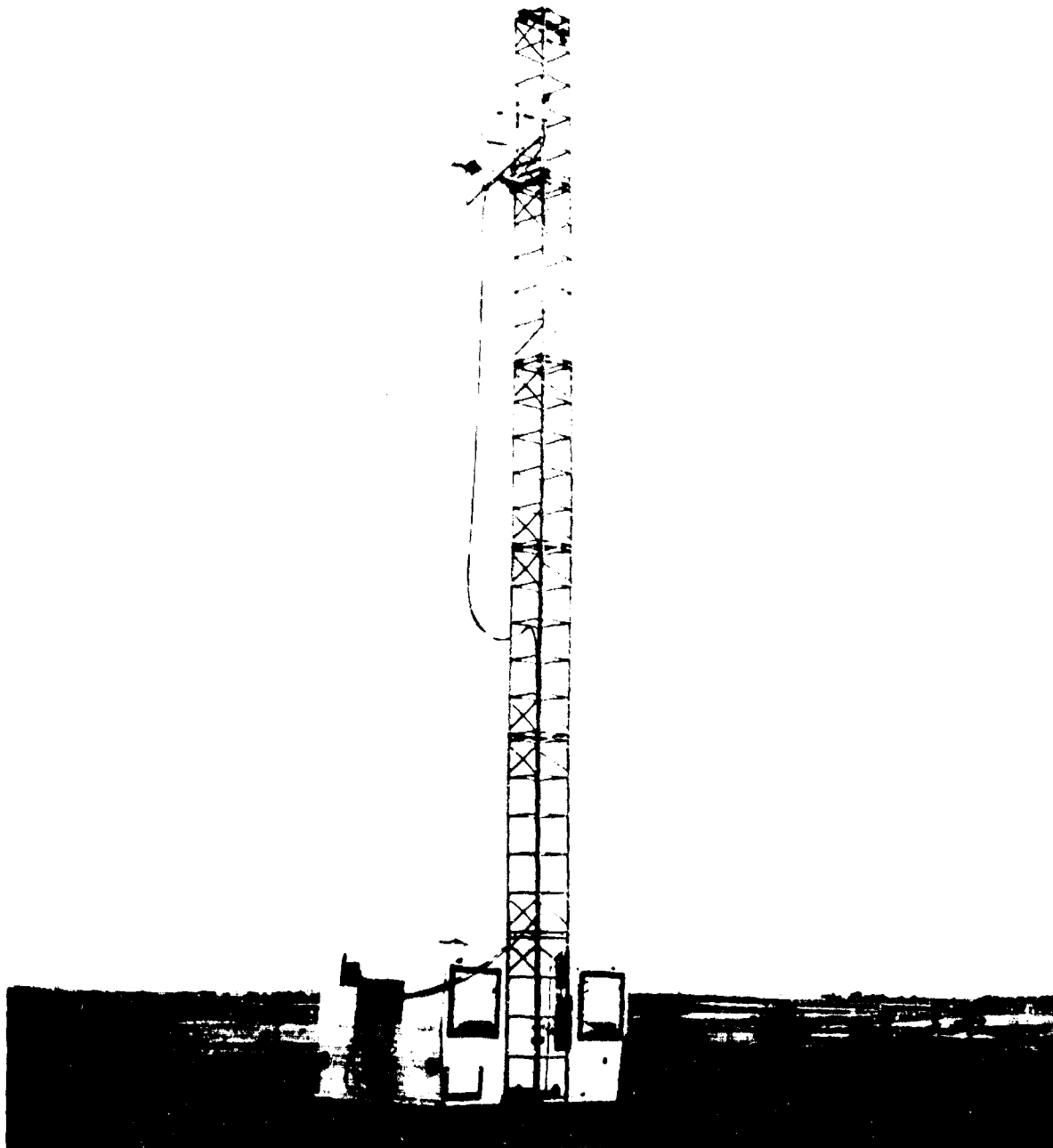


FIGURE 5 RECEIVING UNIT LOWER FREQUENCY GROUP

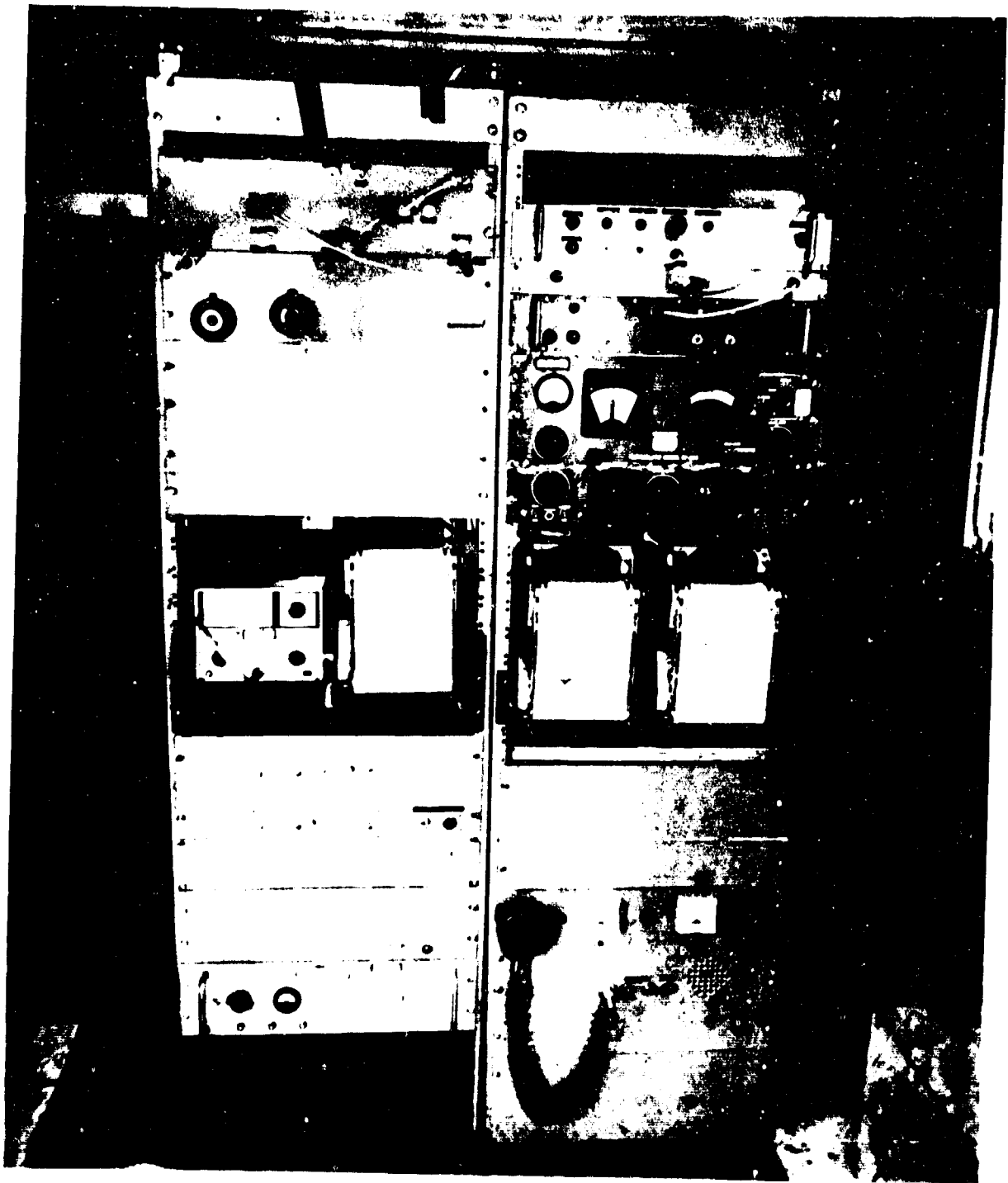


FIGURE 6 RECEIVING EQUIPMENT LOWER FREQUENCY GROUP



FIGURE 7 RECEIVING UNIT UPPER FREQUENCY GROUP

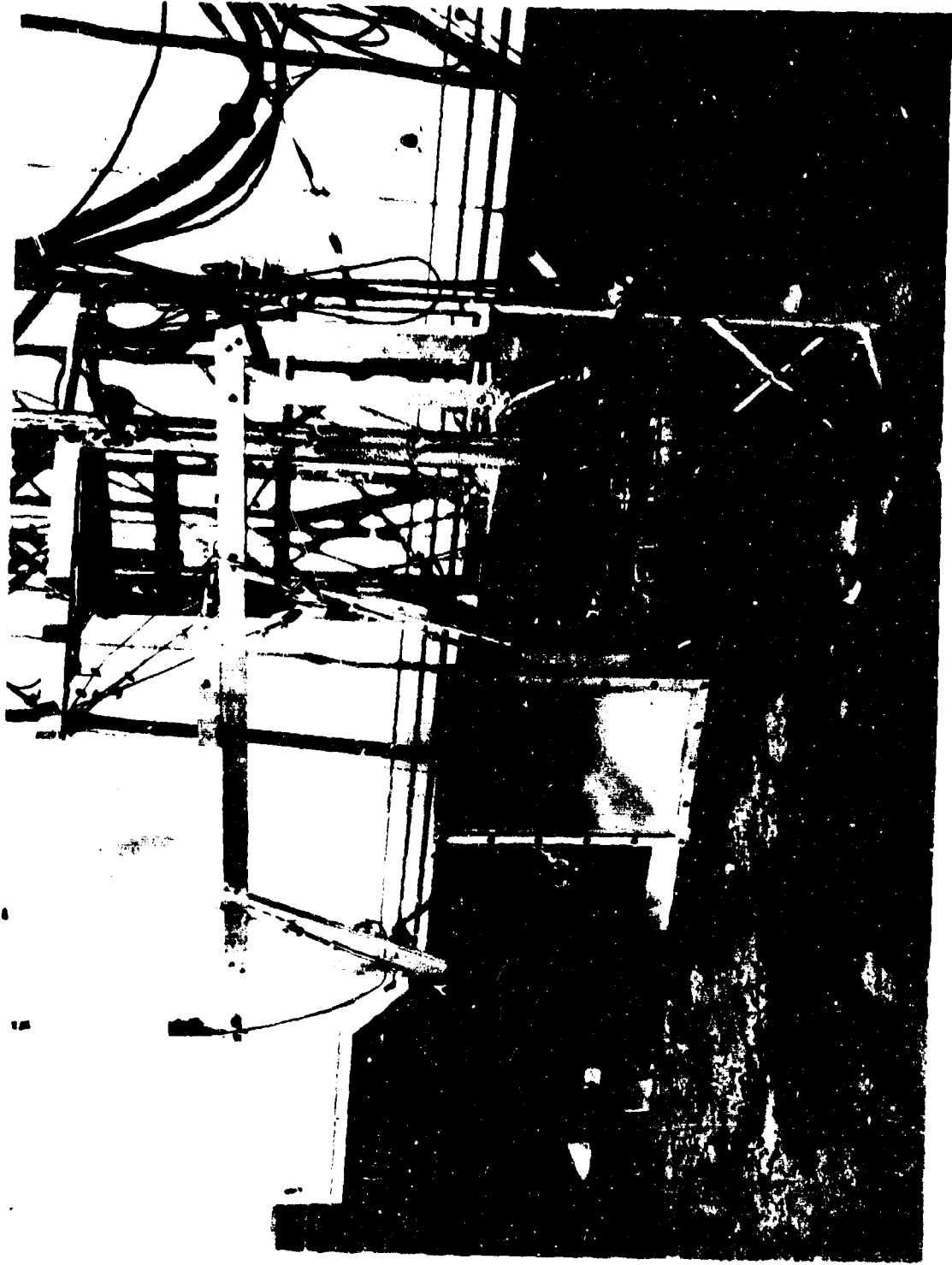


FIGURE 8 ANTENNA SYSTEM UPPER FREQUENCY GROUP

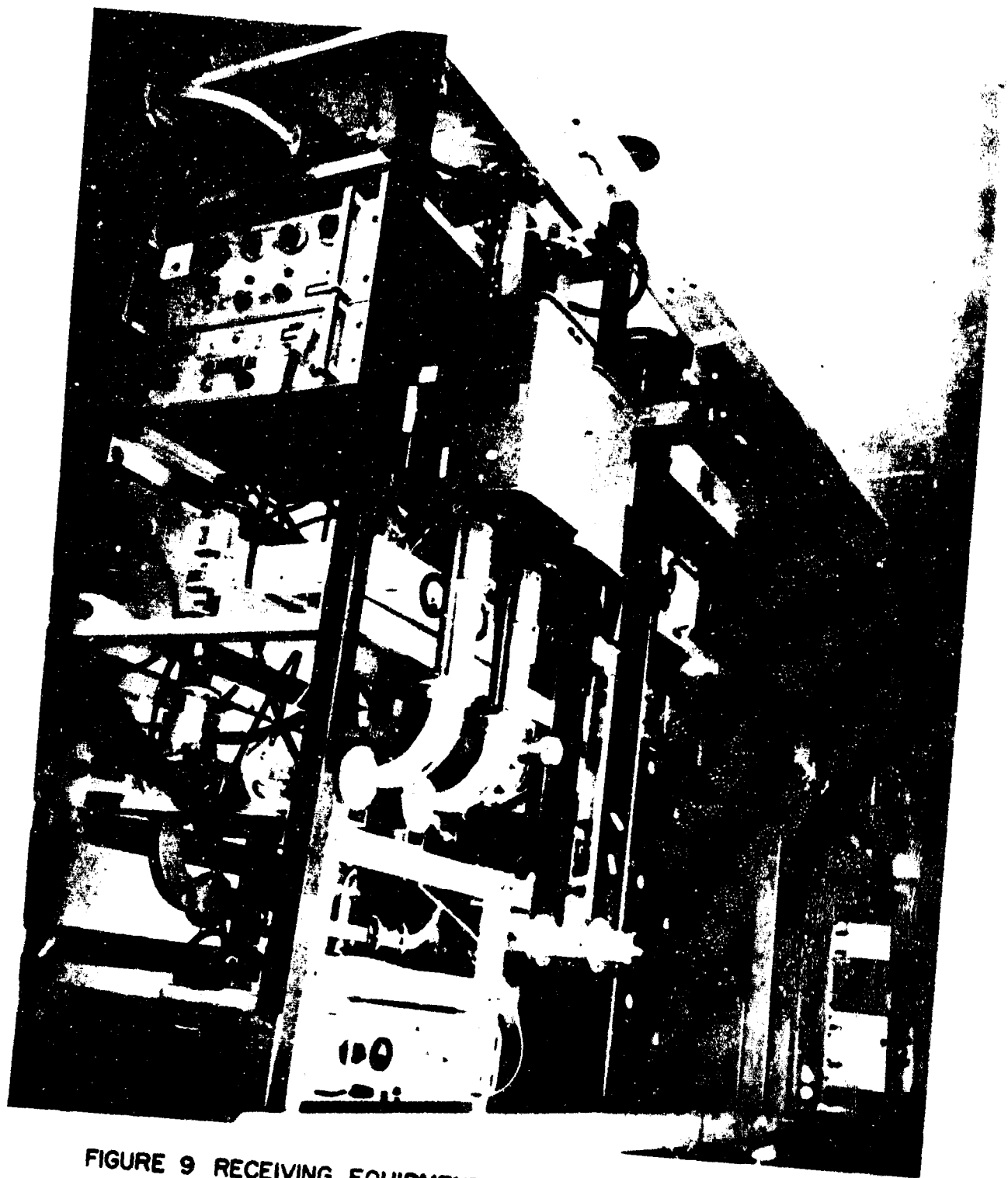


FIGURE 9 RECEIVING EQUIPMENT UPPER FREQUENCY GROUP

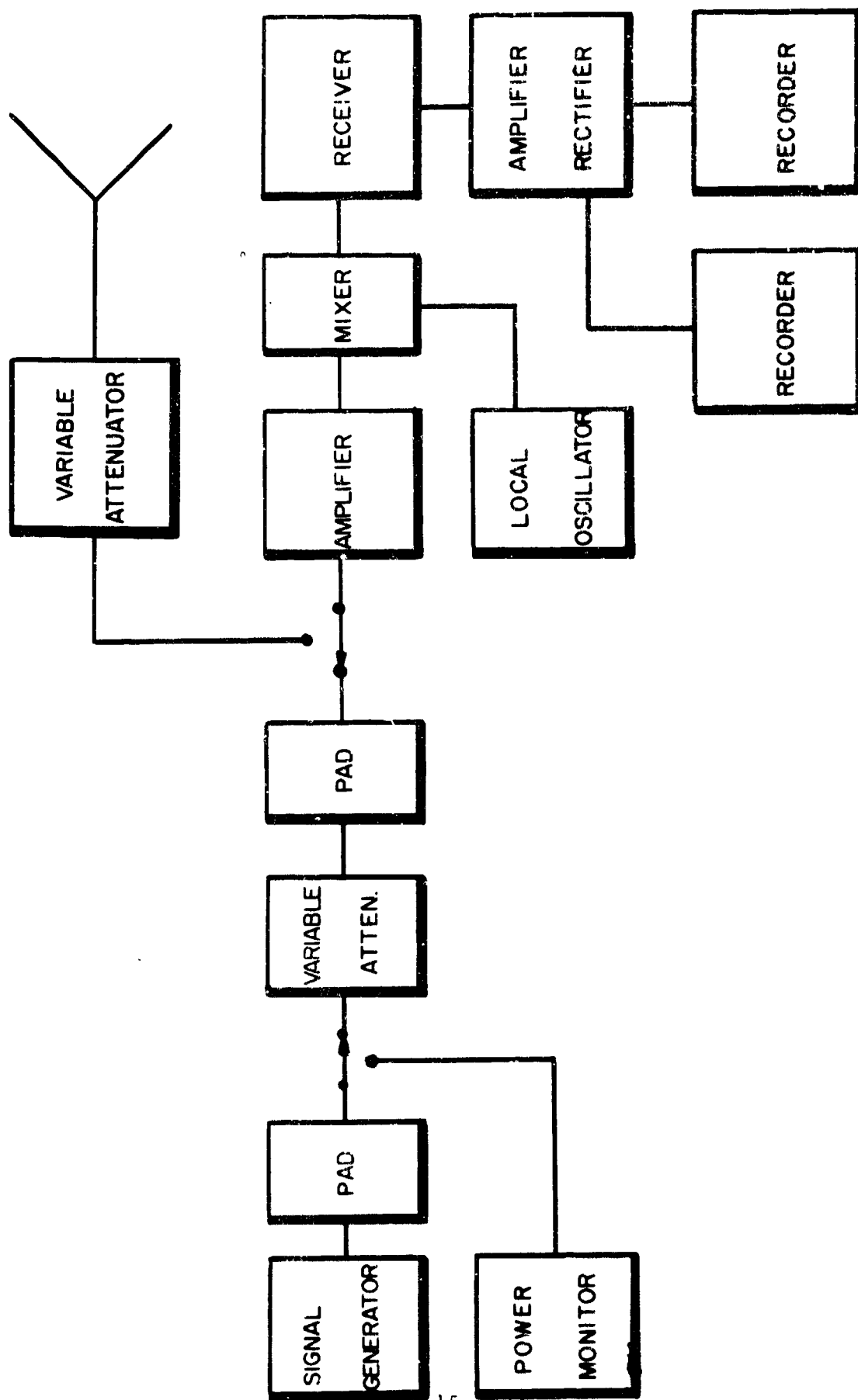


FIGURE 10 BASIC RECEIVING SYSTEM

TABLE 1

ANTENNA PARAMETERS

Freq. in MHz	1/2 Power beamwidth	Description	Free-space gain above isotropic, dB	Height above ground, m	
				Transmitting	Receiving
230	38°	half-wave center-fed dipole with reflector	6.9	6.6	1-13 (continuously variable at all frequencies)
410	58°	3-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°	4-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	

The receiving antennas in each group were mounted side by side on a framework that could be installed on any of the four tower faces, and raised or lowered between the limits of 1 and 13 m above ground. A system of relays between the tower and the trailers controlled the chart driven upon which the height-gain recordings were made, letting the operator know, at all times, at what height the antennas were positioned.

Waveguides were used at 4595 and 9190 MHz; the remaining frequencies utilized coaxial cable for both transmitting and receiving terminals. The receiving system as viewed from the receiver input exhibited essentially no change in the voltage standing-wave ratio (VSWR) as the antennas were moved up and down the tower. For calibration of the receiving units, crystal controlled signal generators, with a stability of one part in 10^6 , or better, were used. To insure a constant output level throughout the calibration, these units were monitored with precision power meters.

2.2 Transmitting Equipment

The transmitting equipment was housed in two mobile units. One unit was used for the three lower frequencies, the other for the four higher frequencies. The photographs in figures 11 and 12 show the units at separate transmitting sites. Rigid masts supported the antennas at

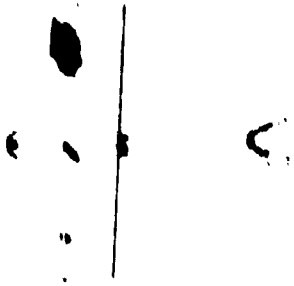


FIGURE II TRANSMITTING UNIT LOWER FREQUENCY GROUP

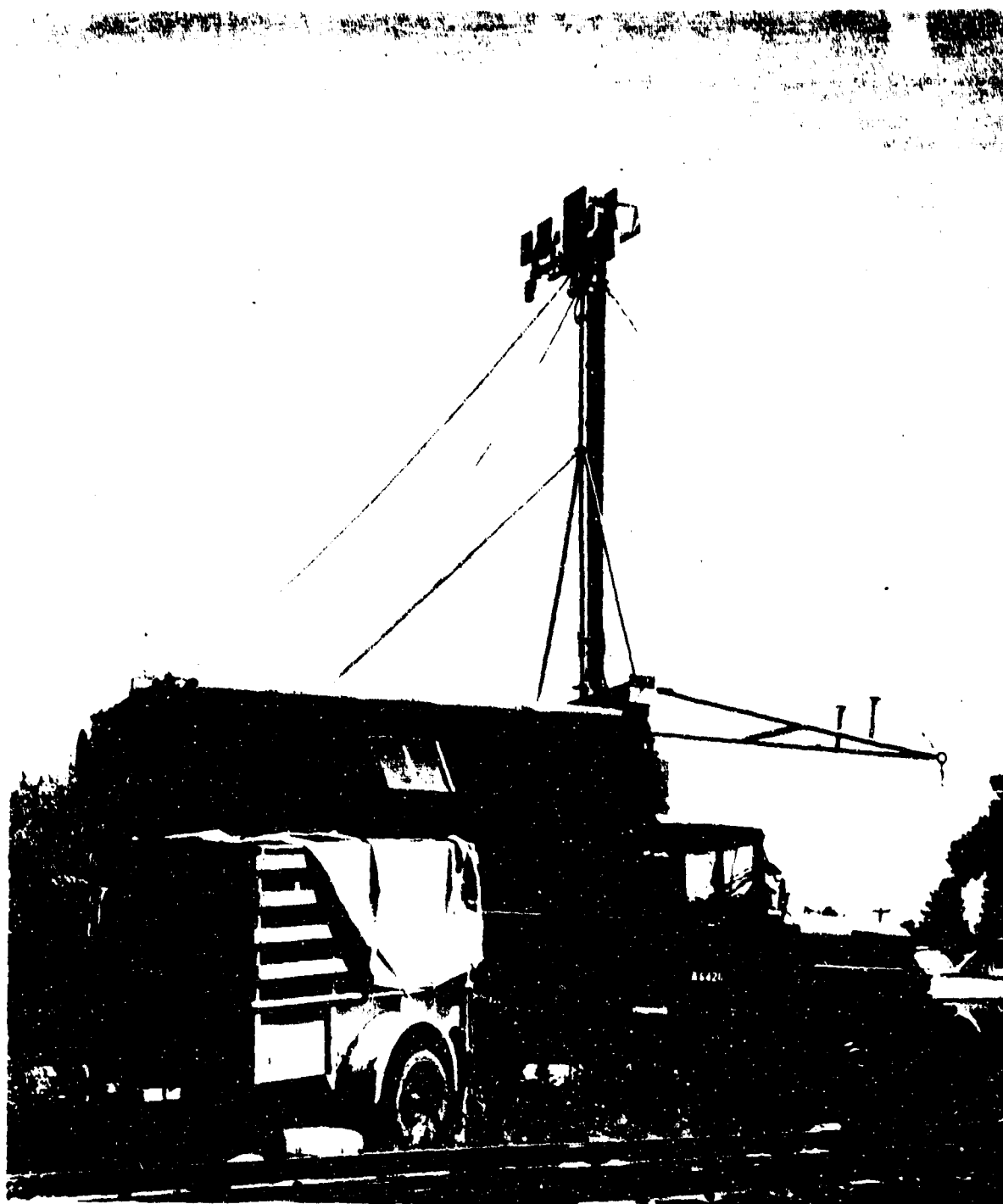


FIGURE 12 TRANSMITTING UNIT UPPER FREQUENCY GROUP

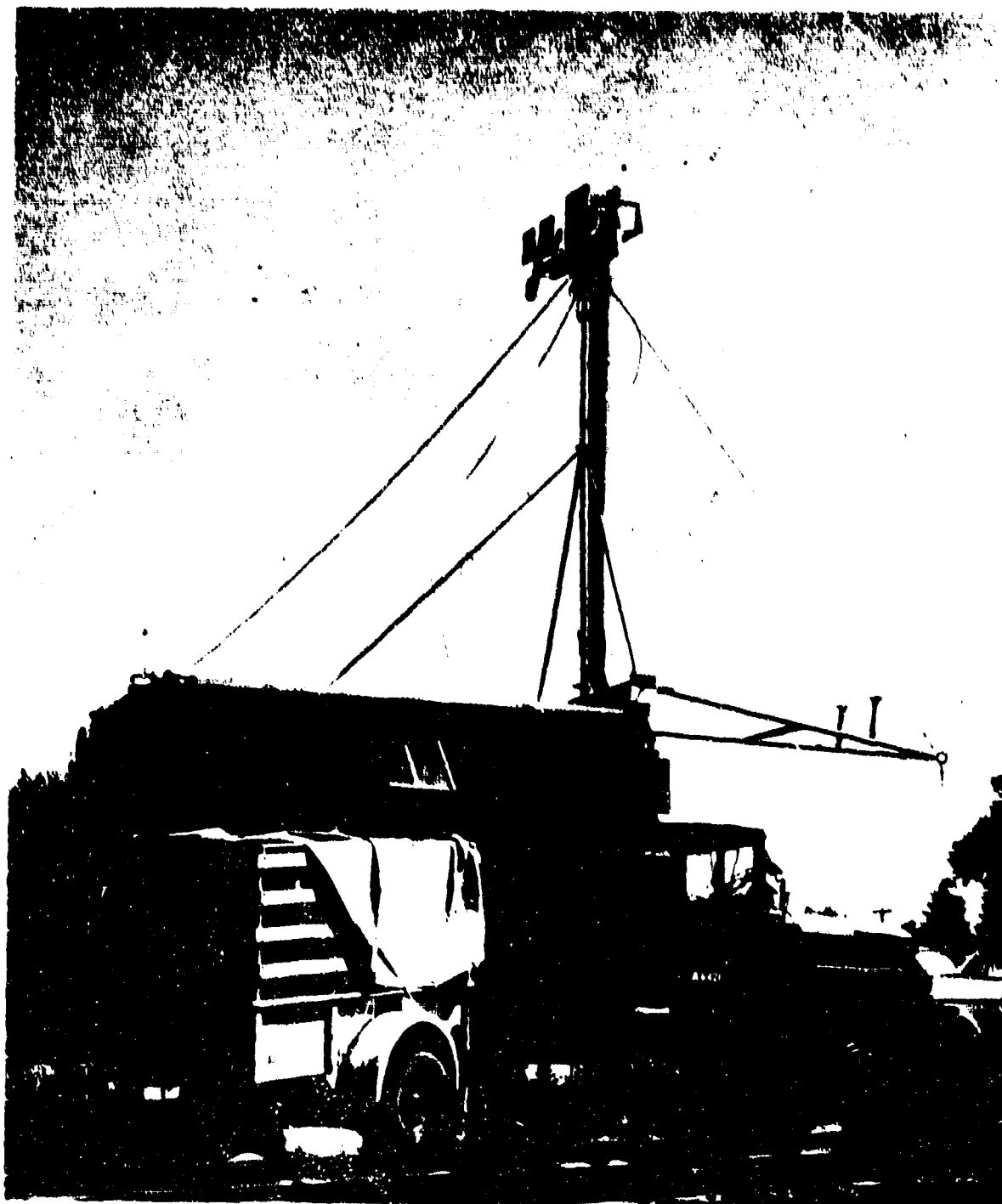


FIGURE 12 TRANSMITTING UNIT UPPER FREQUENCY GROUP

3. Measurement Procedures

Three prerequisites determined the location of the transmitter sites: (1) meeting the selected distances of 0.5, 3, 5, 10, 20, 50, 80, and 120 km as closely as possible; (2) accessibility to both transmitter units; and (3) clear and unobstructed foreground, except in the cases of the pairs of open and concealed sites where accessibility only dictated the selection. Areas were chosen from U. S. Geological Survey topographic maps for distance and accessibility and sites were then visited to pin-point exact locations for the transmitting units.

All antenna orientations were determined from the maps. As the receiving antennas were varied in height between 1 and 13 m, the signal was recorded continuously on strip charts. Before these height-gain recordings were made, a 10-min sample was recorded on each frequency in order to ascertain the temporal stability of the received signal. In the case of the lower frequency group, this recording was made at the 13-m level; for the higher frequency group 7.3 m was used. In all instances where the time recorded signal varied by more than 2 dB, additional recordings were made at the 1- and 7.3-m levels for the lower frequencies and at the tower extremes for the higher frequencies. Data for open and concealed sites were obtained within the smallest possible time interval.

At the beginning and immediately upon completion of data recording at any site, each receiver was calibrated to insure that all receiver parameters remained constant throughout the recording time.

If, upon completion of the data analysis for any site, any of the data were judged in doubt, the site was revisited and additional recordings made. All data for each site are plotted together by frequency regardless of the time interval between runs and are presented in section 8 of this report.

4. Antenna Measurements

In order to obtain free-space gain values and pattern data for the transmitting and receiving antennas, measurements were made at the Gunbarrel Hill receiving site (R1), which is reasonably flat in the vicinity of the antenna tower. Three test paths were used: the first was 90 m long over plowed ground, the second 150 m long over a field of wheat stubble, and the third, also 150 m long, extended over a combination of plowed ground and wheat stubble. The resulting gain values from these three paths differed from their average by less than 0.5 dB.

The measurements were made by placing the transmitting antennas at a fixed height (6.6 or 7.3 m) above ground, and recording the received signal level continuously while the receiving antennas were

raised from 1 to 13 m above ground. From the analysis of maxima and minima in the height-gain curves obtained in this way, the received signal power corresponding to free-space loss can easily be obtained, and the sum of the free-space antenna gain is then determined from knowledge of the transmitter power, the received signal power, the line losses, and the free-space basic transmission loss over the test path. Since the transmitting and the receiving antenna for each frequency were identical, equal gain values were assumed.

Necessary assumptions also were that antenna circuit losses were negligible, and that the impedance of the antenna does not change with height above ground. The first of these is well justified for the type of antennas used in the frequency range above 200 MHz. Independent checks did not show any significant variations of the antenna impedance with antenna height above ground at the Gunbarrel Hill site; furthermore, only maxima and minima of the height-gain pattern that were more than 4.6 m above ground were used in the antenna gain determination. This minimum height represents 3.5 wavelengths even at the lowest frequency used (230 MHz).

Antenna patterns over a limited azimuth range were obtained with the receiving antennas 3 m above ground, and the transmitting antennas 6.6 or 7.3 m above ground. The receiving antennas were revolved over a sufficiently wide azimuth to include the main lobe. Since the antennas

were always oriented along the propagation path during the entire measurement program, the azimuthal patterns are not of primary importance.

5. Presentation of Data

Measurement results from the Gunbarrel Hill receiving site (R1) only are presented in this part of the report (see sec. 8). Data from the other three receiving sites will be presented in subsequent parts.

The data are arranged and coded by path distance and for each distance sequentially by azimuth counted clockwise from true north. For example: R1-20-T4 indicates a 20-km path from common receiver site R1 to transmitter site T4, which is the fourth site at the 20-km distance counted clockwise from true north. Pairs of open and concealed sites are denoted by "O and C".

For each transmission path, the data are arranged in the following order:

1. The site designation and code accompanying photographs of the terrain taken from each of the two terminals in the direction toward the other; in the case of "O and C" sites, the photographs were taken from both the open and the concealed transmitter site.
2. A graph of basic transmission loss vs. receiving antenna height derived from the measurements for all seven frequencies with the dates of the measurement runs indicated; only data from open sites are shown. Values of the maximum measurable loss are also indicated if the received signal level is below

the receiver noise level, in addition to the free-space basic transmission loss values for all frequencies.

3. The path profile, with site elevation and path length indicated, drawn (Rice et al., 1966) in each case by using an effective earth radius based on a surface refractivity value of 290 N-units. This represents an average for the area where the measurements were made.
4. The results of the time recording made before each height-gain run, but only for those dates corresponding to the data shown on the preceding height-gain graphs. The $\Delta 10\%-90\%$ value is the dB difference between the level of the received signal exceeded 90 percent of the time and the level exceeded 10 percent of the time during the time recording period.
5. Field notes describing the terrain and significant obstacles along the transmission path.
6. Additional graphs (where applicable) of basic transmission loss vs. antenna height, showing comparisons of height-gain runs for different dates, or of data for the "O and C" pairs.
7. In the case of "O and C" sites, pertinent profile information, time run data, and descriptive material related to the concealed site.

The measured data were converted to basic transmission loss (Rice et al., 1966) by means of the following approximation:

$$L_b = P_t - P_r + G_t + G_r - L_t - L_r ,$$

where

* L_b = basic transmission loss in dB

P_t = transmitter power in dBW

* P_r = received signal power in dBW

G_t = free-space gain of the transmitting antenna in dB
relative to an isotropic radiator

G_r = free-space gain of the receiving antenna in dB
relative to an isotropic radiator

L_t = line losses in dB between transmitter and transmitting antenna

L_r = line losses in dB between receiving antenna and receiver input

Indicators for the transmitter power output were calibrated against laboratory standards. The received power level was determined by comparison with signal generators using the substitution method, and is essentially the power into a 50- Ω receiver input impedance. The received signal power was assumed equal to the power available from an equivalent loss-free antenna.

The conversion formula assumes that free-space gain values for the antennas are realized, that there are no losses in the antenna circuits, and that the antenna impedance values are constant at all measurement

* When the received signal level is below the receiver noise level, P_r is the receiver minimum detectable signal and L_b will be the maximum measurable loss in dB. See pages 271, 274, 283, 286, and 289.

locations. As already noted, no significant change in antenna impedance was observed at the Gunbarrel Hill receiving site when the antennas were raised from 1 to 13 m above ground. Some changes in the transmitting antenna impedance may have occurred, however, when the antennas were moved from an open to a concealed site, because the transmitter operators noted small changes in the voltage standing-wave ratio (VSWR) measured along the transmission line near the transmitting output terminal; being minor, these changes were not logged. The basic transmission loss values shown in section 8 may therefore contain a small variable component due to changes in the antenna impedance that cannot now be separated from the total path effects. It is not likely that this component ever exceeded 2 dB, since for a more substantial mismatch the operation of the transmitters would have been materially affected. As a result, it appears justified to neglect antenna impedance changes and associated effects of mismatch in the derivation of basic transmission loss values from the measurements. Also, any errors introduced would be of approximately the same magnitude as the unavoidable calibration errors of the system.

Section 8 of this part of the report also contains a comprehensive listing of meteorological parameters obtained during the measurement period, and of the topographic maps used to obtain path profiles; latitude and longitude for the terminals of each path and coordinates of the path intersections with the edges of the map used are included.

6. Acknowledgments

Thanks are due almost all personnel within the Spectrum Utilization Program Area of the Tropospheric Telecommunication Laboratory, who participated in the collection, analysis, and evaluation of the data. The authors also want to thank Messrs. R. S. Kirby and J. J. Tary for their review and suggestions.

7. References

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- Miles, M. J., and A. P. Barsis (1966), "Summary of 20-100 MHz propagation measurements results over irregular terrain using low antenna heights," ESSA Technical Report IER 10-ITSA 10.
- Rice, P. L., A. G. Longley, K. A. Norton, and A. P. Barsis (1966), "Transmission loss predictions for tropospheric communication circuits," NBS Technical Note 101 (Revised).

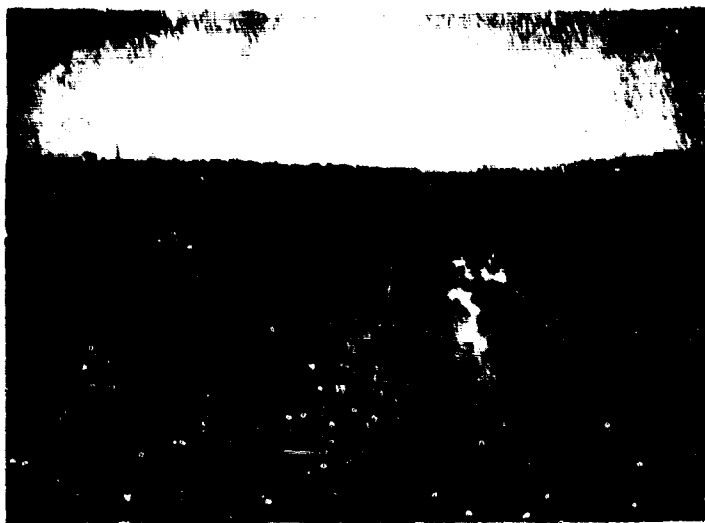
8. Data Tabulations

Data tabulations are contained on the following pages, 29 through 336.

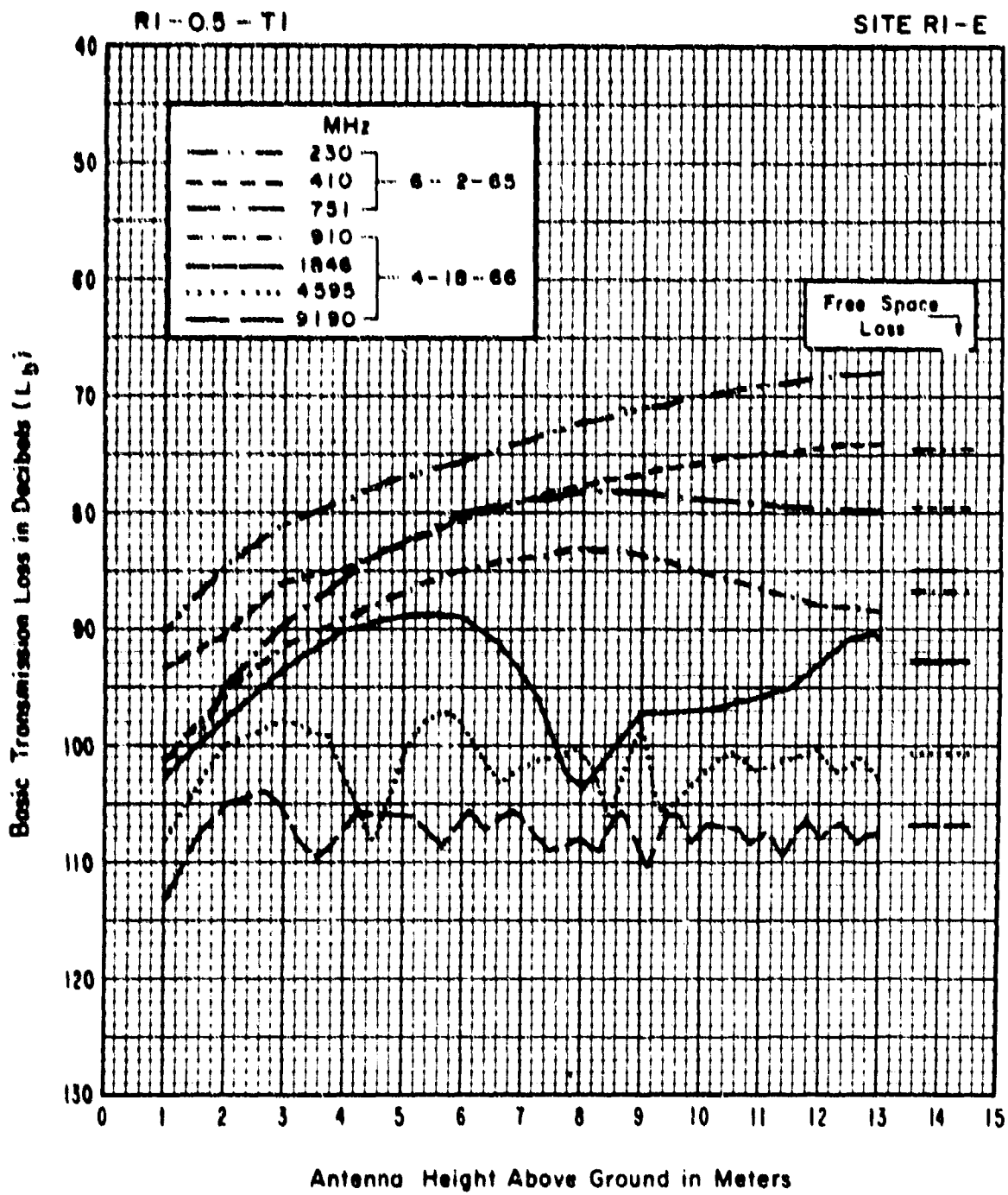
R1-0 5-T1
R1E



PATH VIEW FROM RECEIVER



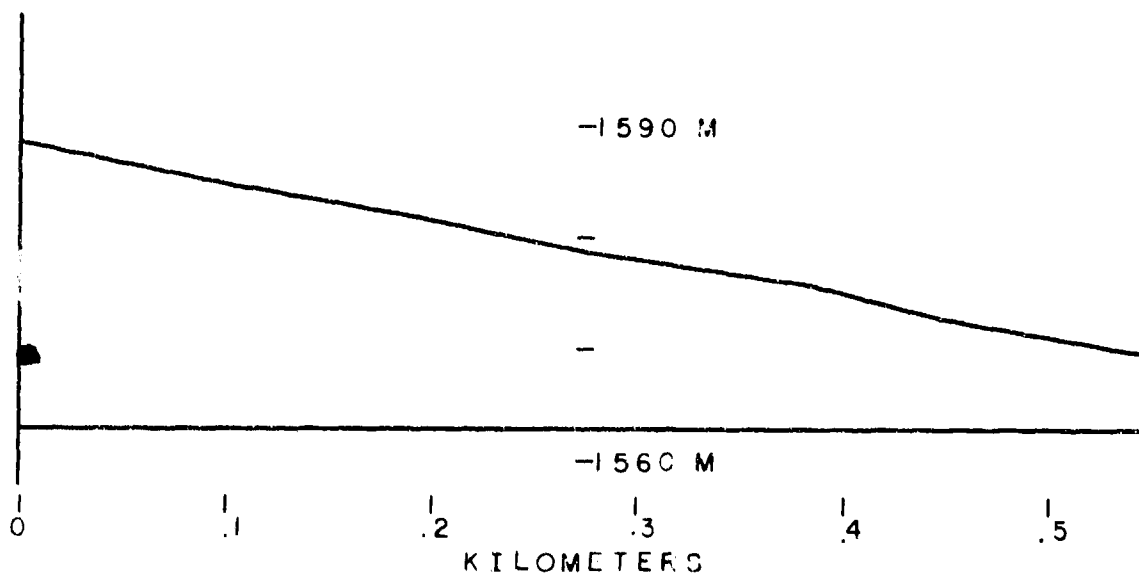
PATH VIEW FROM TRANSMITTER



RCVR. ELEV.
1589 M

R1-0.5-T1
PATH LENGTH 0.54 km

XMTR. ELEV.
1570 M



L_b (dB) SHORT TERM SIGNAL VARIABILITY

Freq (MHz)	230	410	751	910	1846	4595	9190
	6-2-65 at 13 M				4-18-66 at 7.3 M		
50%	68.1	74.3	78.3	83.2	98.6	100.4	109.5
$\Delta 10\%-90\%$	<3	<3	<3	<3	<3	<3	<3

This site is approximately 1500 ft east of the receiver. In the foreground are alternating strips of plowed ground and wheat stubble. The only obstruction is a low fence about 800 ft away.

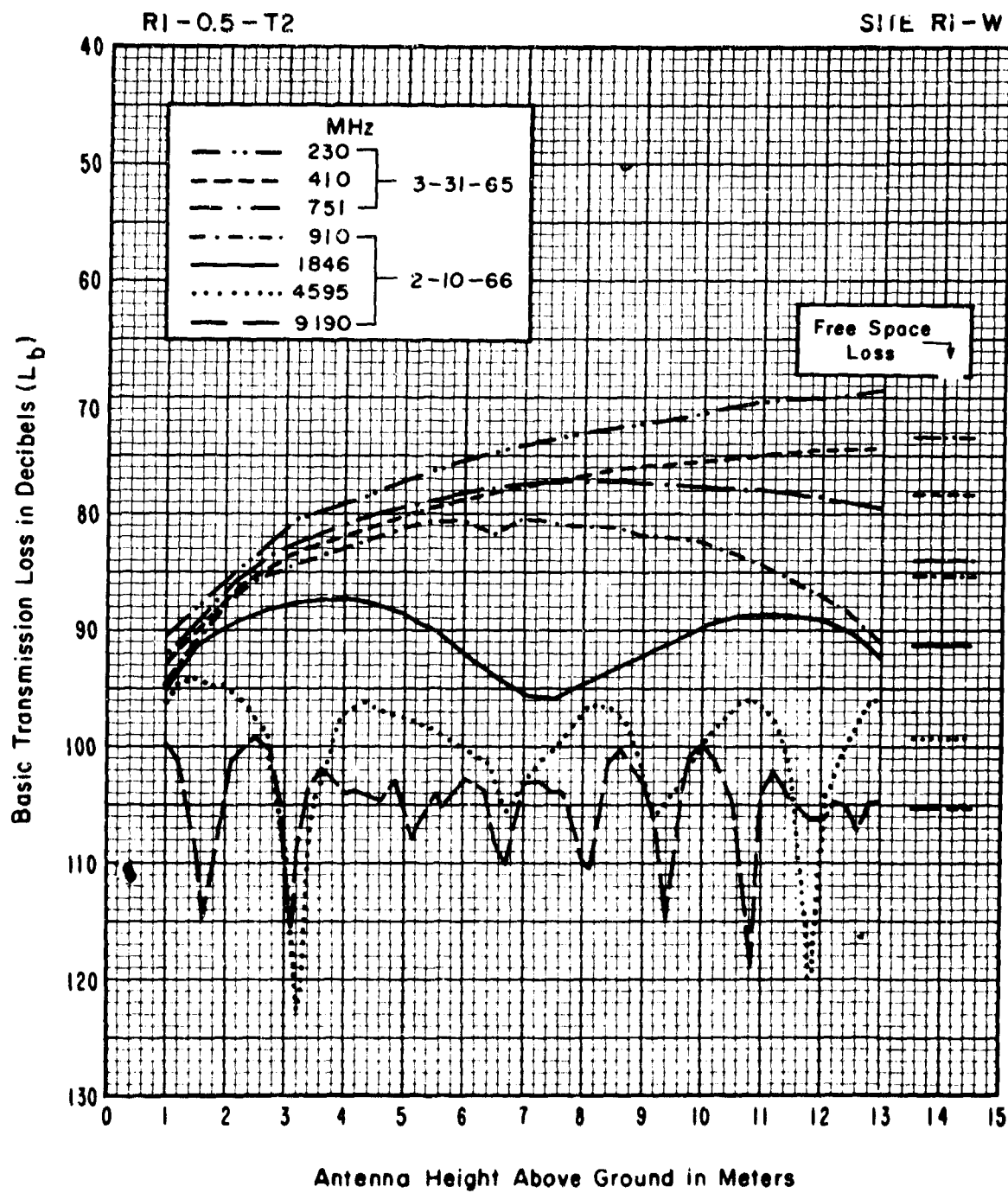
R1-0.5-T2
R1W

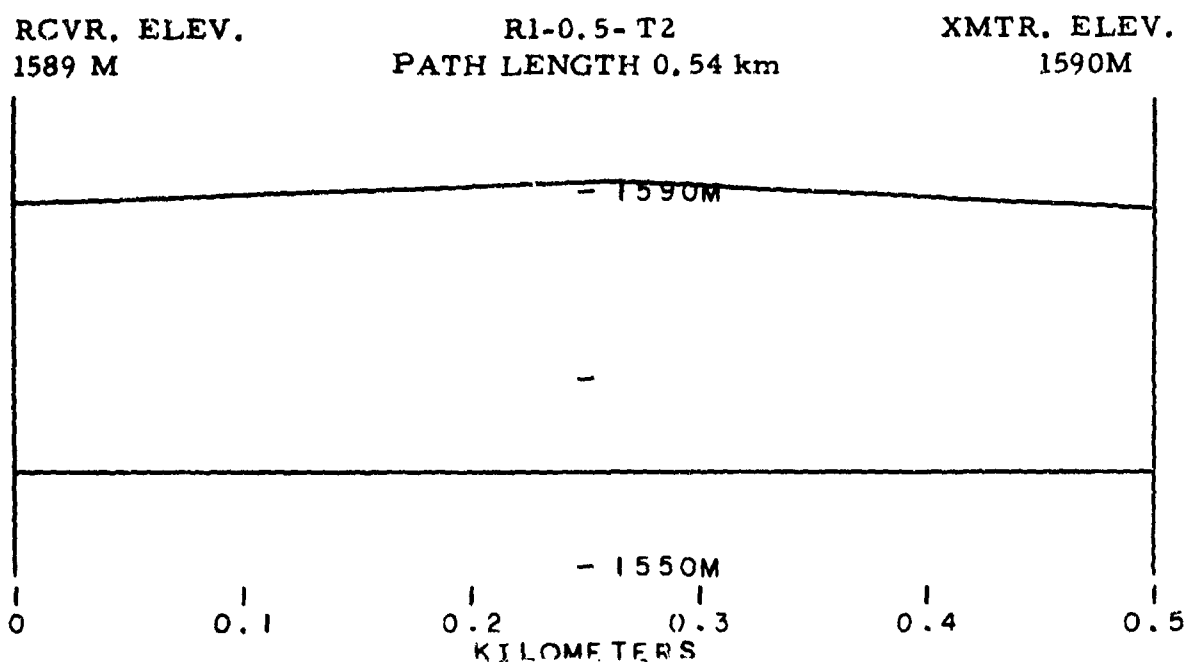


PATH VIEW FROM RECEIVER



PATH VIEW FROM TRANSMITTER





L_b (dB) SHORT TERM SIGNAL VARIABILITY

Freq (MHz)	230	410	751	910	1846	4595	9190
3-31-65 at 13 M				2-10-66 at 13 M			
50%	71.2	73.5	74.4	95.5	95.7	96.3	98.3
$\Delta 10\%-90\%$	< 3	< 3	< 3	< 3	< 3	< 3	< 3
				2-10-66 at 6 M			
50%				80.8	94.9	101.0	101.8
$\Delta 10\%-90\%$				< 3	< 3	< 3	< 3
				2-10-66 at 1 M			
50%				94.0	94.8	94.7	98.9
$\Delta 10\%-90\%$				< 3	< 3	< 3	< 3

This site is about 1600 ft west of the receiver. The terrain in the foreground alternates between plowed ground and wheat stubble. There are no obstructions on the path.

R1-3-T1
NIWOT E1



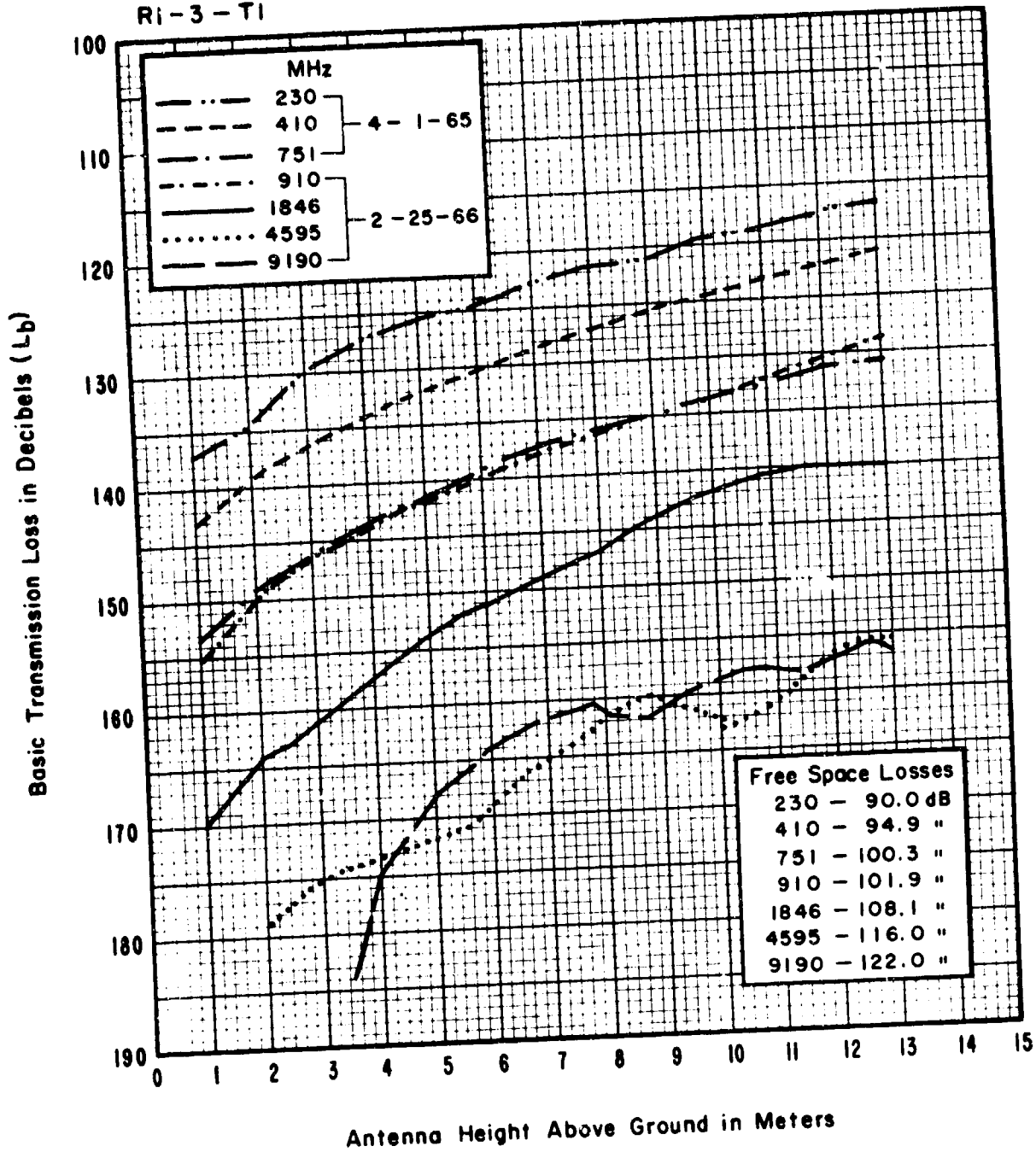
PATH VIEW FROM RECEIVER



PATH VIEW FROM TRANSMITTER

NIWOT EI

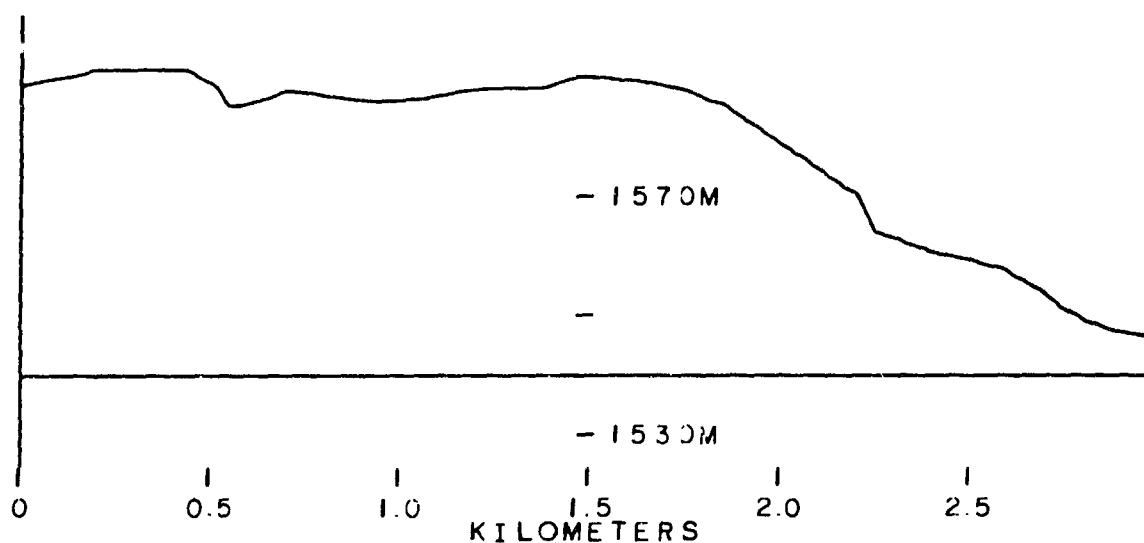
Ri-3-T1



RCVR. ELEV.
1589 M

R1-3-T1
PATH LENGTH 2.981 km

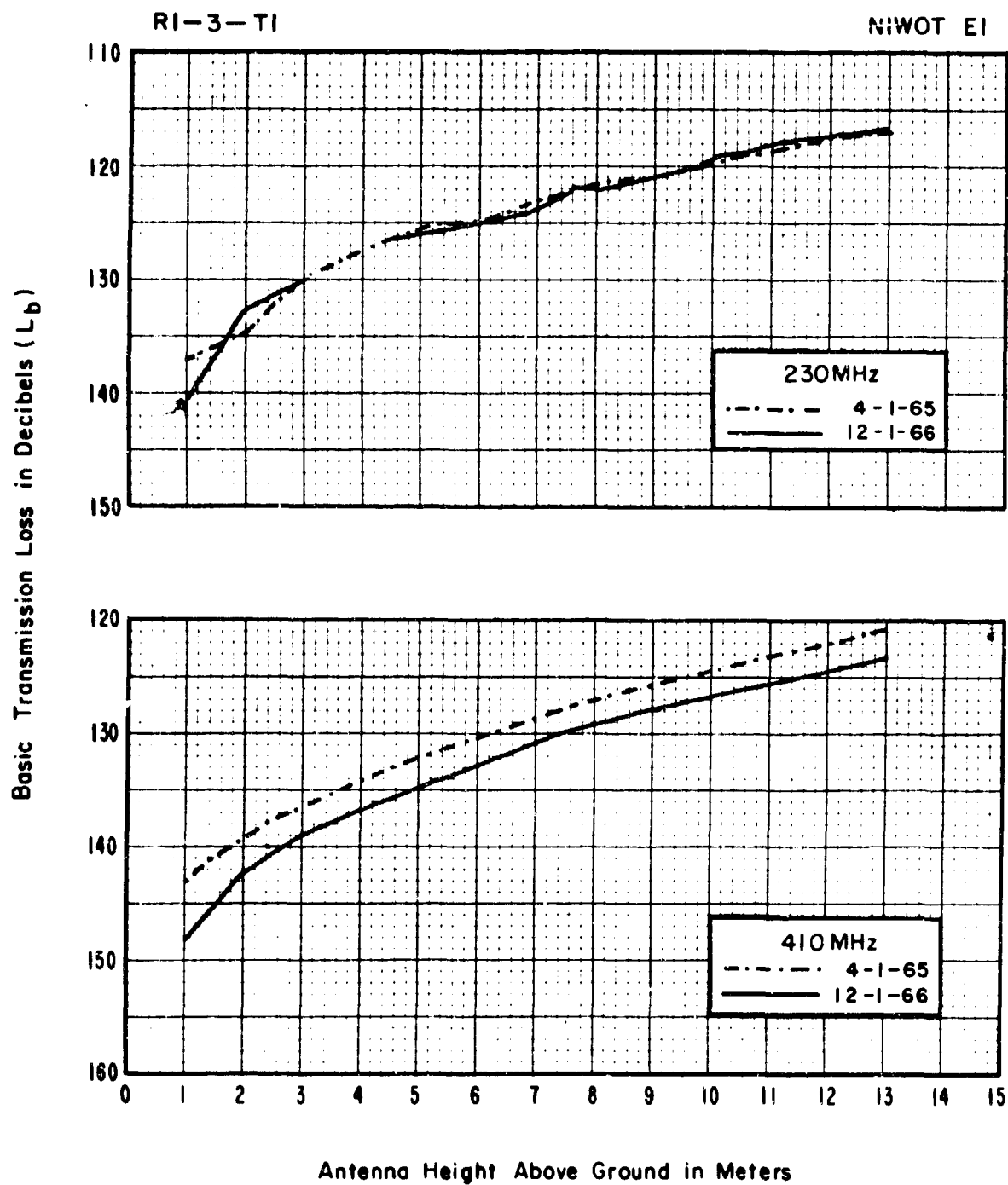
XMTR. ELEV.
1546 M

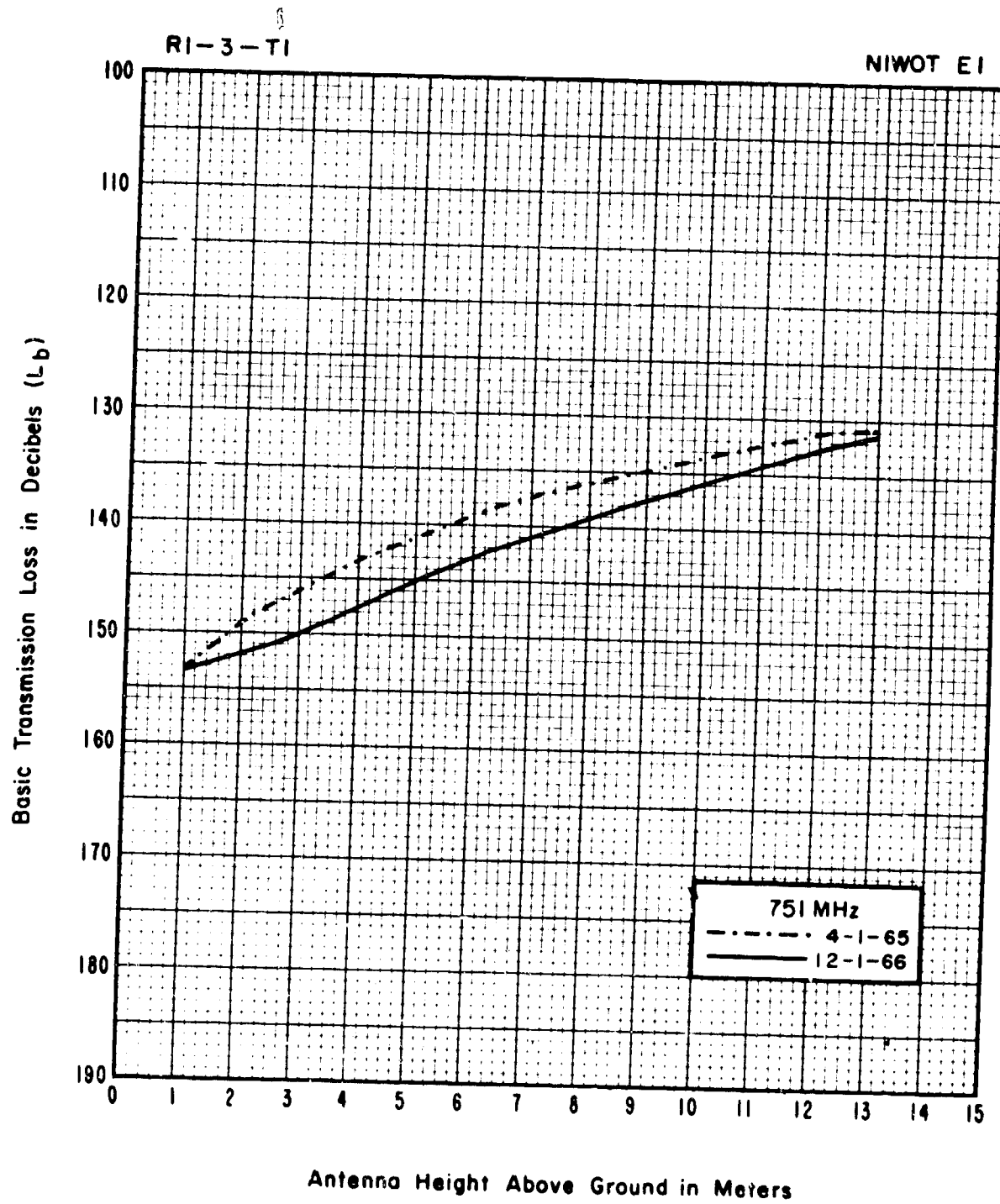


L_b (dB) SHORT TERM SIGNAL VARIABILITY

Freq (MHz)	230	410	751	910	1846	4595	9190
	4-1-65 at 13 M				2-25-66 at 7.3 M		
50%	116.6	121.1	131.0	137.7	147.6	163.2	160.6
$\Delta 10\%-90\%$	< 3	< 3	< 3	< 3	< 3	< 3	< 3

This path extends over approximately 650 ft of wheat stubble to a strip of plowed ground 200 ft wide beyond which a moderately traveled highway, with power lines on its far side, runs at 70° to the path. The ground then slopes gently upward toward the horizon and a small group of homes located approximately 1 mi away.





RE 3-12
WALLER LAKE NW 1



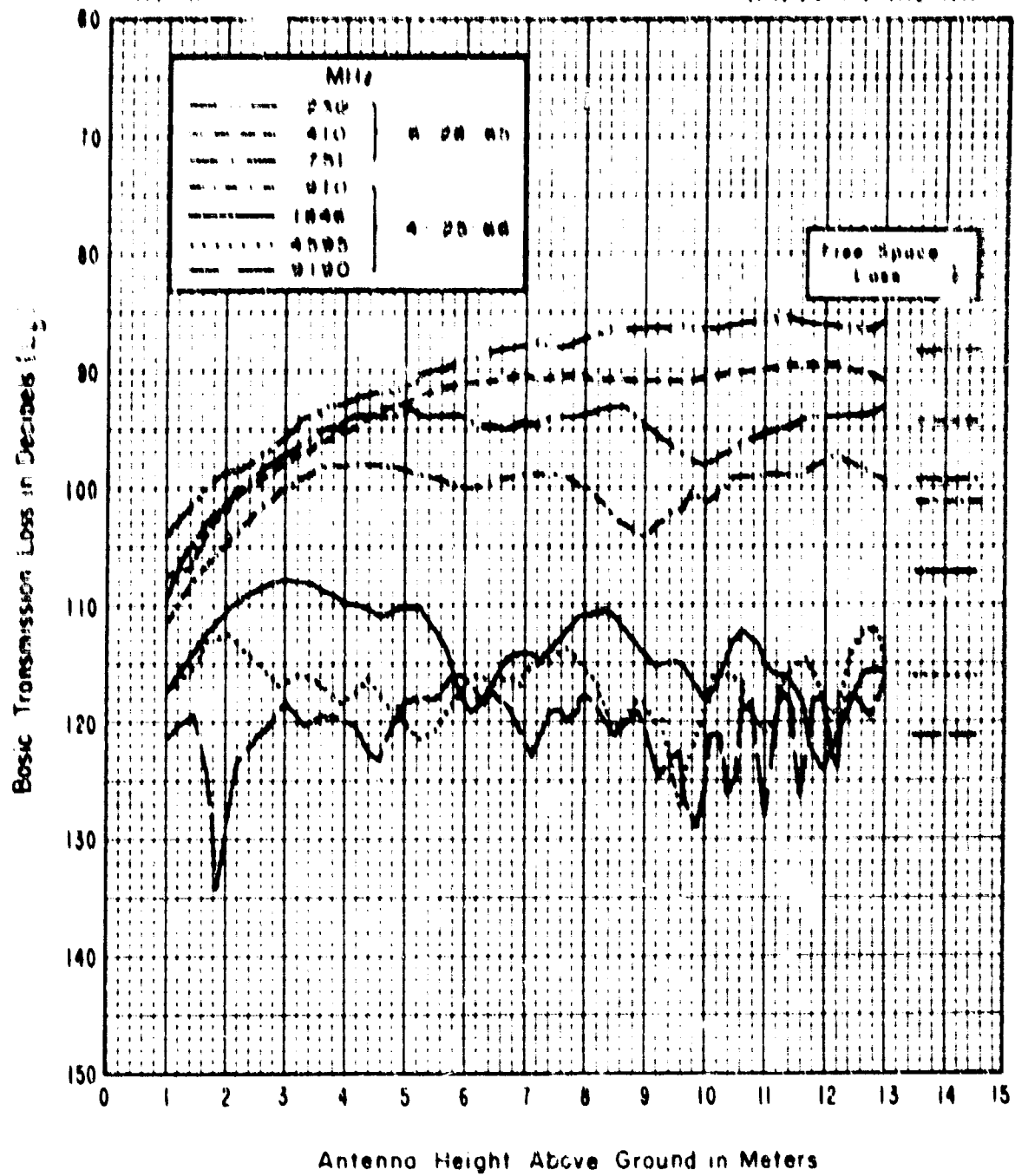
PATH VIEW FROM RECEIVER



PATH VIEW FROM TRANSMITTER

RI 5 1

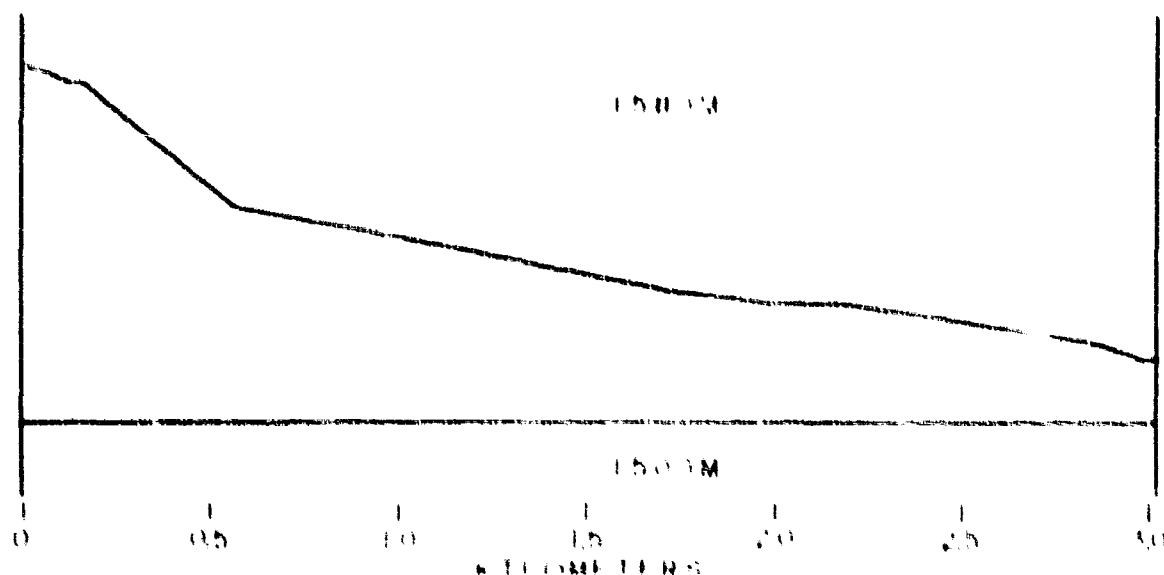
HALLER LAKE NWI



RCVR. ELEV.
1500 M

RECEIVER
PATH LENGTH 3.02 km

XMTR. ELEV.
1524 M



L_p (dB) SHORT TERM SIGNAL VARIABILITY

Freq (MHz)	230	410	751	910	1846	4595	9190
6-28-65 at 13 M				4-25-66 at 7.3 M			
50%	85.3	91.5	92.8	98.4	113.2	114.2	117.8
$\Delta 10\%-90\%$	< 3	< 3	< 3	< 3	< 3	< 3	< 3

This path extends over 1 mi of plowed ground to a thin line of trees, 40 ft high, growing perpendicular to the path. From there to the receiver site, which is in line of sight, the terrain of grass-covered fields slopes gently upward.

RI-3-T3
HALLER LAKE N



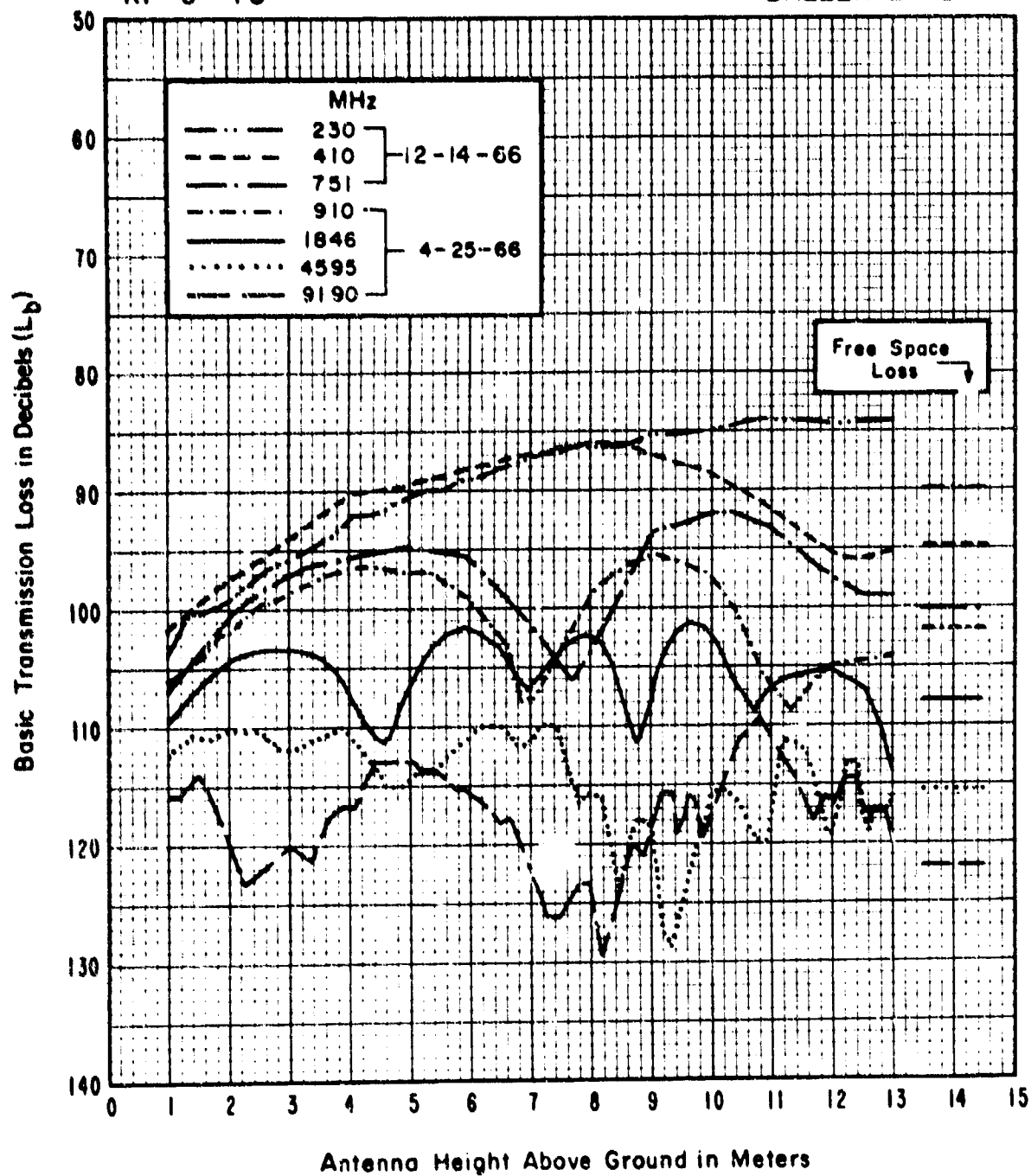
PATH VIEW FROM RECEIVER



PATH VIEW FROM TRANSMITTER

RI-3-T3

BALLER LAKE N



RCVR. ELEV.
1589 M

R1-3-T3
PATH LENGTH 3.22 km

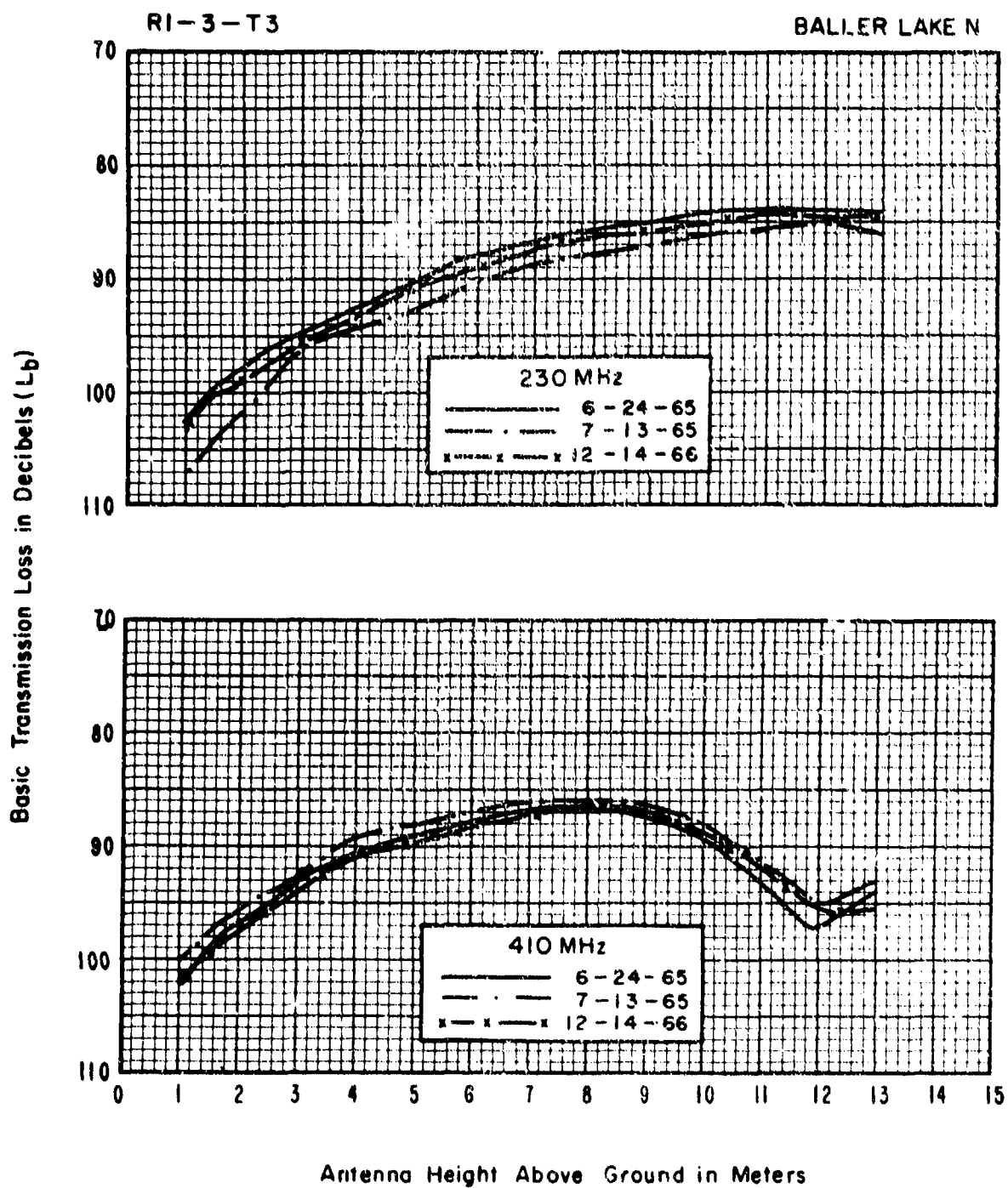
XMTR. ELEV.
1539 M



L_b (dB) SHORT TERM SIGNAL VARIABILITY

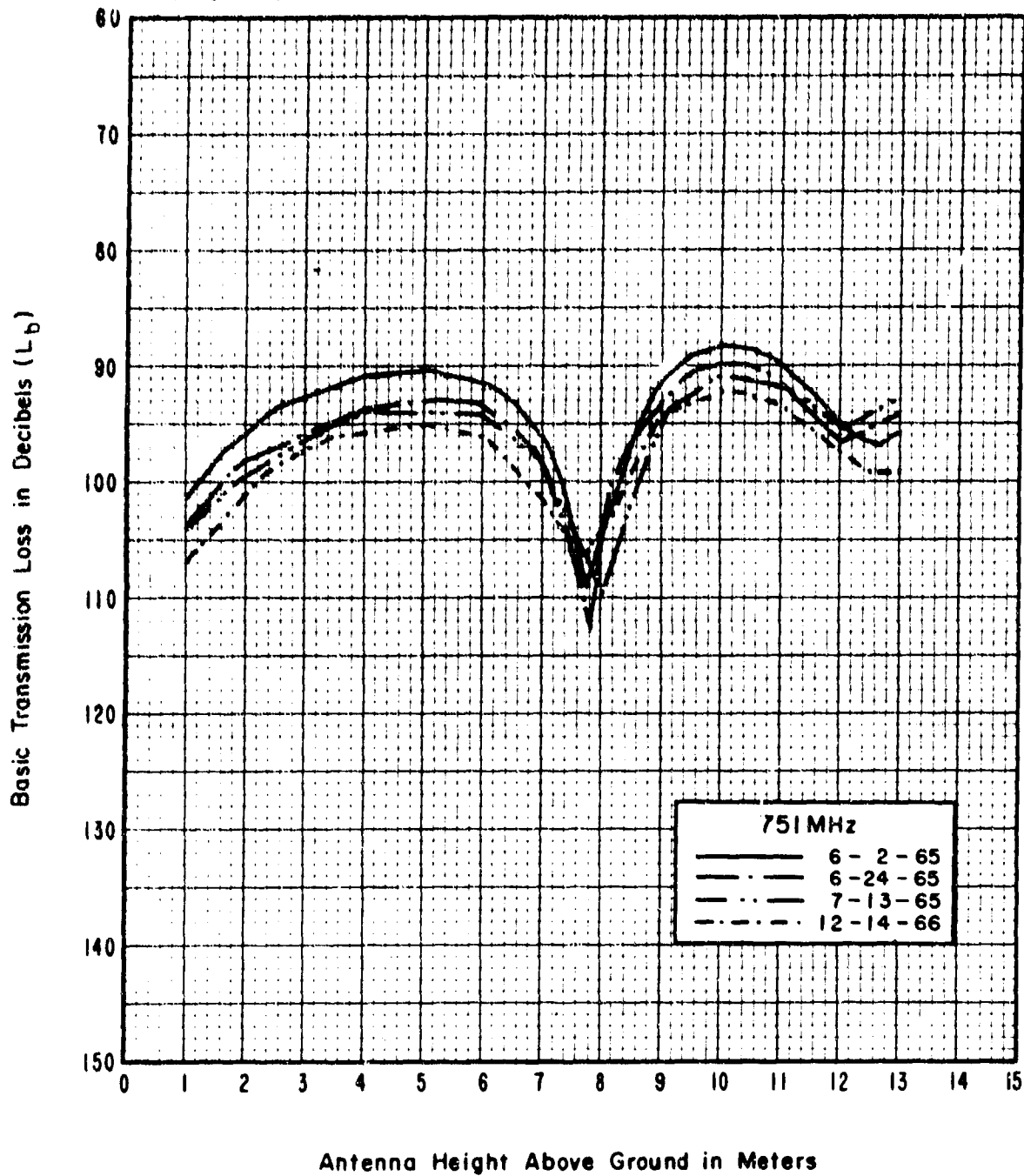
Freq (MHz)	230	410	751	910	1846	4595	9190
7-13-65 at 13 M				4-25-66 at 13 M			
50%	86.3	91.9	97.7	103.6	115.6	122.1	122.2
$\Delta 10\%-90\%$	< 3	< 3	< 3	< 3	< 3	< 3	< 3
				4-25-66 at 7.3 M			
50%				103.6	103.4	110.0	124.9
$\Delta 10\%-90\%$				< 3	< 3	< 3	< 3
				4-25-66 at 1.0 M			
50%				105.2	108.2	110.0	116.2
$\Delta 10\%-90\%$				< 3	< 3	< 3	< 3

This path extends over the corner of a grass-covered field bounded by a 3-ft wire fence in the immediate foreground. From 100 ft away to a moderately traveled highway, 1 mi distant, stretches a plowed field. Power and telephone lines are parallel to the highway. Just to the left of the path, approximately 3/4 of a mile away, is a grove of 40-ft high cottonwood trees. The ground slopes evenly upward to the receiver site, which is in line of sight.



RI-3-T3

BALLER LAKE N



R1-3-T4
LOOKOUT ROAD AT US 287



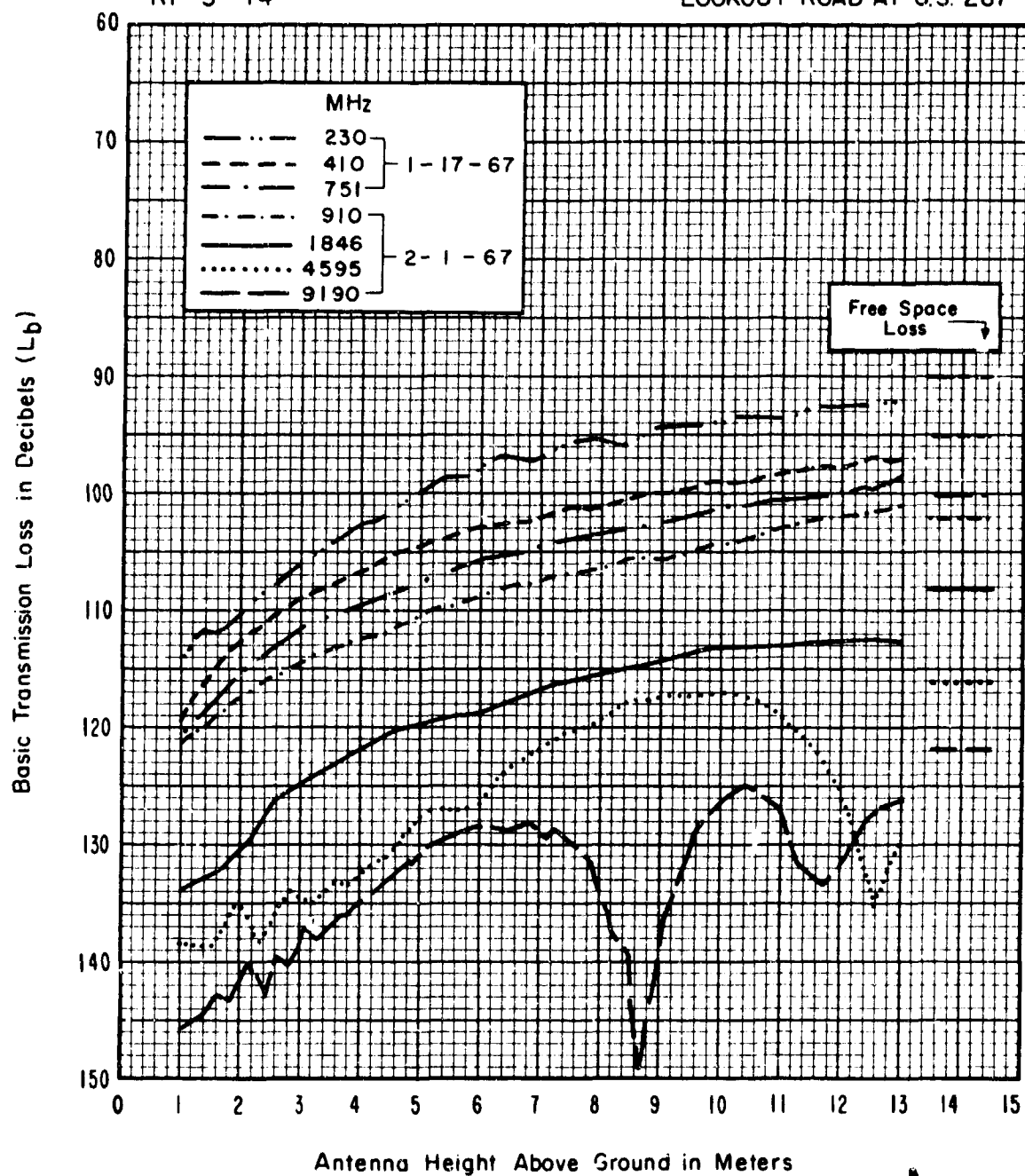
PATH VIEW FROM RECEIVER



PATH VIEW FROM TRANSMITTER

RI-3-T4

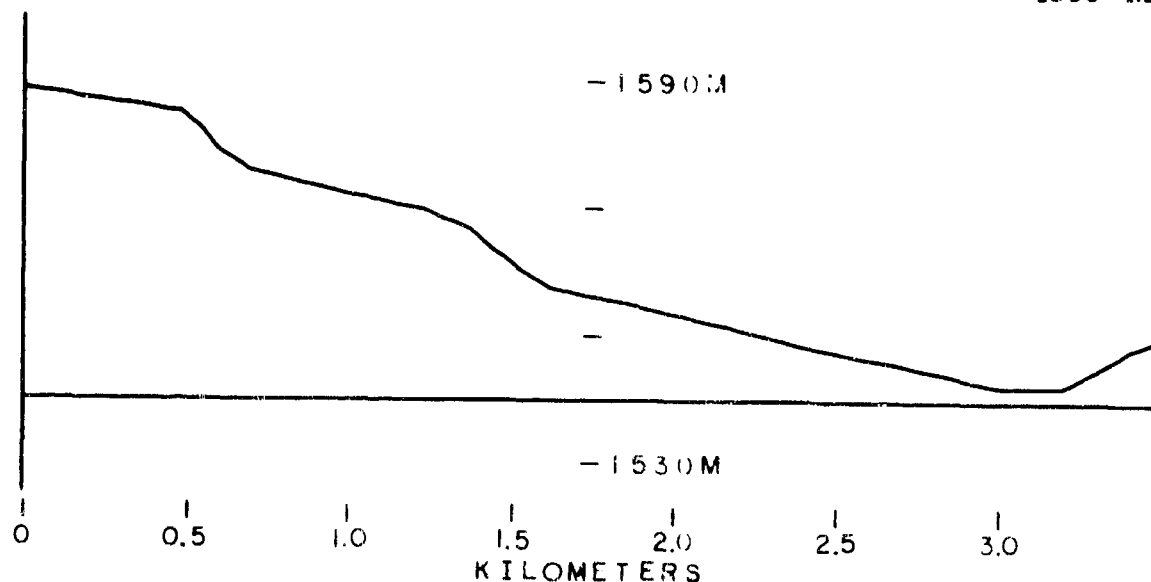
LOOKOUT ROAD AT U.S. 287



RCVR. ELEV.
1589 M

R1-3-T4
PATH LENGTH 3.48 km

XMTR. ELEV.
1550 M



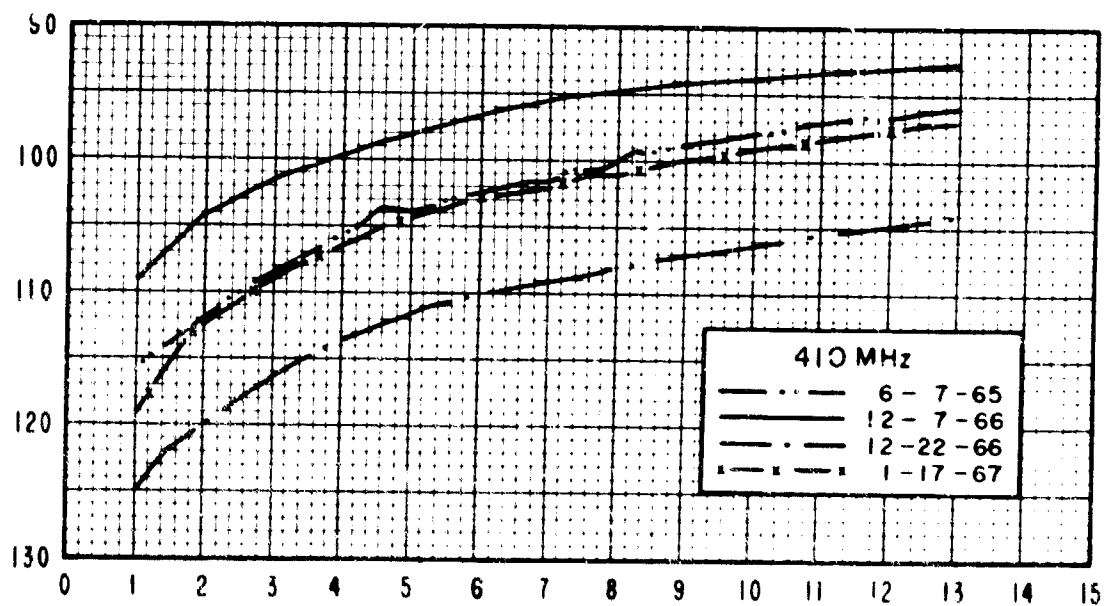
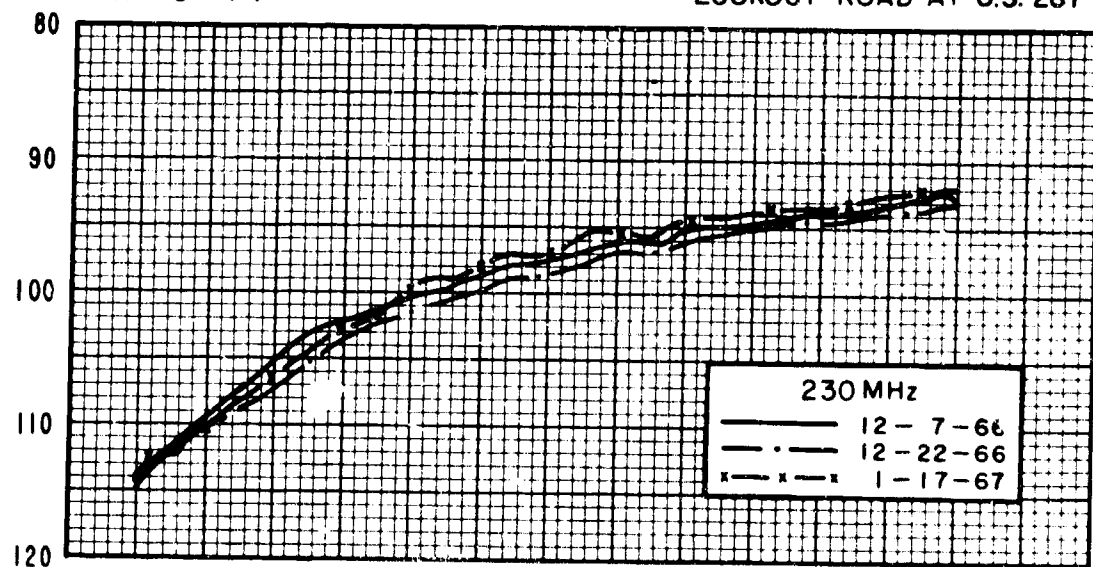
L_p (dB) SHORT TERM SIGNAL VARIABILITY

Freq (MHz)	230	410	751	910	1846	4595	9190
	1-17-67 at 13 M				2-1-67 at 7.3 M		
50%	95.4	97.8	100.7	107.5	114.0	121.0	128.4
$\Delta 10\%-90\%$	< 3	< 3	< 3	< 3	< 3	< 3	< 3

The path extends across 300 yd of wheat stubble to a high-voltage power line running perpendicular to the path. The next 1/2 mi is plowed ground leading to a moderately traveled highway along which power and telephone lines run parallel. Scattered cottonwood trees, 40-ft tall, rise on the path approximately 2 mi away. Alternate strips of plowed ground and field grass lie perpendicular to the path from the highway to the receiver site, which is in line of sight.

R1-3-T4

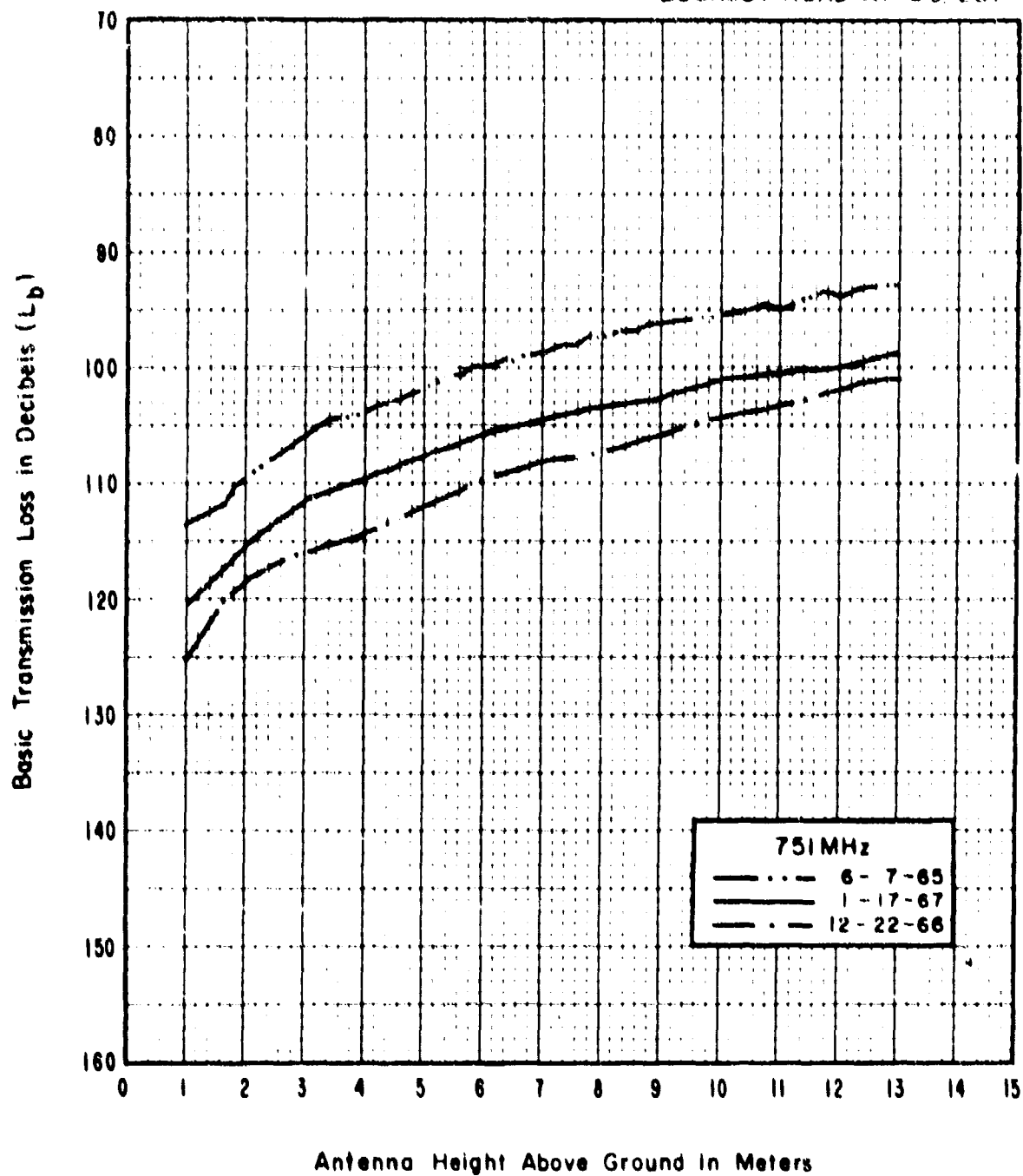
LOOKOUT ROAD AT U.S. 287



Antenna Height Above Ground in Meters

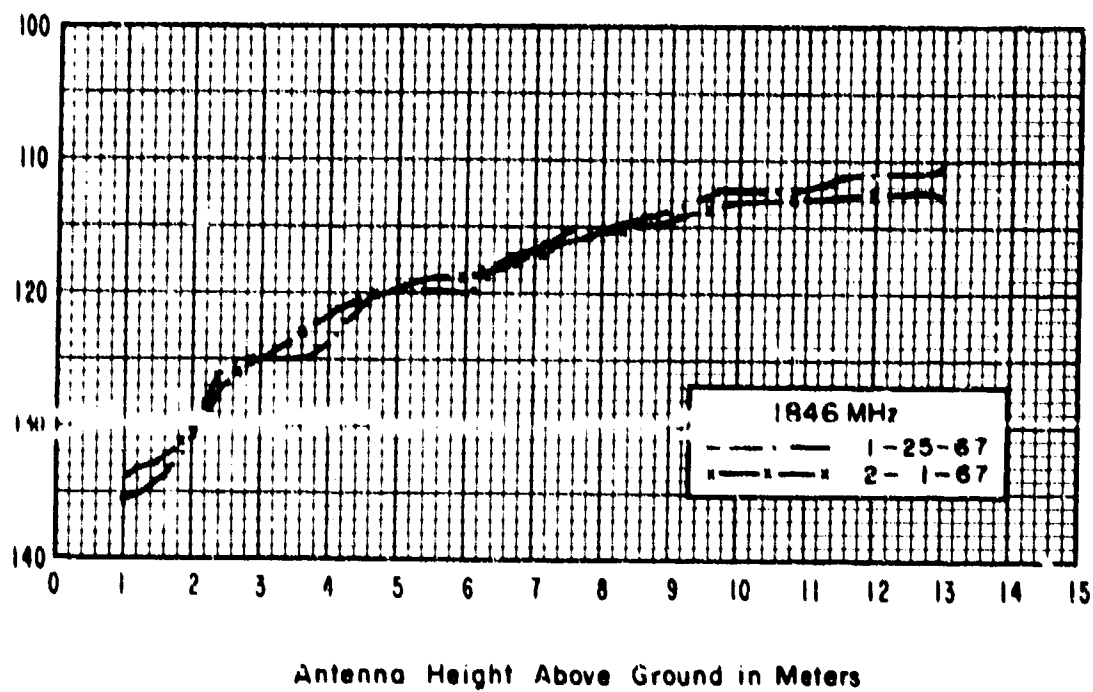
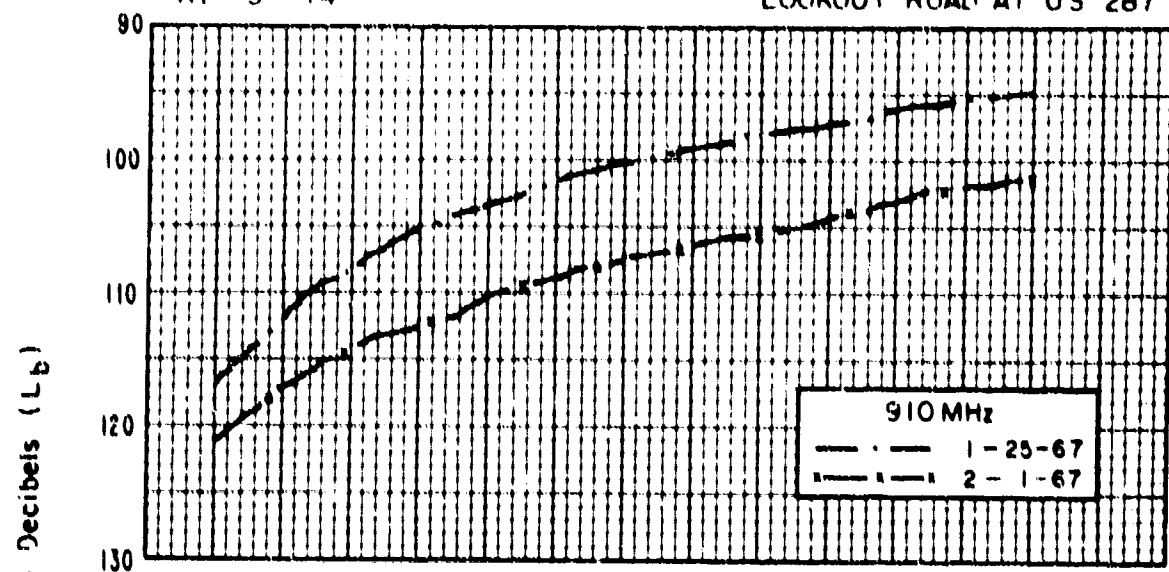
RI-3 - T4

LOOKOUT ROAD AT US 287



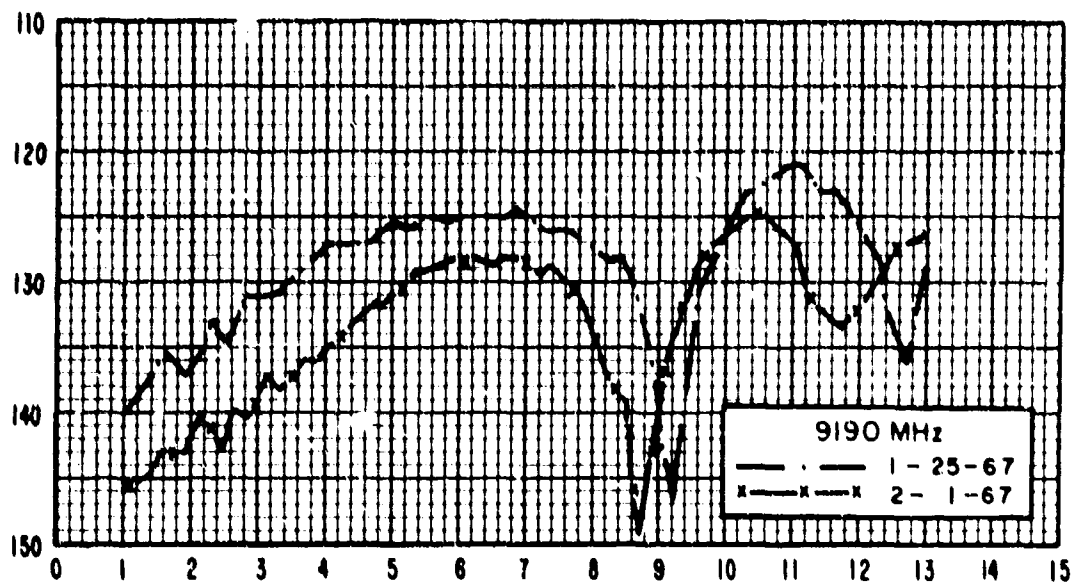
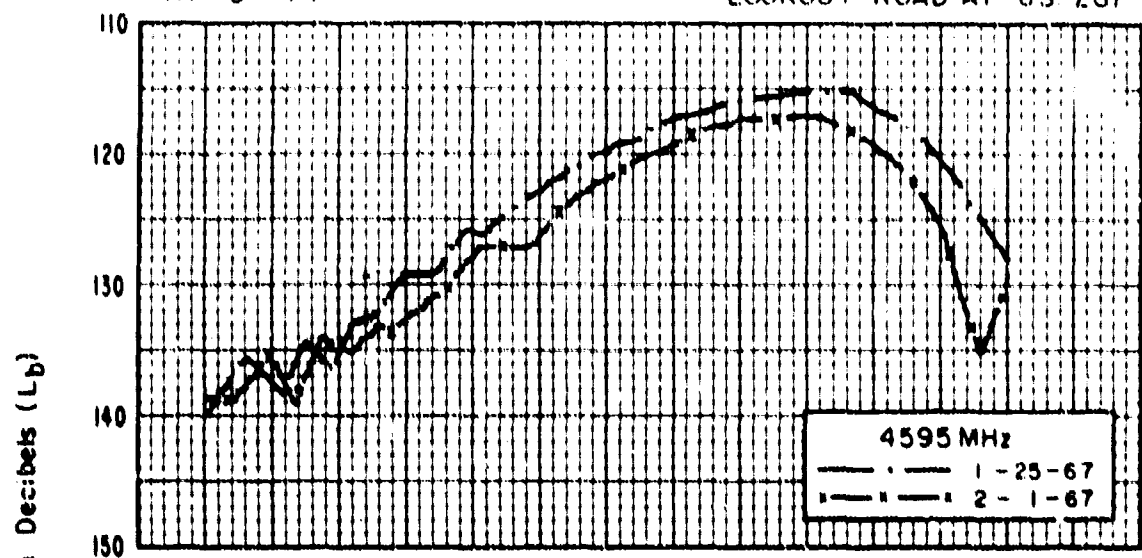
RI-3-T4

LOOKOUT ROAD AT US 287



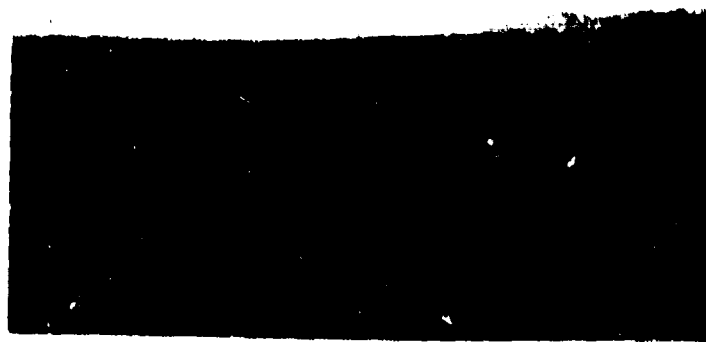
R1-3-T4

LOOKOUT ROAD AT US 287

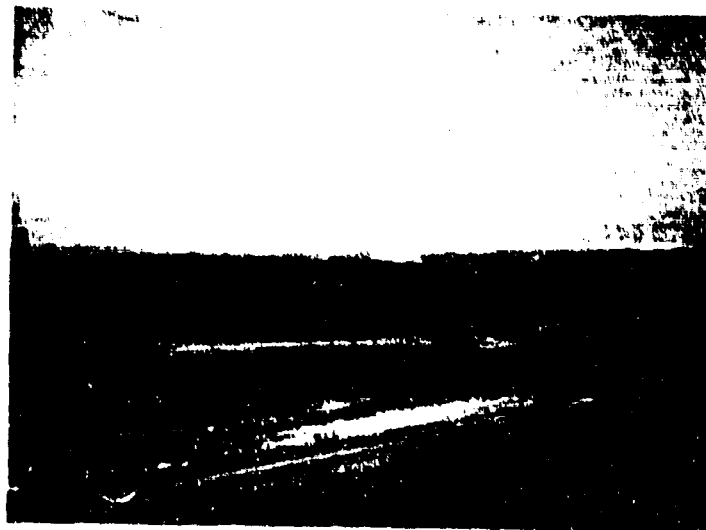


Antenna Height Above Ground in Meters

RI-3-15
GUNBARREL HILL SUMMIT



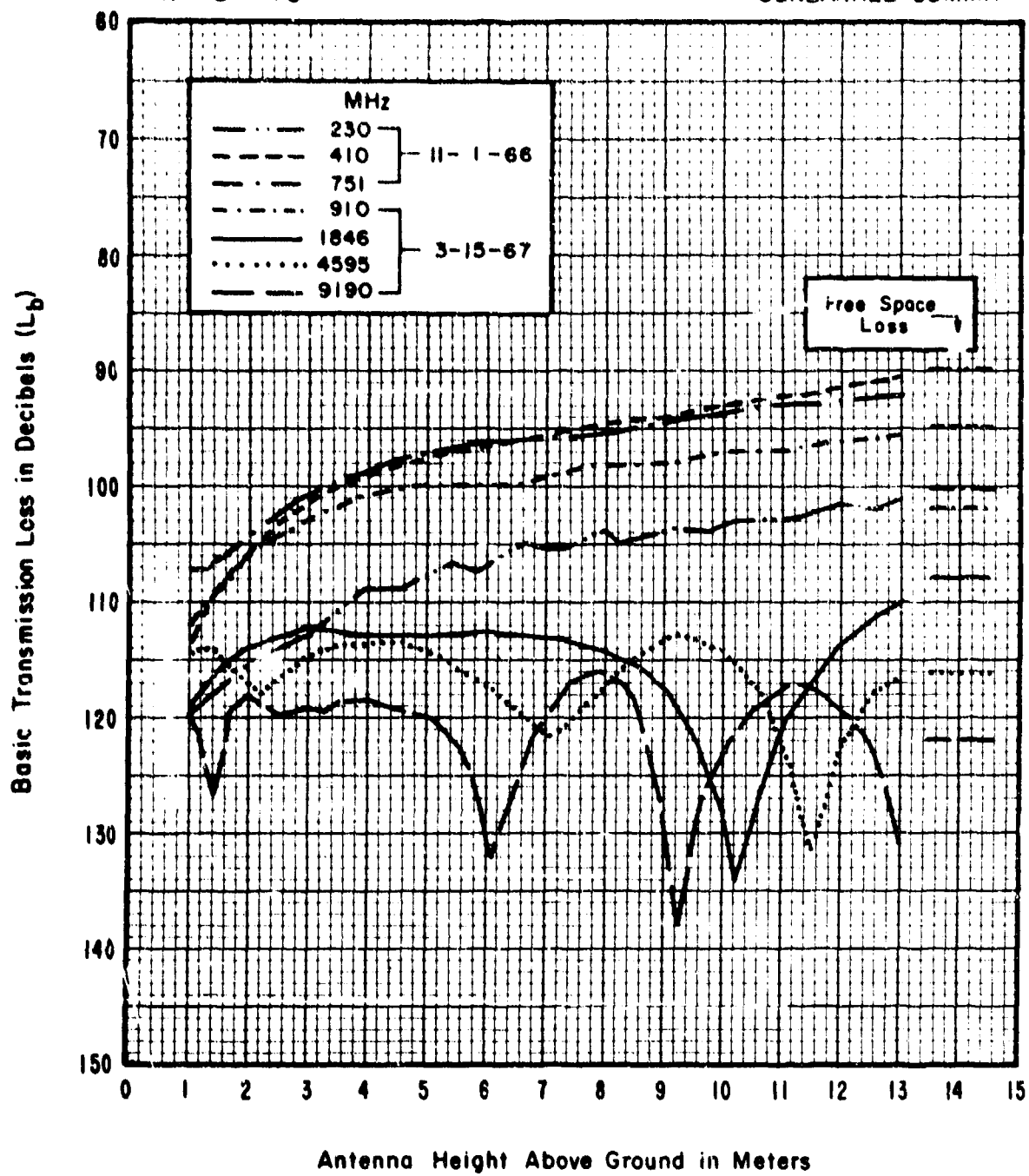
PATH VIEW FROM RECEIVER



PATH VIEW FROM TRANSMITTER

RI - 3 - T5

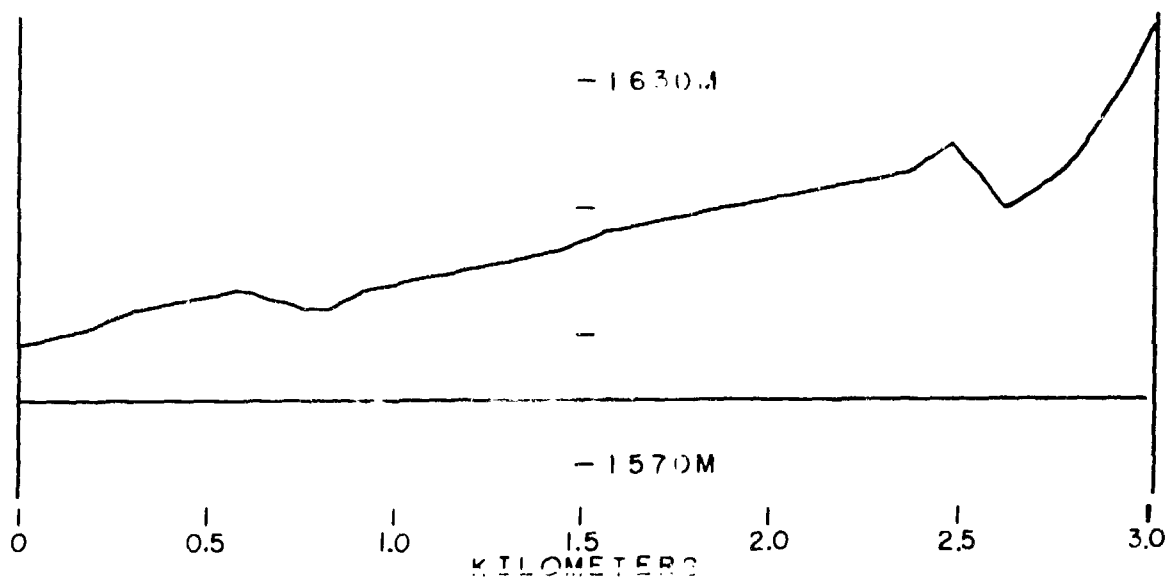
GUNBARREL SUMMIT



RCVR. ELEV.
1589 M

R1-3-T5
PATH LENGTH 3.01 km

XMTR. ELEV.
1638 M



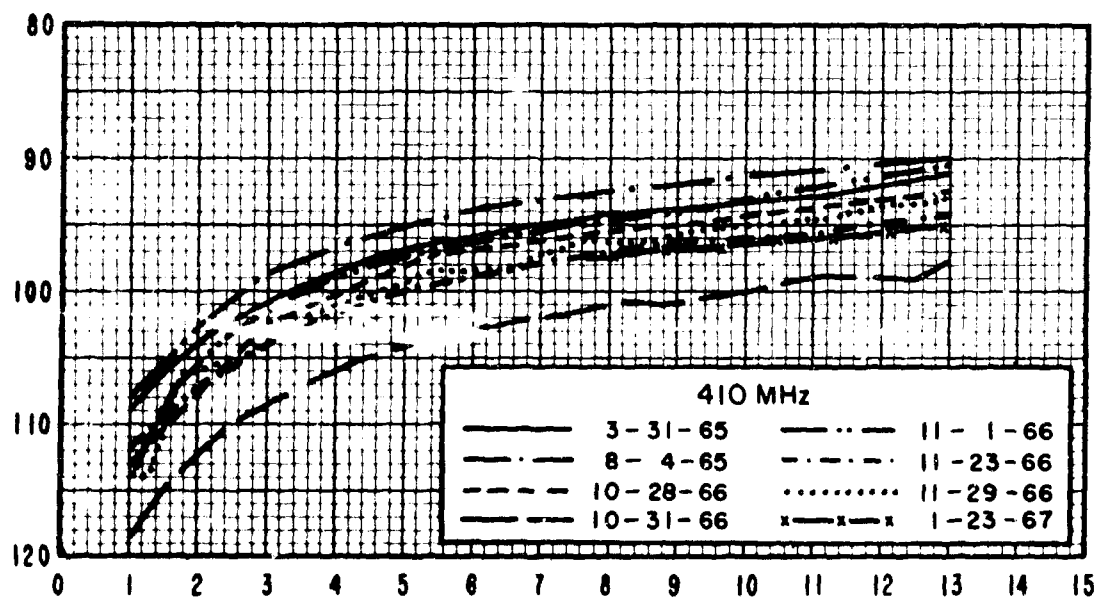
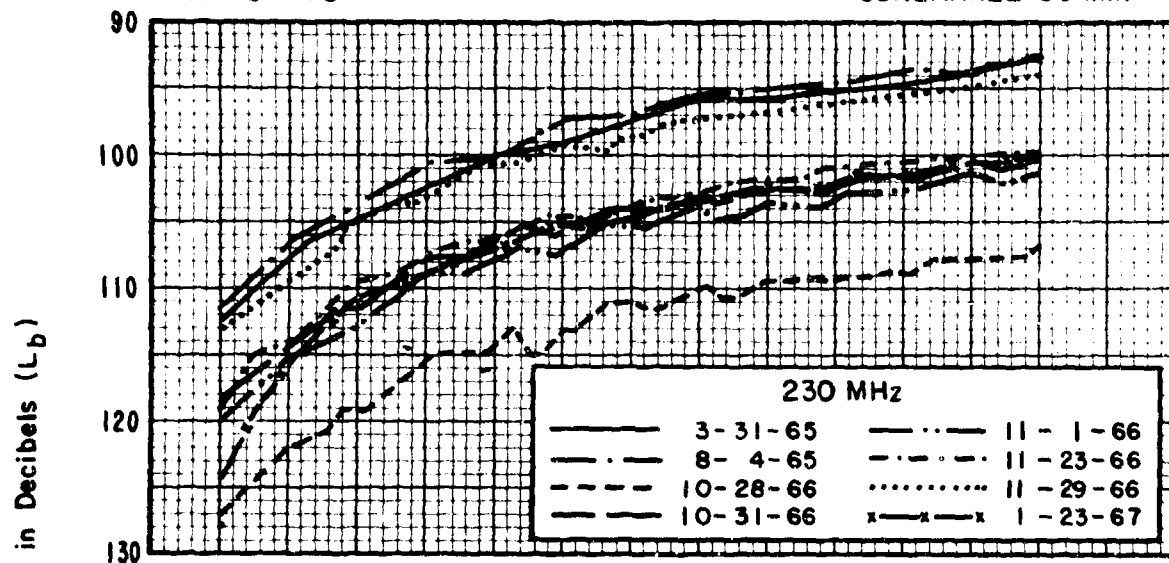
L_p (dB) SHORT TERM SIGNAL VARIABILITY

Freq (MHz)	230	410	751	910	1846	4595	9190
	11-1-66 at 6.6 M				3-15-67 at 7.3 M		
50%	105.0	95.7	97.3	99.0	113.1	122.1	116.8
$\Delta 10\%-90\%$	< 3	< 3	< 3	< 3	< 3	< 3	< 3

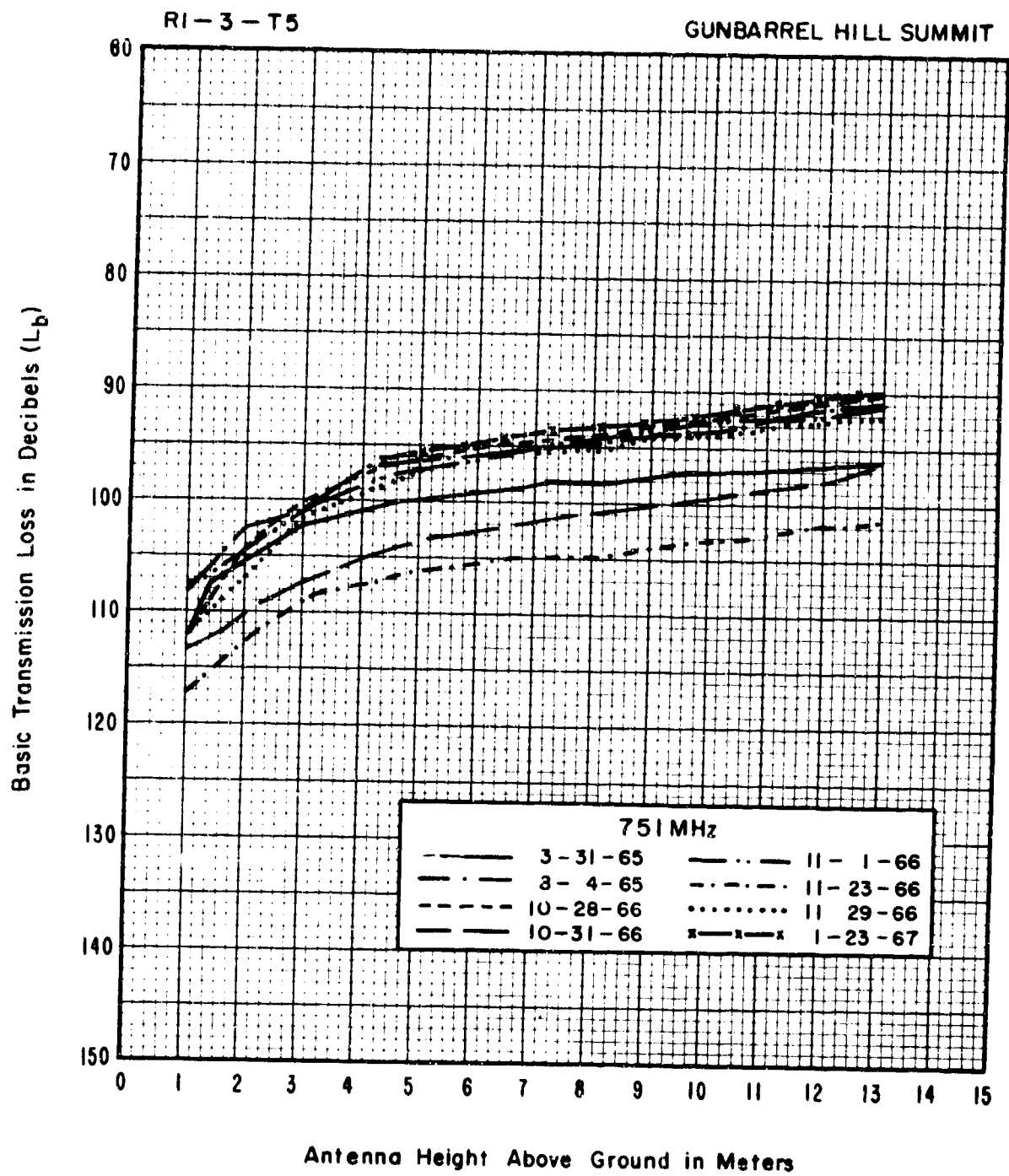
Power lines run approximately 4 ft above and 25 ft in front of the antennas. The terrain slopes steeply downward for about 1500 ft, then upward to a small knoll, continuing downward to the receiver site. The entire path is over alternating strips of wheat stubble and plowed ground. Approximately 1-1/2 mi away is a dirt road with telephone lines paralleling it and crossing the path at 80° .

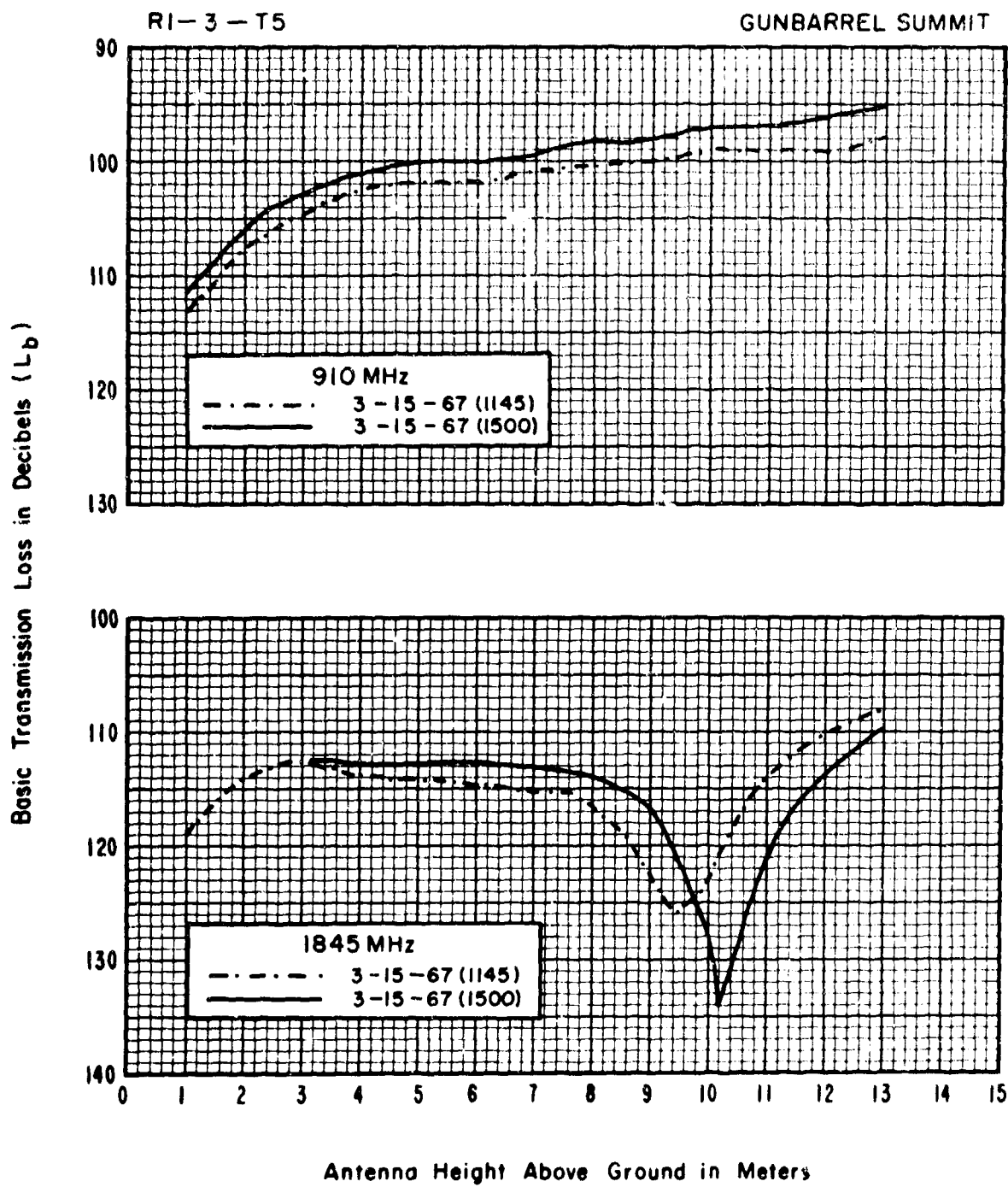
RI-3-T5

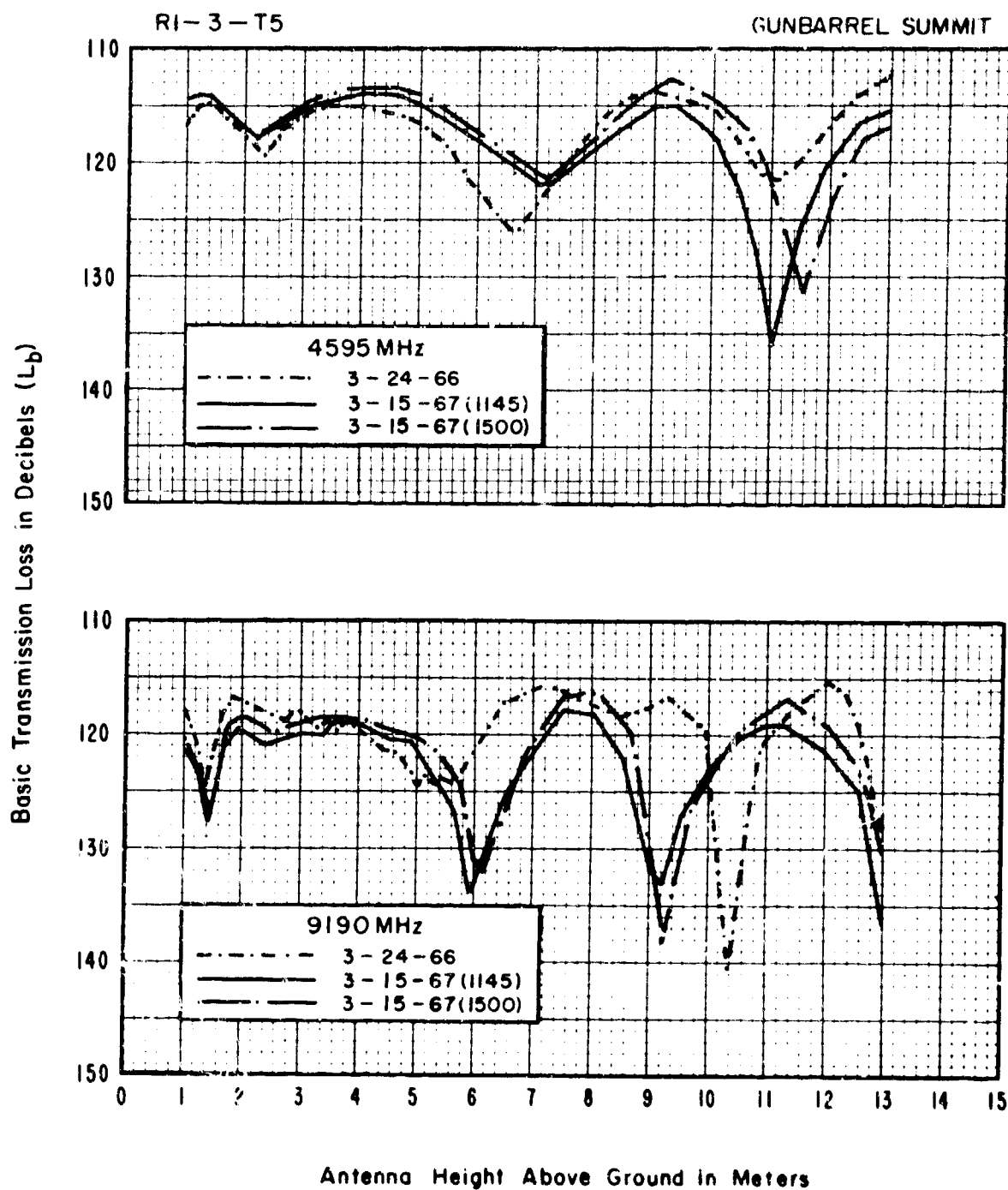
GUNBARREL SUMMIT



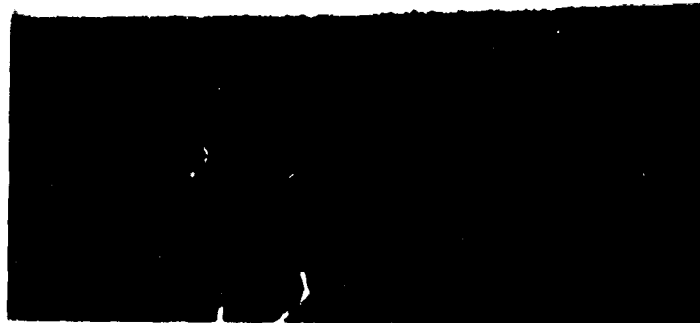
Antenna Height Above Ground in Meters







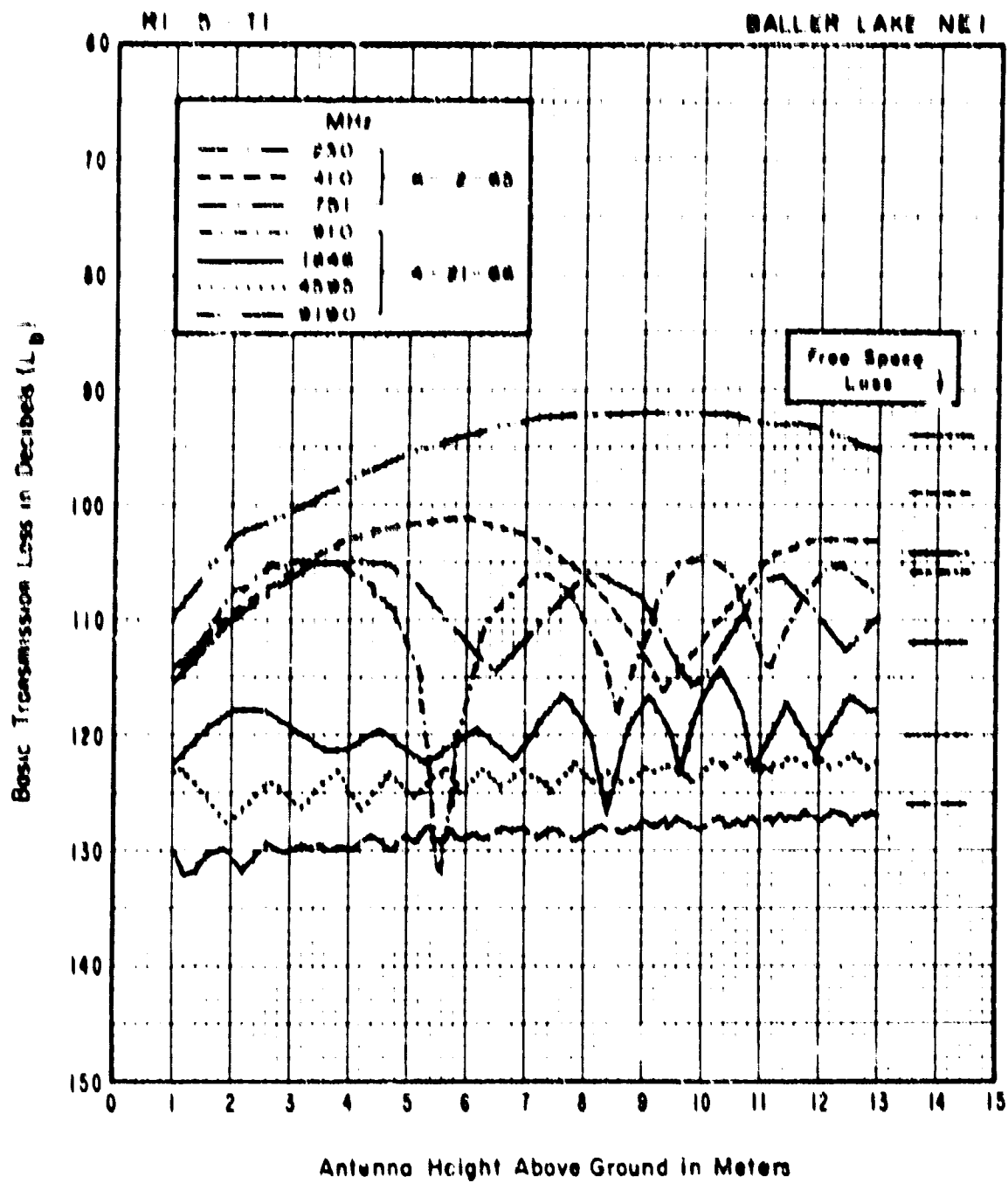
RI-5 F1
WALLER LAKE NET



PATH VIEW FROM RECEIVER



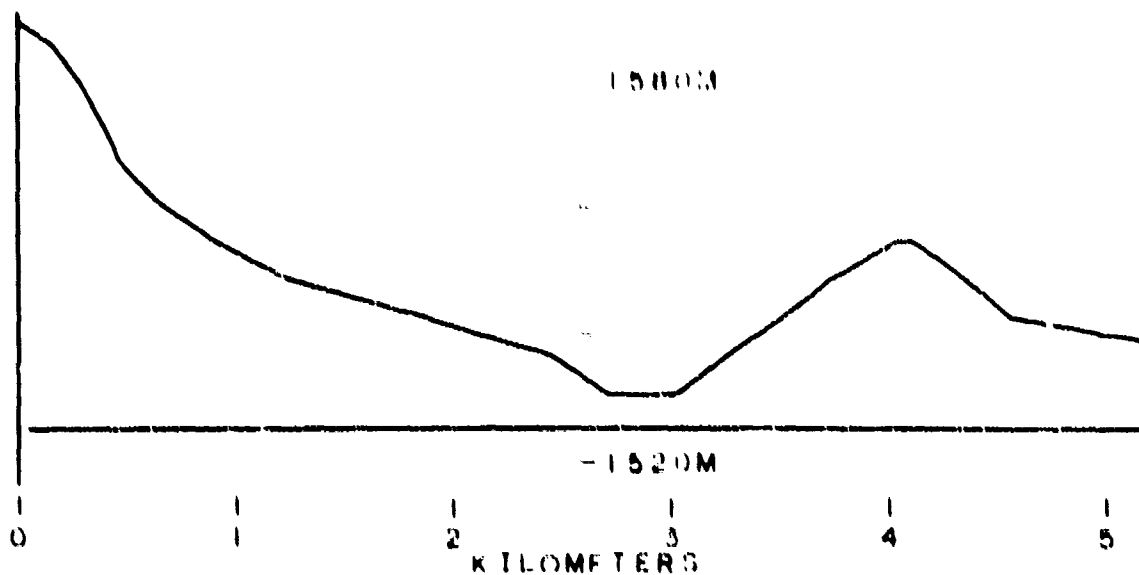
PATH VIEW FROM TRANSMITTER



RCVR. ELEV.
1589 M

RI-S-TI
PATH LENGTH 5.22 km

XMTR. ELEV.
1519 M



L_p (dB) SHORT TERM SIGNAL VARIABILITY

Freq (MHz)	230	410	751	910	1846	4595	9190
6-2-65 at 13 M				4-21-66 at 7.3 M			
50%	95.4	103.6	109.1	106.5	116.9	123.5	127.6
$\Delta 10\%-90\%$	< 3	< 3	< 3	< 3	< 3	< 3	< 3

The path extends across plowed ground to the horizon about 1 mi away. About 700 ft from the transmitter, running at 70° to the path, is a single phase power line. There are no other obstructions.

R1-5-T2
DALLER LAKE S1



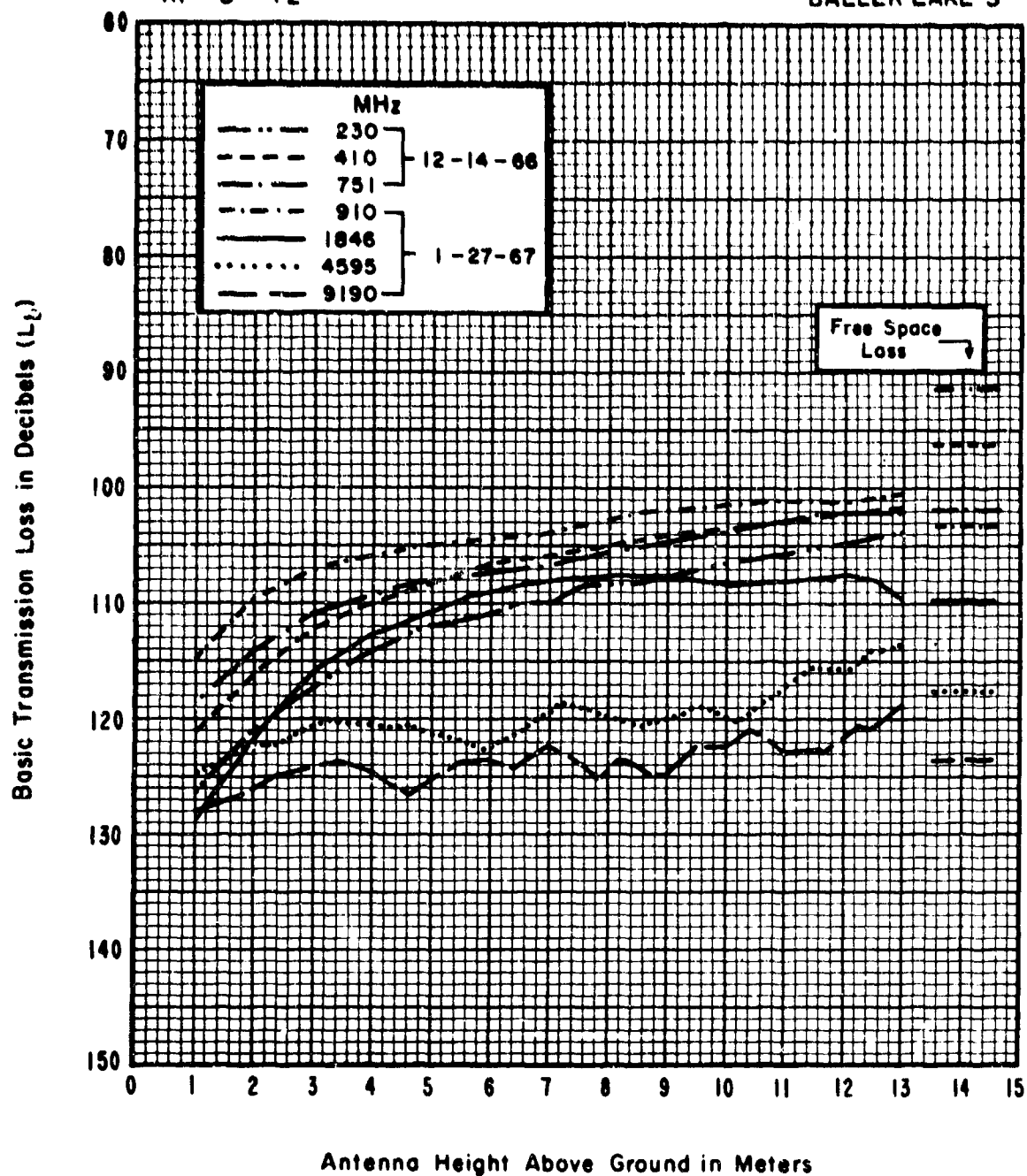
PATH VIEW FROM RECEIVER



PATH VIEW FROM TRANSMITTER

RI-5-T2

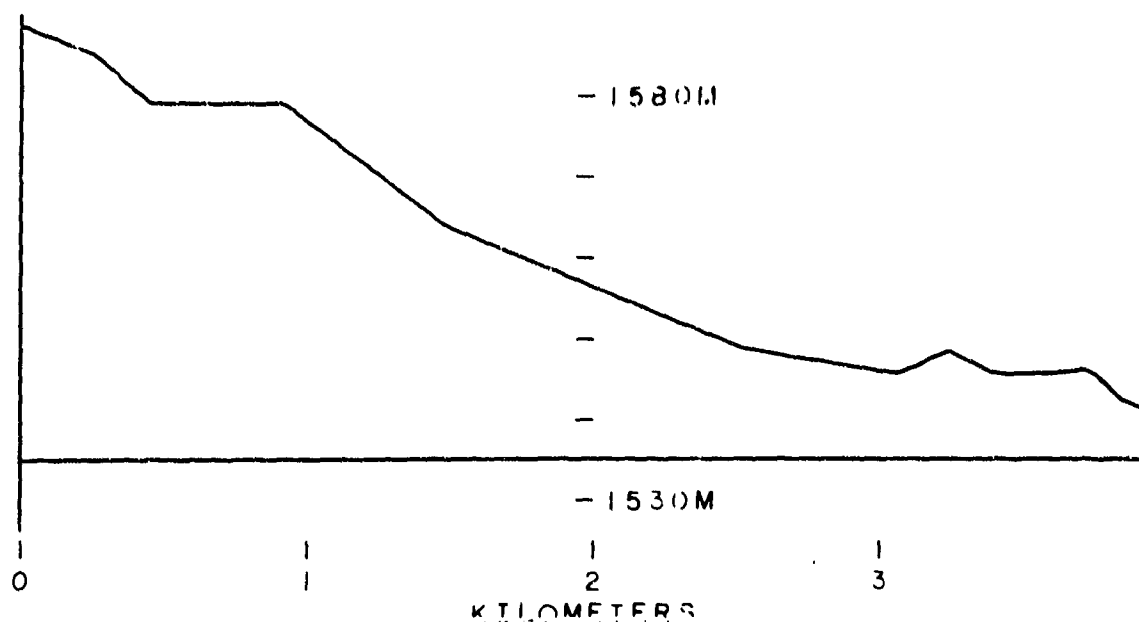
BALLER LAKE S



RCVR. ELEV.
1589 M

R1-5-T2
PATH LENGTH 3.94 km

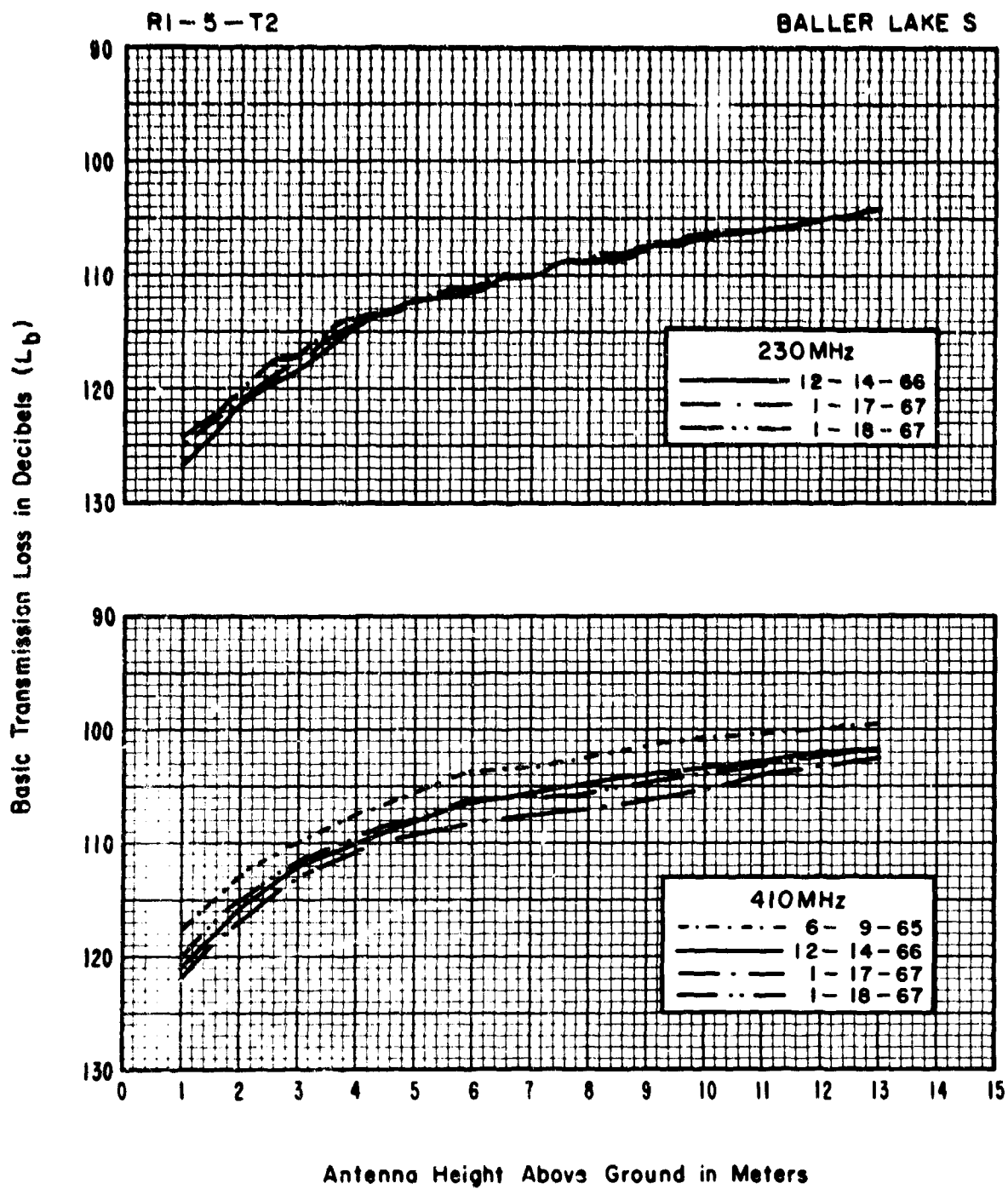
XMTR. ELEV.
1541 M



L_p (dB) SHORT TERM SIGNAL VARIABILITY

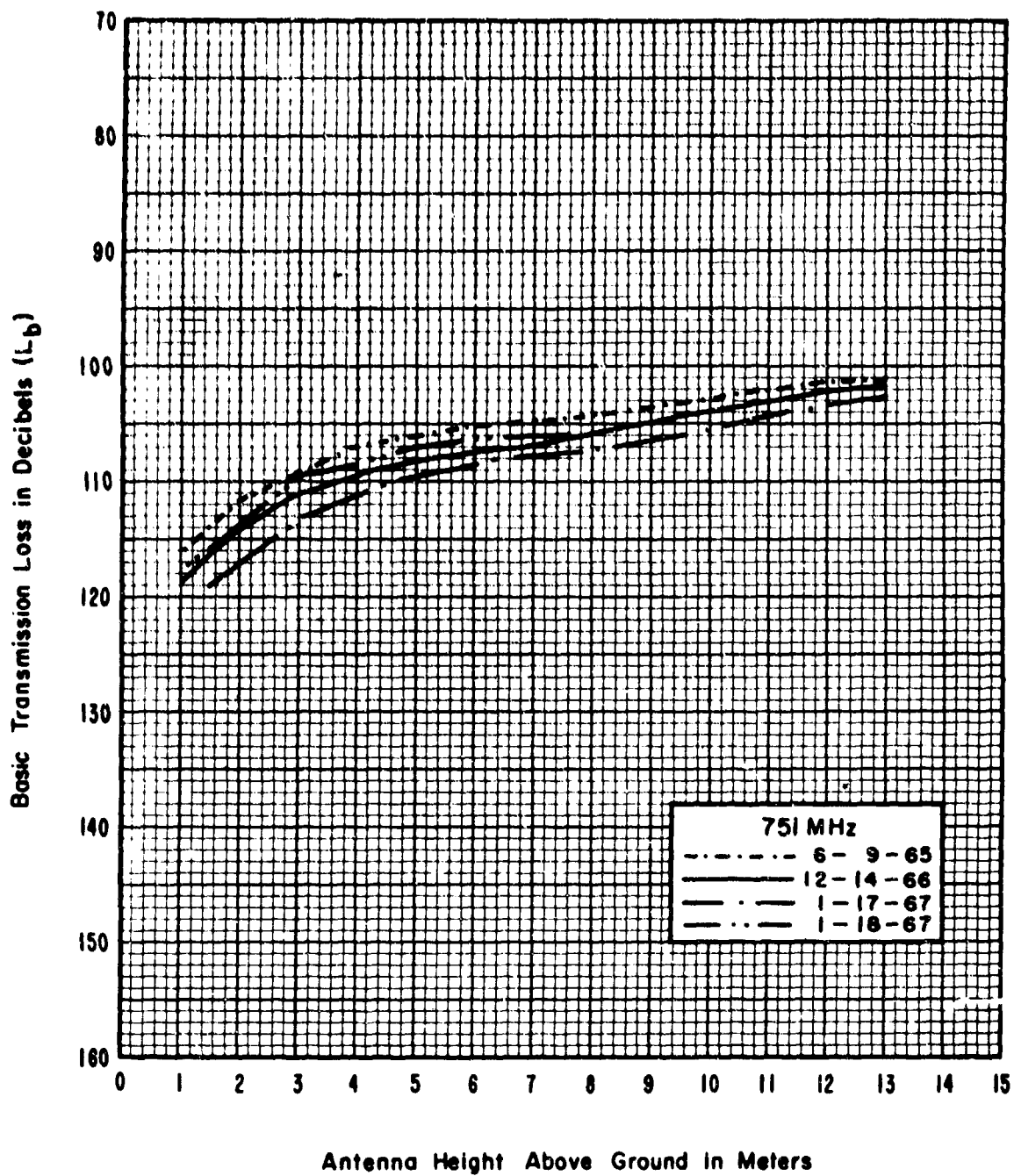
Freq (MHz)	230	410	751	910	1846	4595	9190
	12-14-66 at 13 M				1-27-67 at 7.3 M		
50%	104.1	101.7	103.8	100.9	107.8	119.1	123.5
$\Delta 10\%-90\%$	< 3	< 3	< 3	< 3	< 3	< 3	< 3

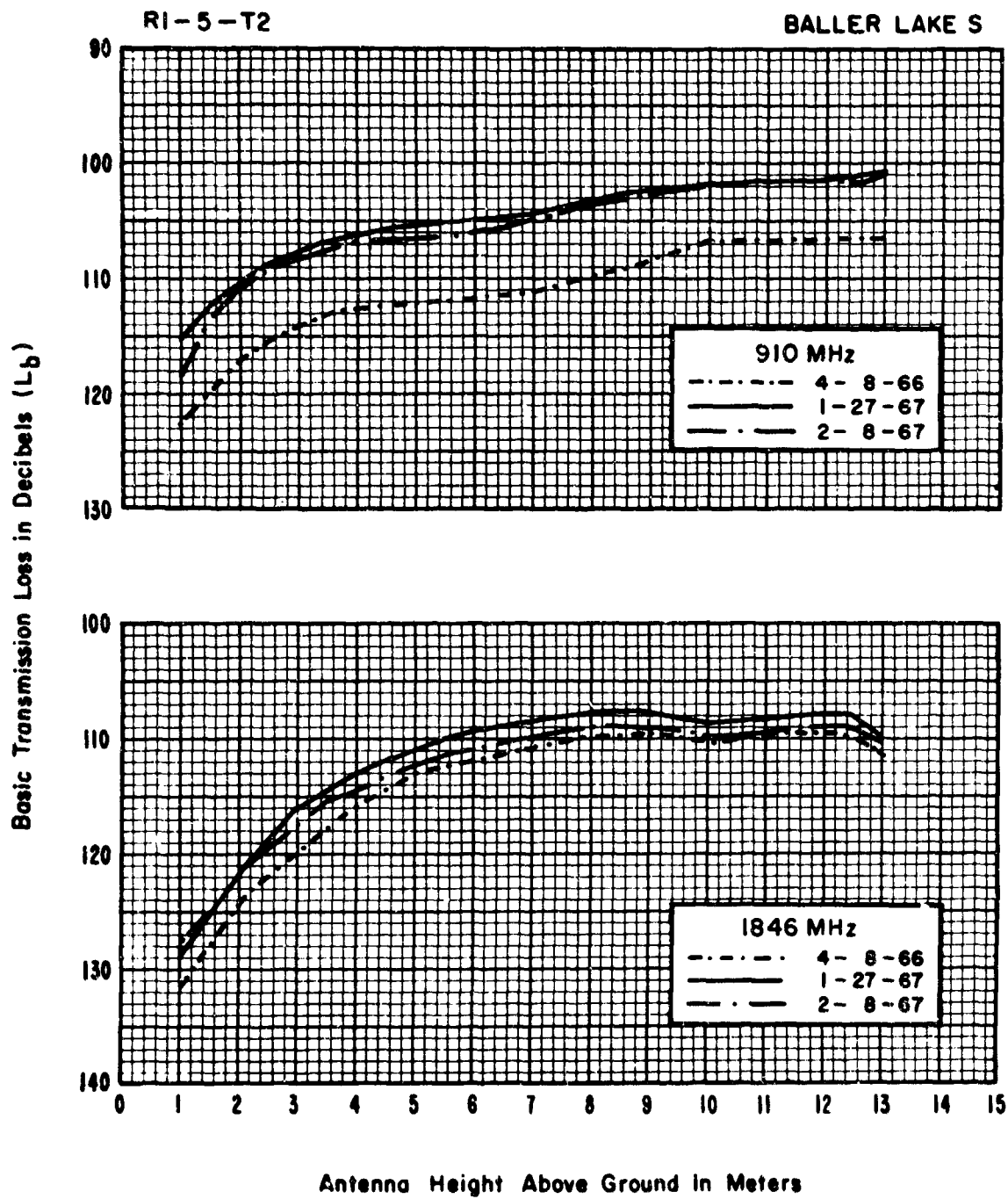
Plowed fields extend for about 1 mi from the transmitter. At a distance of 150 yd, a 3-ft wire fence crosses the path at 80° . Scattered trees about 1/4 mi away are the only obstruction.

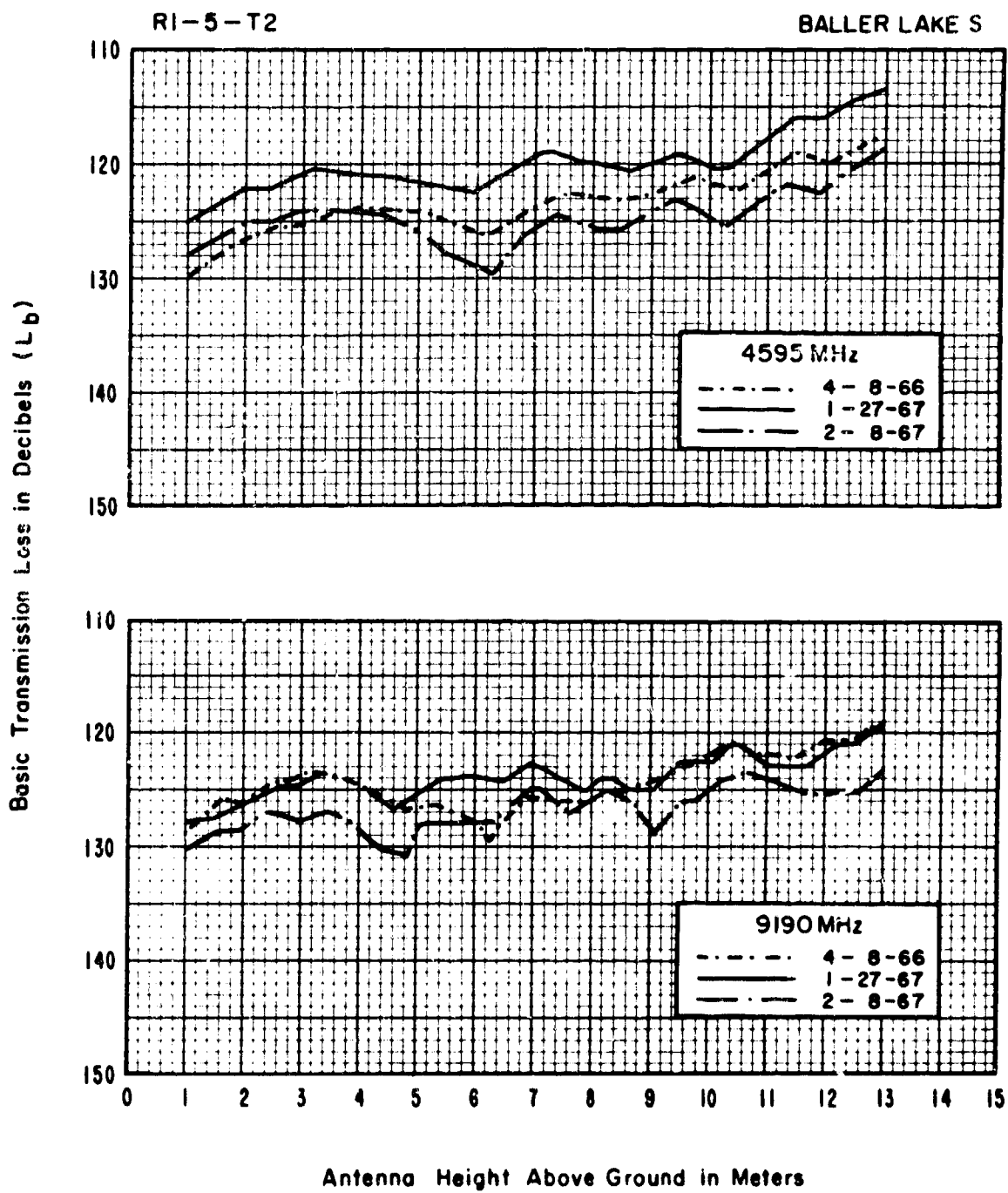


RI-5-T2

BALLER LAKE S



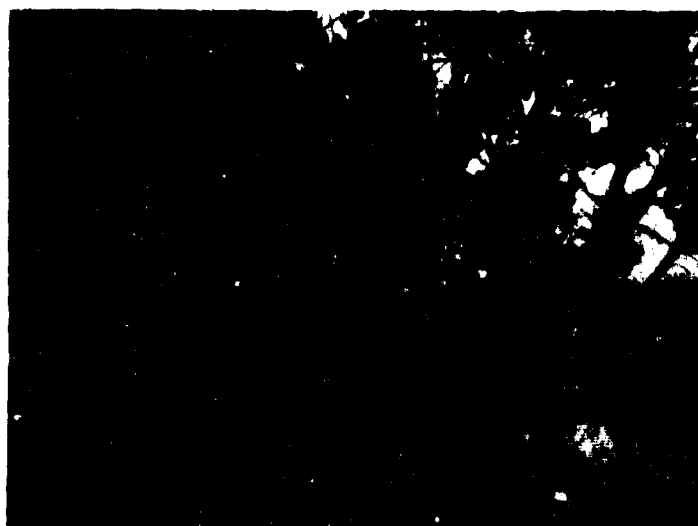




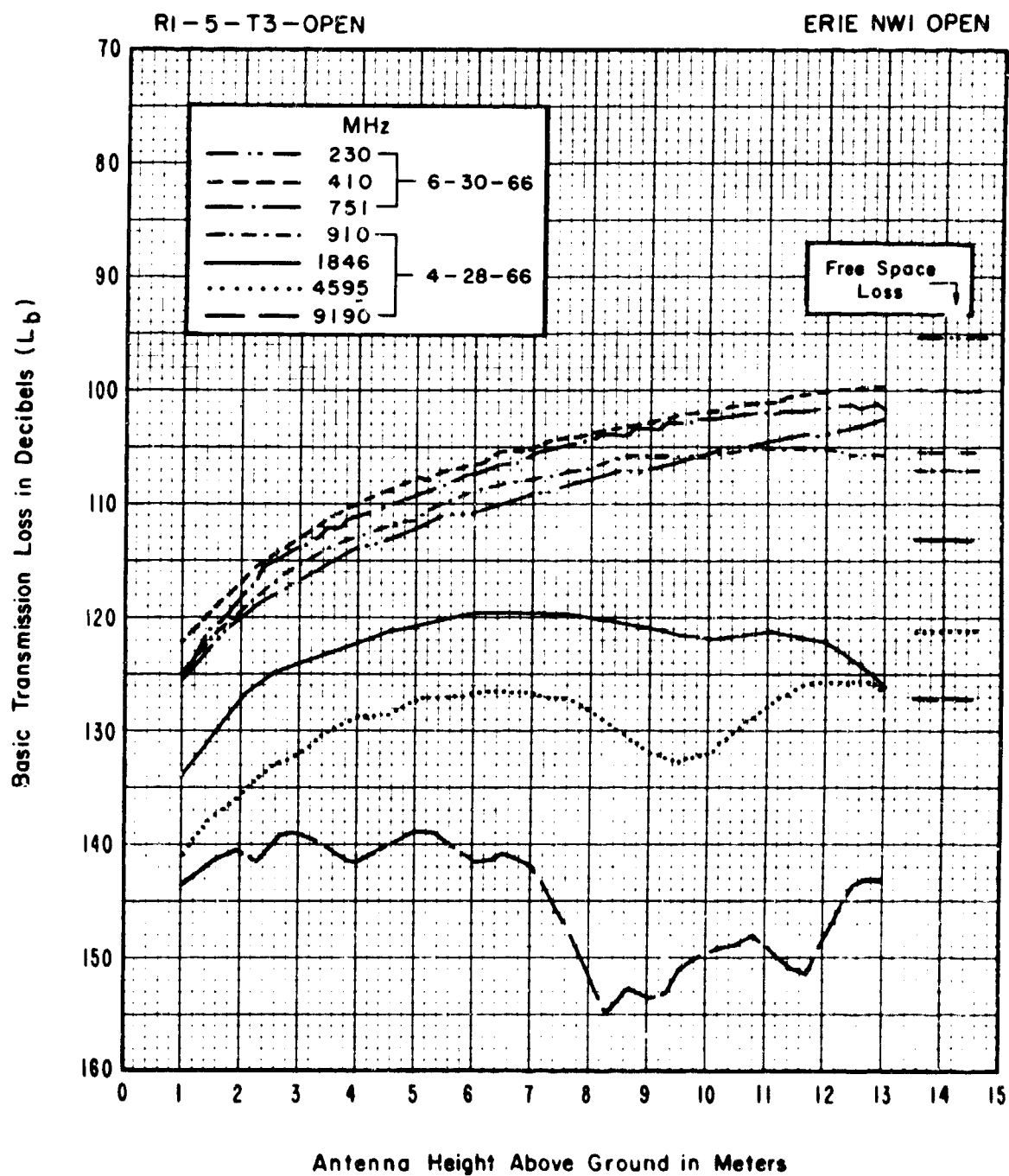
R1-5-T3 OPEN AND CONCEALED
ERIE NW1



PATH VIEW FROM OPEN SITE



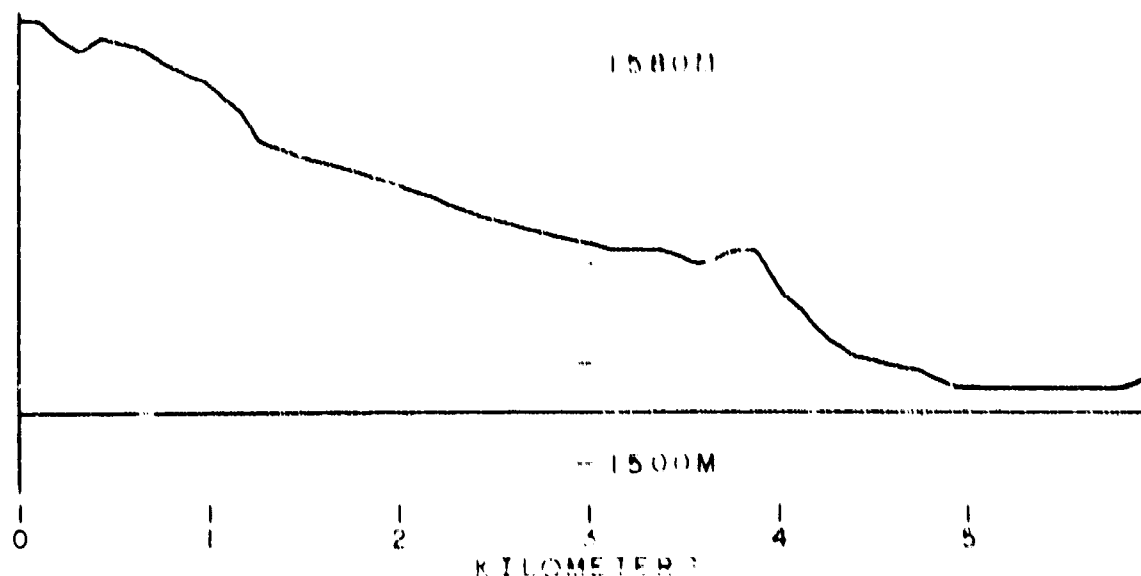
PATH VIEW FROM CONCEALED SITE



RCVR. ELEV.
1589 M

REFLECTOR OPEN
PATH LENGTH 5.96 km

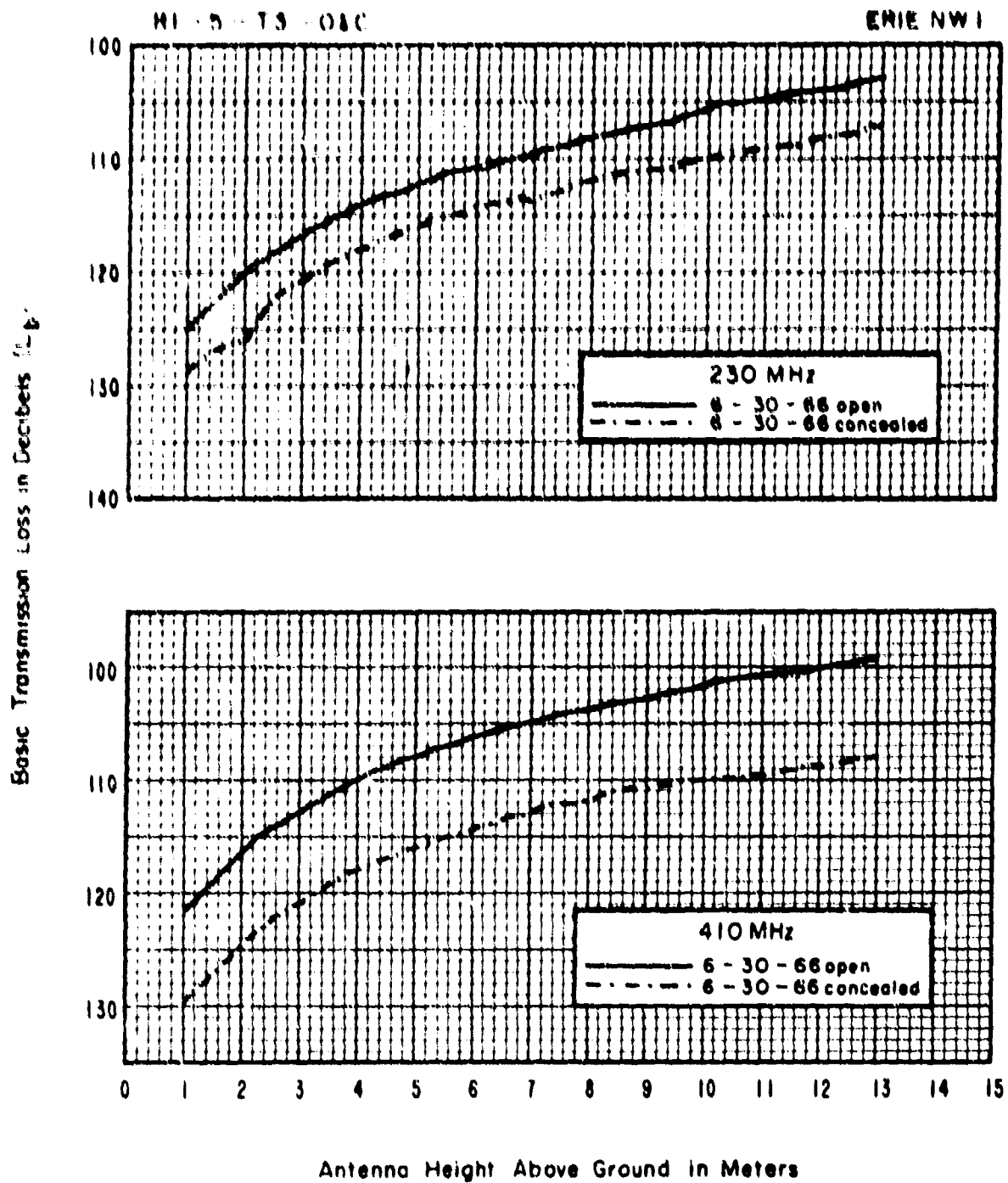
XMTR. ELEV.
1517 M



L_b (dB) SHORT TERM SIGNAL VARIABILITY

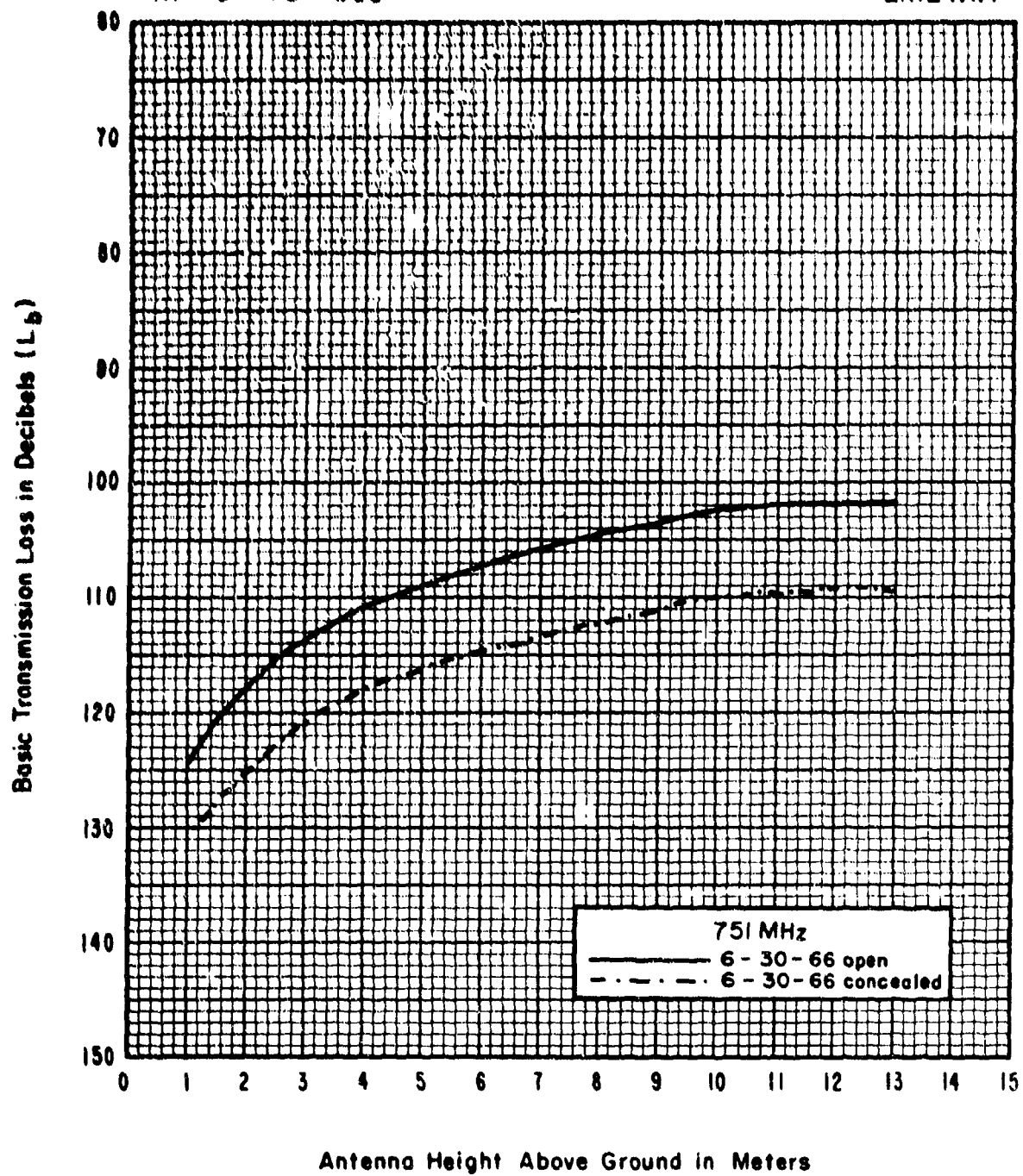
Freq (MHz)	230	410	751	910	1846	4595	9190
6-30-66 at 13 M				4-28-66 at 7.3 M			
50%	103.2	100.0	100.9	107.3	118.6	126.4	145.6
$\Delta 10\%-90\%$	<3	<3	<3	<3	<3	<3	<3

The transmitter site lies 143 ft west of its concealed companion site. The terrain is open grass land. There are no obstructions except a fence, about 200 ft away, which runs perpendicular to the path. About 1/2 mi away, scattered cottonwood trees lie to both the left and right of the path.



RI-5-TS-O&C

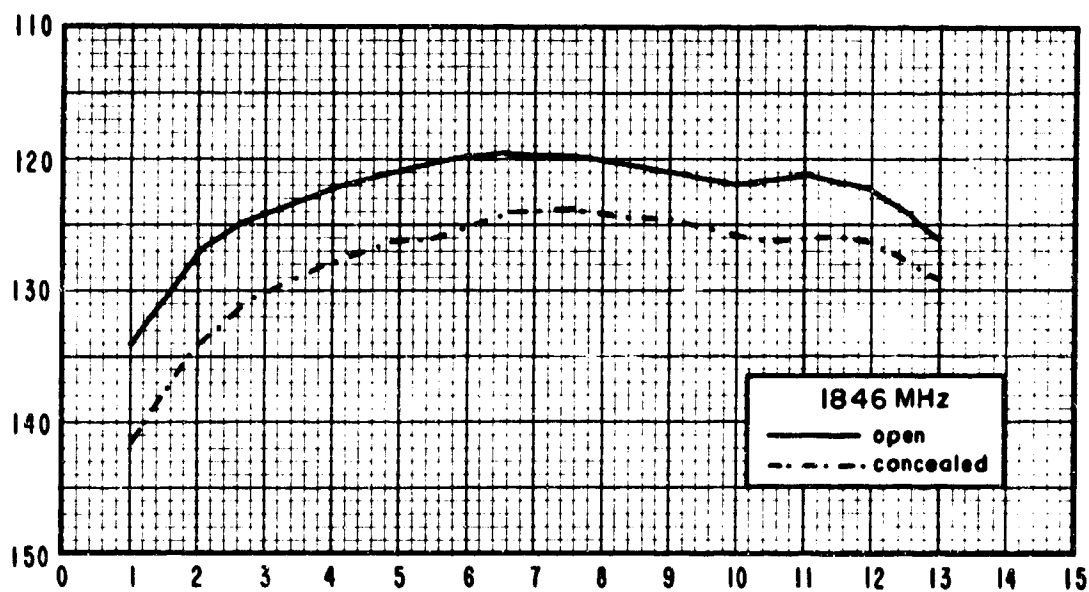
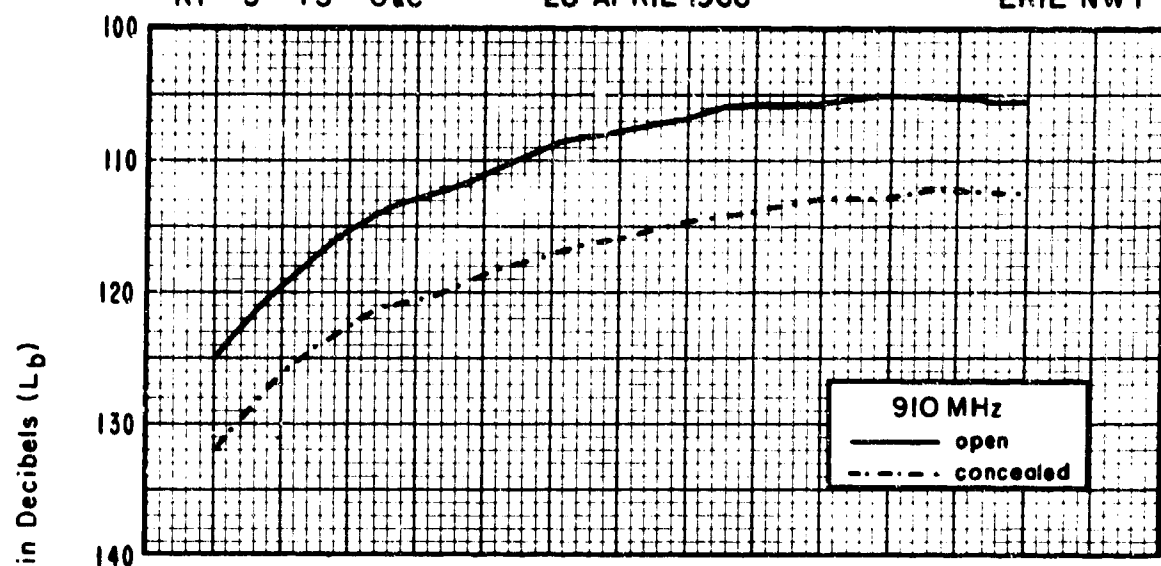
ERIE NW1



RI-5-T3-01C

28 APRIL 1966

ERIE NW I

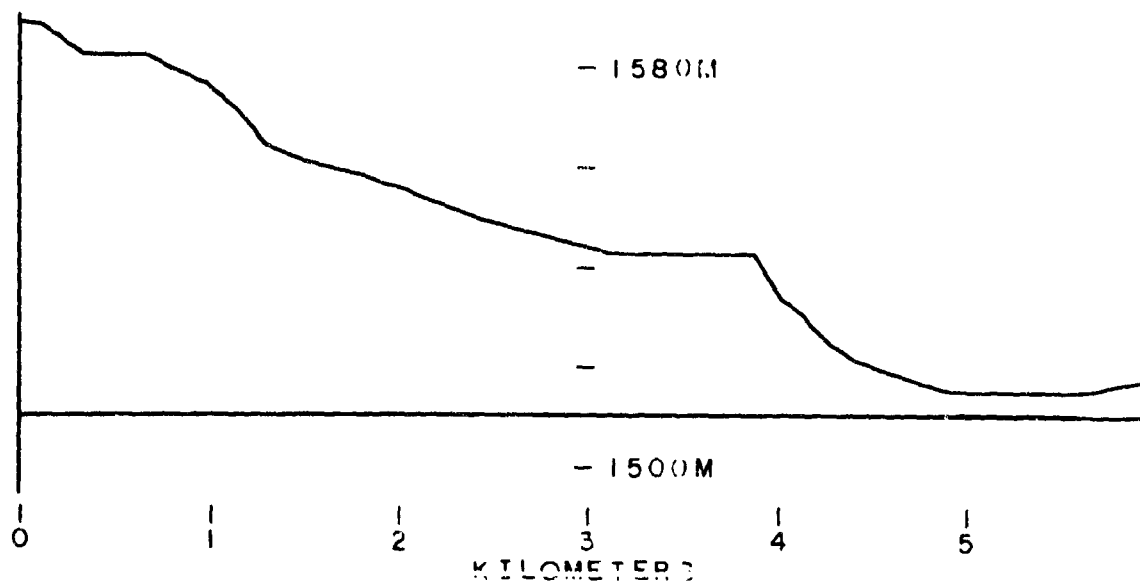


Antenna Height Above Ground in Meters

RCVR. ELEV.
1589 M

R1-5-T3 CONCEALED
PATH LENGTH 5.98 km

XMTR. ELEV.
1518 M



L_b (dB) SHORT TERM SIGNAL VARIABILITY

Freq (MHz)	230	410	751	910	1846	4595	9190
	6-30-66 at 13 M				4-28-66 at 7.3 M		
50%	107.0	109.1	108.8	115.4	123.6	125.6	135.6
$\Delta 10\%-90\%$	< 3	< 3	< 3	< 3	< 3	< 3	< 3

The antennas at this site were concealed 40 ft behind a grove of cottonwood trees. The trees are about 30 ft tall and extend for about 45 ft toward the receiver site. Beyond the trees are 1-1/2 mi of pasture, before the ground rises abruptly to the horizon.

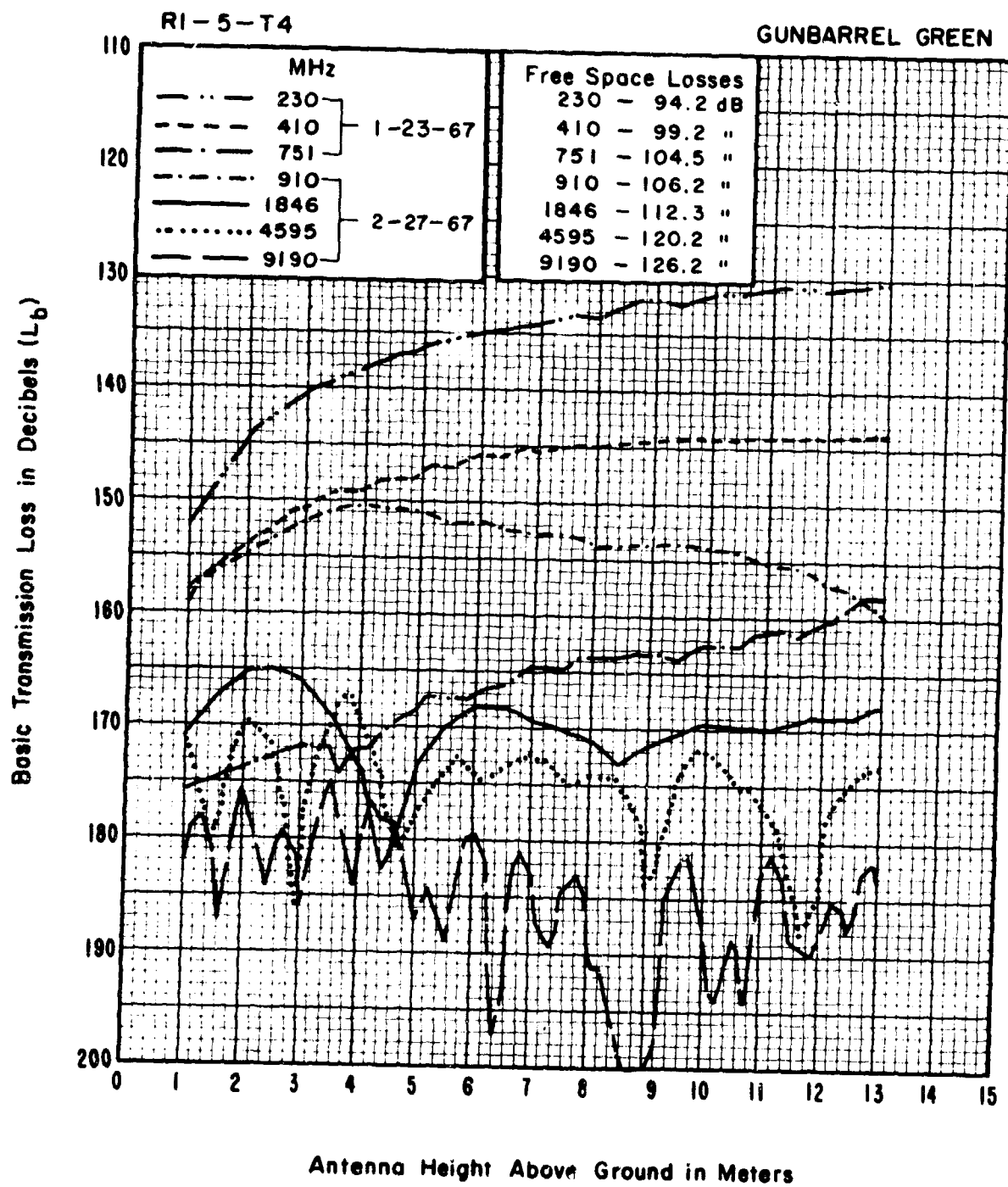
R1-5-T4
GUNBARREL GREEN



PATH VIEW FROM RECEIVER



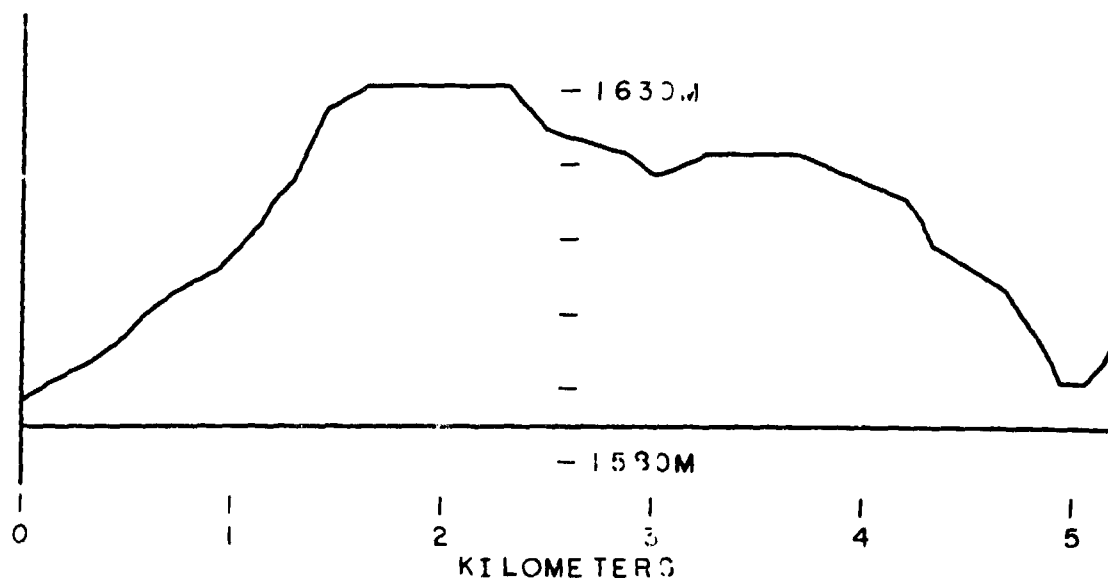
PATH VIEW FROM TRANSMITTER



RCVR. ELEV.
1589 M

R1-5-T4
PATH LENGTH 5.20 km

XMTR. ELEV.
1597 M



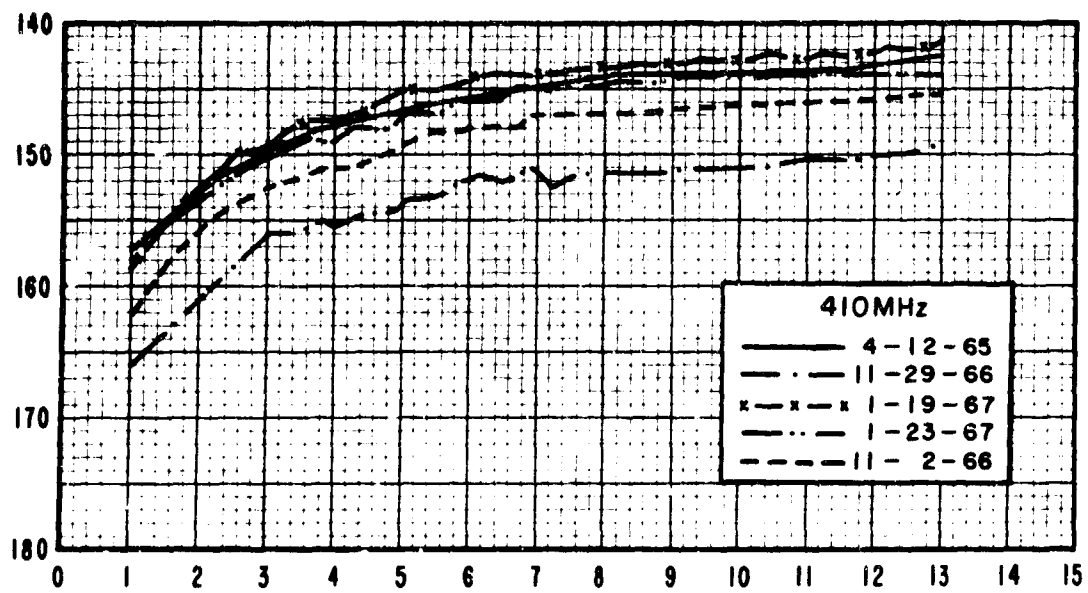
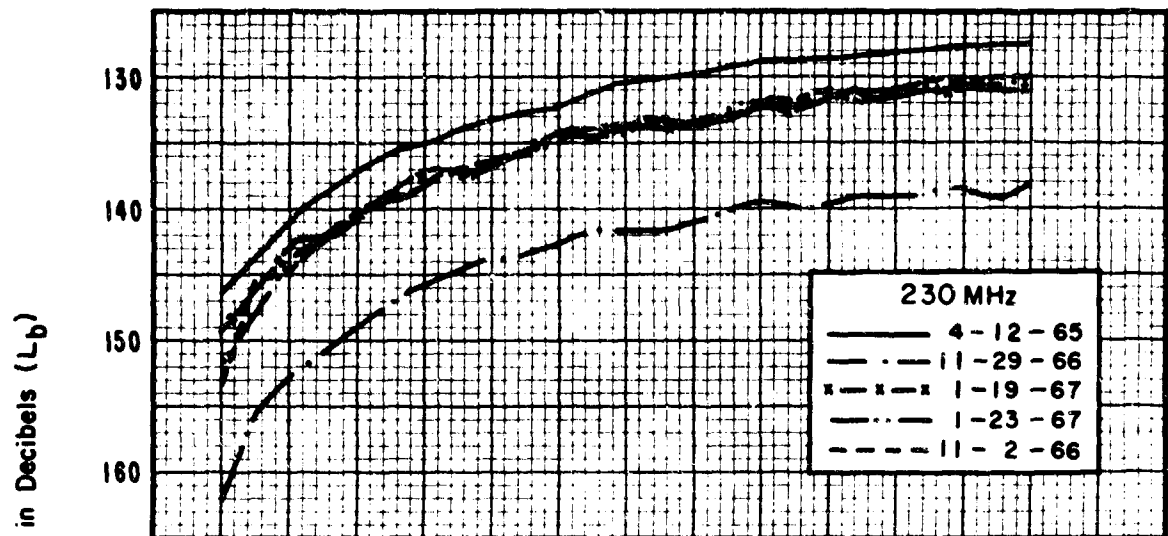
L_b (dB) SHORT TERM SIGNAL VARIABILITY

Freq (MHz)	230	410	751	910	1846	4595	9190
	1-19-67 at 13 M				2-27-67 at 7.3 M		
50%	130.4	141.8	157.9	152.8	170.3	172.6	189.2
$\Delta 10\%-90\%$	<3	<3	<3	<3	<3	<3	<3

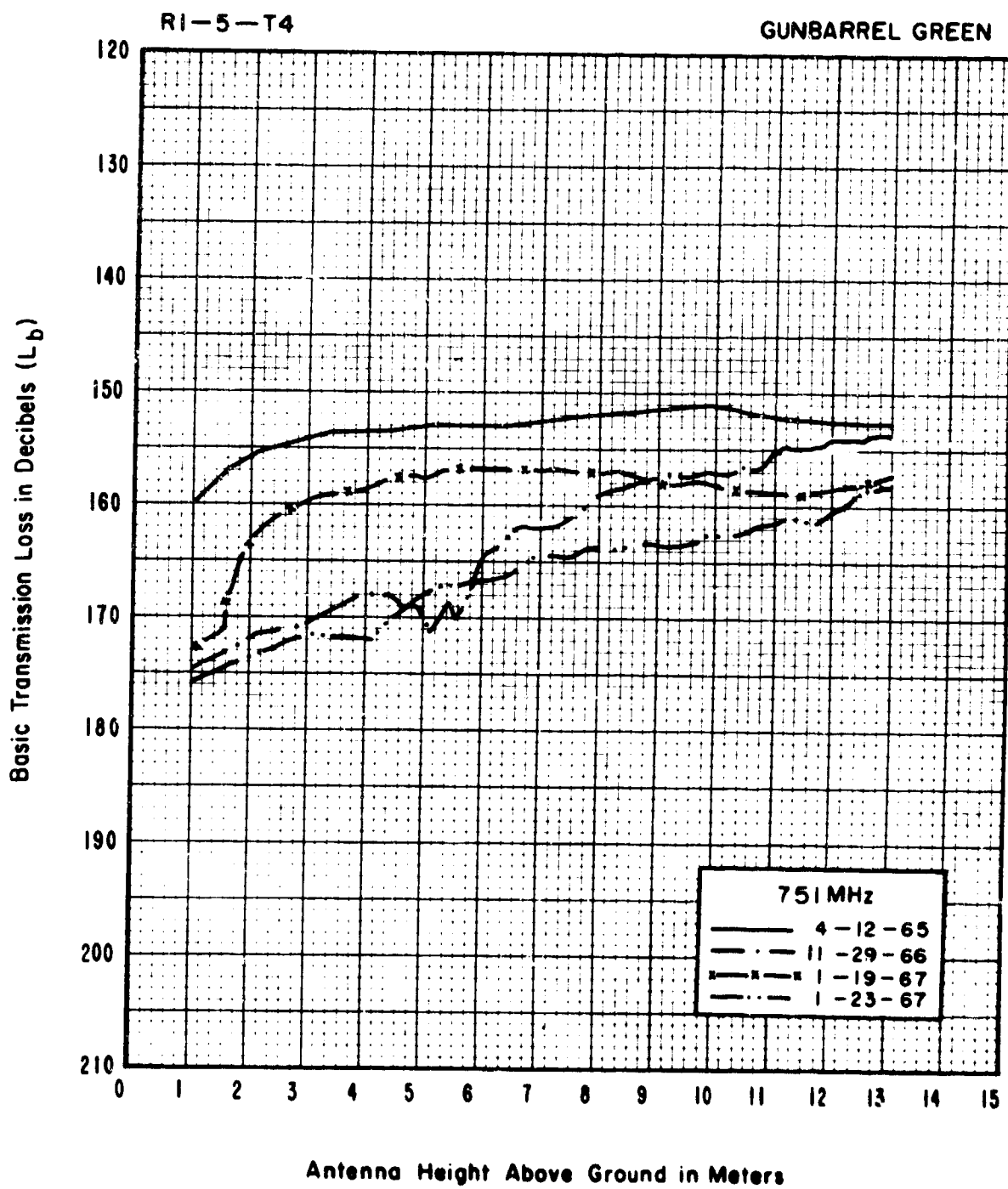
The path extends across plowed fields alternating with strips of field grass. A 5-wire, high-tension power line crosses the path 150 yds away perpendicular to it.

RI-5-T4

GUNBARREL GREEN



Antenna Height Above Ground in Meters



R1-5-T5
NIWOT W1



PATH VIEW FROM RECEIVER

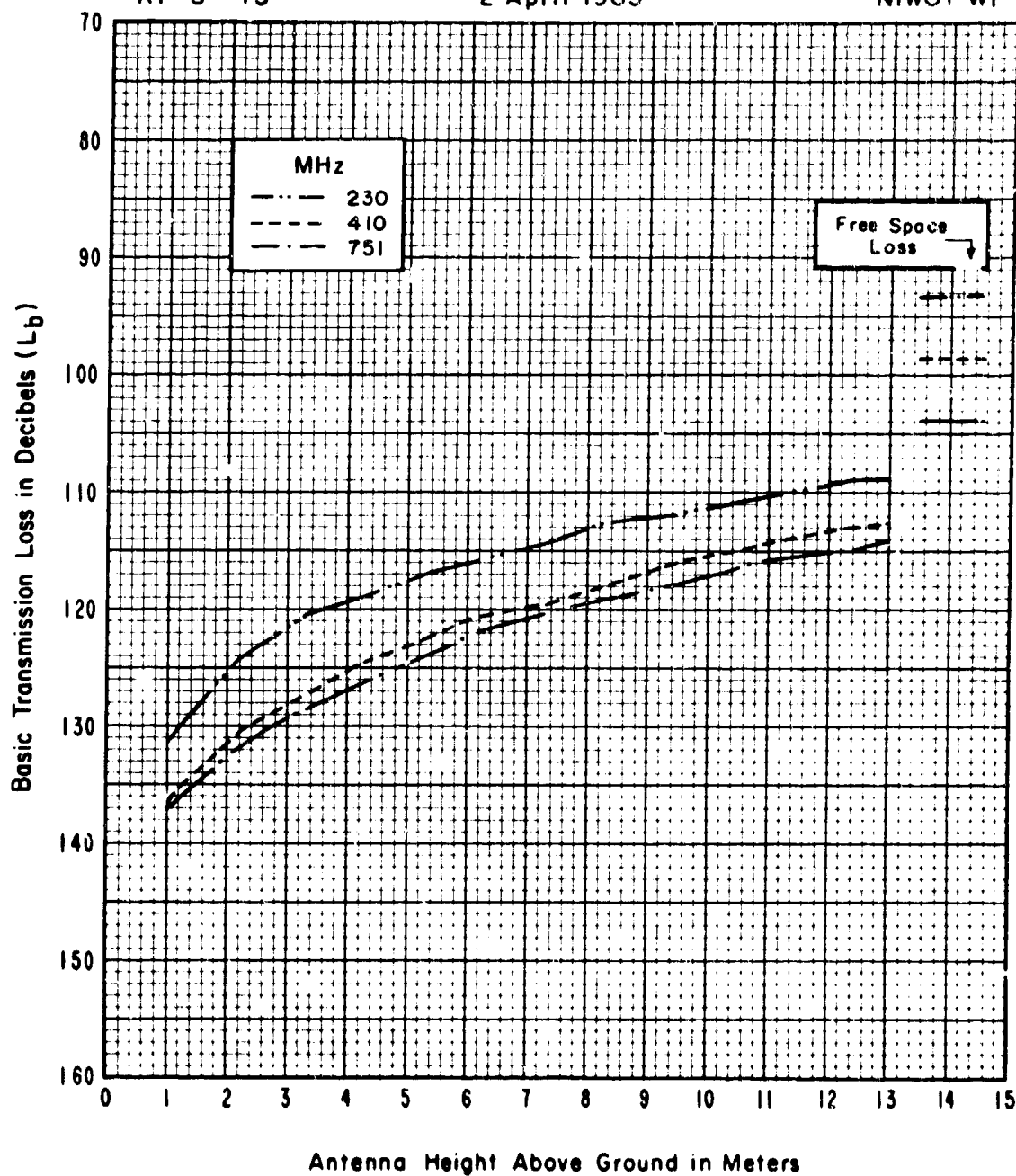


PATH VIEW FROM TRANSMITTER

RI-5-T5

2 April 1965

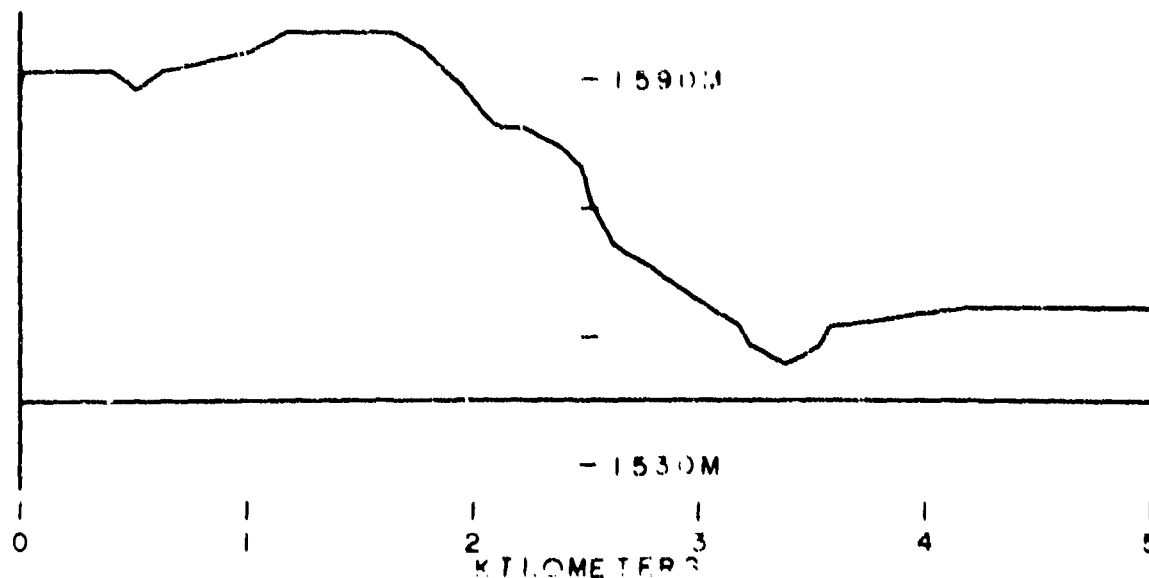
NIWOT WI



RCVR. ELEV.
1589 M

RI-5-T5
PATH LENGTH 5.02 km

XMTR. ELEV.
1554 M

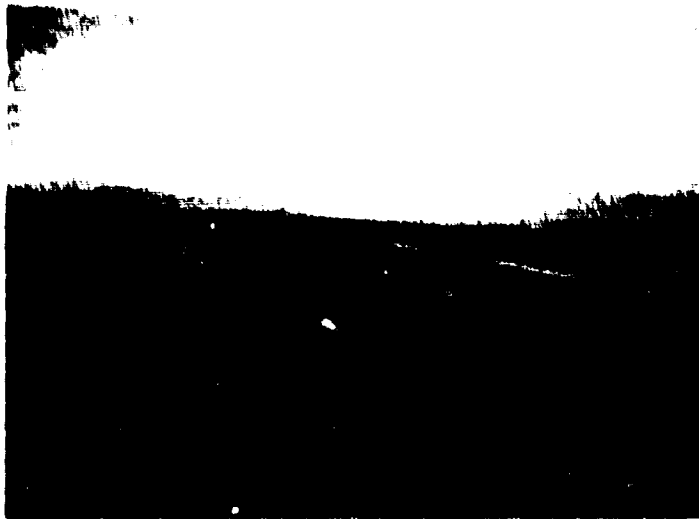


L_p (dB) SHORT TERM SIGNAL VARIABILITY

Freq (MHz)	230	410	751	910	1846	4595	9190
4-2-65 at 13 M							
50%	109.6	113.4	115.8				
$\Delta 10\%-90\%$	< 3	< 3	< 3				

The immediate foreground at this site is a dirt road running perpendicular to the path. Just beyond is a farm complex. The path crosses a 50-yd wide barnyard, surrounded by a low, wooden rail fence and containing wooden feeding troughs. Beyond is a small shed with a tin roof, about 75 yd away, and plowed fields and areas of field grass, which extend to the horizon about 2 mi away.

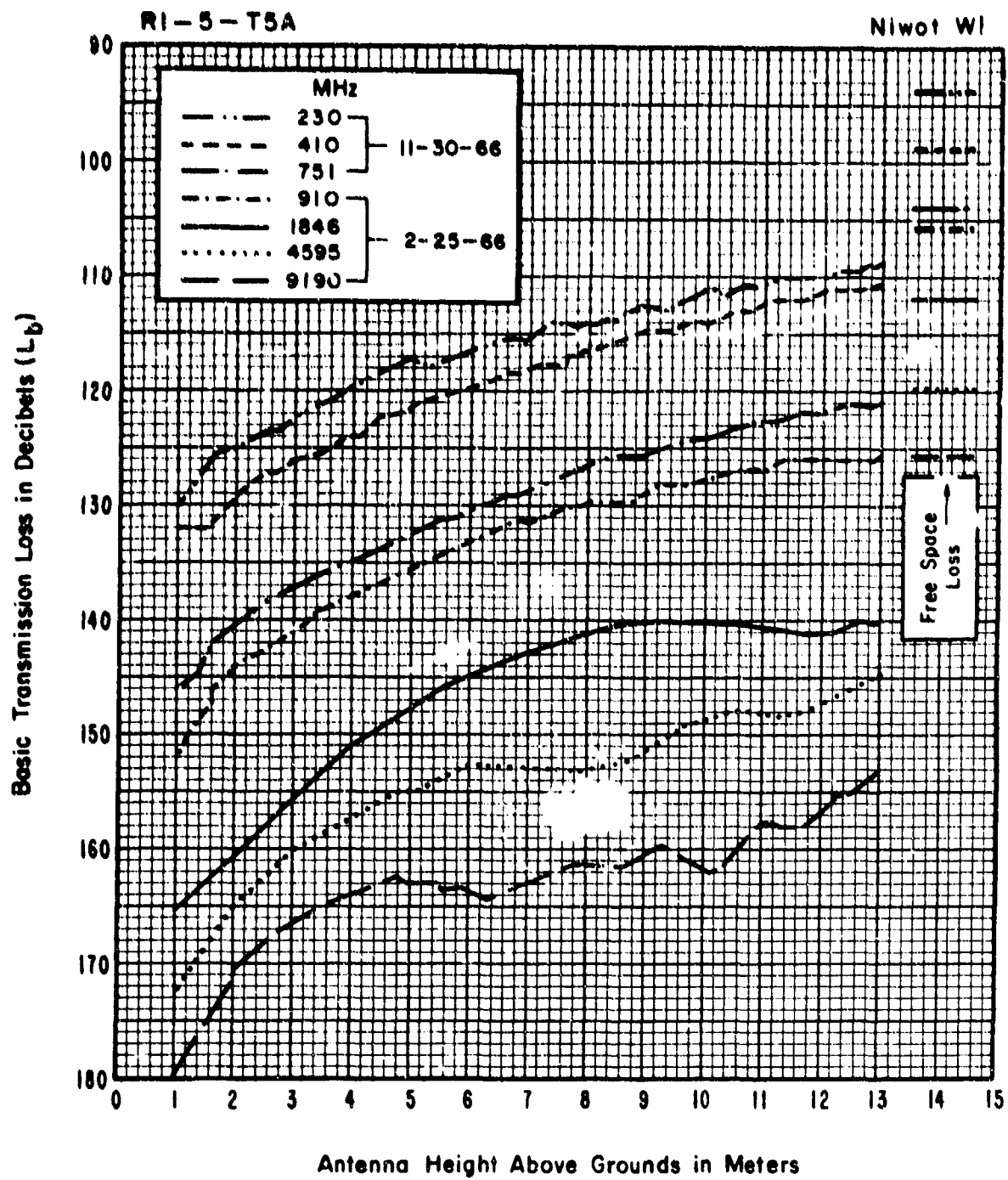
RI-5-TGA
NIWOT WI



PATH VIEW FROM RECEIVER



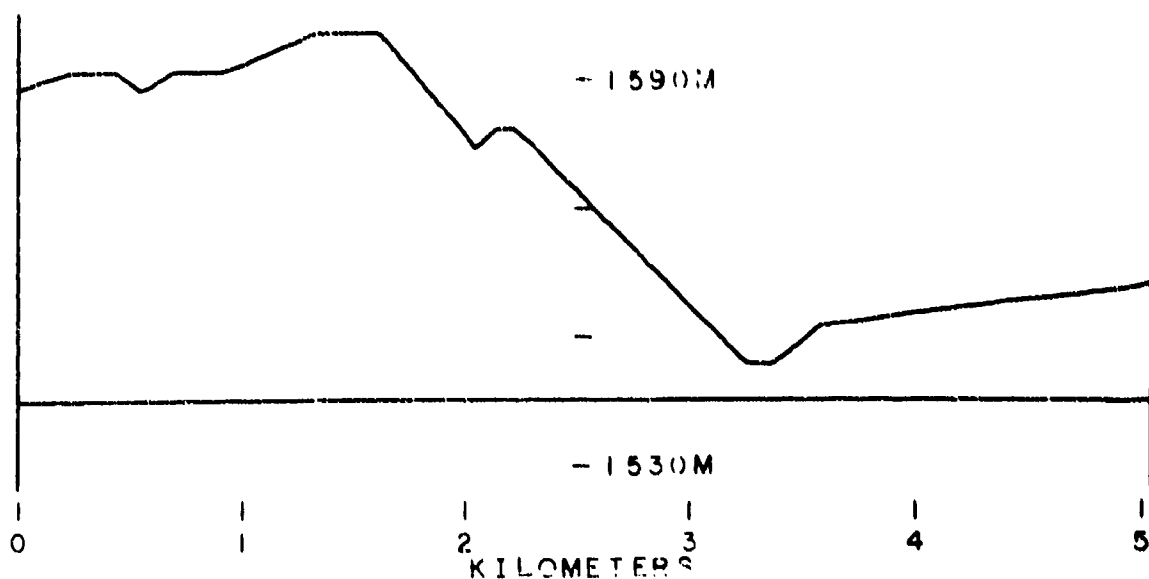
PATH VIEW FROM TRANSMITTER



RCVR. ELEV.
1589 M

RI-5-T5A
PATH LENGTH 5.04 km

XMTR. ELEV.
1558 M



L_b (dB) SHORT TERM SIGNAL VARIABILITY							
Freq (MHz)	230	410	751	910	1846	4595	9190
11-30-66 at 6.6 M				2-25-66 at 7.3 M			
50%	115.0	118.1	128.5	132.0	141.9	152.2	161.9
$\Delta 10\%-90\%$	< 3	< 3	< 3	< 3	< 3	< 3	< 3

There is a 3-ft high barbed-wire fence perpendicular to the path about 25 ft from the transmitter van. Beyond the fence are 100 yd of plowed fields and a farmyard containing some tin-roofed sheds; a concrete silo lies to the immediate right of the path. The path is directly over a large cottonwood tree, 40-ft high, which obscures the horizon. The rest of the terrain is rolling, grass-covered hills. The horizon is 2 mi away.

R1-5-T6
NIWOT NI



PATH VIEW FROM RECEIVER

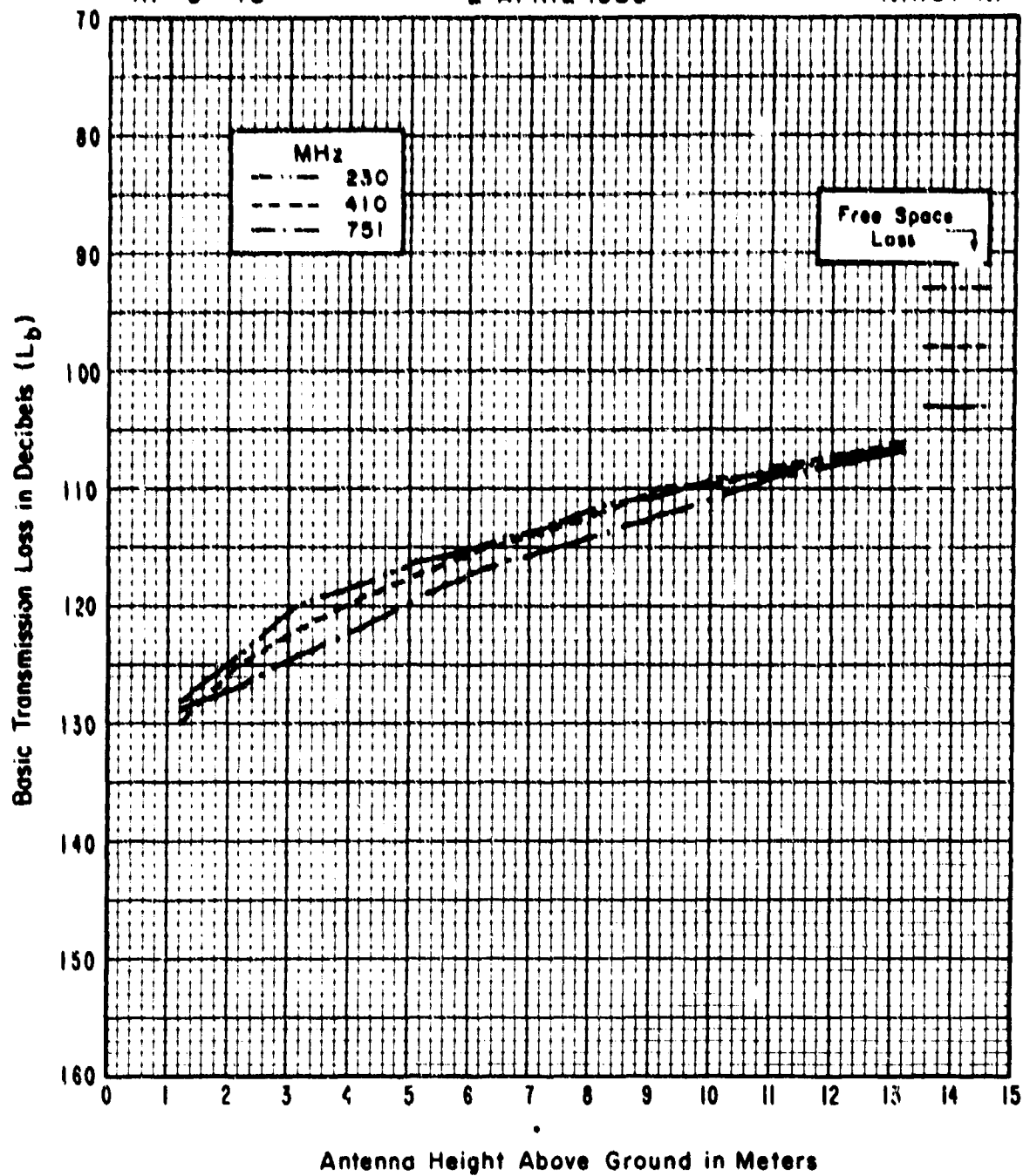


PATH VIEW FROM TRANSMITTER

RI-5-T6

2 APRIL 1965

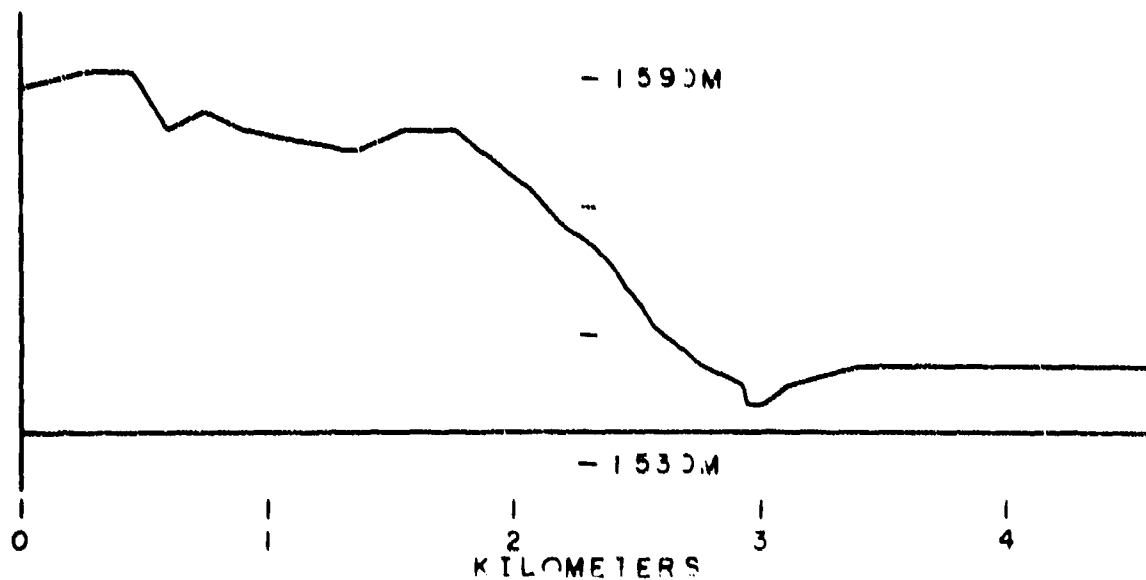
NIWOT NI



RCVR. ELEV.
1589 M

RI-5-T6
PATH LENGTH 4.60 km

XMTR. ELEV.
1545 M



L_b (dB) SHORT TERM SIGNAL VARIABILITY

Freq (MHz)	230	410	751	910	1846	4595	9190
4-2-65 at 13 M							
50%	106.8	106.9	107.9				
$\Delta 10\%-90\%$	< 3	< 3	< 3				

The path extends across 1/4 mi of hay field, with a 15-ft hay-stack 150 yd from the transmitter. A 3-ft high, barbed-wire fence runs perpendicular to the path at about 150 ft. The path terrain slopes gently upwards to the horizon, which is about 2 mi away.

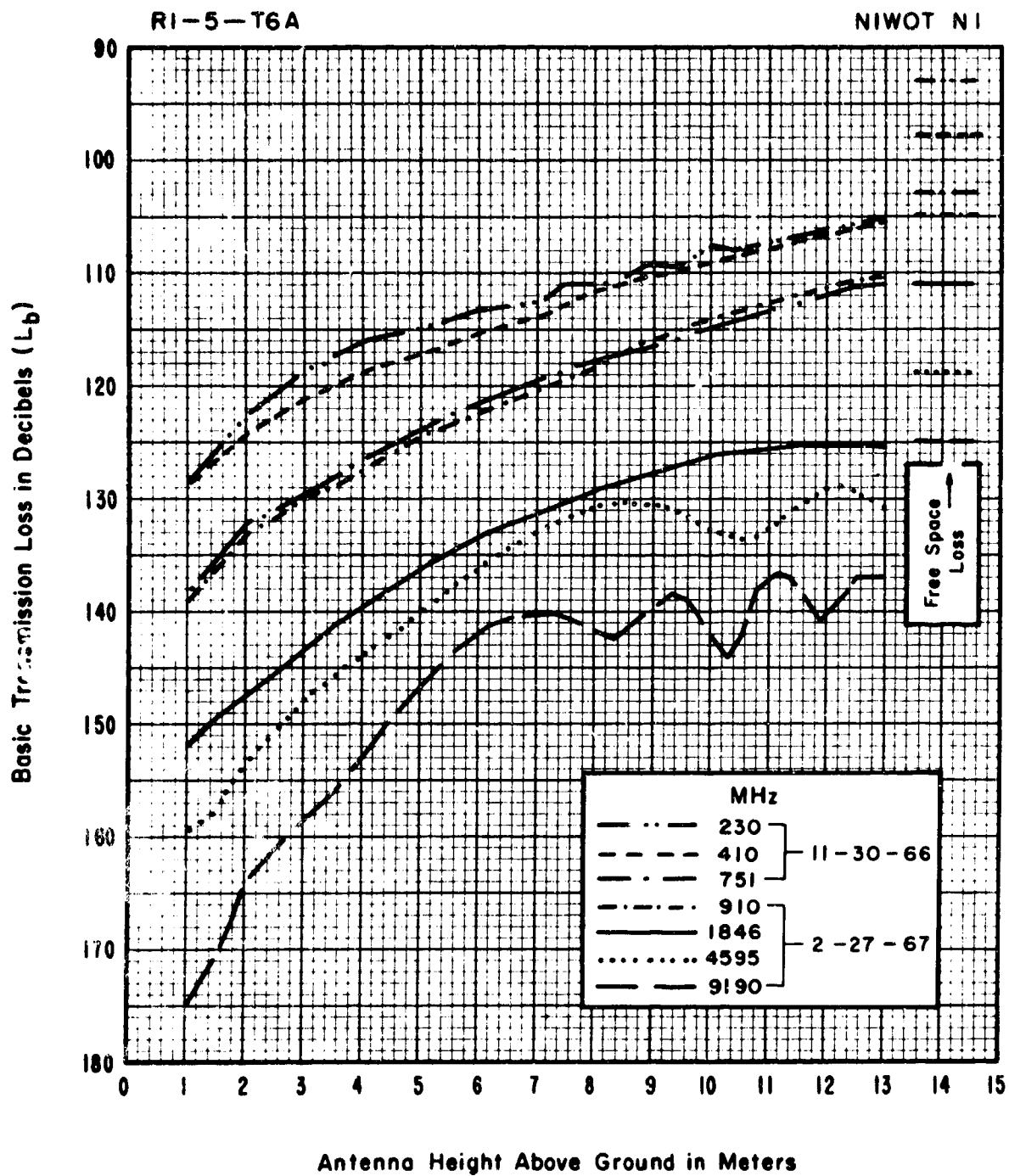
R1-5-T6A
NIWOT NI



PATH VIEW FROM RECEIVER



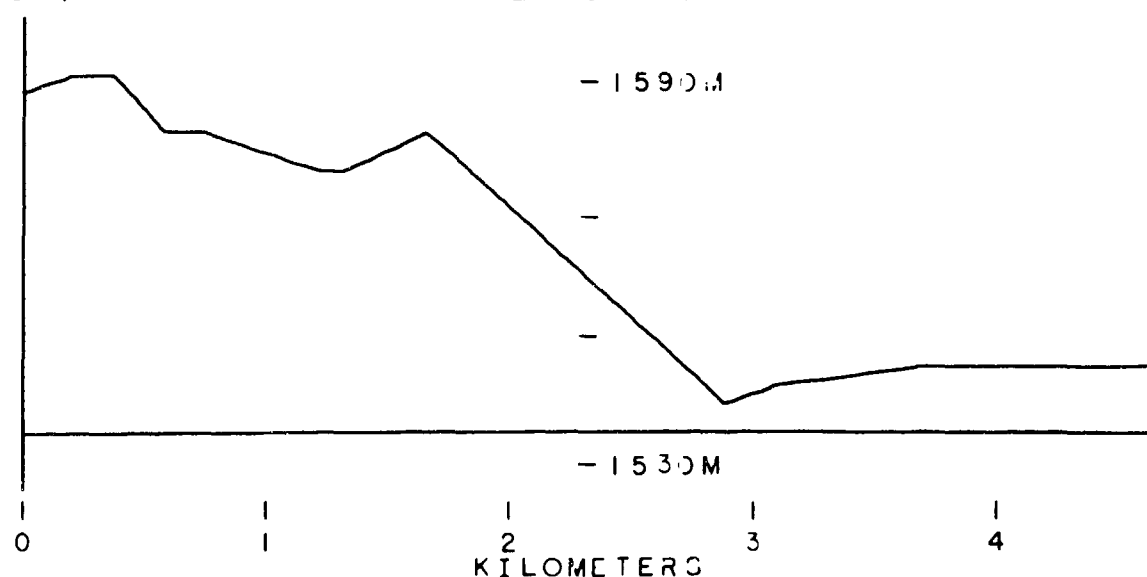
PATH VIEW FROM TRANSMITTER



RCVR. ELEV.
1589 M

R1-5-T6A
PATH LENGTH 4.64 km

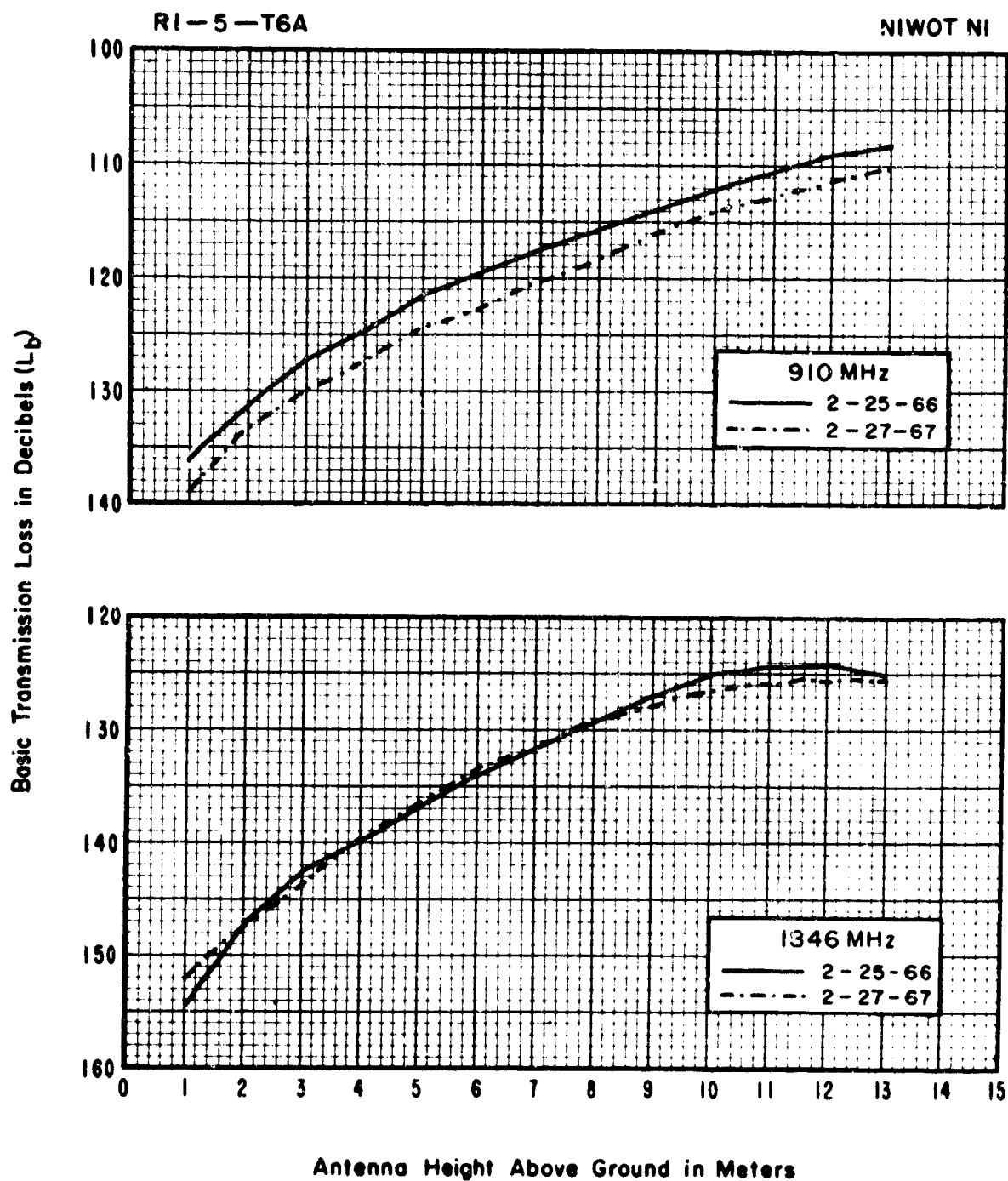
XMTR. ELEV.
1546 M



L_b (dB) SHORT TERM SIGNAL VARIABILITY

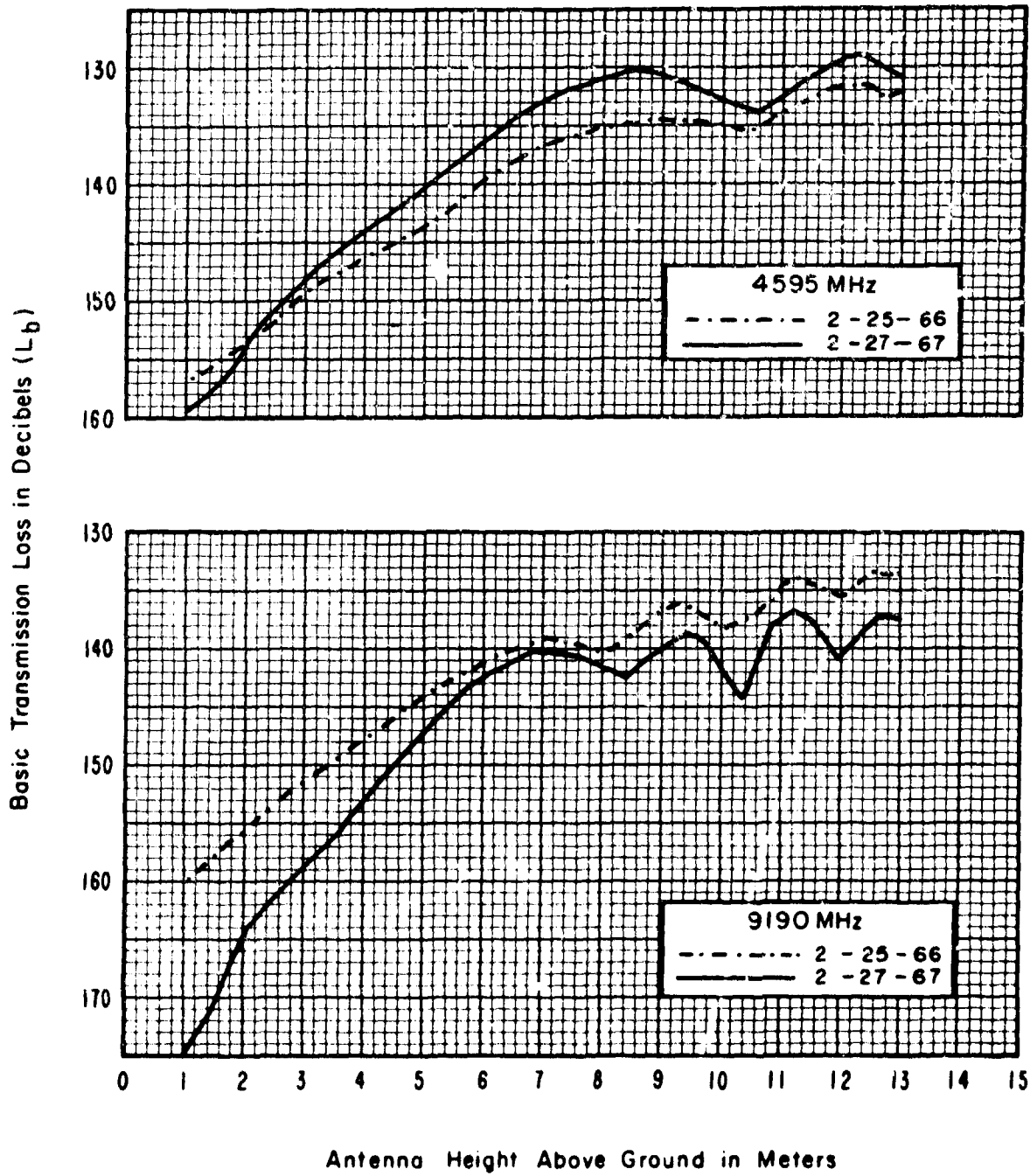
Freq. (MHz)	230	410	751	910	1846	4595	9190
	11-30-66 at 6.6 M				2-27-67 at 7.3 M		
50%	111.5	114.8	118.6	118.4	130.7	132.1	141.1
$\Delta 10\%-90\%$	< 3	< 3	< 3	< 3	< 3	< 3	< 3

The path extends across 30 yd of wheat field to a dirt road running at 50° to the path. On the far side of the road is a 3-ft, barbed-wire fence surrounding a 75-yd wide field of grass. From there to the horizon, 1-1/2 mi away, the path crosses rolling plains with scattered trees and homes.



RI-5-T6A

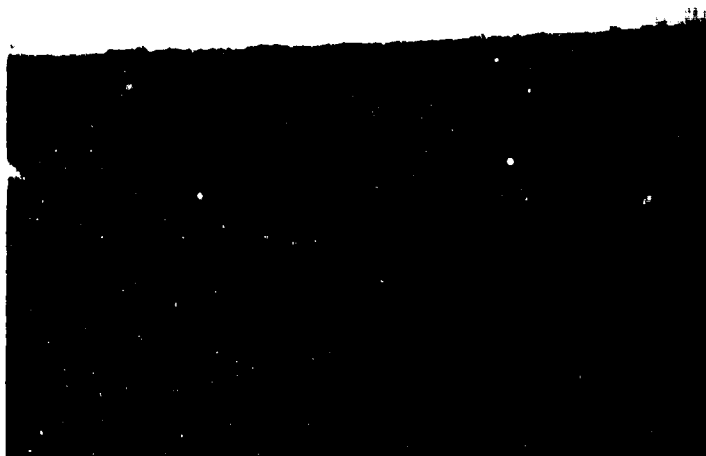
NIWOT NI



R1-10-T1
IDAHO CREEK



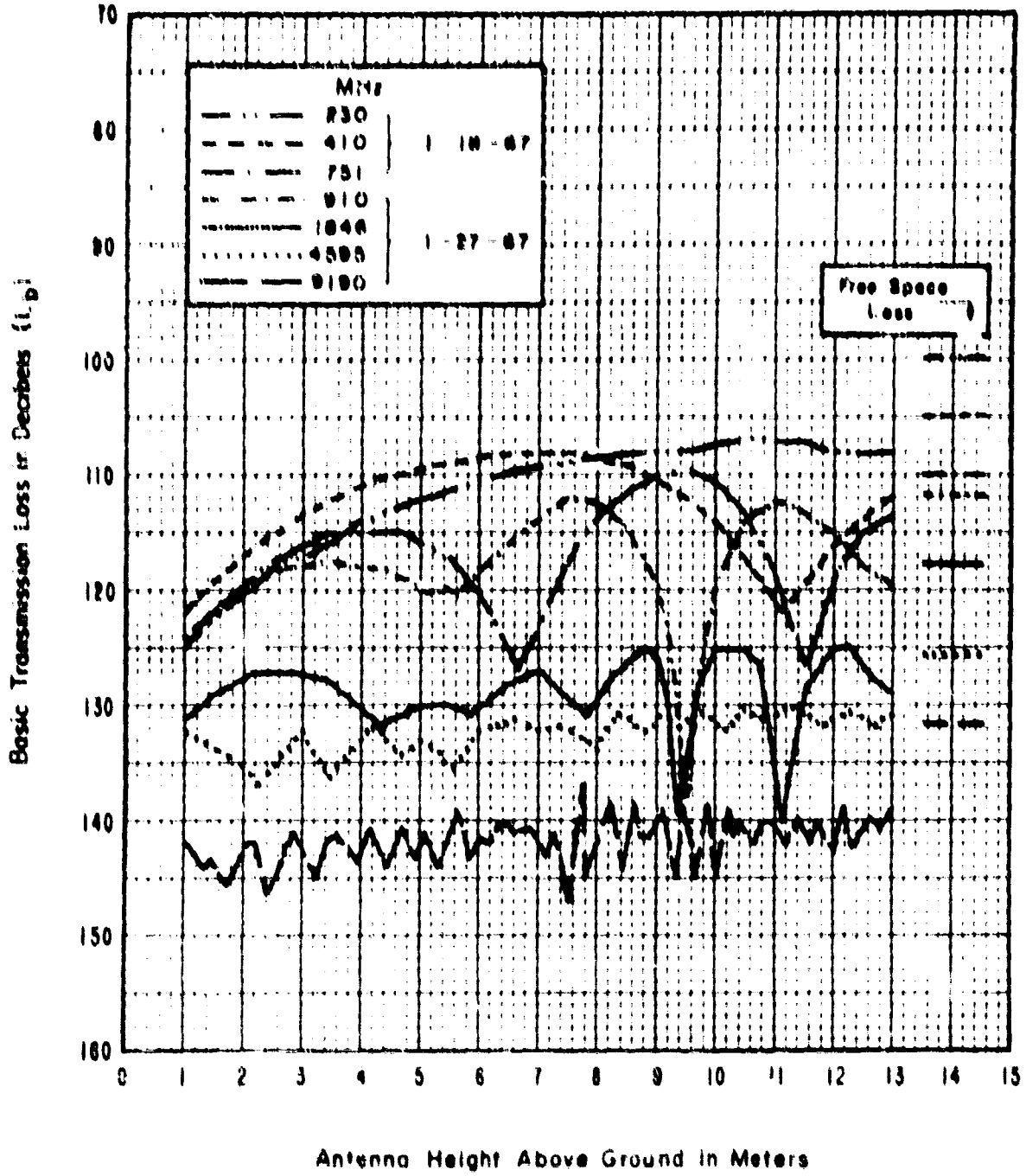
PATH VIEW FROM RECEIVER



PATH VIEW FROM TRANSMITTER

NI-10-TI

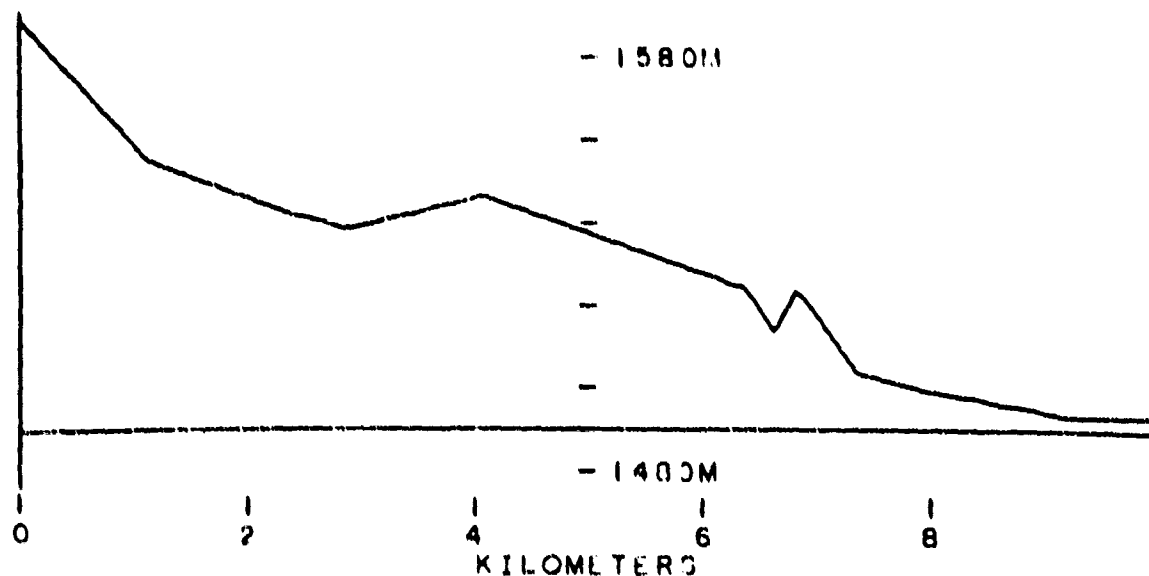
IDAHO CREEK SCHOOL



RCVR. ELEV.
1589 M

RI-10-T1
PATH LENGTH 9.98 km

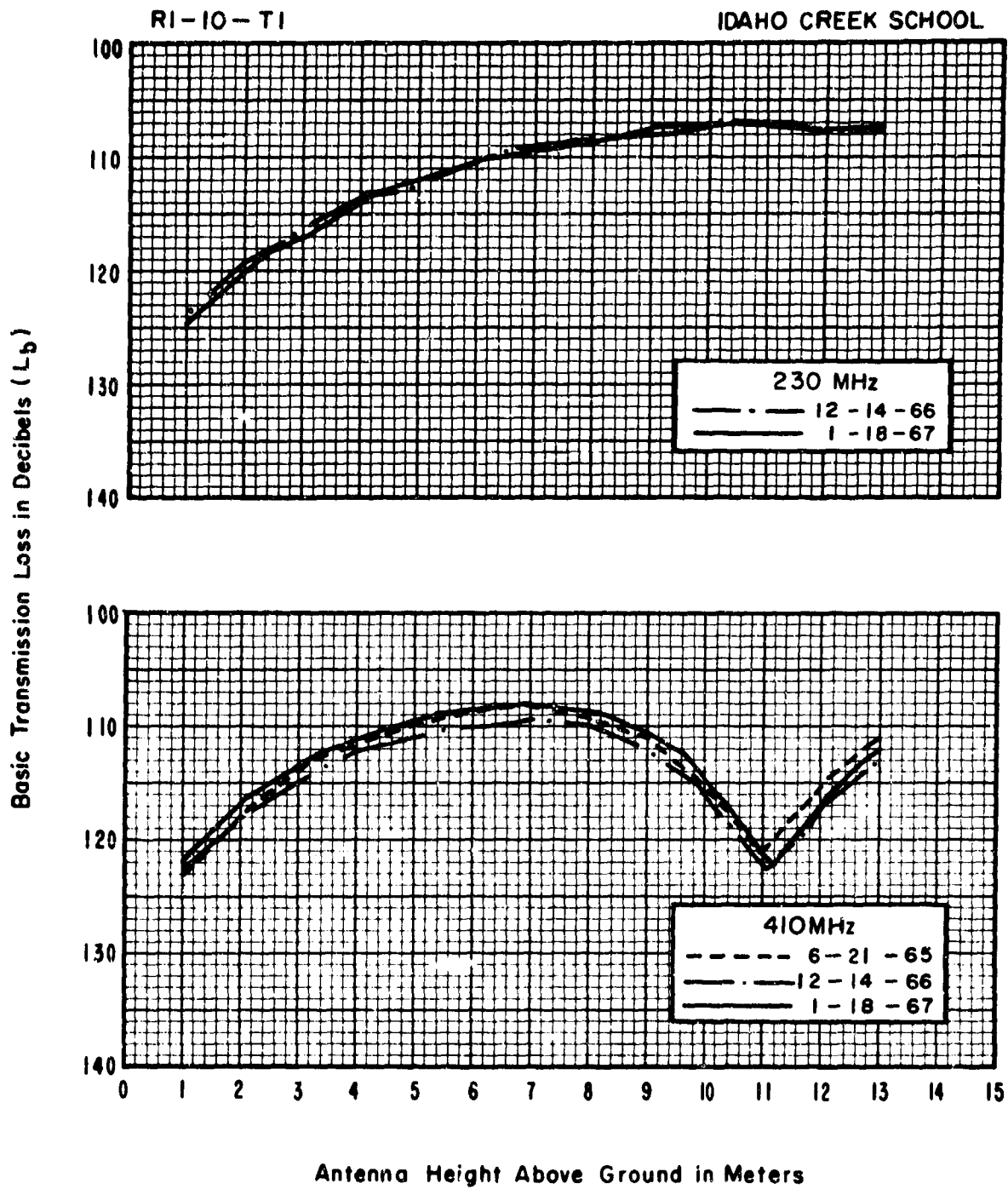
XMTR. ELEV.
1494 M

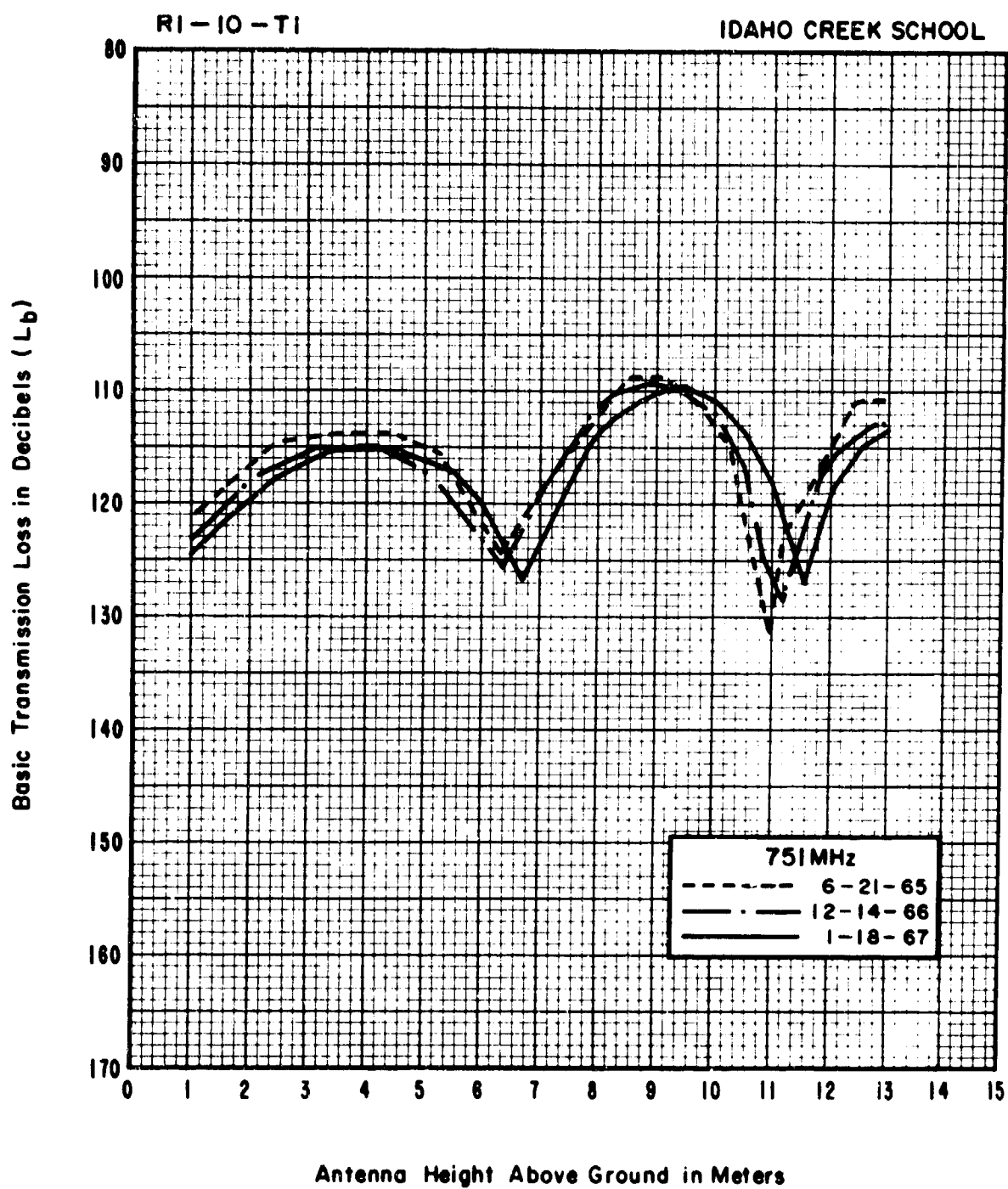


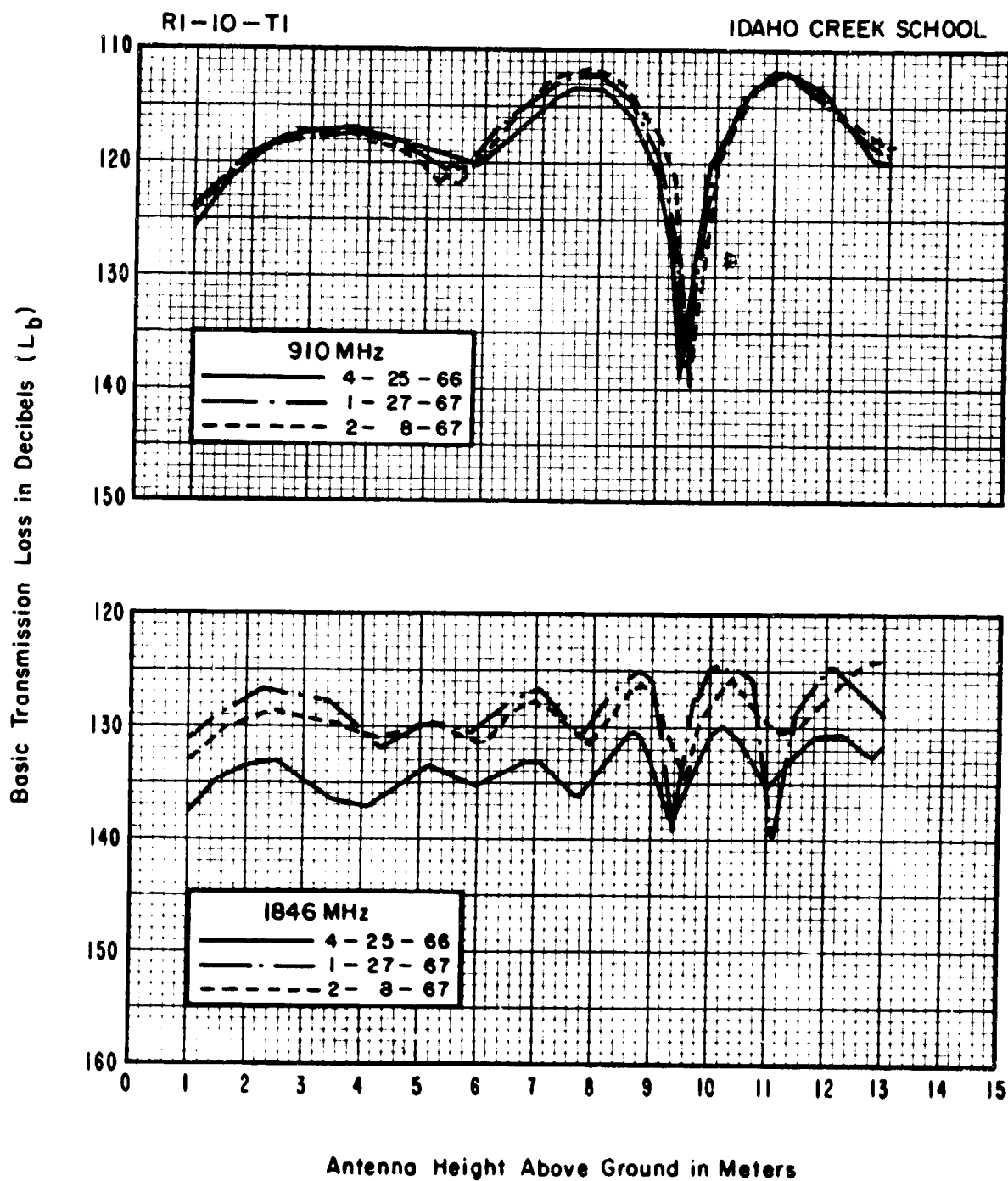
L_b (dB) SHORT TERM SIGNAL VARIABILITY

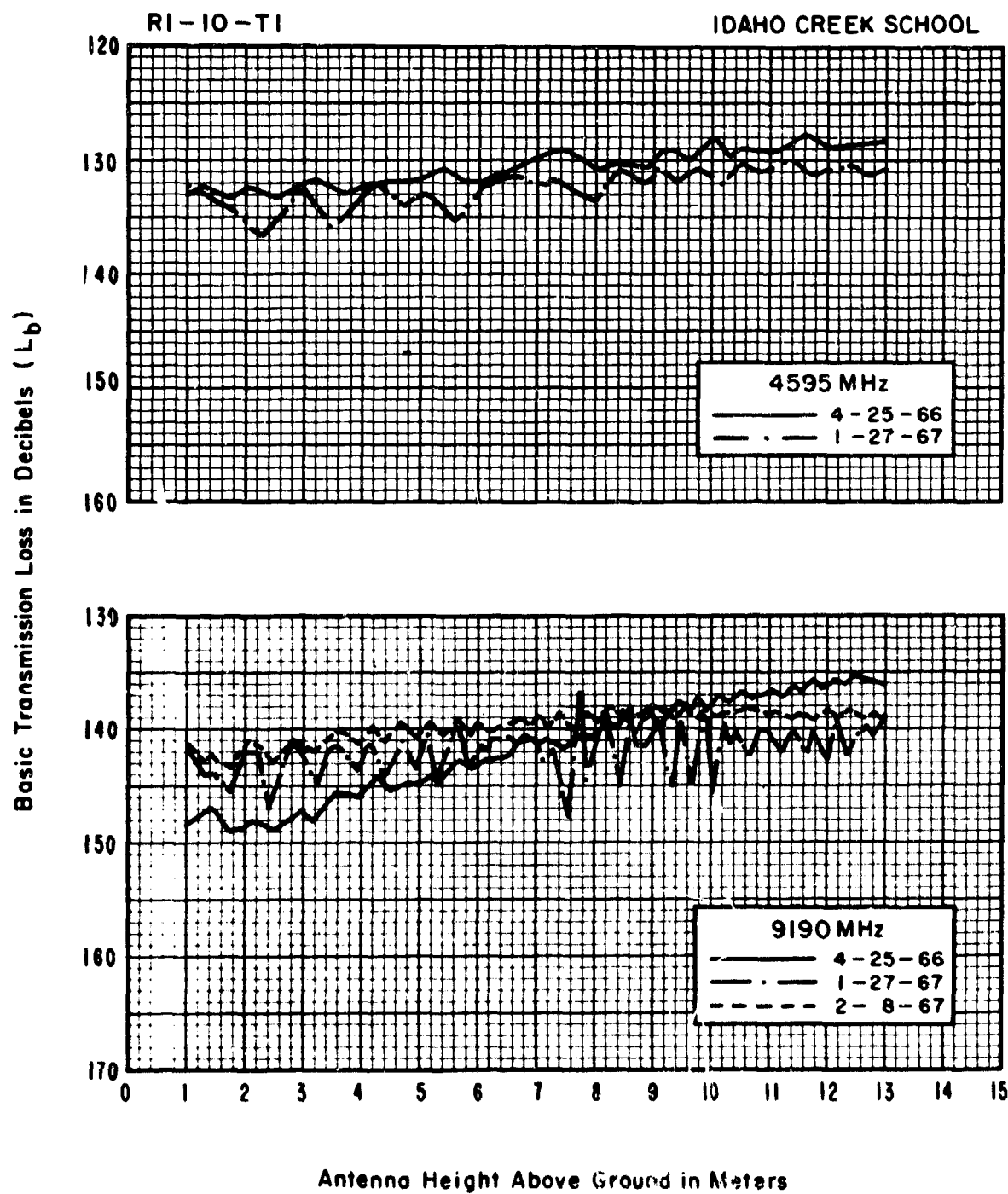
Freq (MHz)	230	410	751	910	1846	4595	9190
	1-18-67 at 13 M				1-27-67 at 7.3 M		
50%	108.6	112.2	113.1	112.6	128.0	133.0	136.4
A10%-90%	< 3	< 3	< 3	< 3	< 3	< 3	< 3

About 75 yd from the transmitter site, railroad tracks cross the path at 90° . The terrain is plowed ground to a distance of $3/4$ mi from the transmitter, with pasture land continuing uphill to the horizon, which is $4-1/2$ mi away.

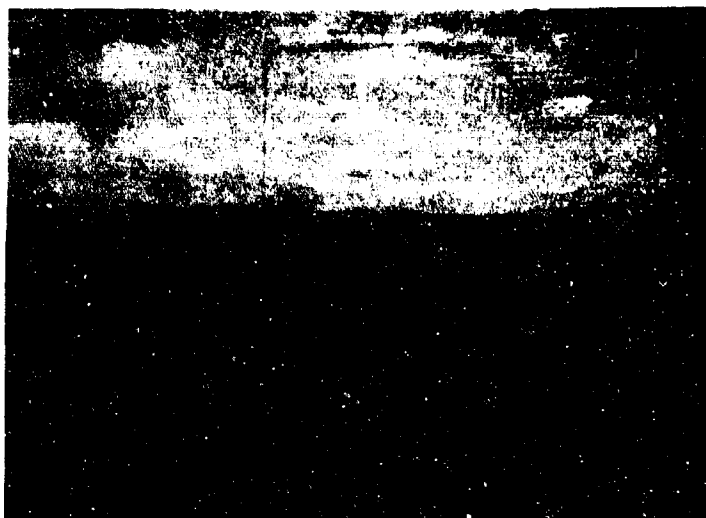








R1-10-T2
BOULDER RESERVOIR



PATH VIEW FROM RECEIVER

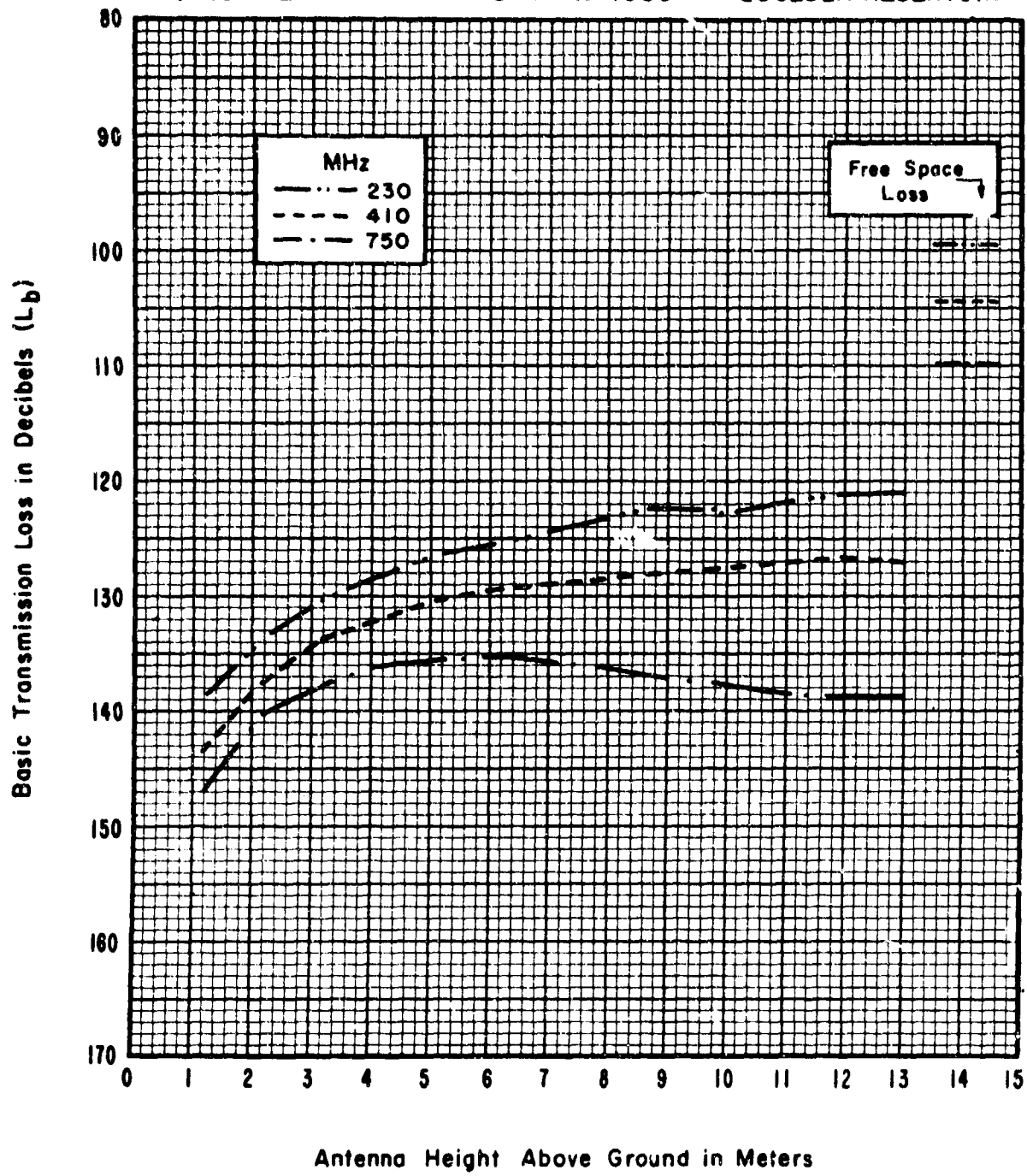


PATH VIEW FROM TRANSMITTER

RI-10-T2

6 APRIL 1965

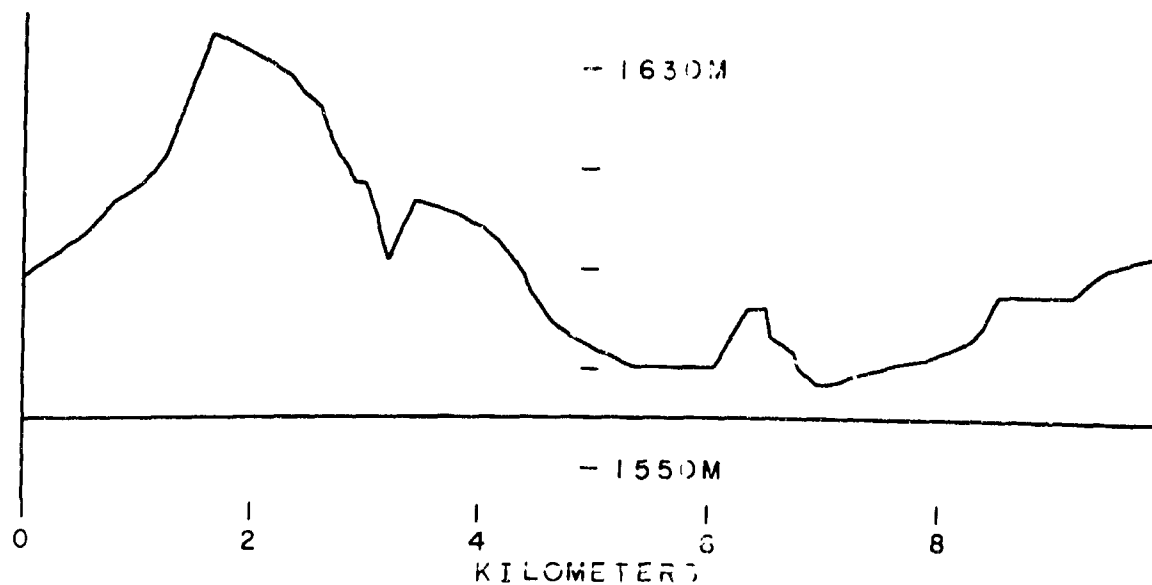
BOULDER RESERVOIR



RCVR. ELEV.
1589 M

R1-10-T2
PATH LENGTH 9.94 km

XMTR. ELEV.
1594 M



L_b (dB) SHORT TERM SIGNAL VARIABILITY

Freq (MHz)	230	410	751	910	1846	4595	9190

4-6-65 at 13 M

50%	120.9	126.8	138.8

$\Delta 10\%-90\%$	< 3	< 3	< 3

The path crosses 25 ft of roadway and a 3-ft, barbed-wire fence.

The path crosses a lake approximately 1/2 mi away from the transmitter van.

Scattered cottonwood trees grow on the far side of the lake. The rest of the terrain to the horizon, which is 5 mi away, is grassland.

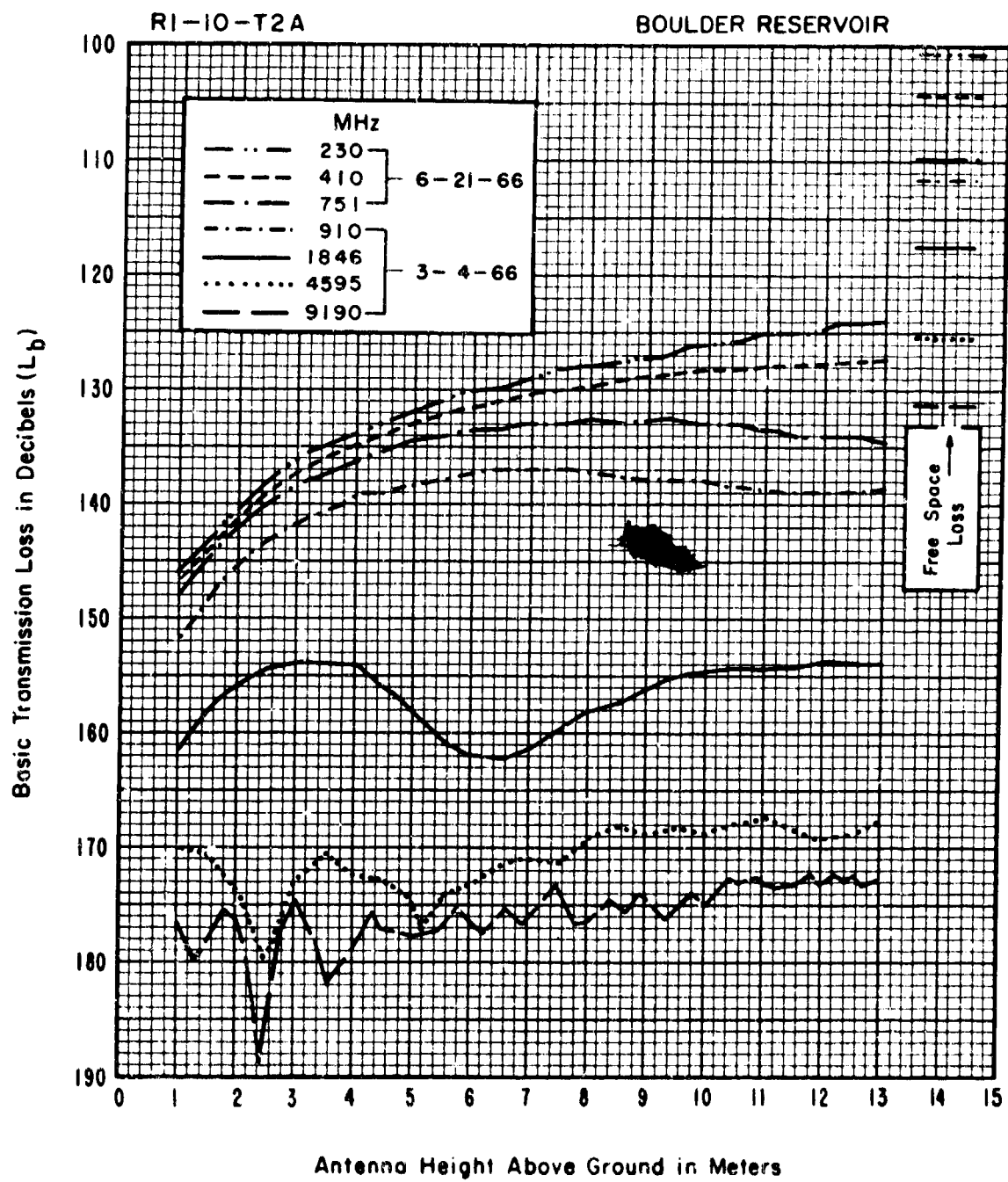
R1-10-T2A
BOULDER RESERVOIR

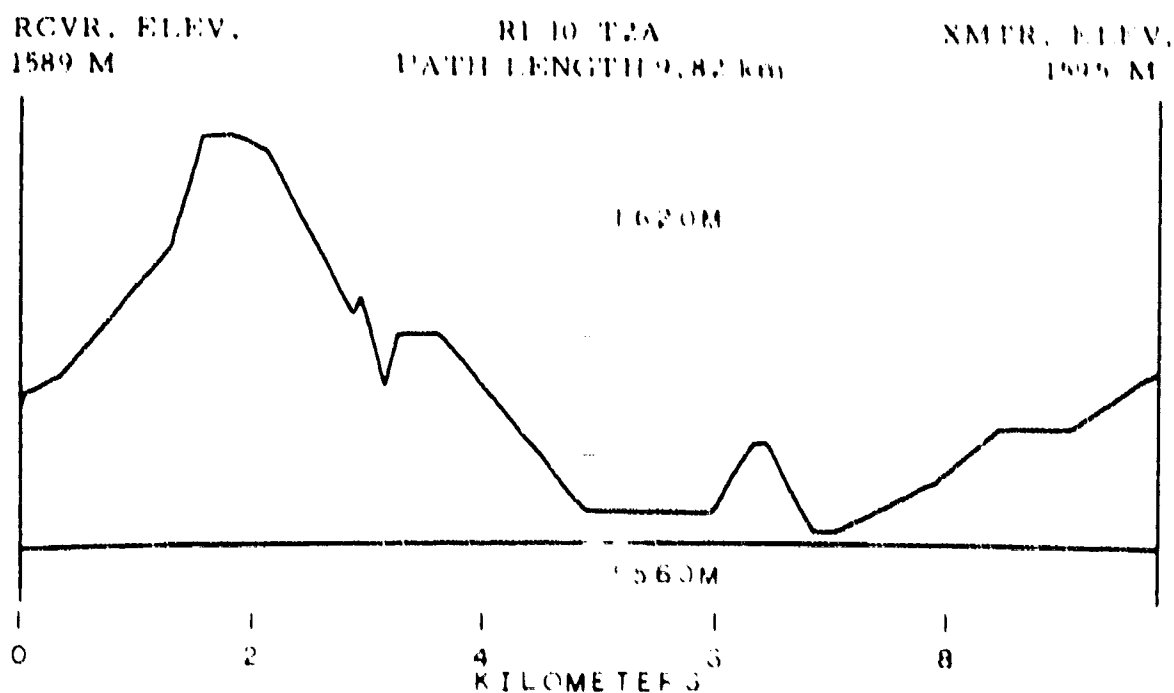


PATH VIEW FROM RECEIVER



PATH VIEW FROM TRANSMITTER

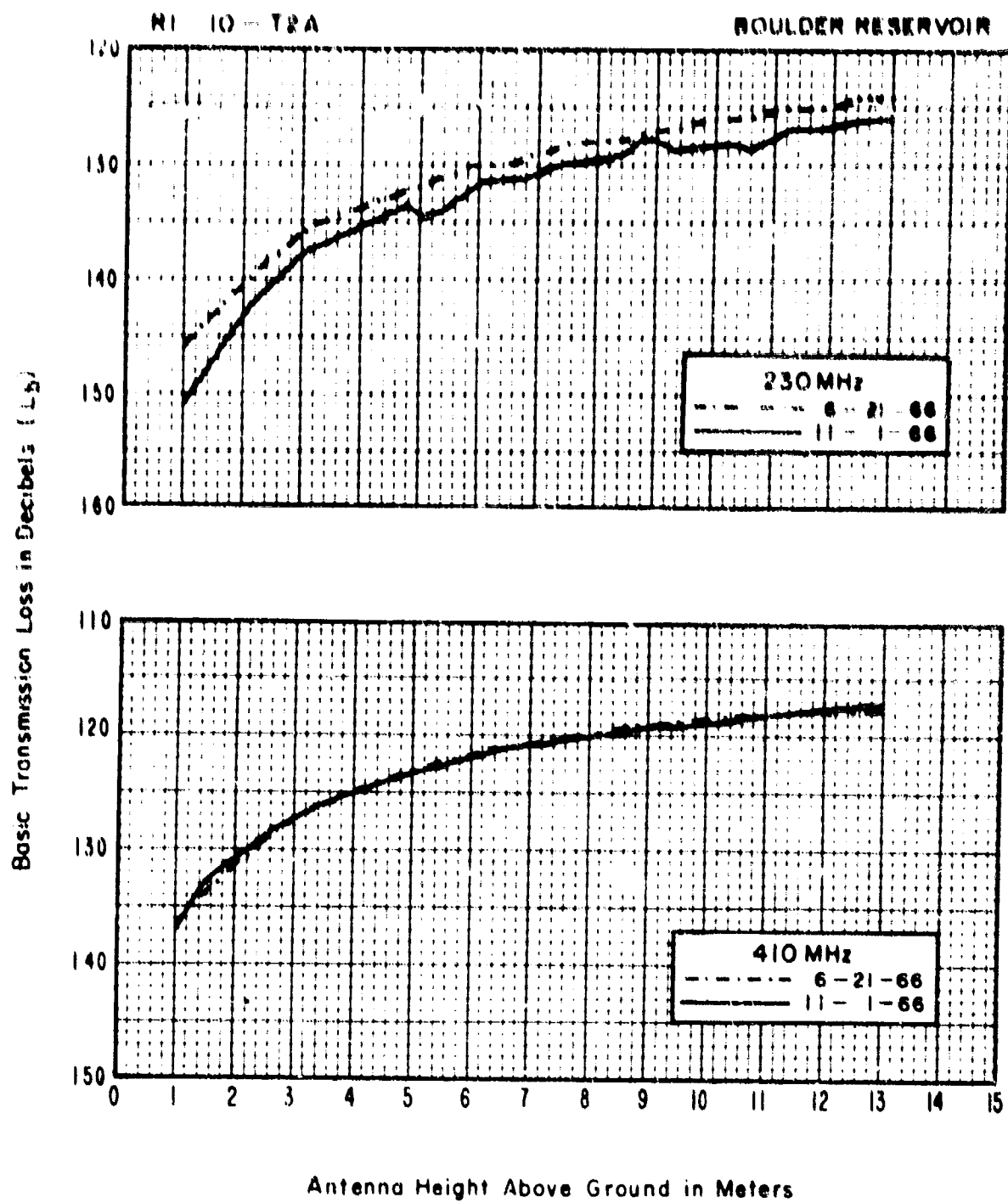


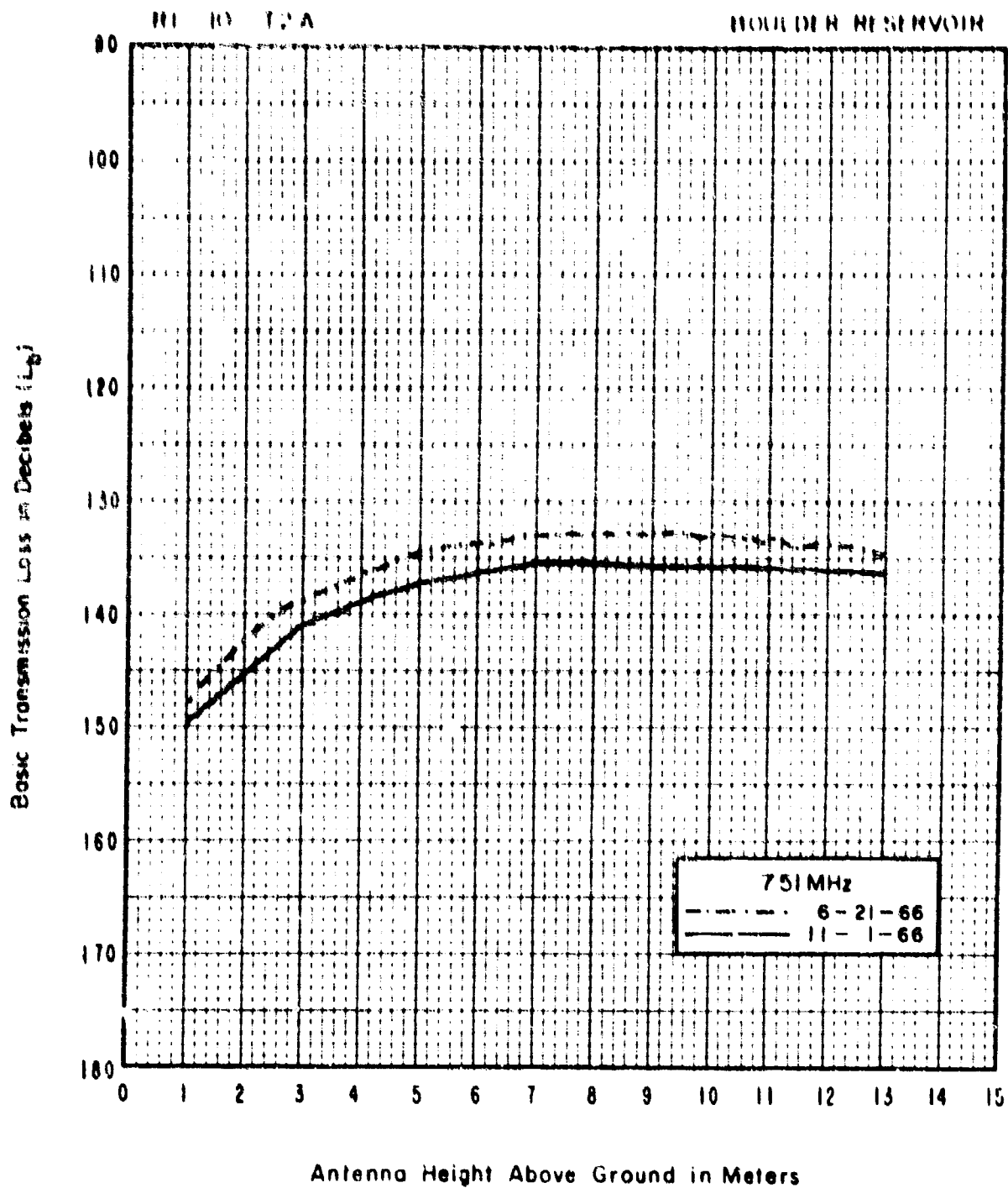


L_p (dB) SHORT TERM SIGNAL VARIABILITY

Freq (MHz)	230	410	751	910	1846	4595	9190
	6-21-66 at 13 M				3-4-66 at 7.3 M		
50%	124.0	127.3	134.4	137.1	159.2	170.9	173.5
$\Delta 10\%-90\%$	< 3	< 3	< 3	< 3	< 3	< 3	< 3

Crossing a 3-ft wire fence, 20 ft away from the transmitter site the path traverses a flat, gravel surface, and a winding asphalt road. One-half mile away, a power line crosses the path at about 30° . The path then traverses a large lake for 2 mi, and extends across a grass-covered, upward slope to the horizon, which is about 5 mi away.

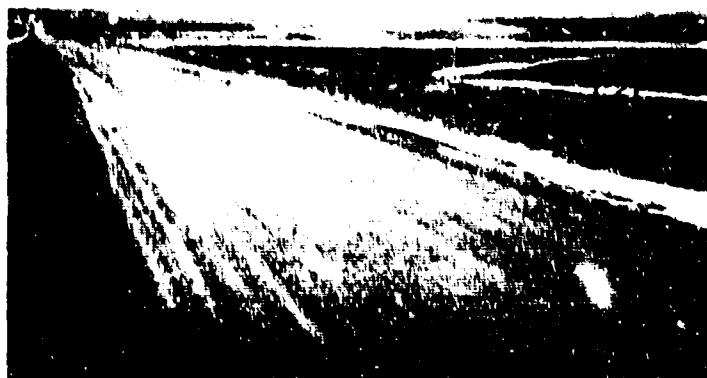




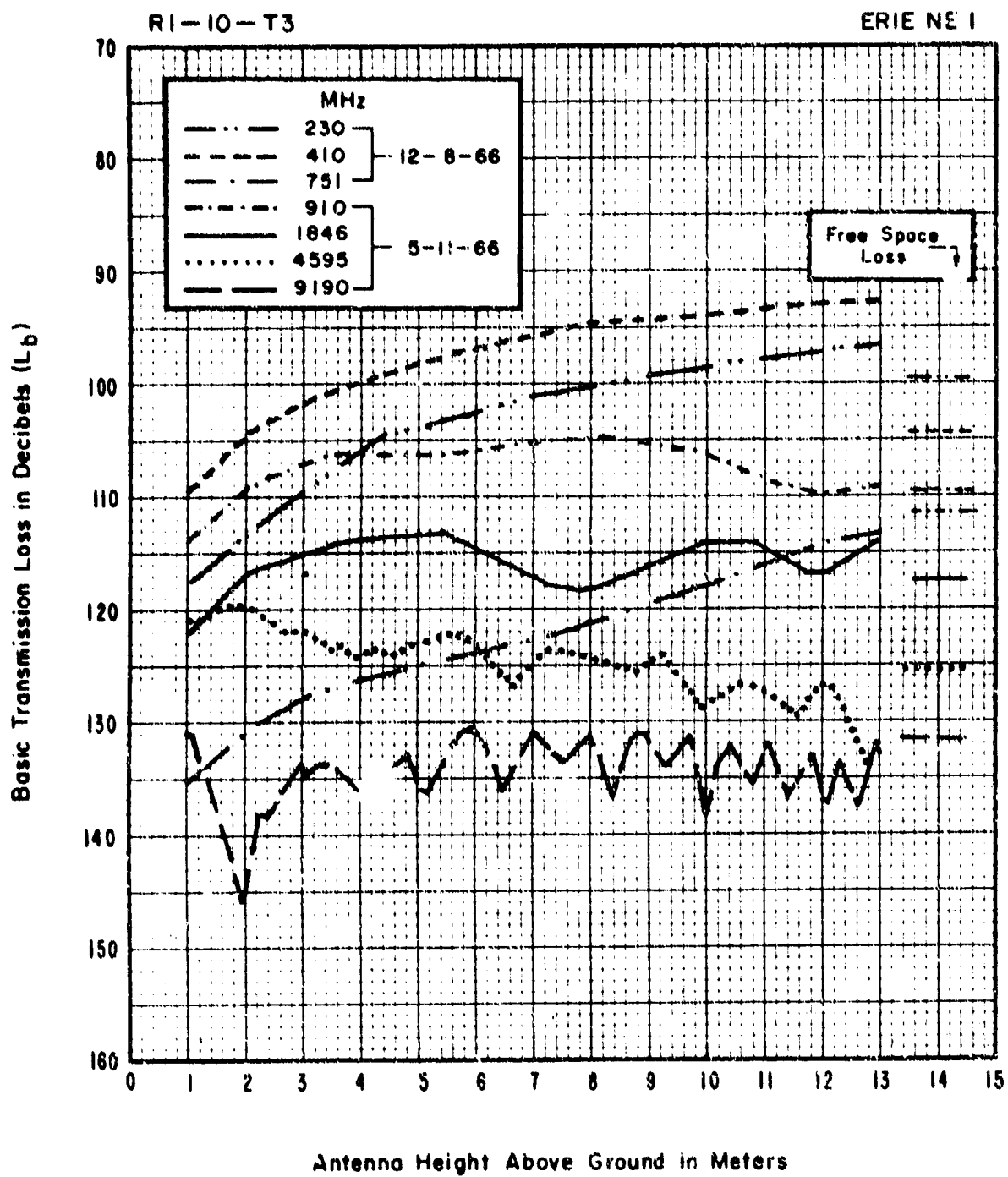
R1-10-13
ERIE NE1



PATH VIEW FROM RECEIVER



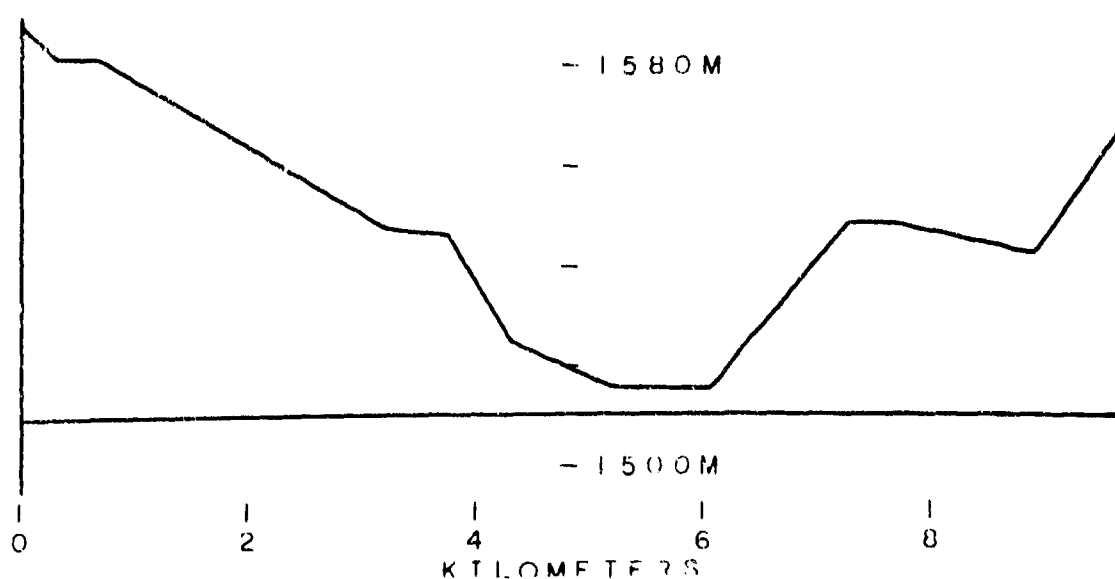
PATH VIEW FROM TRANSMITTER



RCVR. ELEV.
1589 M

RI-10-T3
PATH LENGTH 9.66 km

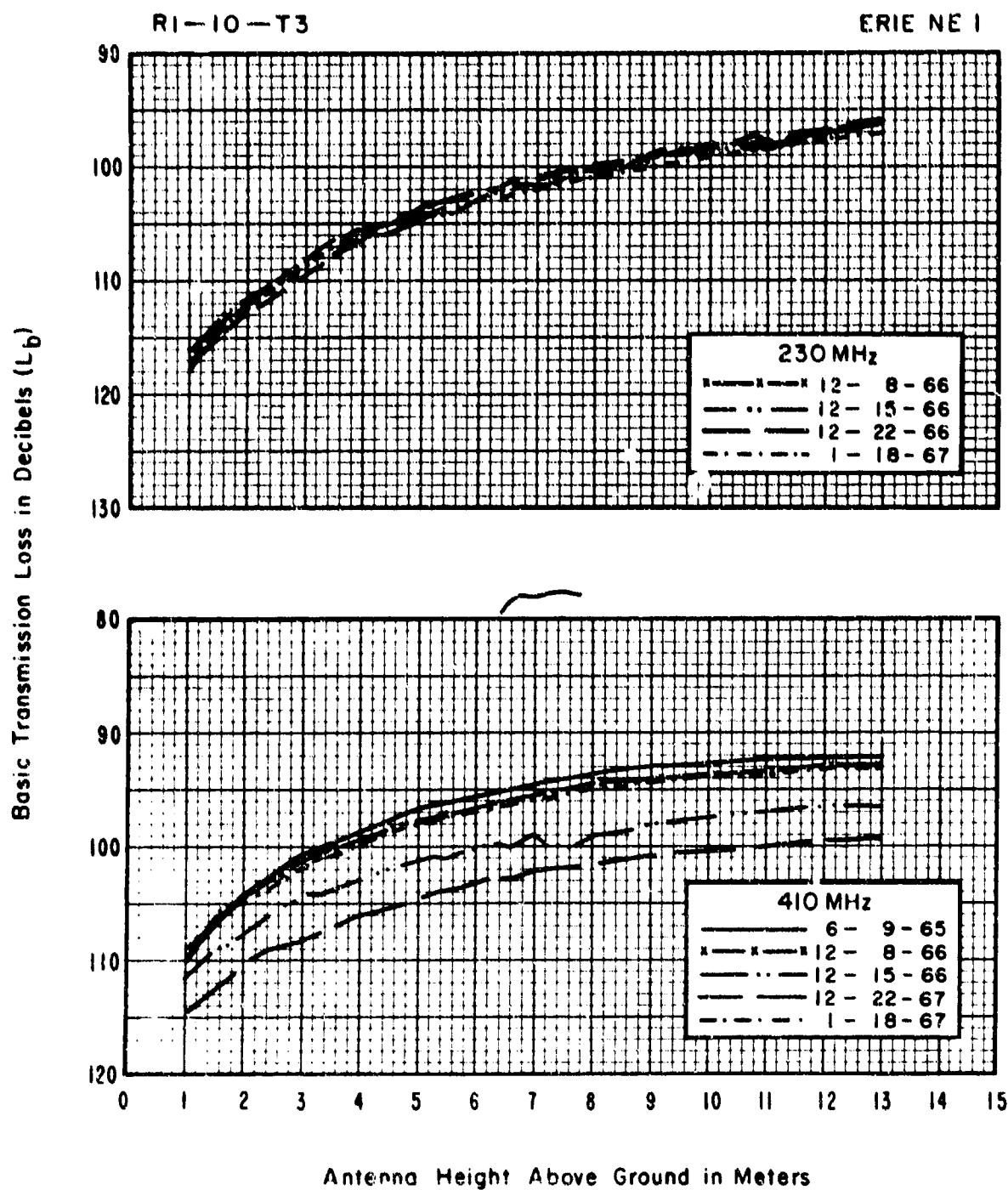
XMTR. ELEV.
1568 M



L_b (dB) SHORT TERM SIGNAL VARIABILITY

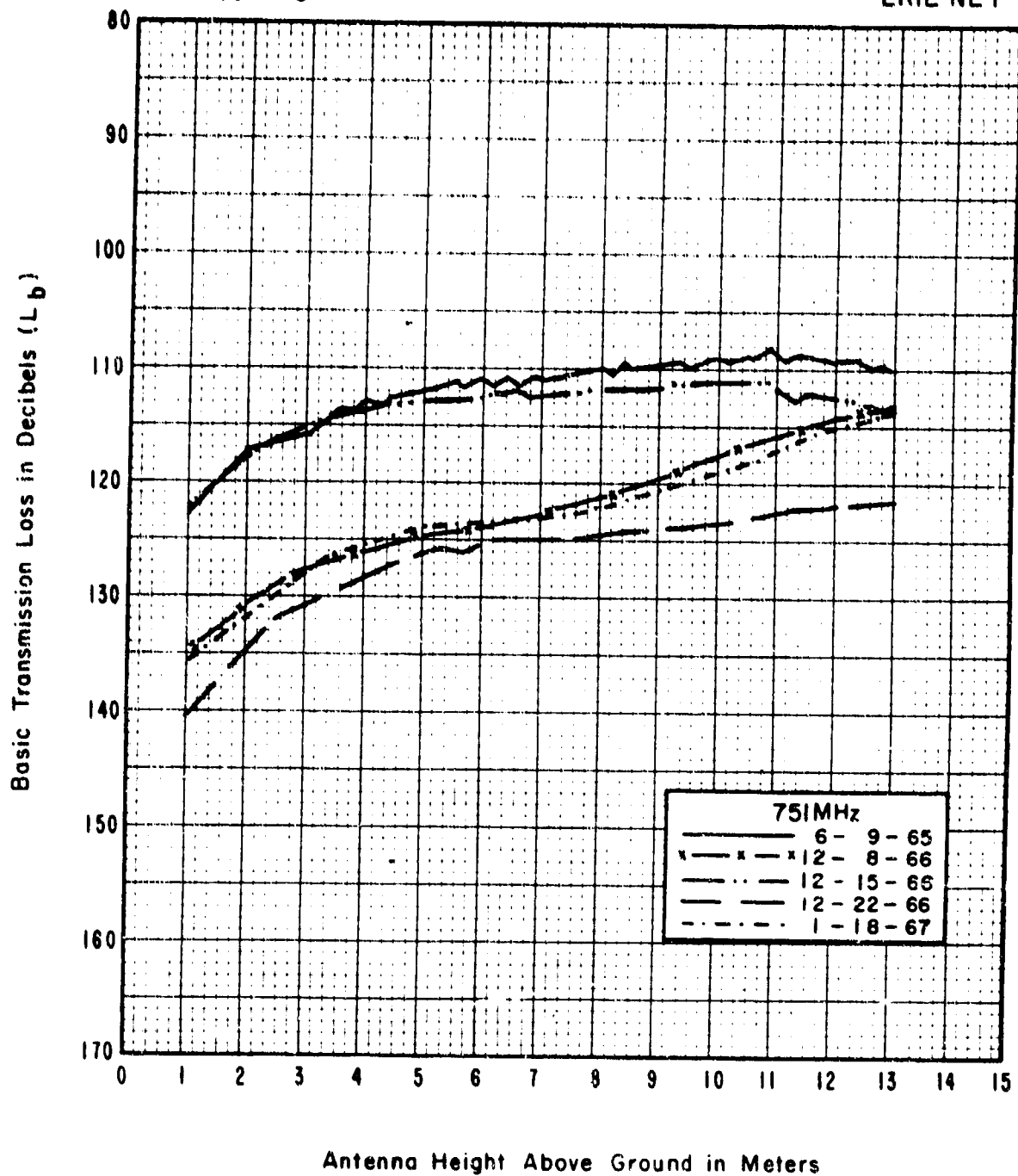
Freq (MHz)	230	410	751	910	1846	4595	9190
	12-8-66 at 6.6 M				5-11-66 at 7.3 M		
50%	101.2	96.6	124.7	105.2	117.8	125.7	136.3
$\Delta 10\% - 90\%$	< 3	< 3	< 3	< 3	< 3	< 3	< 3

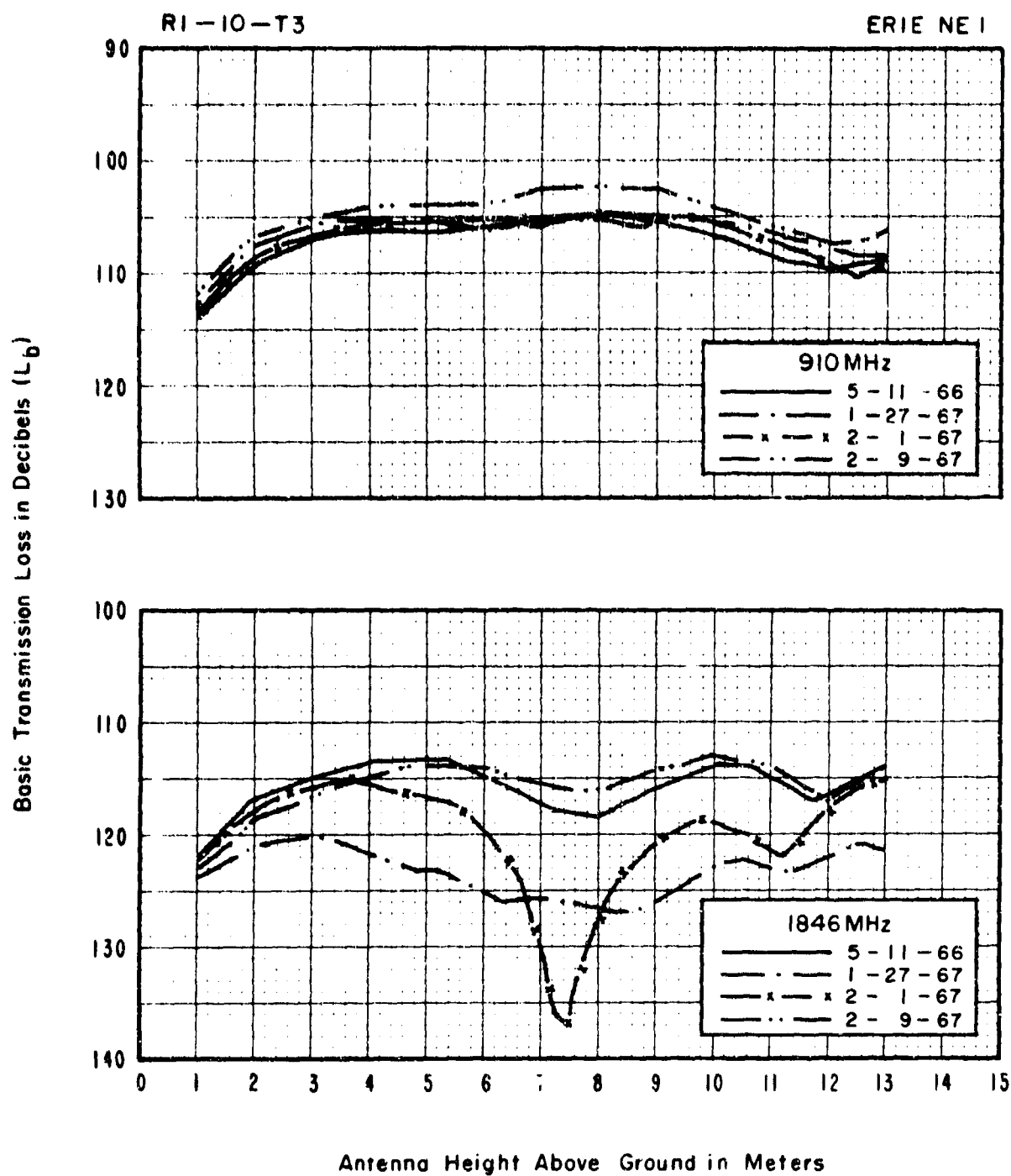
This line-of-sight path extends for 150 ft across a dirt road to a 3-ft barbed-wire fence at the near edge of a plowed field. Beyond 250 ft of plowed ground and grassy fields are railroad tracks 1 mi away. The rest of the terrain consists of open fields with scattered cottonwood trees.



RI-10-T3

ERIE NE 1

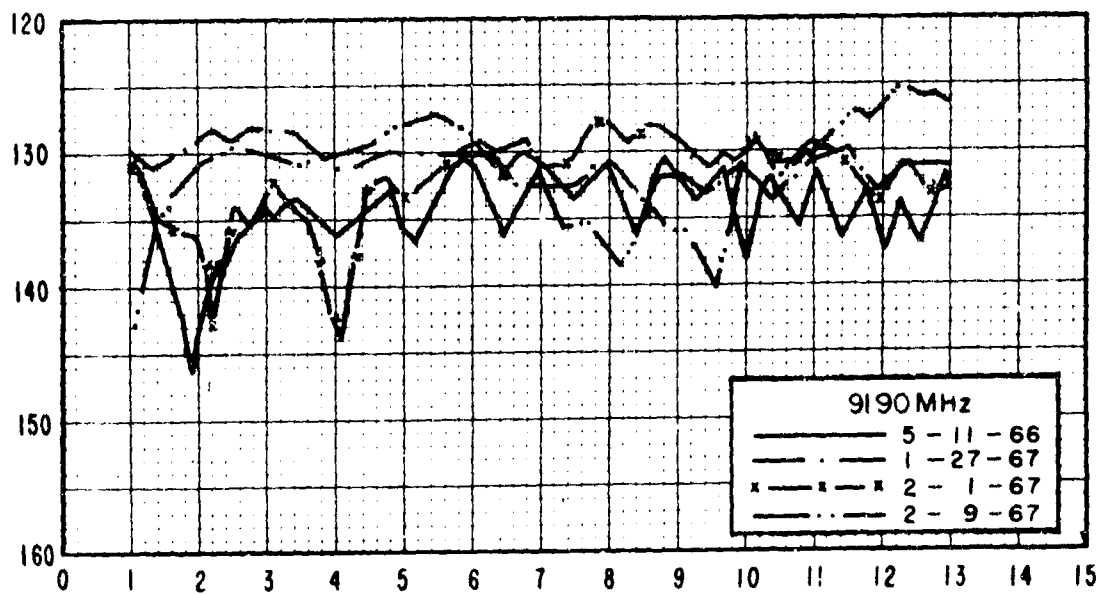
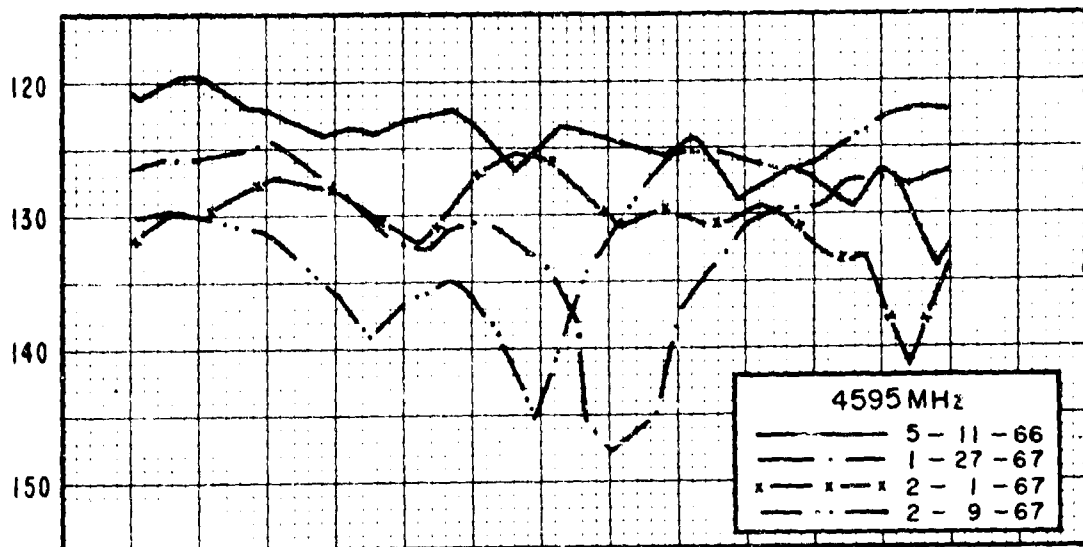




RI-10-T3

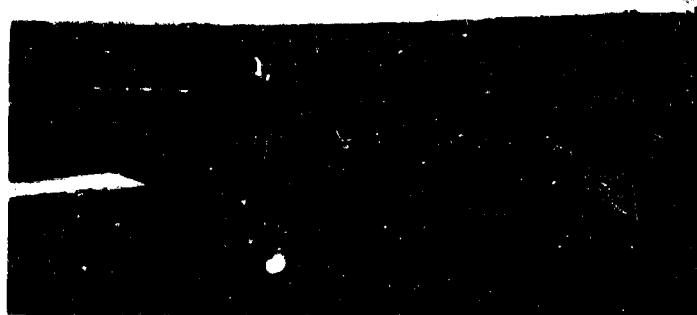
ERIE NE 1

Basic Transmission Loss in Decibels (L_b)



Antenna Height Above Ground in Meters

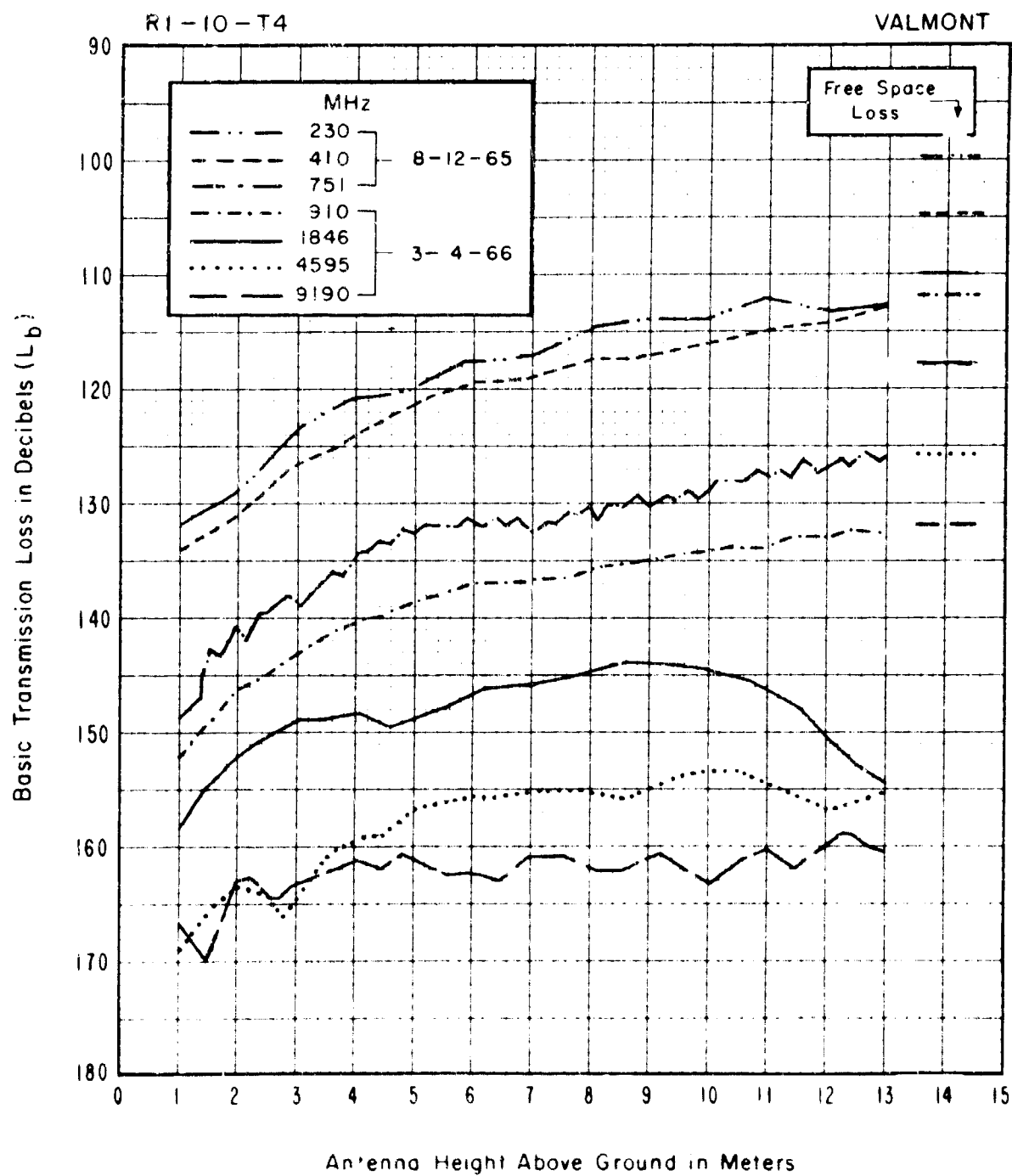
R1-10-T4
VALMONT



PATH VIEW FROM RECEIVER



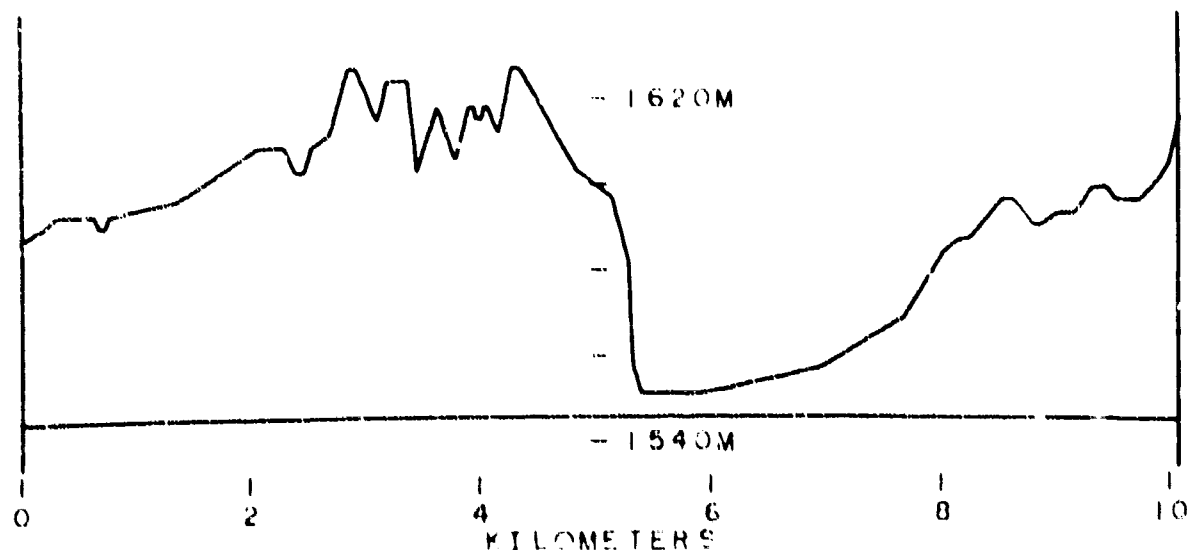
PATH VIEW FROM TRANSMITTER



RCVR. ELEV.
1589 M

R1-10-T4
PATH LENGTH 10.08 km

XMTR. ELEV.
1615 M



L_b (dB) SHORT TERM SIGNAL VARIABILITY

Freq (MHz)	230	410	751	910	1846	4595	9190
8-12-65 at 13 M				3-4-66 at 7.3 M			
50%	112.1	113.9	126.4	130.8	144.8	155.0	160.1
$\Delta 10\%-90\%$	< 3	< 3	< 3	< 3	< 3	< 3	< 3

The foreground at this site consists of down-sloping grass-covered fields. Railroad tracks and high-voltage power lines cross the path approximately 300 yd away, but are far below it. Beyond the tracks, to the horizon 3-1/2 mi away, the ground cover is grass.

RI-10-15
HAYSTACK EAST



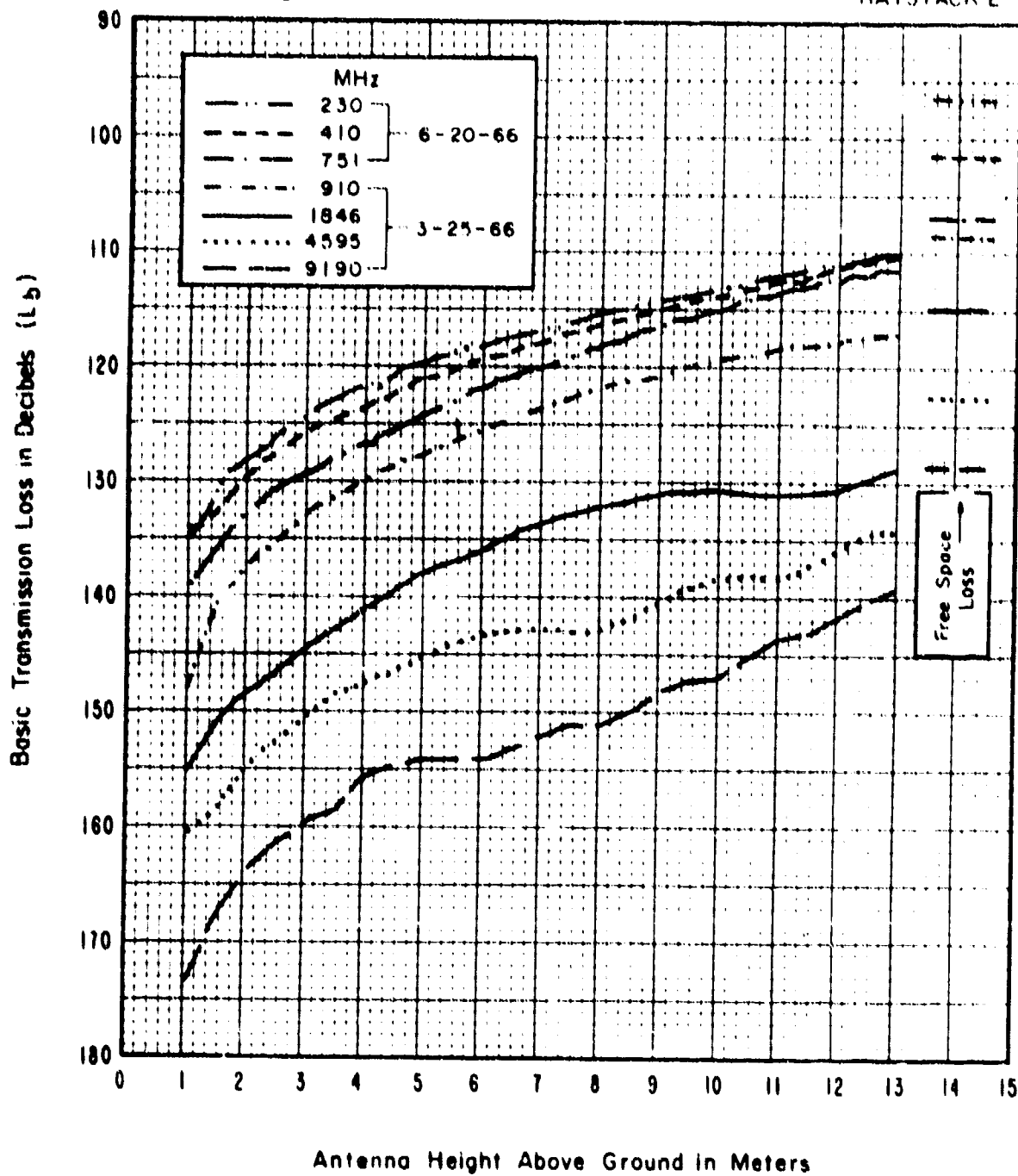
PATH VIEW FROM RECEIVER



PATH VIEW FROM TRANSMITTER

RI-10-T5

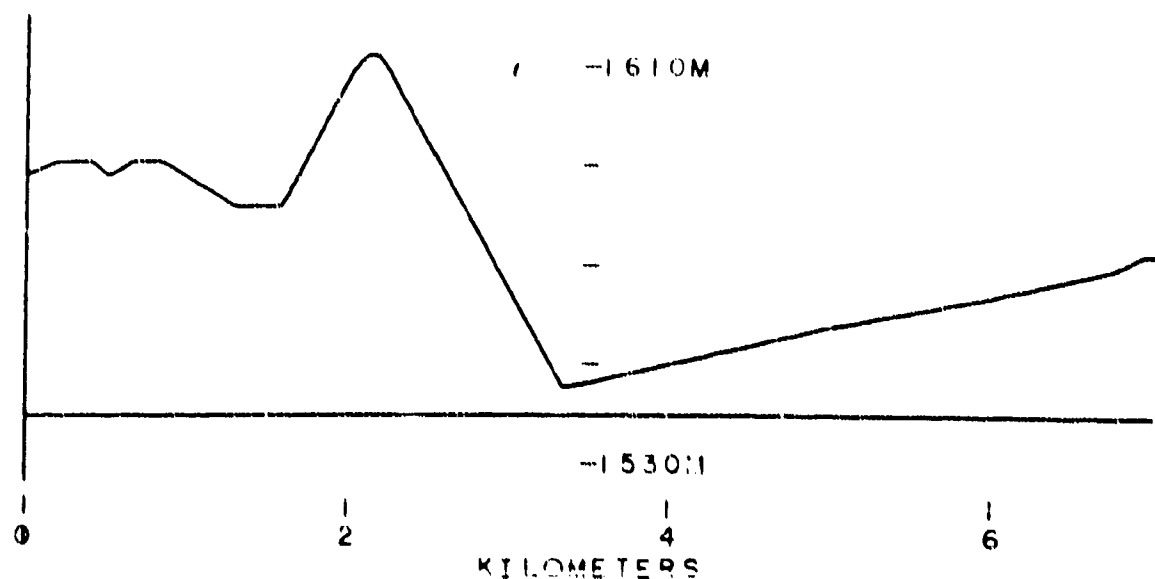
HAYSTACK E



RCVR. ELEV.
1589 M

RI-10-T5
PATH LENGTH 7.03 km

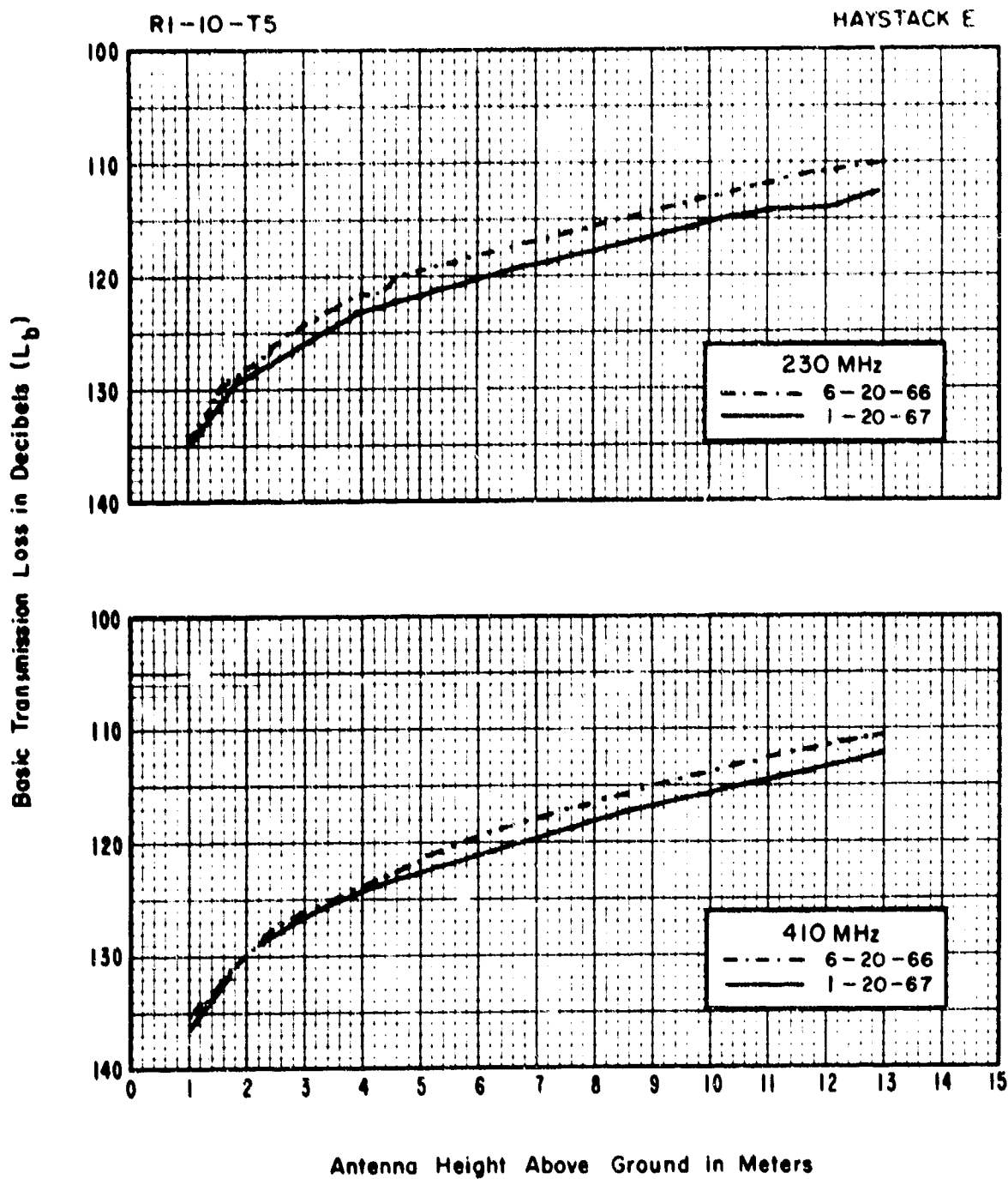
XMTR. ELEV.
1573 M

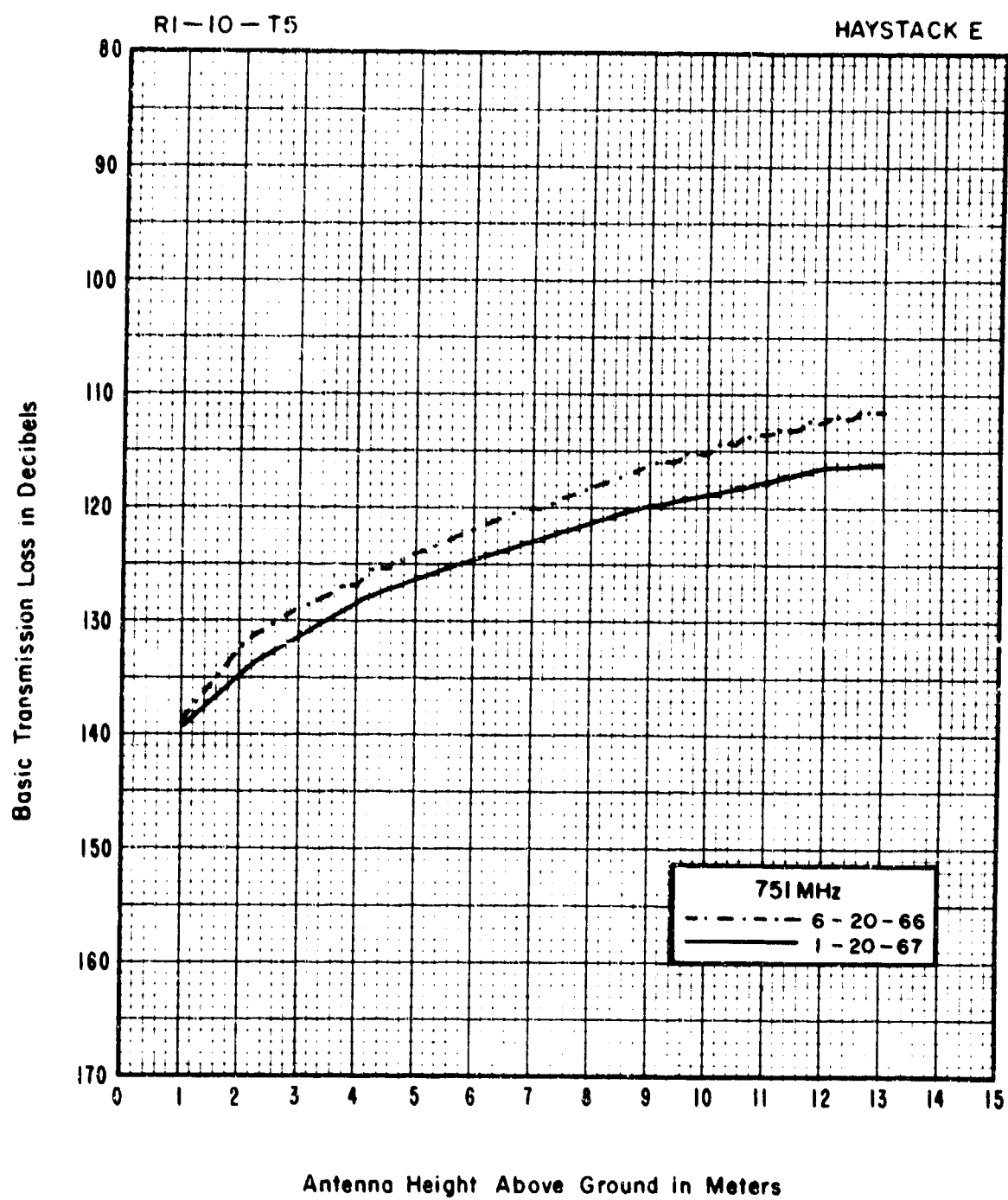


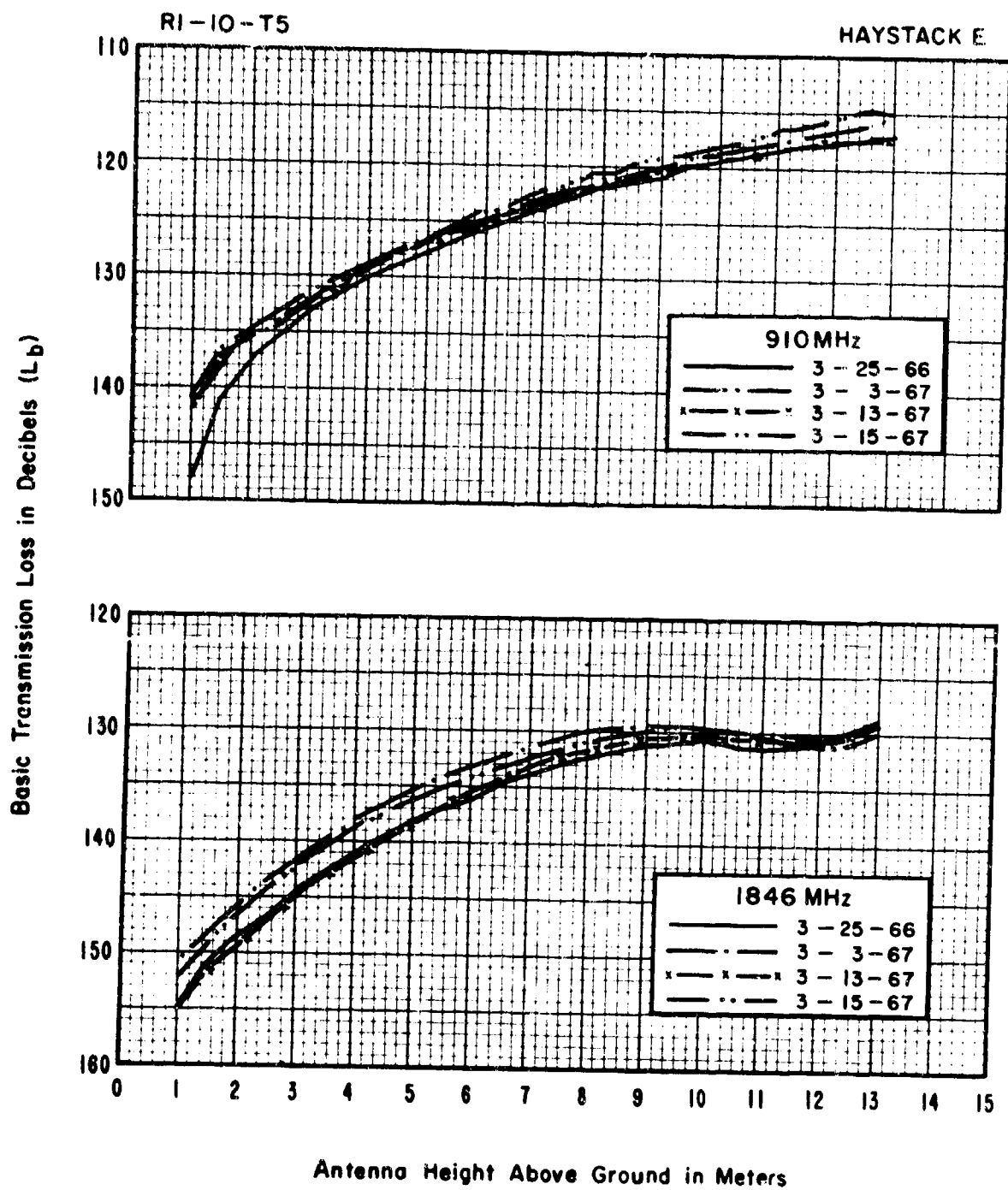
L_b (dB) SHORT TERM SIGNAL VARIABILITY

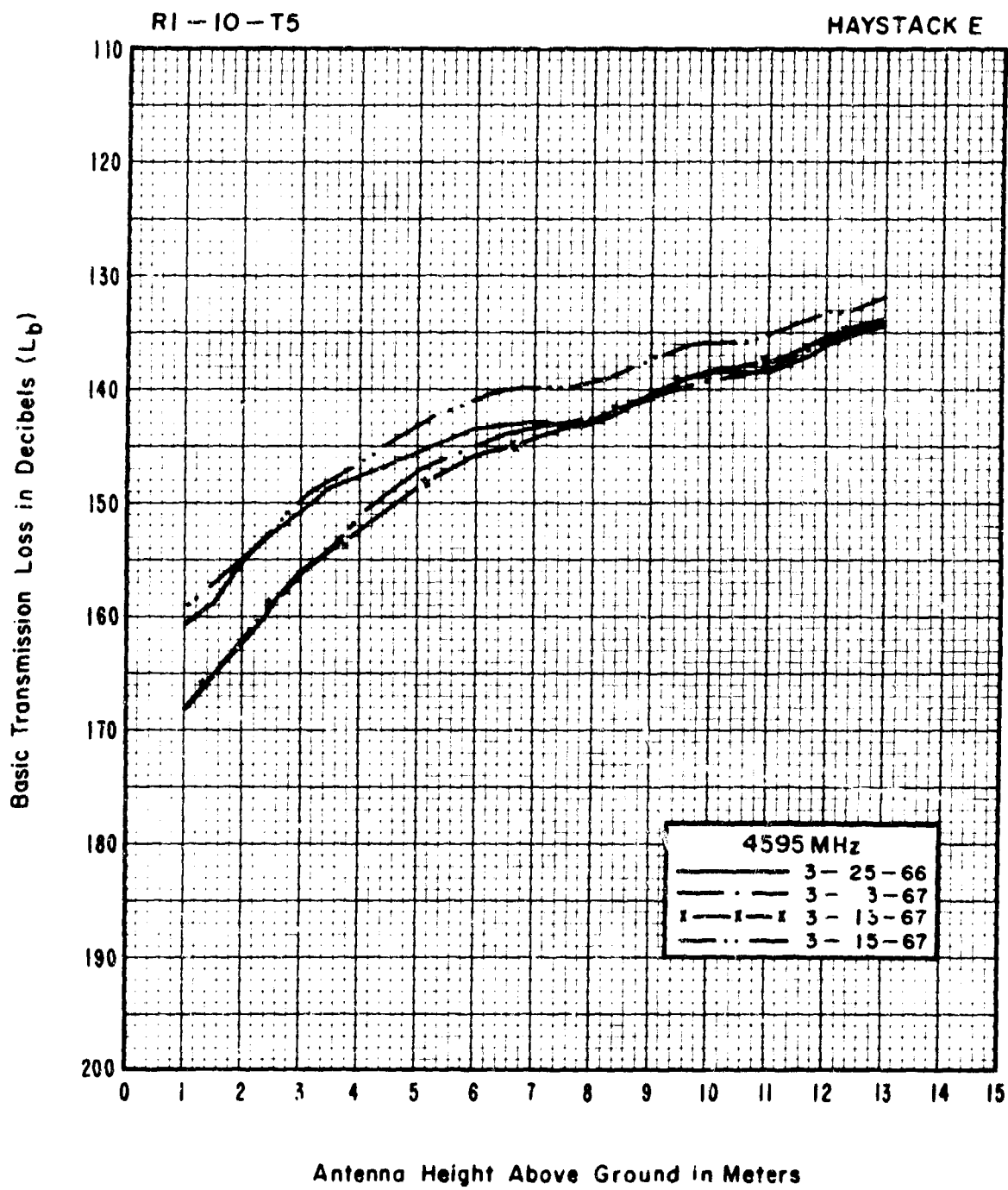
Freq (MHz)	230	410	751	910	1846	4595	9190
	6-20-66 at 13 M				3-25-66 at 7.3 M		
50%	109.9	109.7	111.3	122.3	132.7	142.4	149.6
$\Delta 10\%-90\%$	< 3	< 3	< 3	< 3	< 3	< 3	< 3

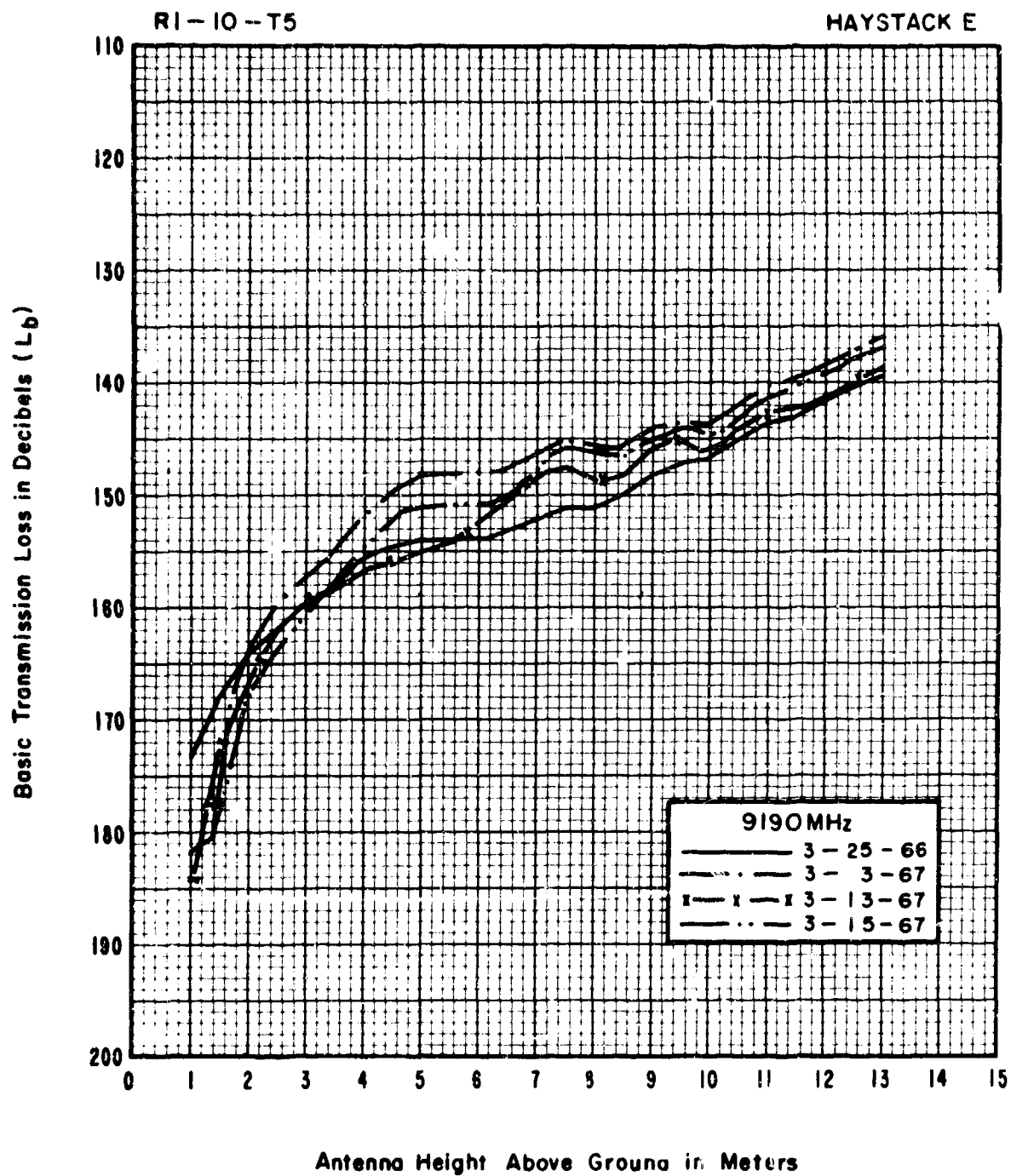
The path extends across rolling, grass-covered terrain. Farm houses and scattered trees appear about 2 mi away and continue to the horizon, which is 3 mi from the transmitter. In the immediate foreground, a power line and a supporting cable rise 20 ft to the left of the path.



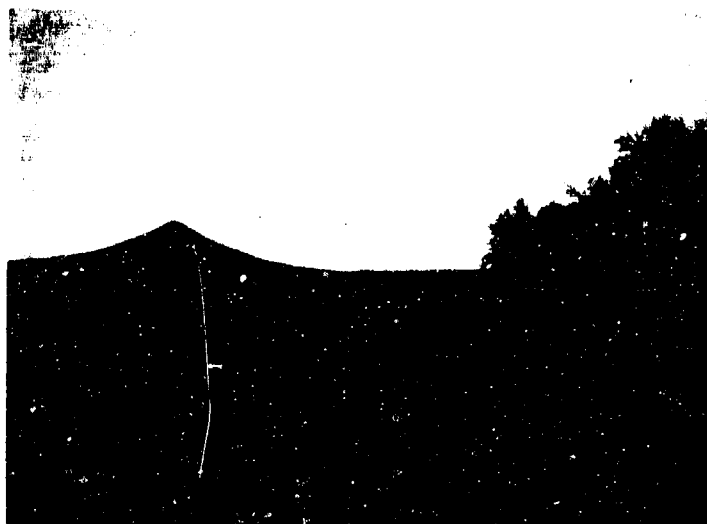




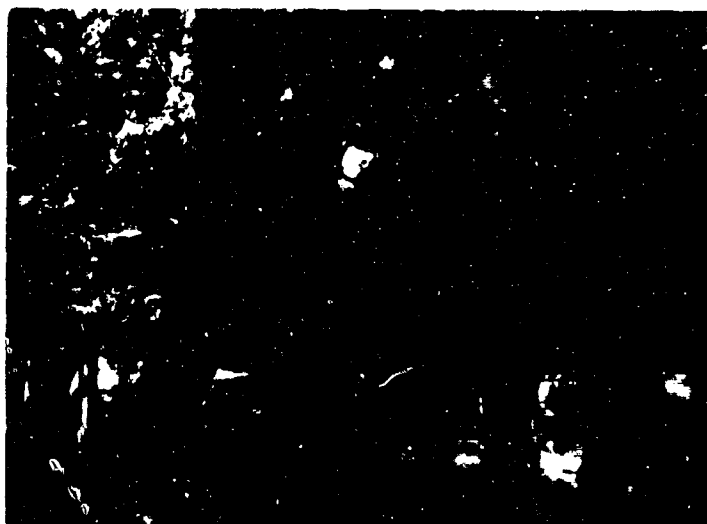




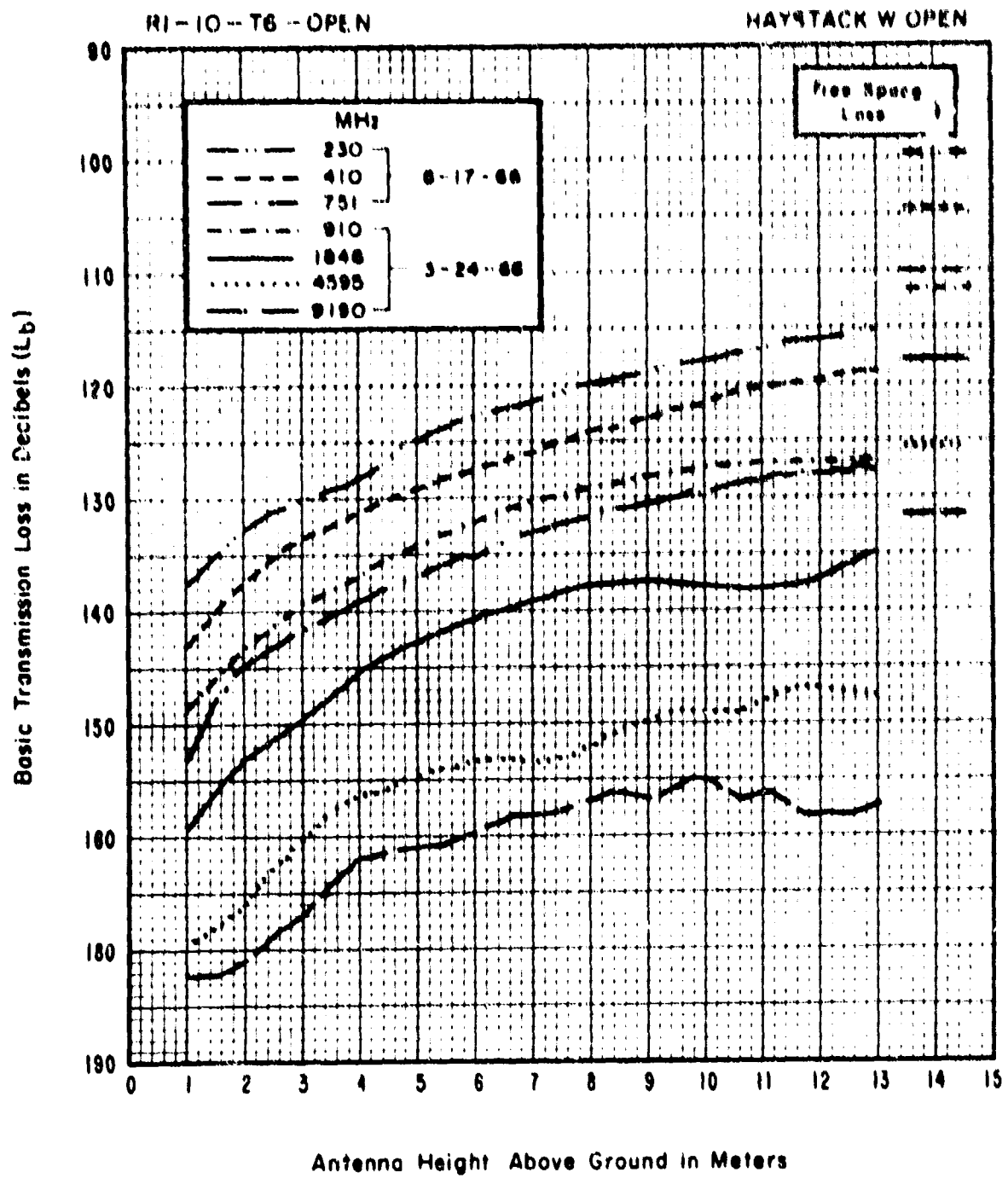
RI-10-T6 OPEN AND CONCEALED
HAYSTACK WEST



PATH VIEW FROM OPEN SITE



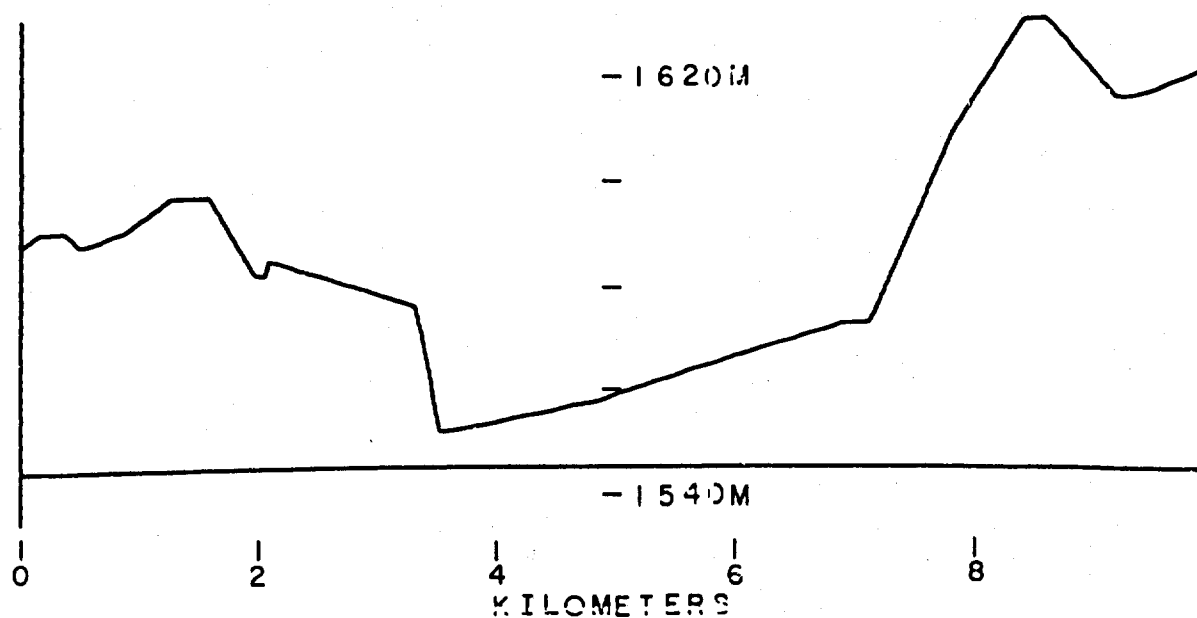
PATH VIEW FROM CONCEALED SITE



RCVR. ELEV.
1589 M

R1-10-T6 OPEN
PATH LENGTH 9.92 km

XMTR. ELEV.
1621 M



L_b (dB) SHORT TERM SIGNAL VARIABILITY

Freq (MHz)	230	410	751	910	1846	4595	9190
	6-17-66 at 13 M				3-24-66 at 7.3 M		
50%	115.9	117.2	126.0	131.6	137.7	152.7	156.7
$\Delta 10\%-90\%$	< 3	< 3	< 3	< 3	< 3	< 3	< 3

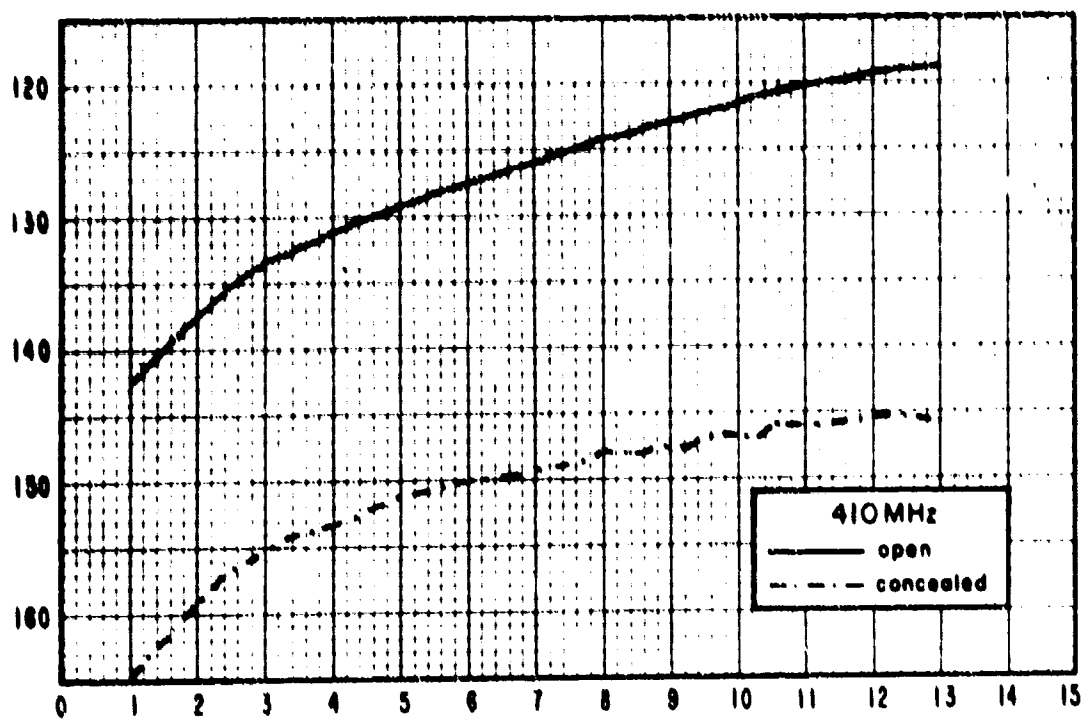
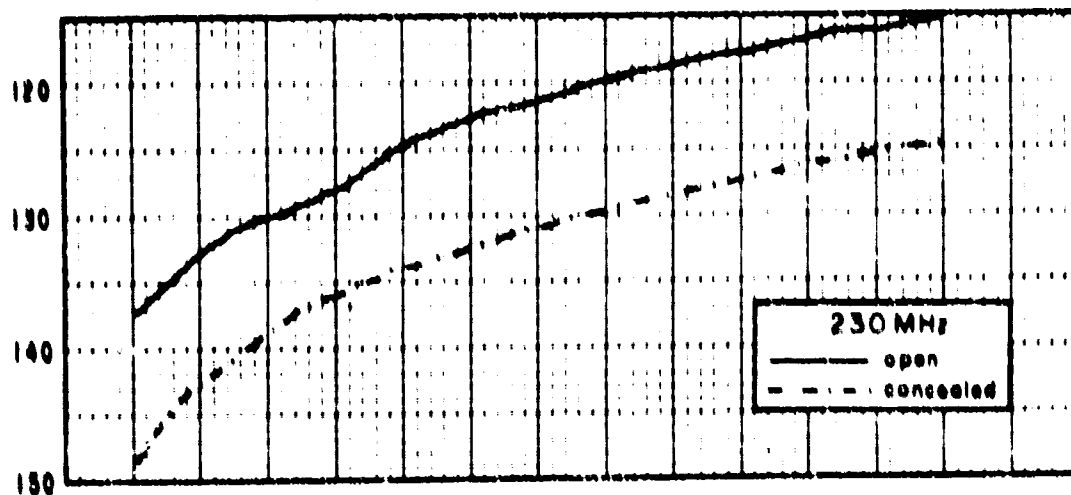
Open pastures extend for 1-1/4 mi to a cone-shaped hill, 250 ft high, at the horizon. There are no other obstructions. A grove of cottonwood trees lies immediately to the left of the path.

RI-10-T6 OLC

17 JUNE 1966

HAYSTACK W

Basic Transmission Loss in Decibels (L_b)

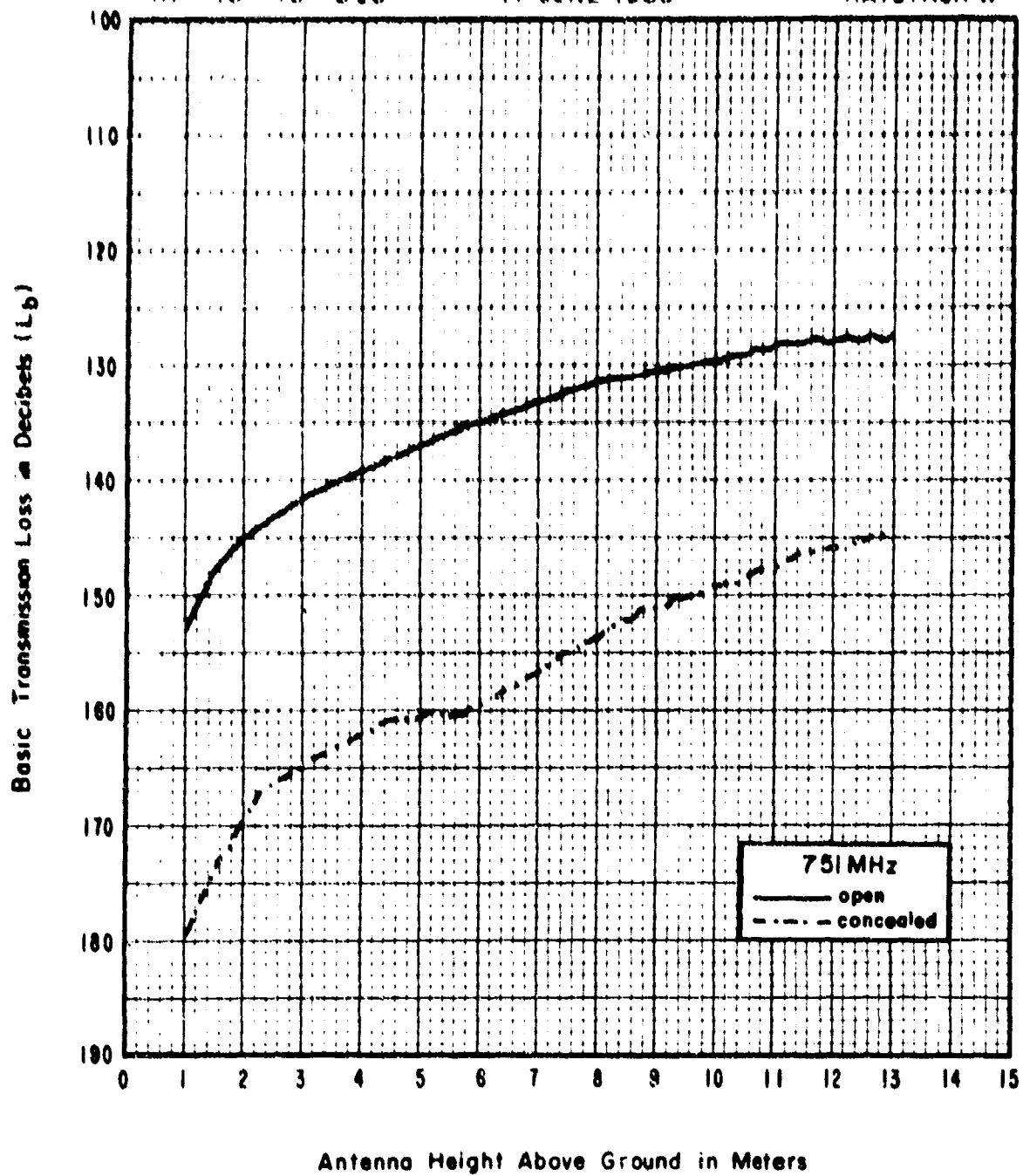


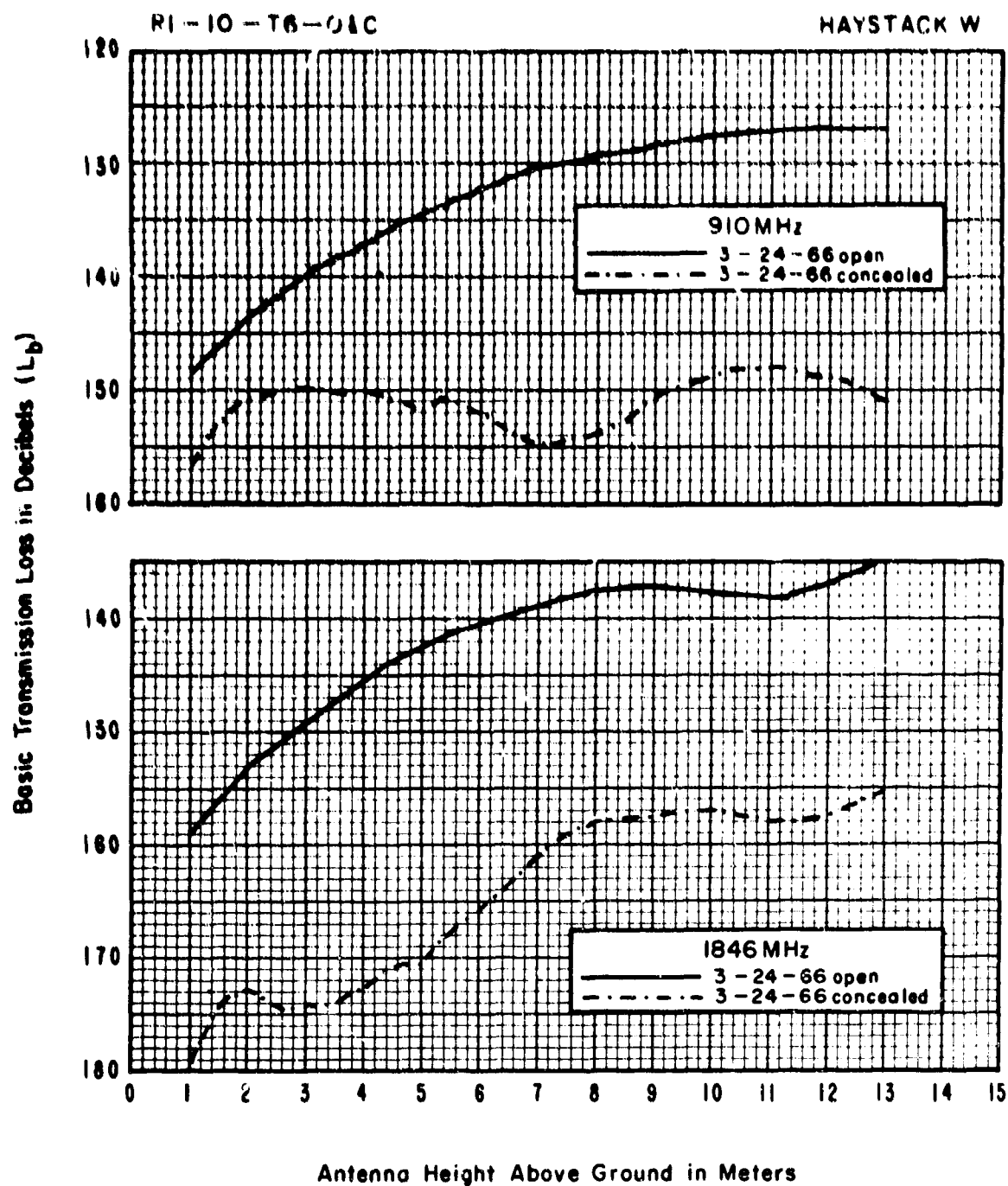
Antenna Height Above Ground in Meters

RI - 10 - T8 - 01C

17 JUNE 1966

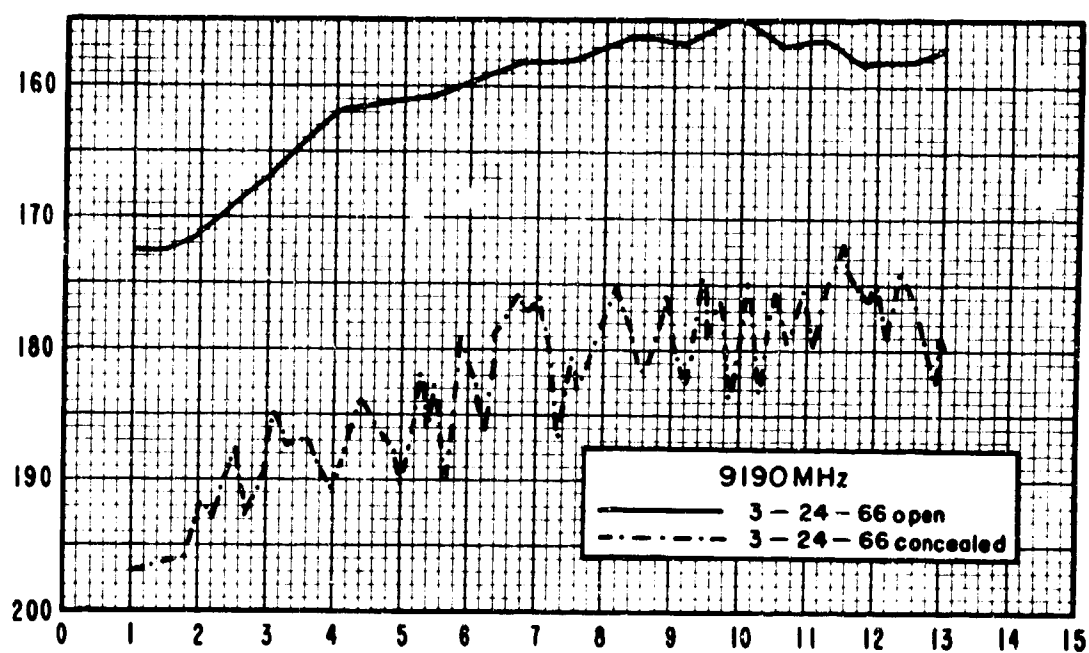
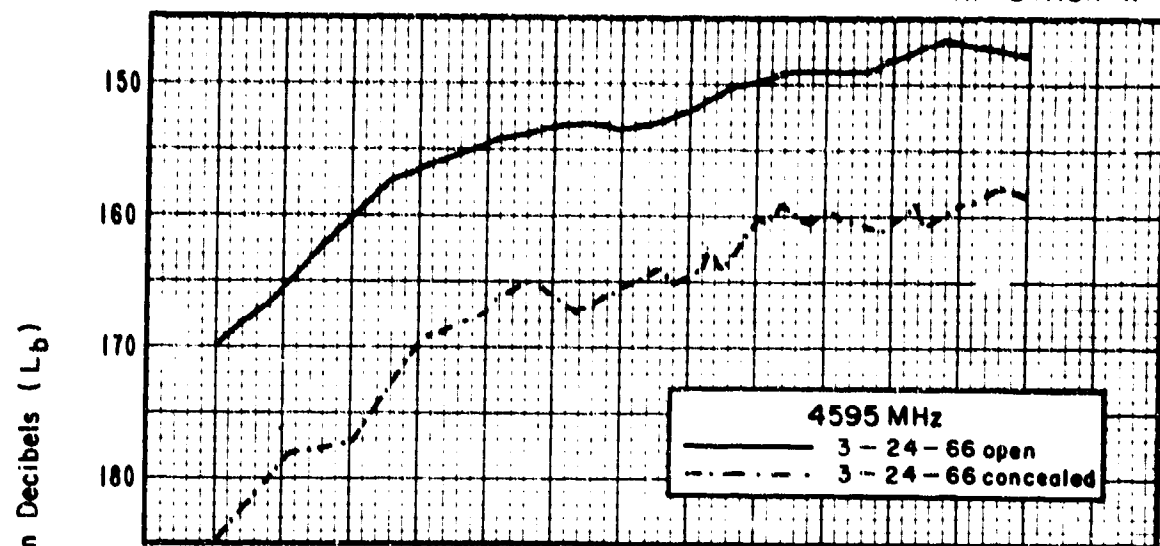
HAYSTACK W





RI-10-T6-O&C

HAYSTACK W

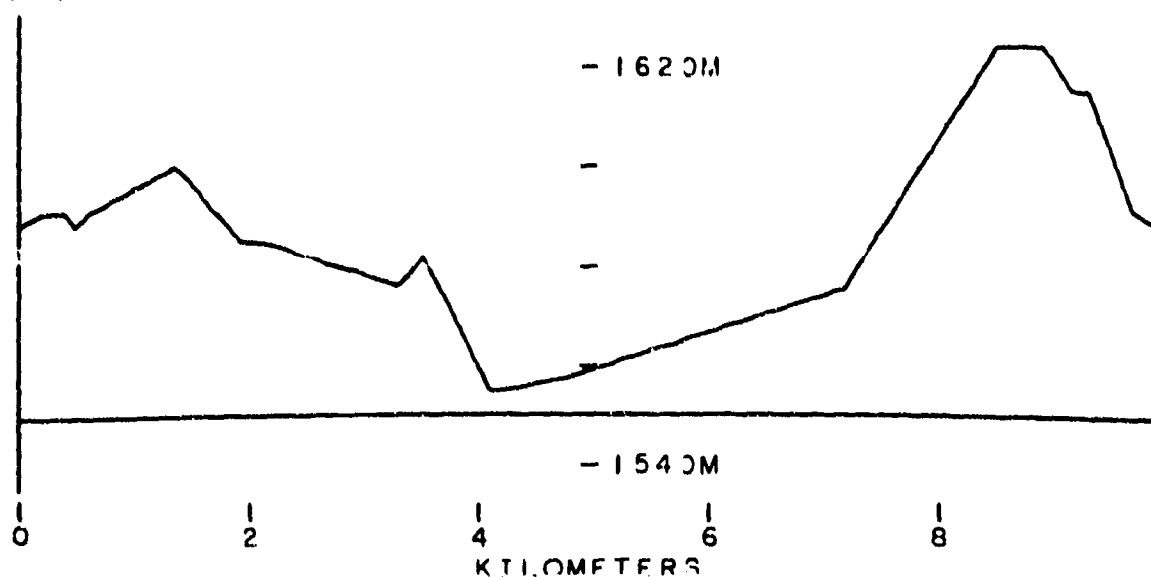


Antenna Height Above Ground in Meters

RCVR. ELEV.
1589 M

RI-10-T6 CONCEALED
PATH LENGTH 9.90 km

XMTR. ELEV.
1620 M



L_b (dB) SHORT TERM SIGNAL VARIABILITY

Freq (MHz)	230	410	751	910	1346	4595	9190
	6-17-66 at 13 M			3-24-66 at 7.3 M			
50%	124.6	145.8	144.8	129.8	137.7	152.7	156.7
$\Delta 10\%-90\%$	< 3	< 3	< 3	< 3	< 3	< 3	< 3

The antennas are concealed behind a stand of cottonwood trees. The path lies through trees 200 ft deep and 40 ft high. Pasture land extends from the trees to a large knoll 1-1/4 mi distant at the horizon.

R1-10-T7
TABLE MOUNTAIN EAST



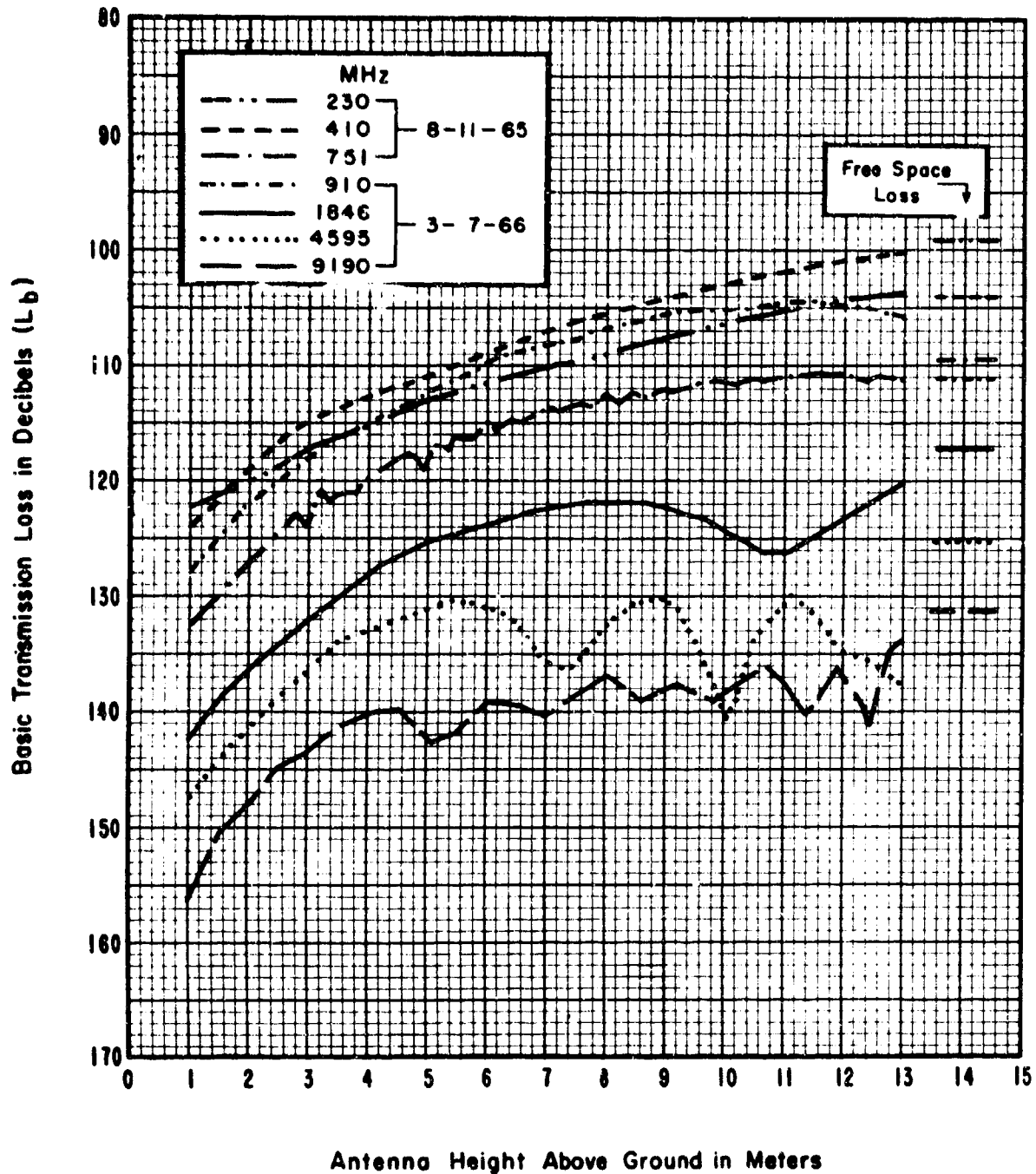
PATH VIEW FROM RECEIVER



PATH VIEW FROM TRANSMITTER

RI-10-T7

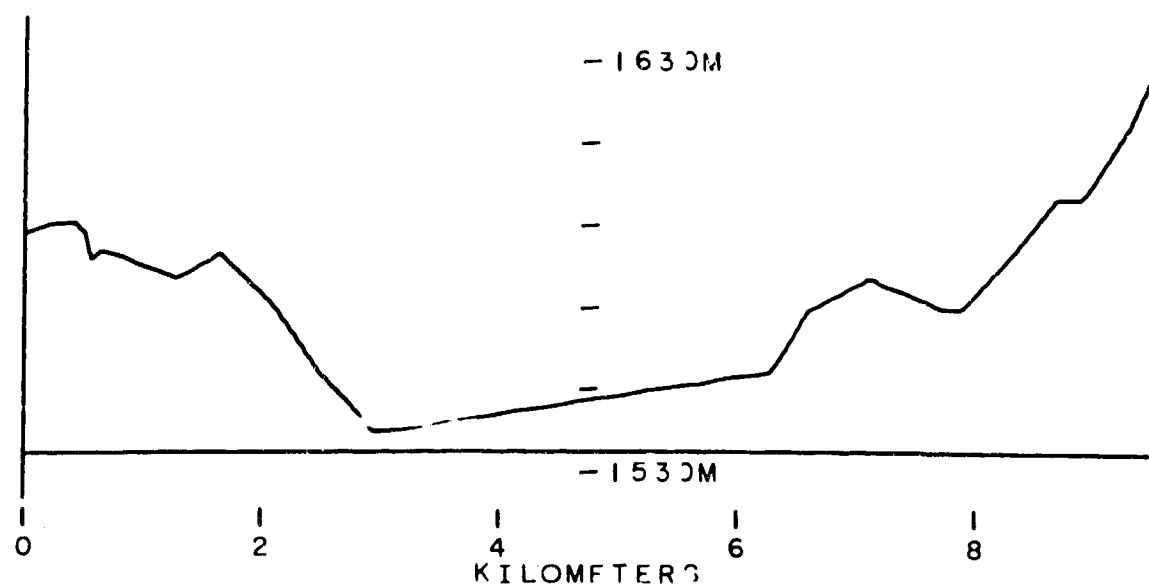
TABLE MOUNTAIN



RCVR. ELEV.
1589 M

R1-10-T7
PATH LENGTH 9.52 km

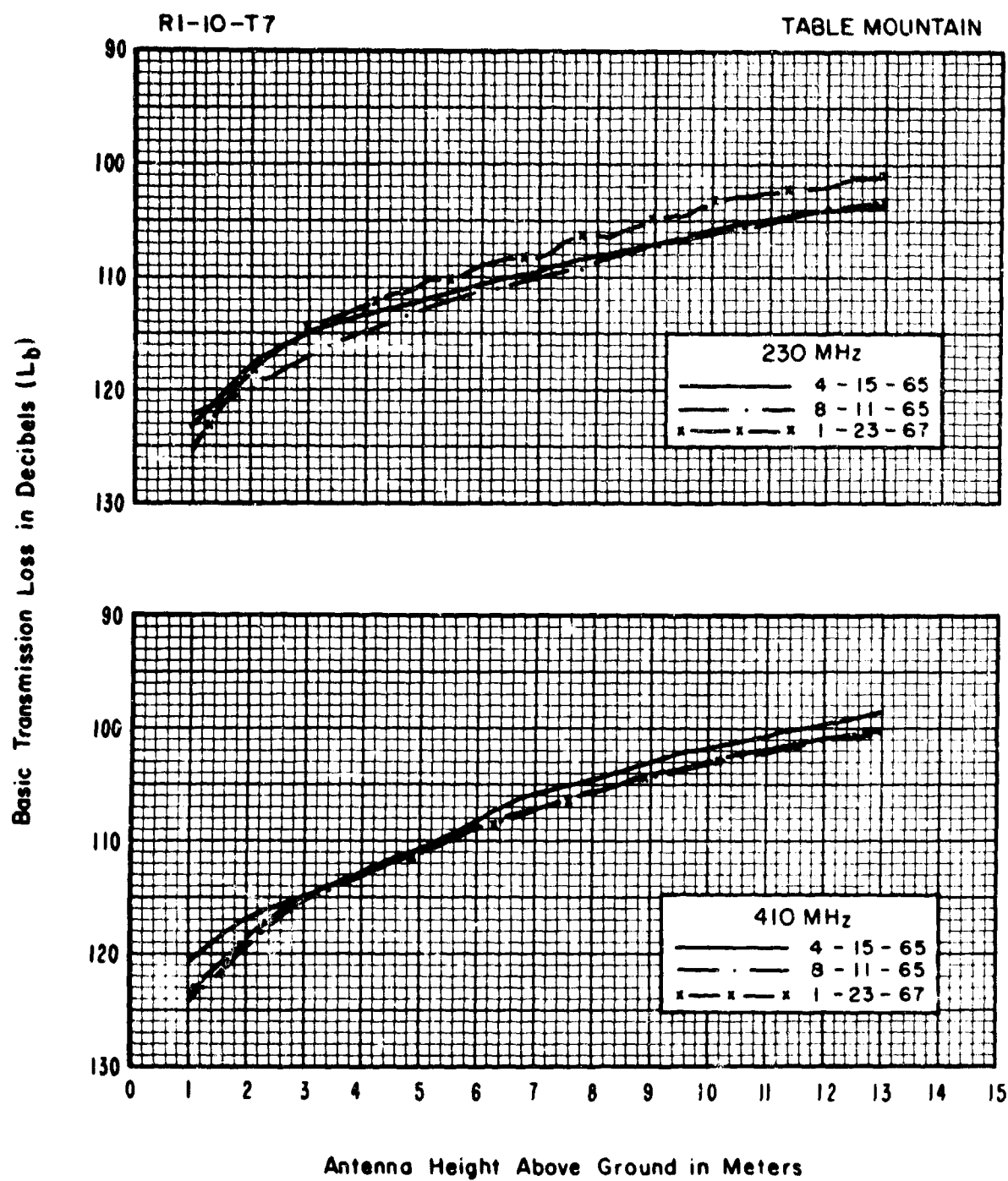
XMT
1589 M



L_b (dB), SHORT TERM SIGNAL VARIABILITY

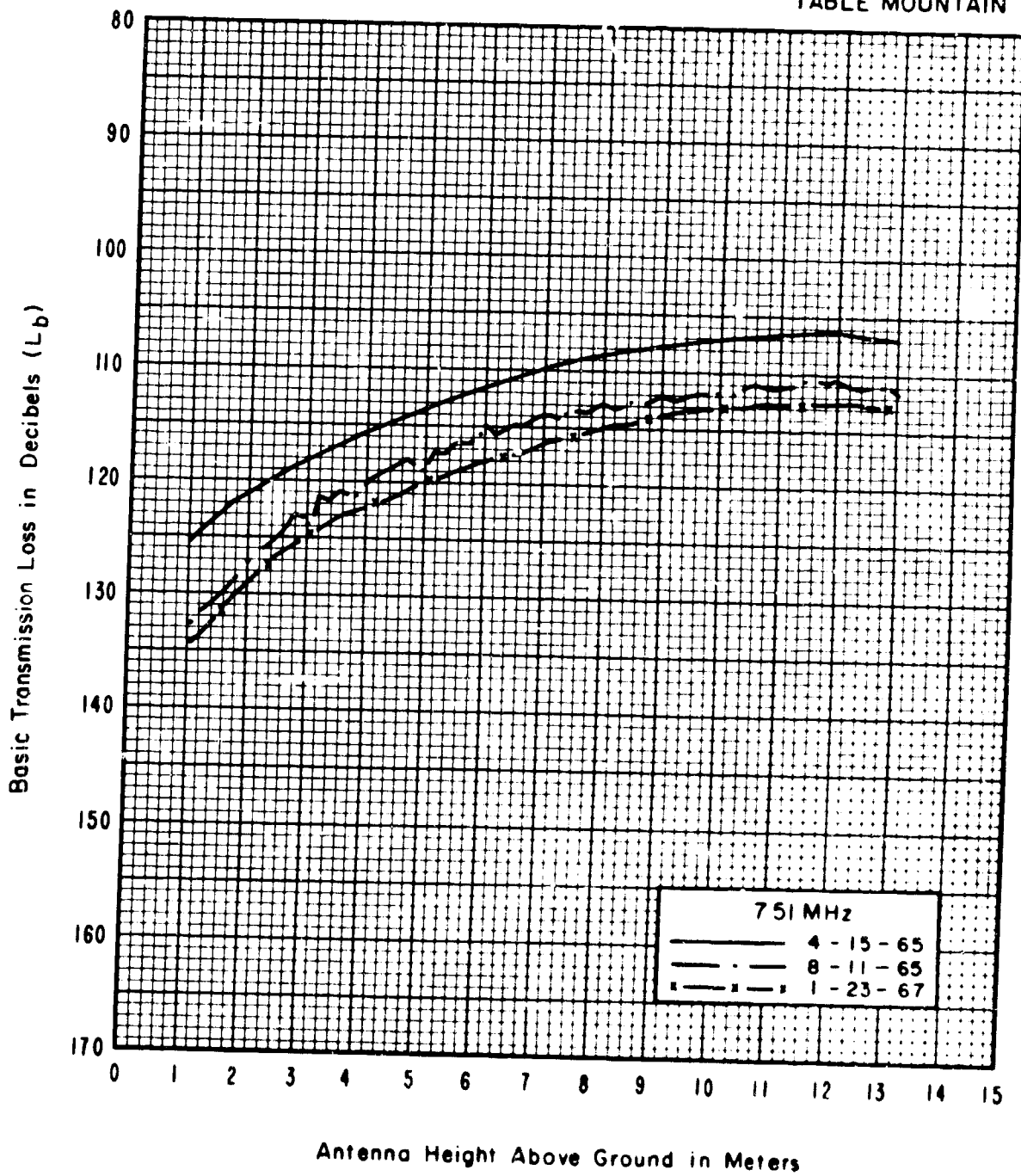
Freq (MHz)	230	410	751	910	1846	4595	9190
	8-11-65 at 13 M				3-7-66 at 7.3 M		
50%	106.1	100.9	113.6	107.9	121.9	135.5	138.6
$\Delta 10\%-90\%$	<3	<3	<3	<3	<3	<3	<3

The immediate foreground of pastures is below the ray path and extends to a thin line of cottonwood trees 100 yd away. The trees are about 50 ft tall. Beyond are another 100 yd of grass-land and a second thin line of cottonwoods. The rest of the path is over rolling, hilly country.



RI-10-T7

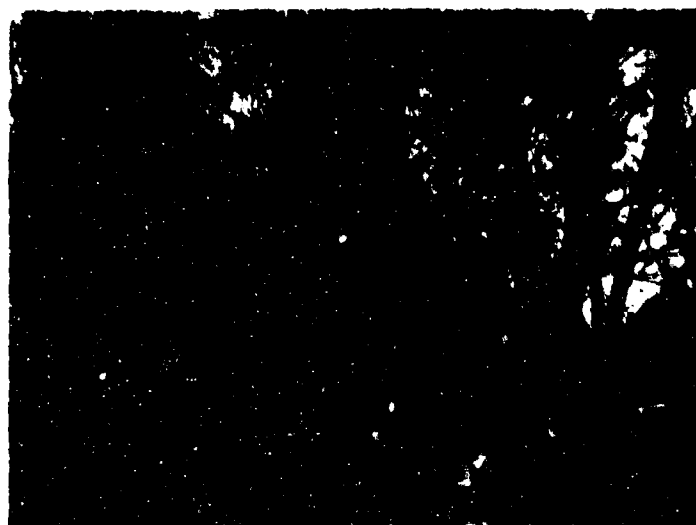
TABLE MOUNTAIN



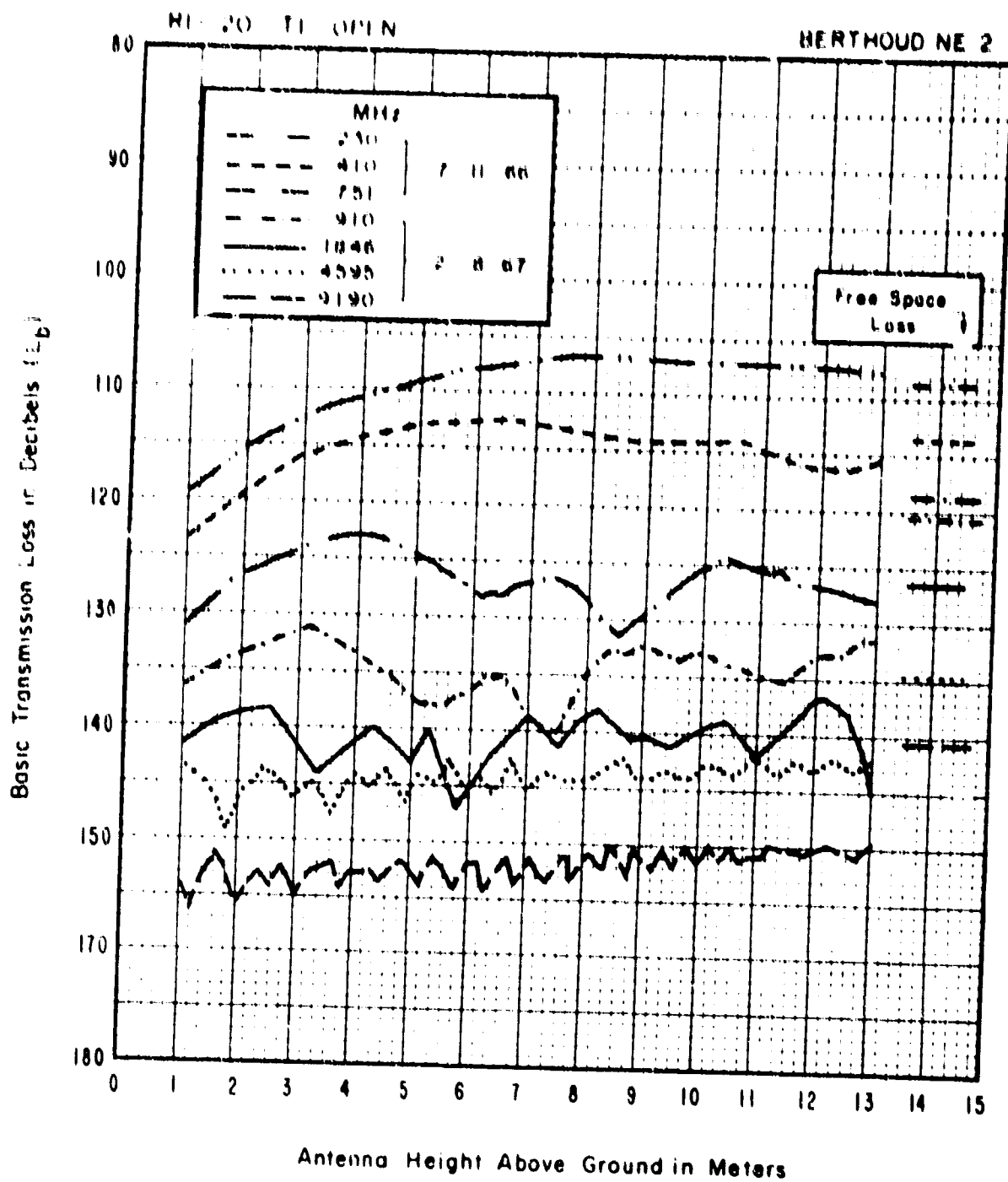
RI-20-T1 OPEN AND CONCEALED
BERTHOUD NE2

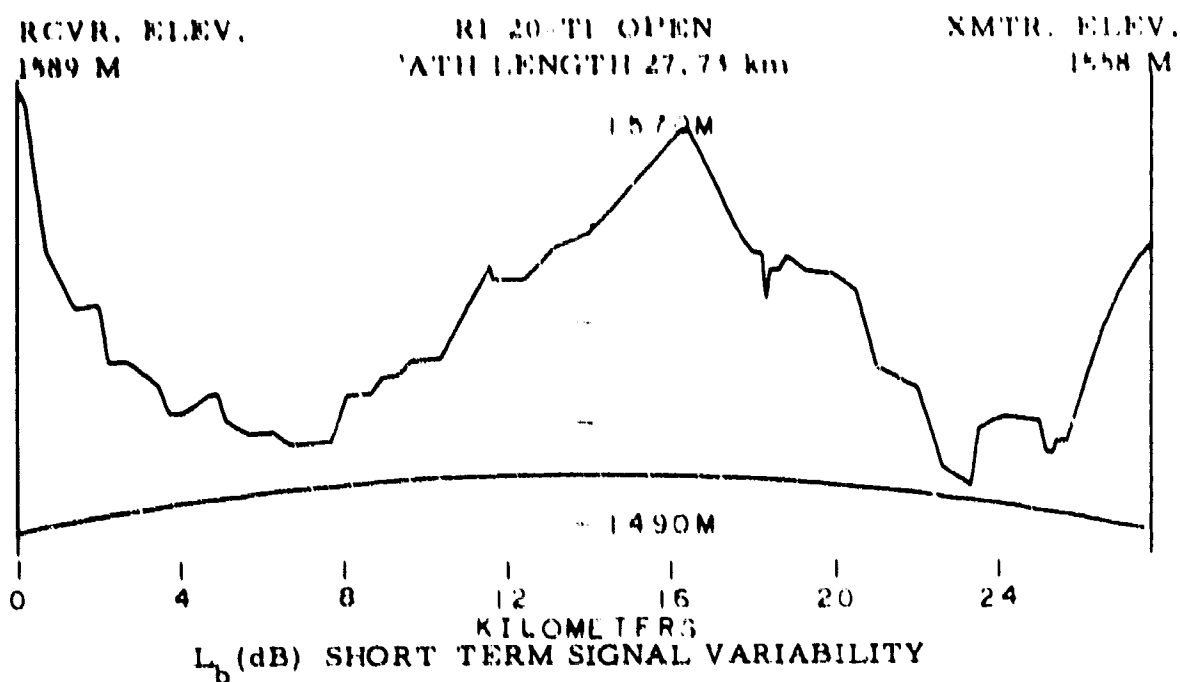


PATH VIEW FROM OPEN SITE



PATH VIEW FROM CONCEALED SITE





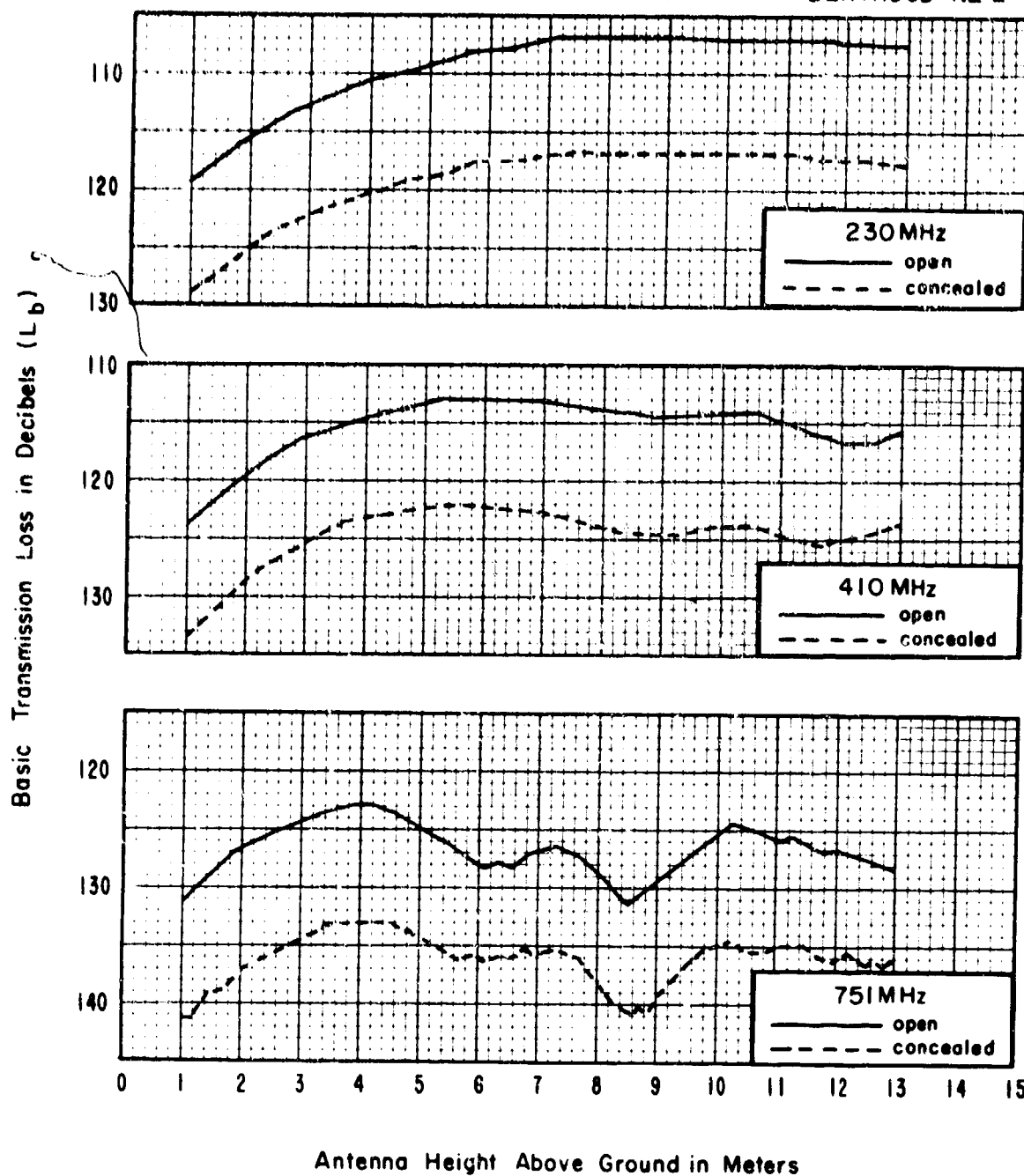
Freq (MHz)	230	410	751	910	1846	4595	9190
	7-11-66 at 13 M				2-8-67 at 7.3 M		
50%	108.1	113.4	127.3	137.0	141.3	144.8	152.6
$\Delta 10\%-90\%$	<3	<3	<3	<3	<3	<3	<3

The immediate foreground at this site is plowed farmland, extending for 1/4 mi to a 1/3-mi wide lake. Beyond, to the horizon, 7-1/2 mi away, the path is over pasture land with scattered trees.

RI-20-TI-O&C

11 JULY 1966

BERTHOUD NE 2

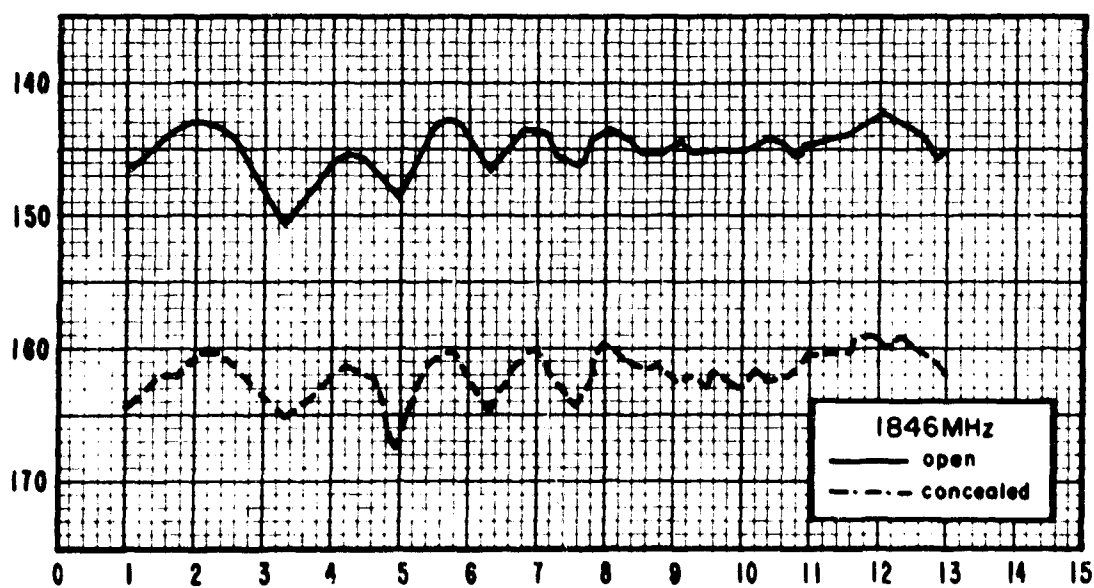
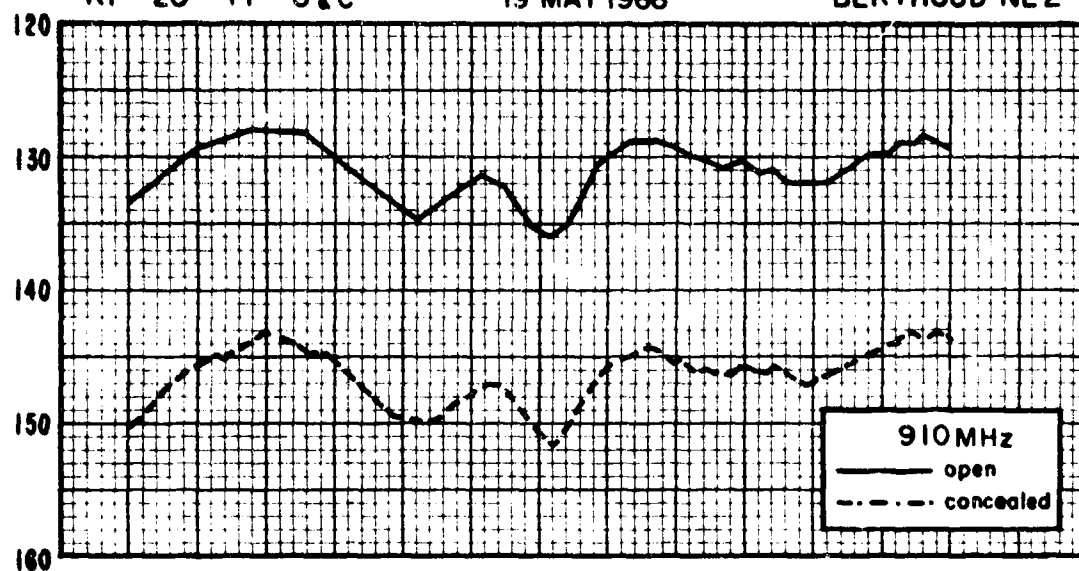


RI-20-TI-0&C

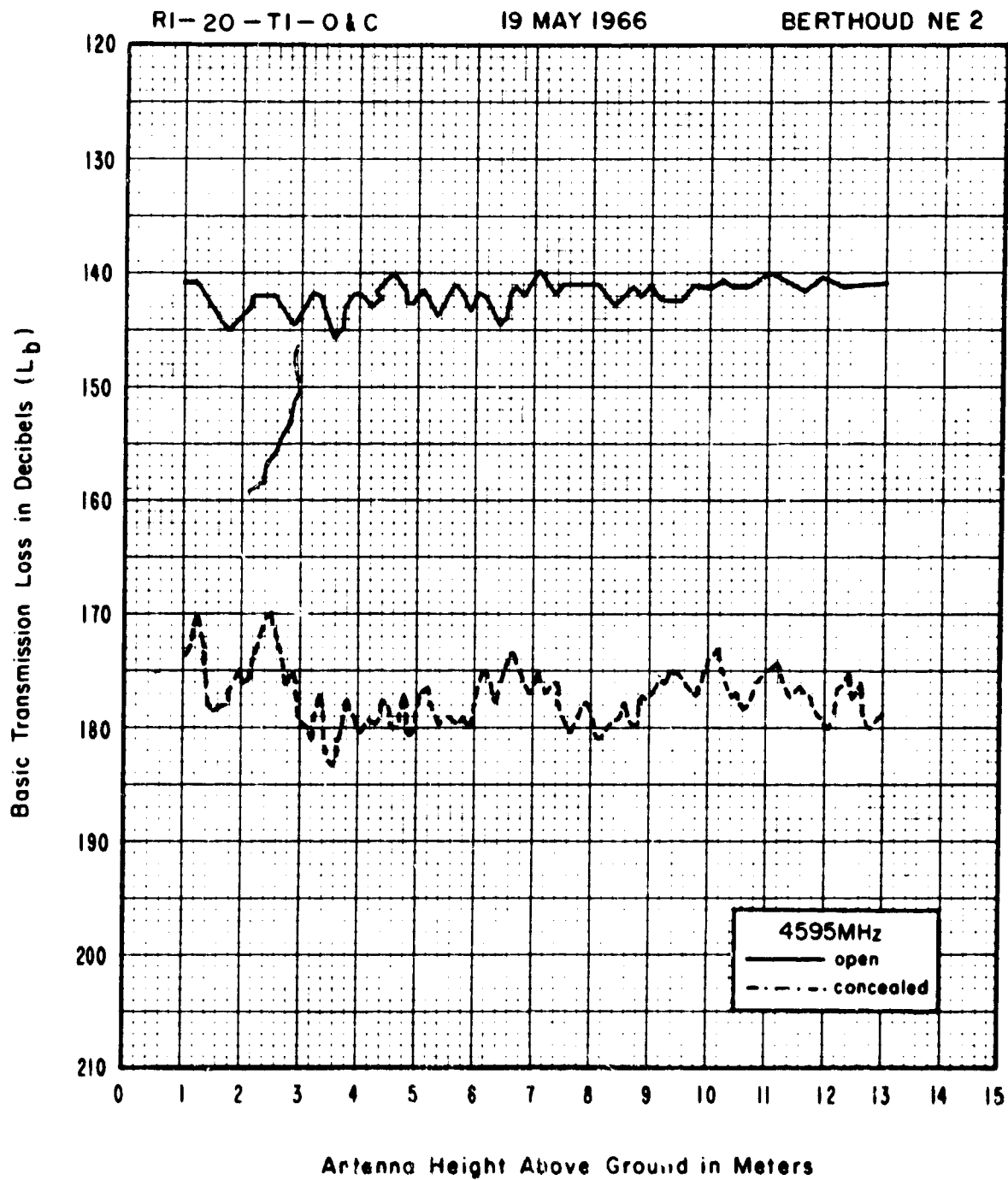
19 MAY 1966

BERTHOUD NE 2

Basic Transmission Loss in Decibels (L_b)



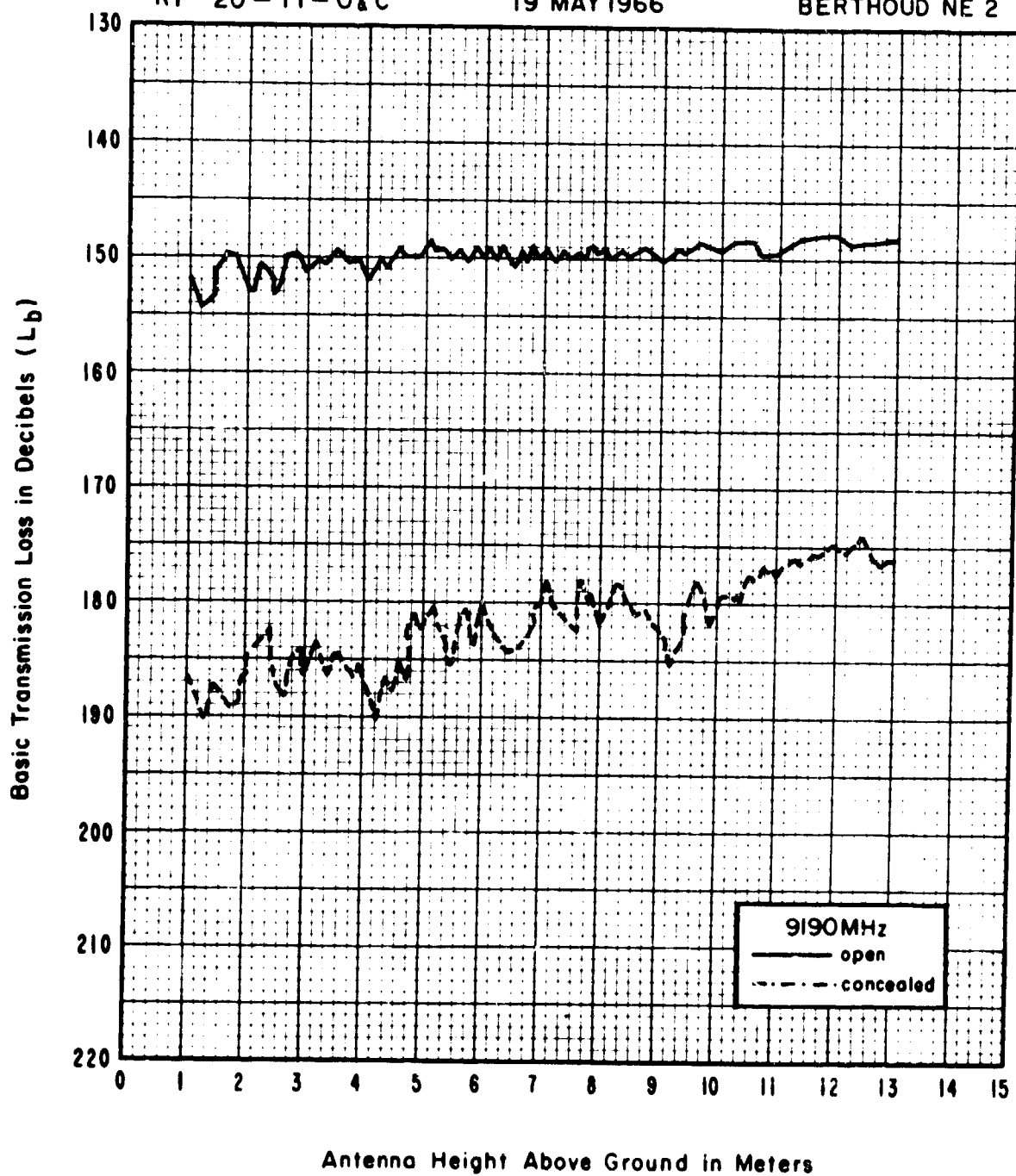
Antenna Height Above Ground in Meters



RI-20-TI-O&C

19 MAY 1966

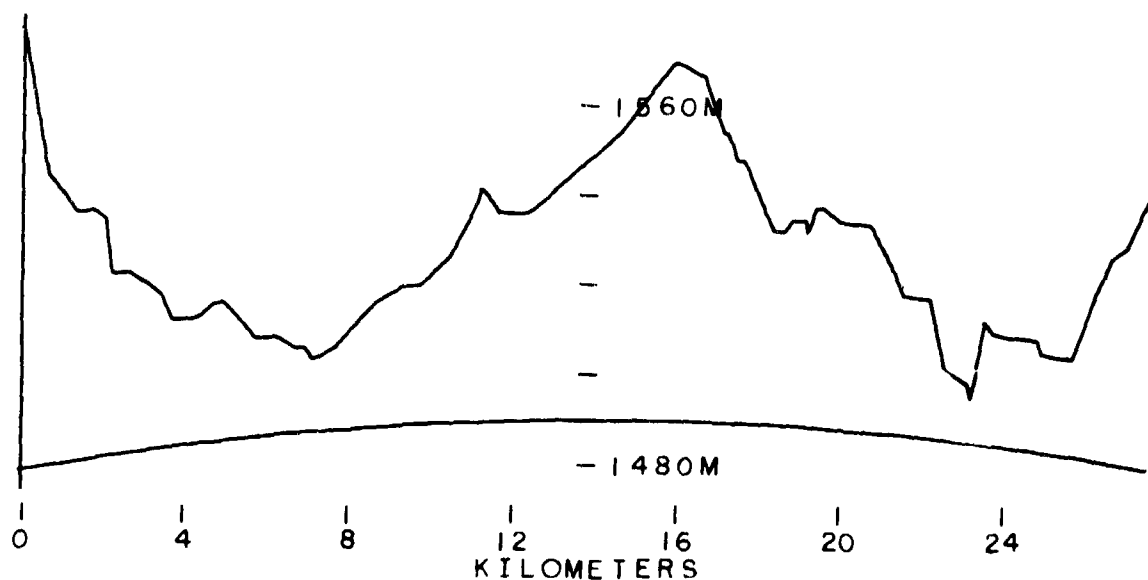
BERTHOUD NE 2



RCVR. ELEV.
1589 M

R1-20-T1 CONCEALED
PATH LENGTH 27.68 km

XMTR. ELEV.
1552 M

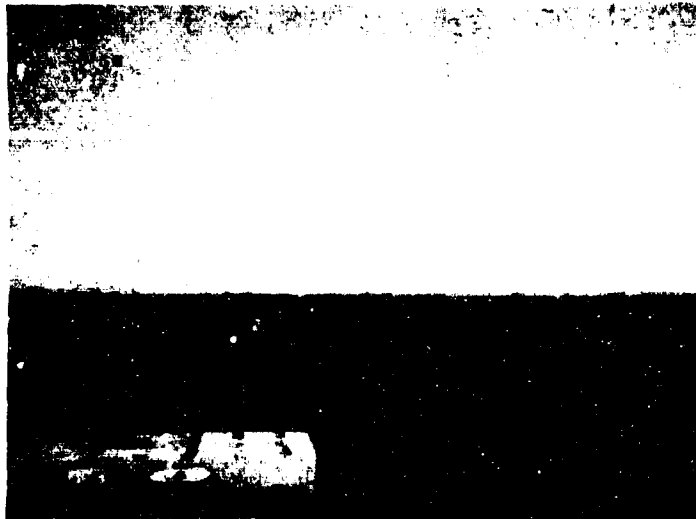


L_p (dB) SHORT TERM SIGNAL VARIABILITY

Freq (MHz)	230	410	751	910	1846	4595	9190
7-11-66 at 13 M				5-19-67 at 13 M			
50%	118.2	123.4	140.7	143.2	161.9	174.9	175.7
$\Delta 10\%-90\%$	<3	<3	<3	<3	3.0	7.0	6.4
7-11-66 at 7.3 M				5-19-67 at 7.3 M			
50%			136.7	150.2	162.5	175.3	180.3
$\Delta 10\%-90\%$			<3	<3	3.9	6.3	8.0
7-11-66 at 1 M				5-19-67 at 1 M			
			140.7	150.2	162.9	177.6	182.3
			<3	<3	<3	6.4	7.1

For concealment, the antennas are placed 20 ft behind a 150-ft deep thicket of cottonwood trees, 40-ft high. Beyond the trees, the path is over 1/4 mi of grassland and a small lake, 1/3 mi wide. From there to the horizon, 7-1/2 mi away, the ground cover is pasture with scattered trees.

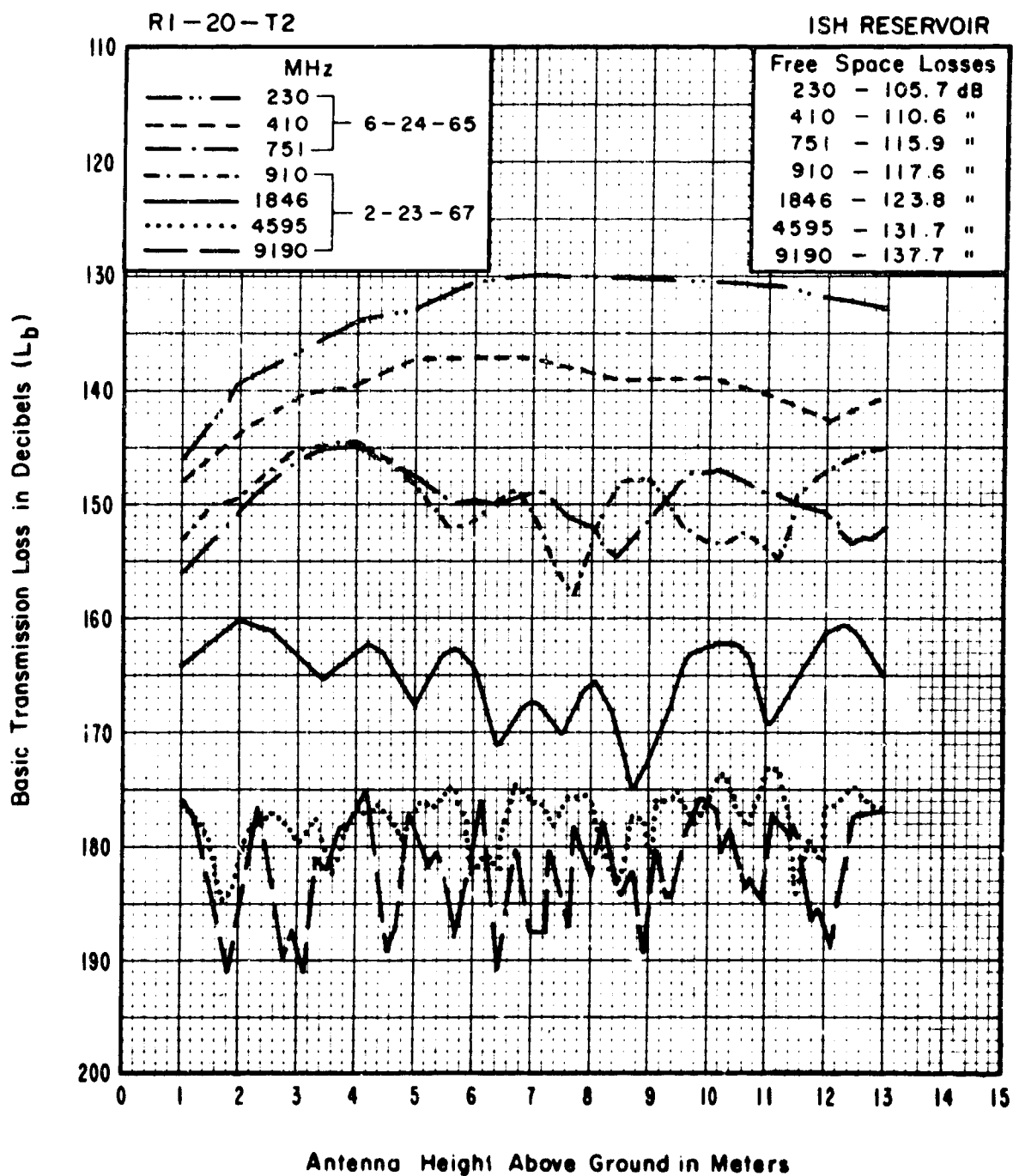
R1-20-T2
ISH RESERVOIR



PATH VIEW FROM RECEIVER



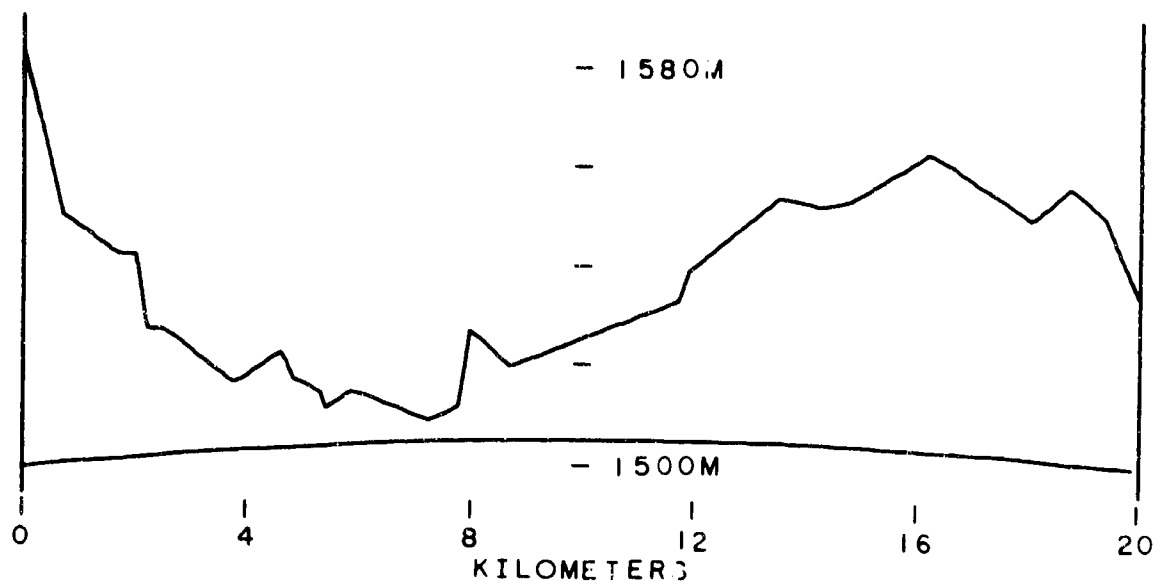
PATH VIEW FROM TRANSMITTER



RCVR. ELEV.
1589 M

R1-20-T2
PATH LENGTH 20.00 km

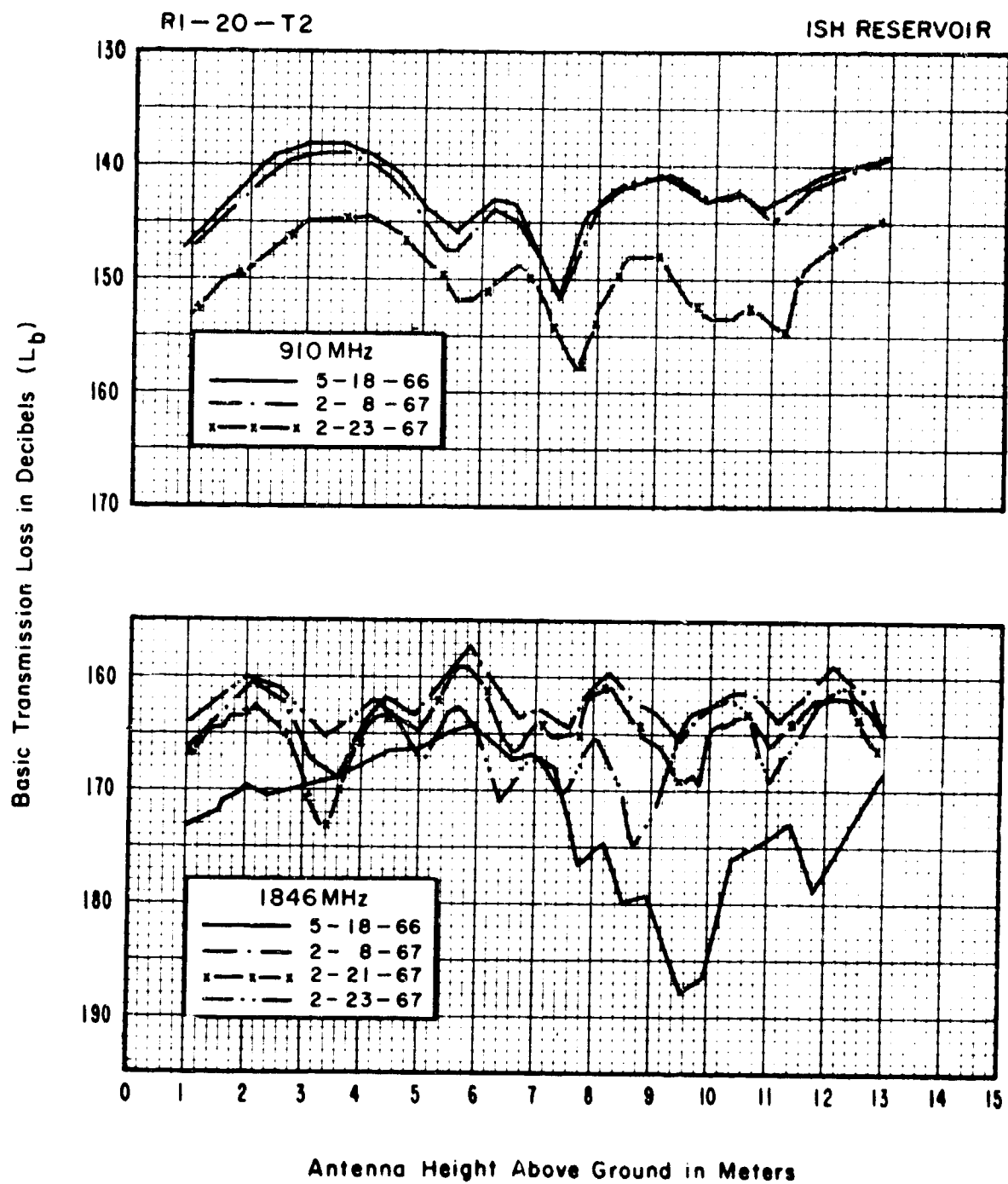
XMTR. ELEV.
1539 M

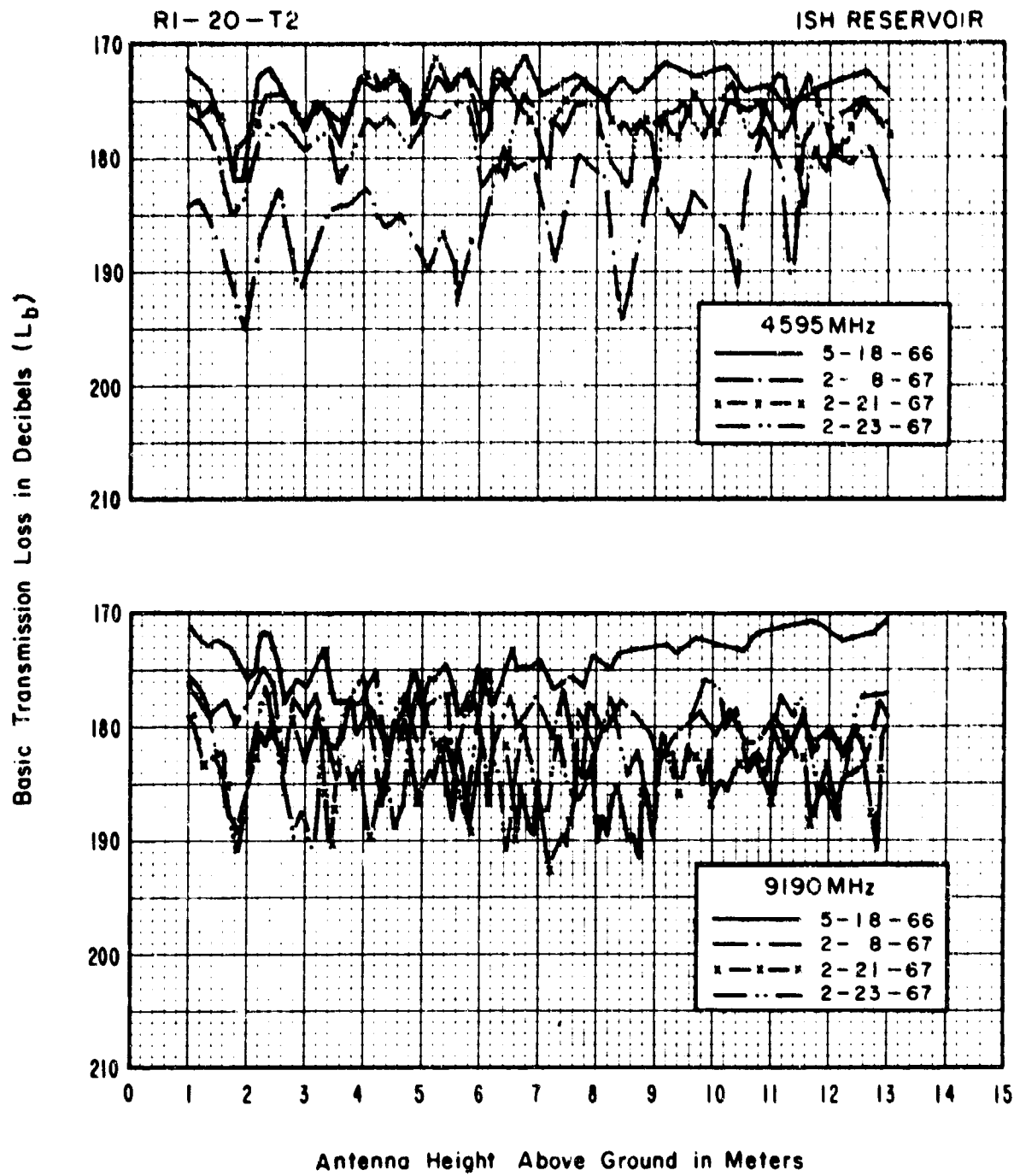


L_b (dB) SHORT TERM SIGNAL VARIABILITY

Freq (MHz)	230	410	751	910	1846	4595	9190
2-23-67 at 13 M							
50%				144.3	165.8	177.5	177.5
$\Delta 10\%-90\%$				< 3	< 3	< 3	4.7
2-23-67 at 7.3 M							
50%				156.3	167.8	176.0	182.5
$\Delta 10\%-90\%$				< 3	< 3	< 3	< 3
2-23-67 at 1 M							
50%				152.5	165.2	179.2	174.3
$\Delta 10\%-90\%$				< 3	< 3	< 3	< 3

The path extends over stubble wheat to the horizon, 1-1/2 mi distant. To the left of the path, and approximately parallel to it, are railroad tracks which curve away at the horizon. A narrow irrigation ditch enters the path, bends sharply, and leaves it 150 yd from the transmitter.

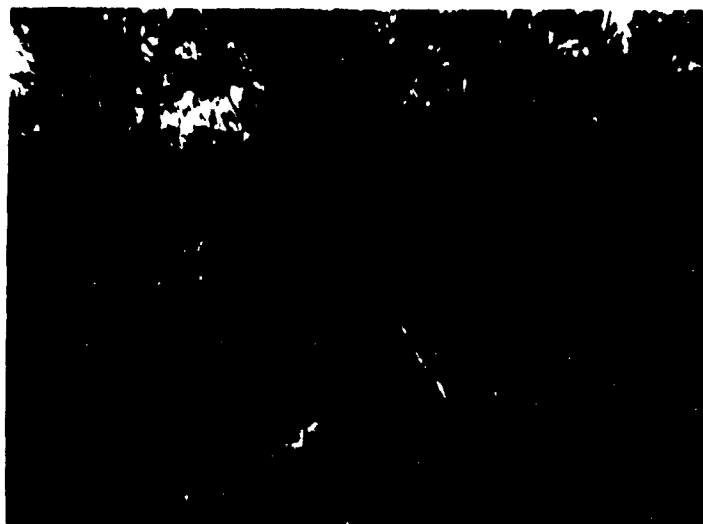




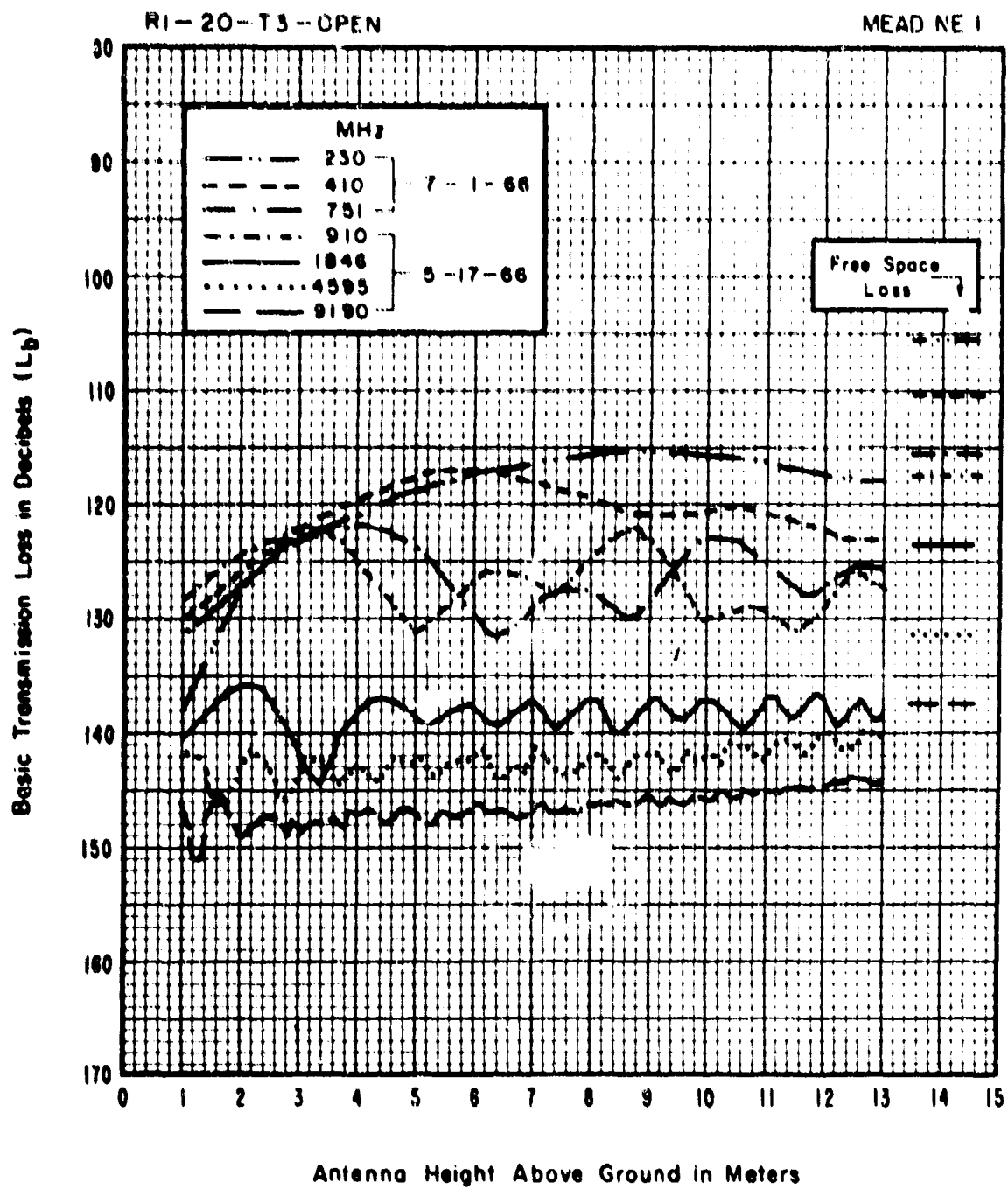
RI-20-T3 OPEN AND CONCEALED
MEAD NEI



PATH VIEW FROM OPEN SITE



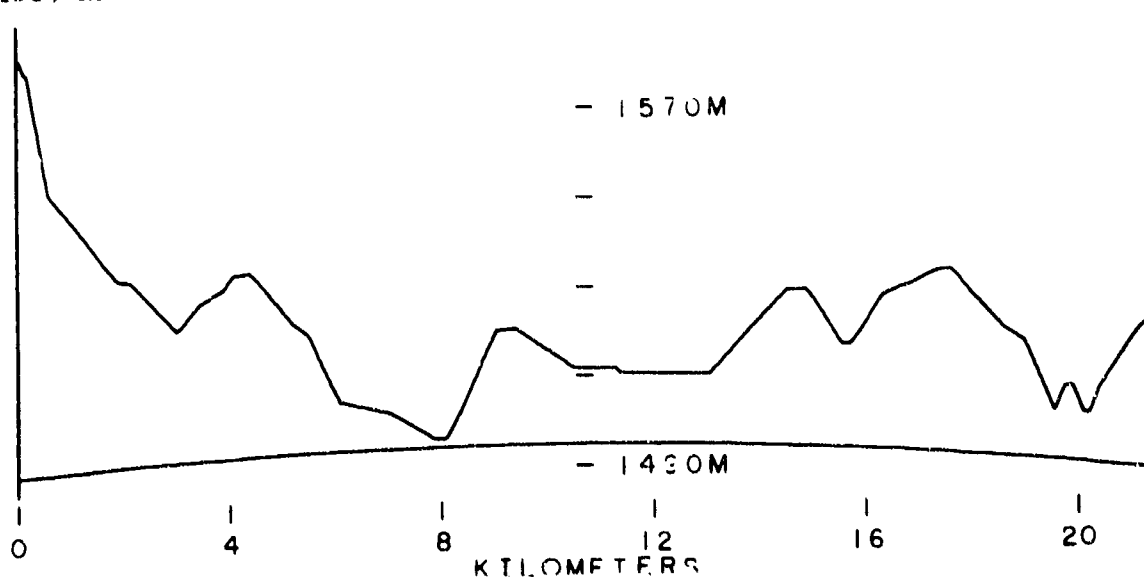
PATH VIEW FROM CONCEALED SITE



RCVR. ELEV.
1589 M

R1-20-T3 OPEN
PATH LENGTH 21.39 km

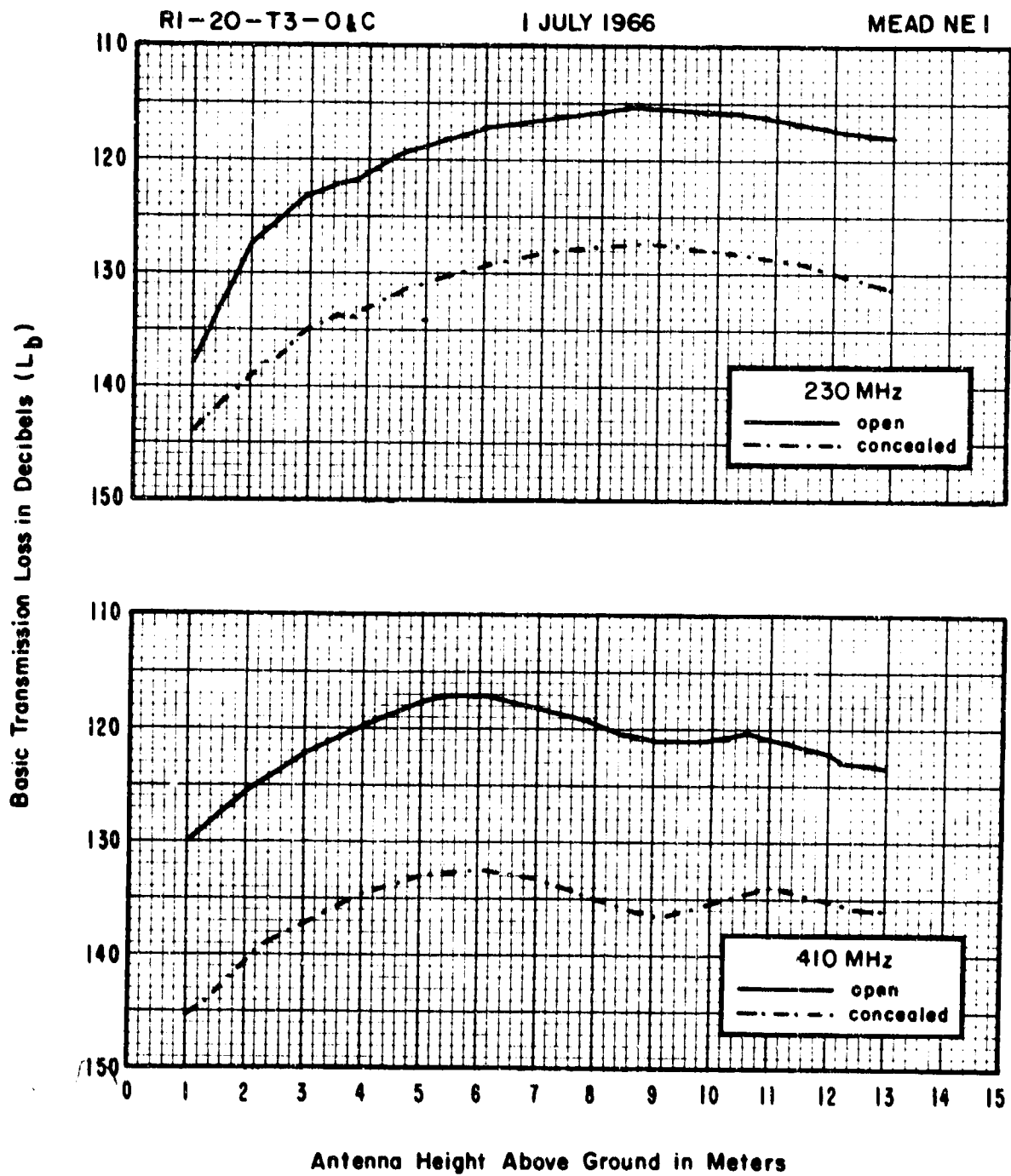
ΔMTR. ELEV.
1529 M



L_b (dB) SHORT TERM SIGNAL VARIABILITY

Freq (MHz)	230	410	751	910	1846	4595	9190
7-1-66 at 13 M				5-17-66 at 13 M			
50%	118.5	121.2	125.9	125.3	138.5	140.0	142.7
Δ10%-90%	< 3	< 3	< 3	< 3	< 3	< 3	< 3
				5-17-66 at 7.3 M			
50%				128.0	139.4	140.9	143.4
Δ 10%-90%				< 3	< 3	< 3	< 3
				5-17-66 at 1 M			
50%				128.5	140.2	140.0	146.9
Δ10%-90%				< 3	< 3	< 3	< 3

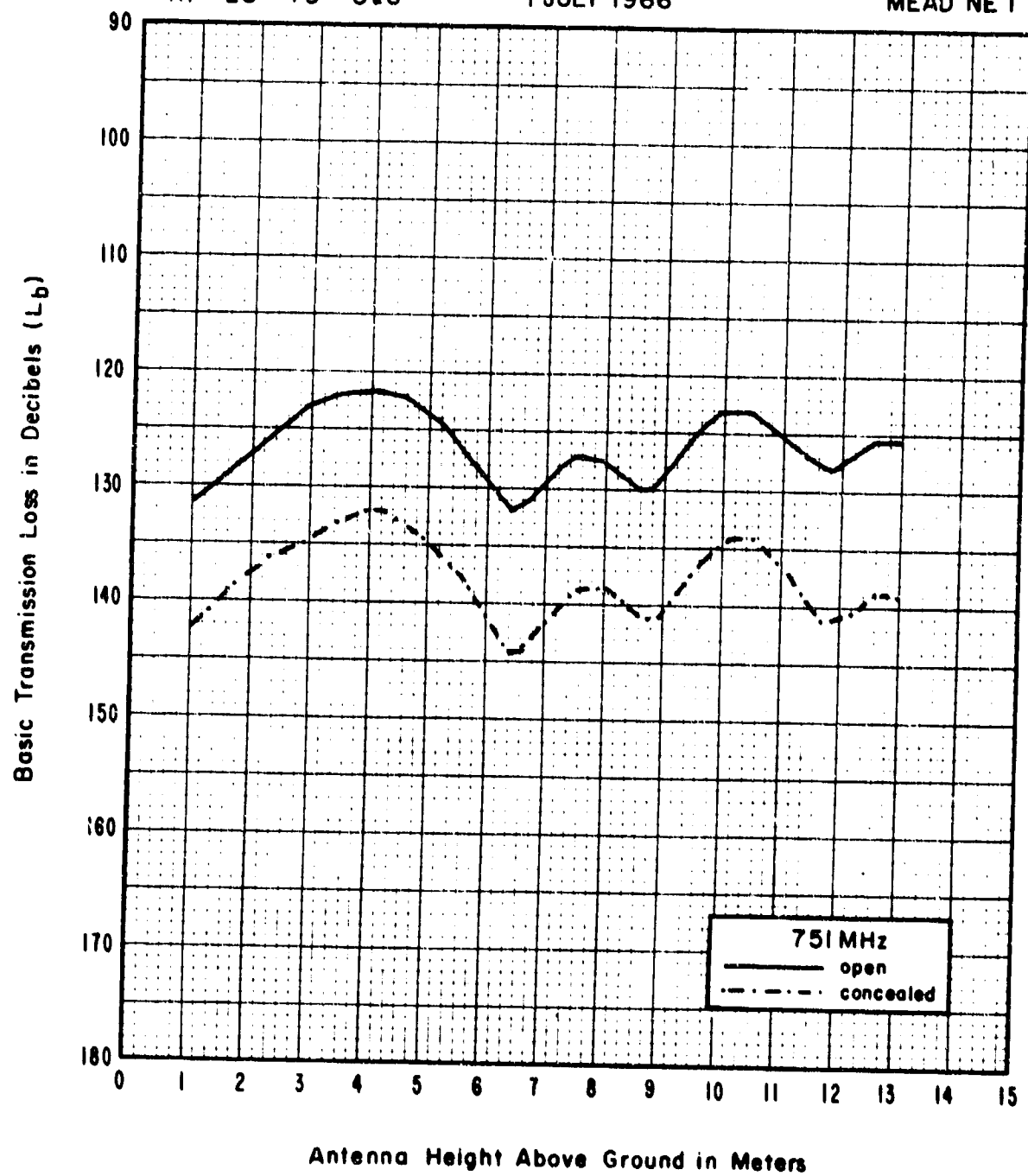
The path is over 150 ft of grass to a strip of plowed ground, with a low wire fence crossing the path 100 yd away at 45°. A 5-wire telephone line parallels the fence at 500 yd. Grassland extends to the horizon, 4 mi away, where there are scattered trees and houses.

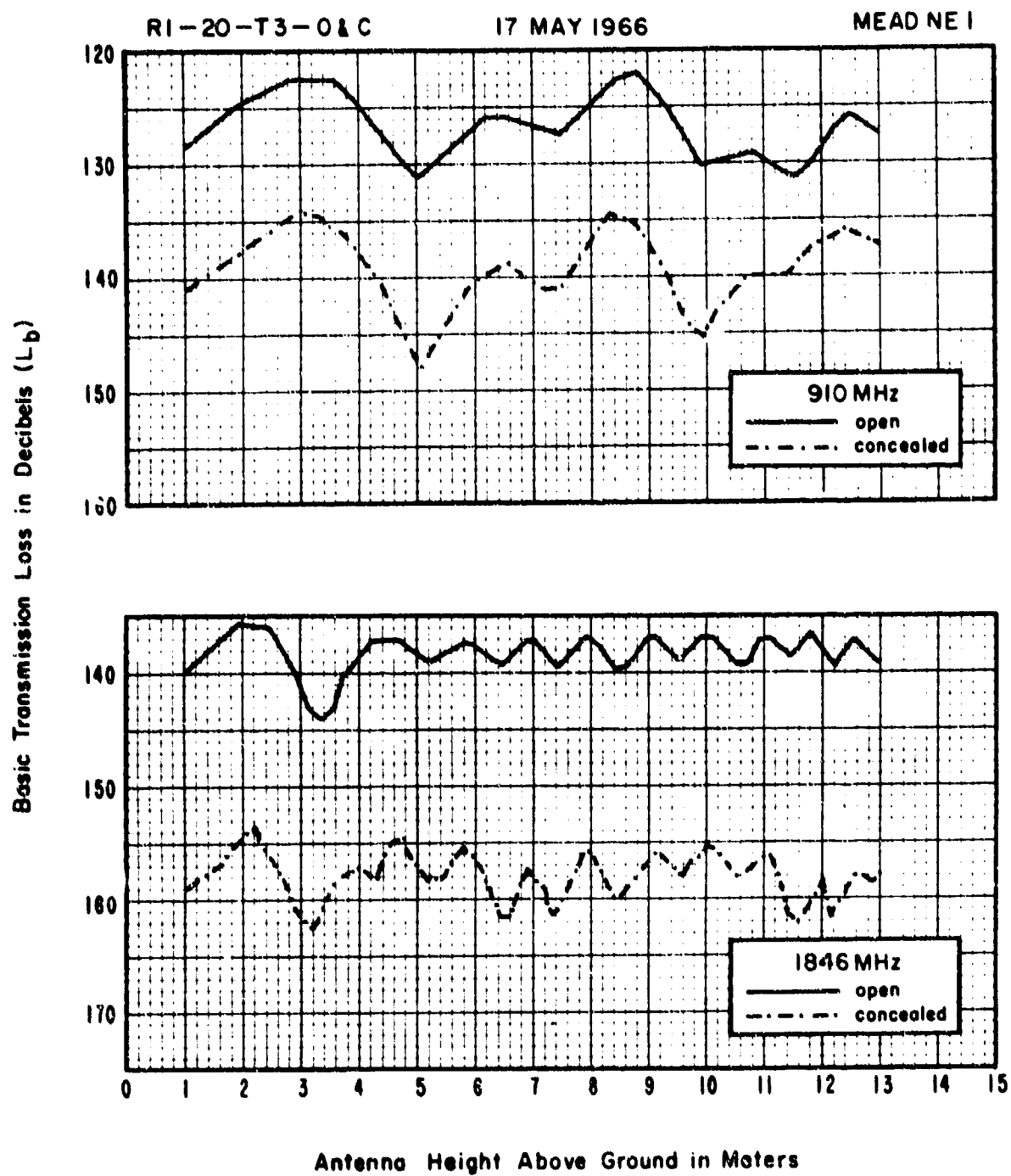


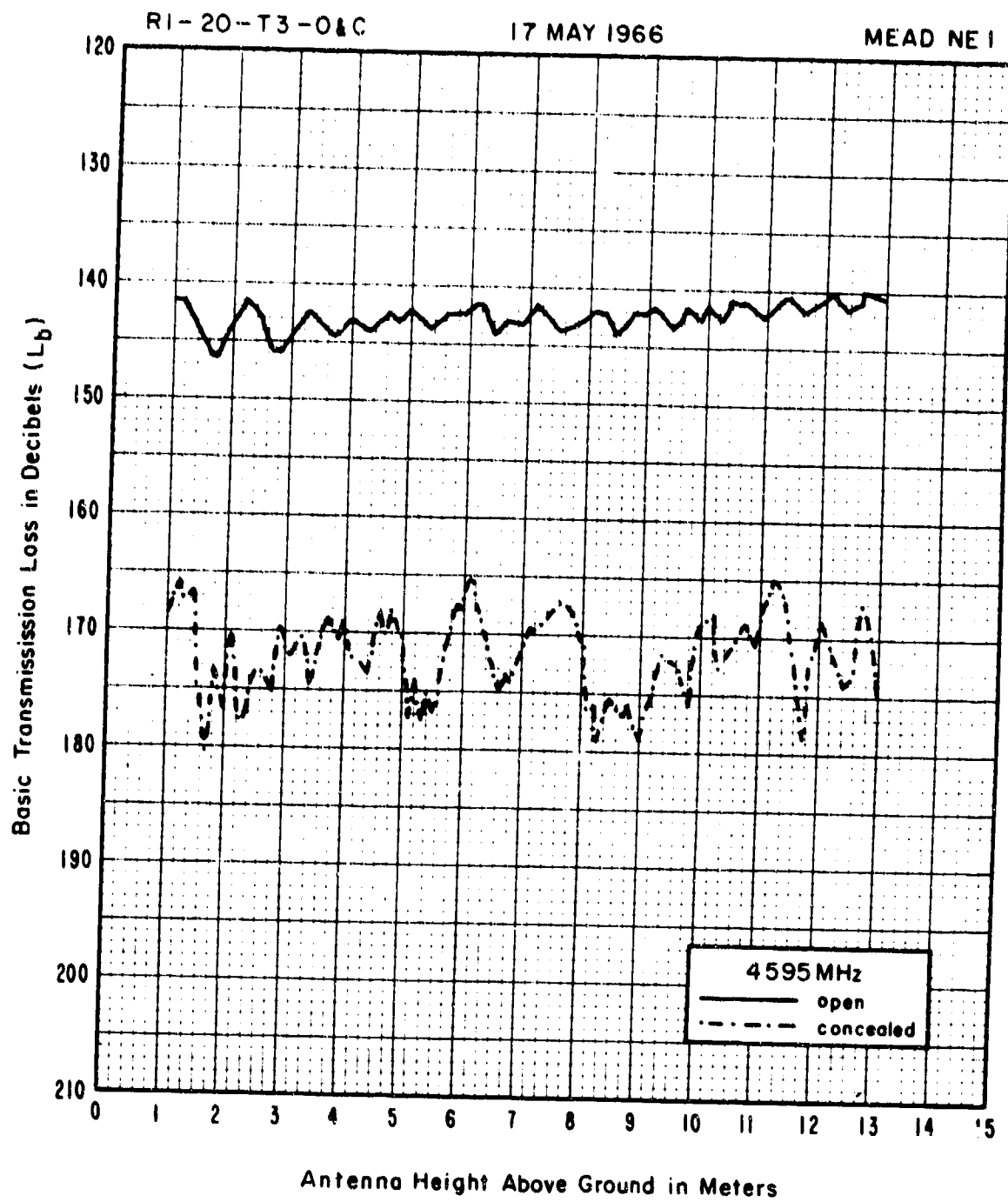
R1-20-T3-O&C

1 JULY 1966

MEAD NE 1



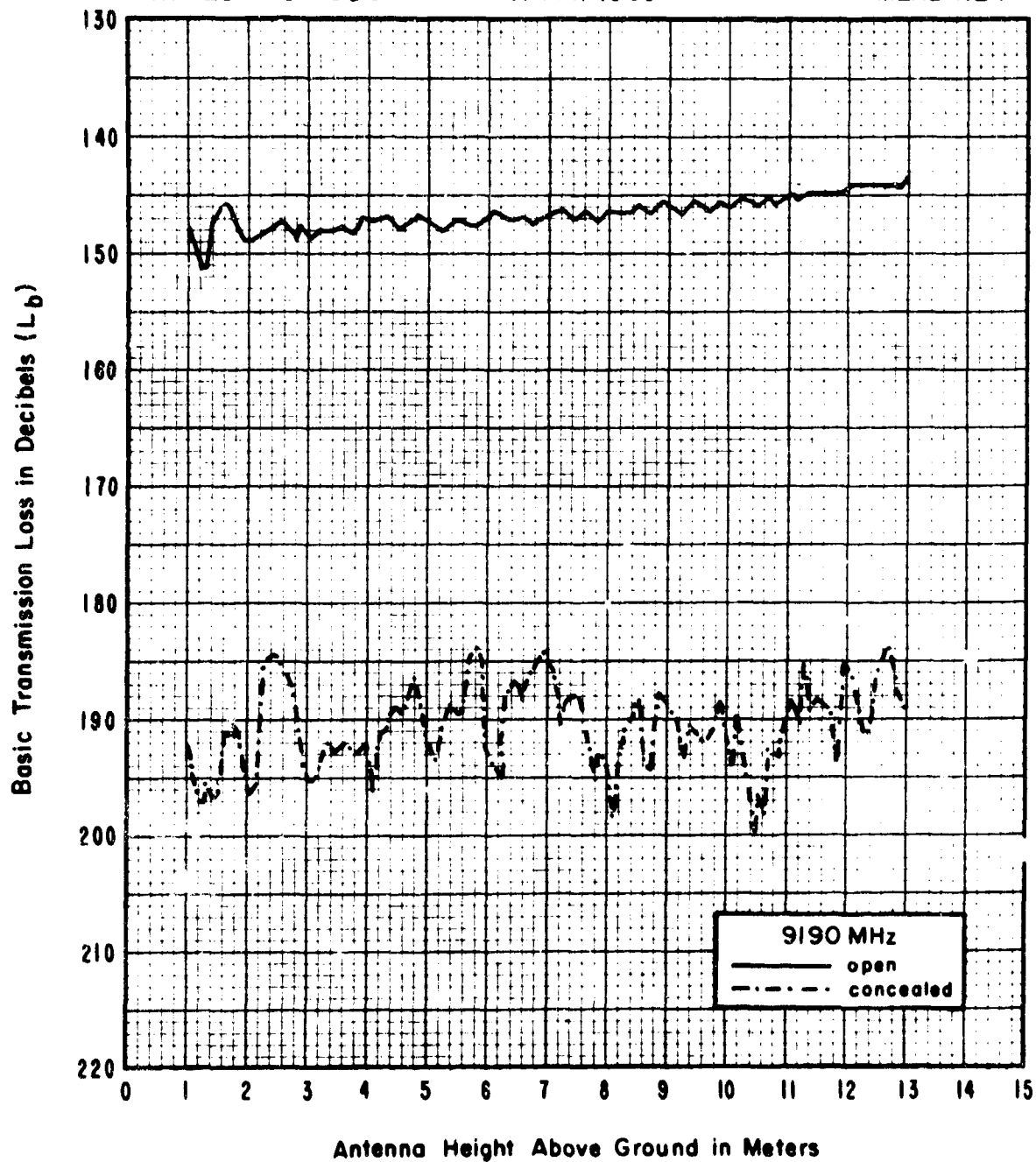




RI-20-T3-O&C

17 MAY 1966

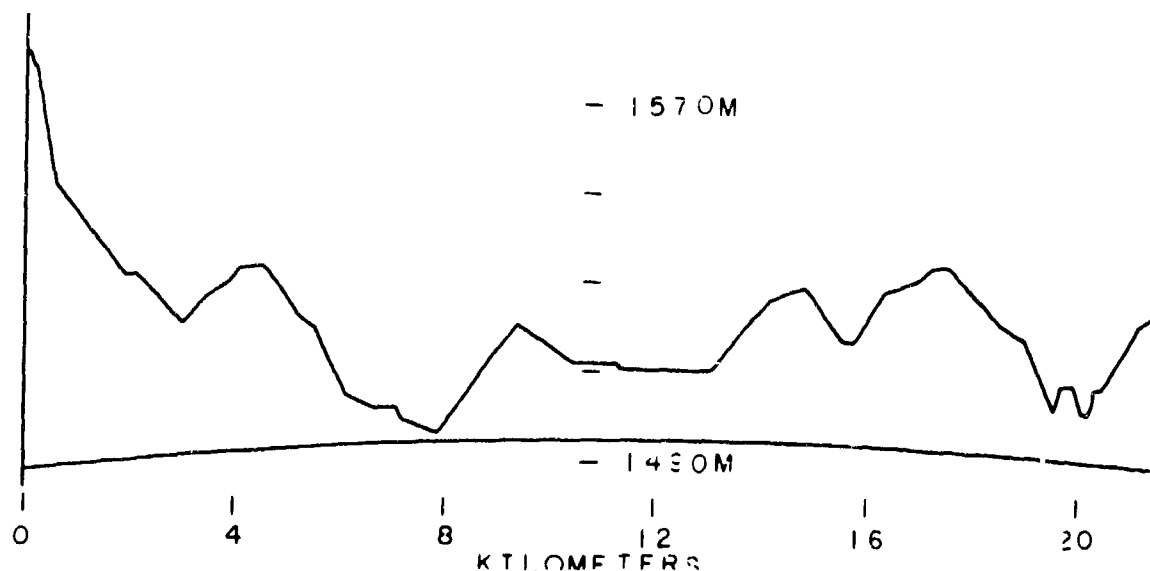
MEAD NE I



RCVR. ELEV.
1589 M

R1-20-T3 CONCEALED
PATH LENGTH 21.52 km

XMTR. ELEV.
1530 M



L_b (dB) SHORT TERM SIGNAL VARIABILITY

Freq (MHz)	230	410	751	910	1846	4595	9190
7-1-66 at 13 M				5-17-66 at 13 M			
50%	131.3	134.5	136.2	137.5	158.4	179.0	186.3
$\Delta 10\%-90\%$	<3	<3	<3	<3	5.5	10.5	10.3
				5-17-66 at 7.3 M			
50%				142.7	160.2	177.5	188.0
$\Delta 10\%-90\%$				<3	.5.0	.9.0	9.9
				5-17-66 at 1 M			
50%				142.7	158.8	176.5	188.8
$\Delta 10\%-90\%$				<3	4.6	5.6	9.2

The antennas are concealed 10 ft behind a 100-yd deep line of cottonwood trees. The trees are 45-ft high and very dense. Beyond the trees the terrain is rolling pasture to the horizon, which is 4 mi away.

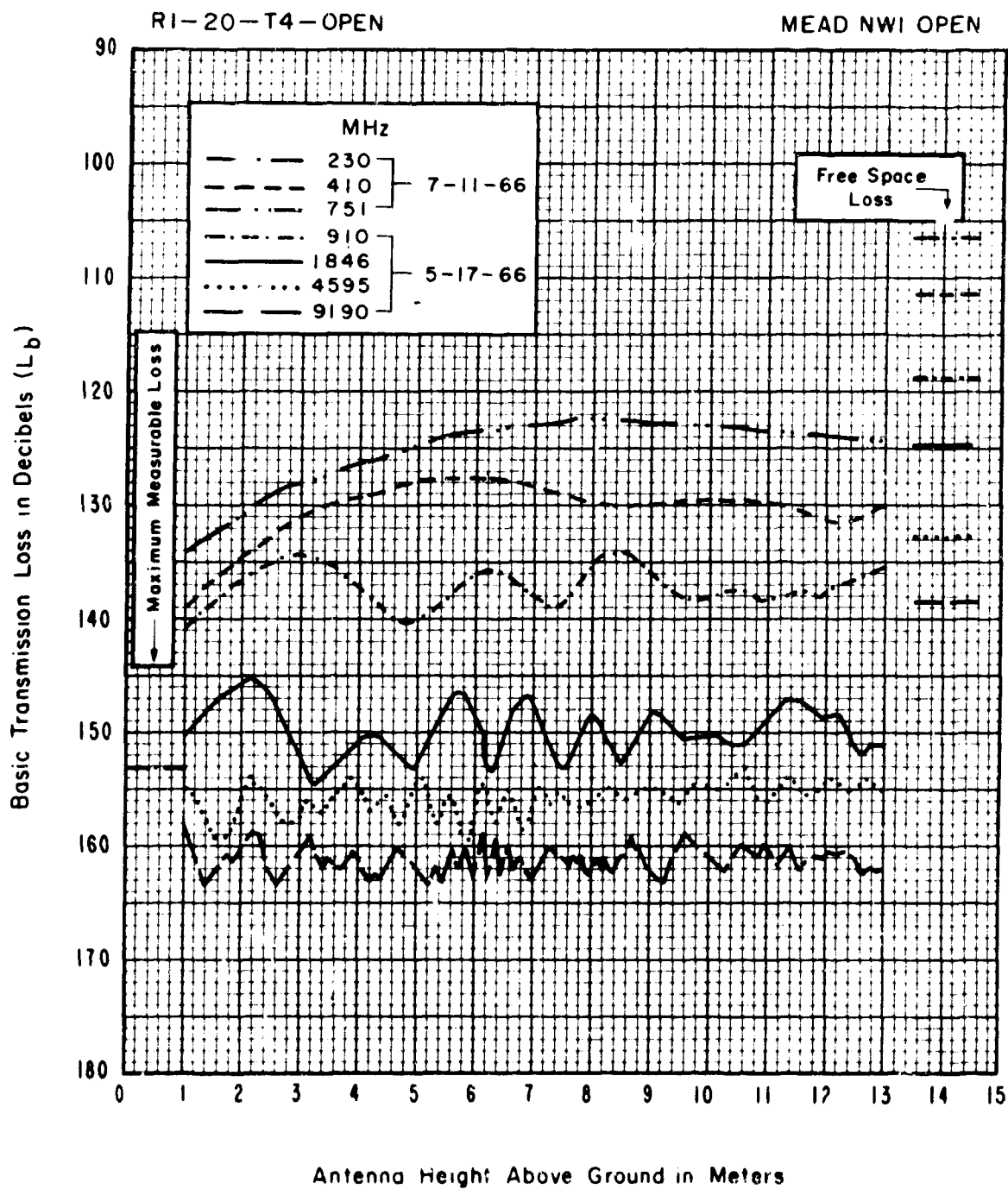
R1-20-T4 OPEN AND CONCEALED
MEAD NW1



PATH VIEW FROM OPEN SITE



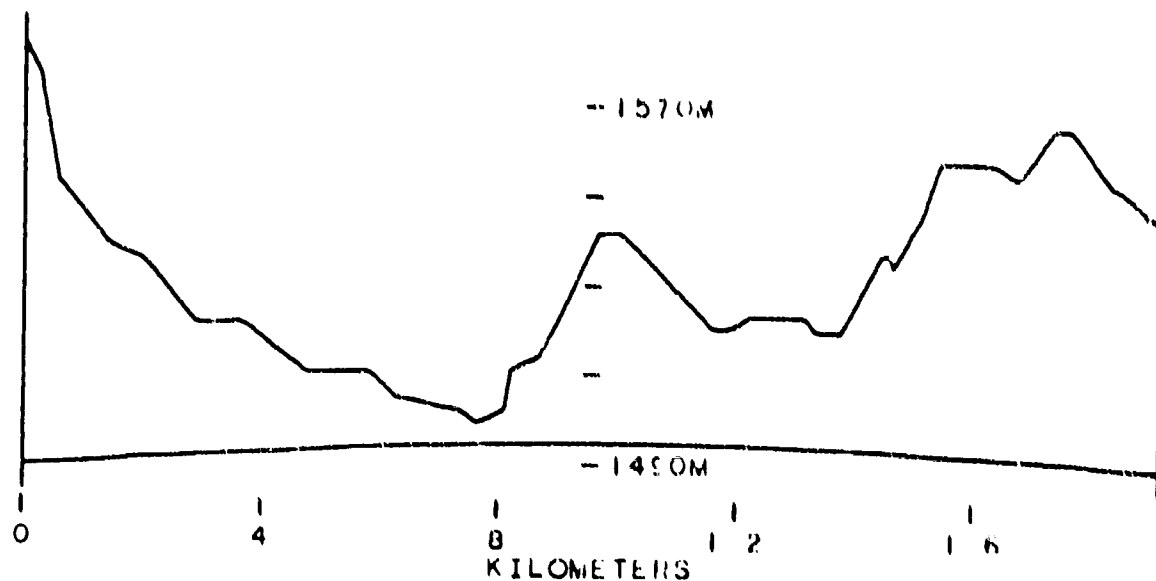
PATH VIEW FROM CONCEALED SITE



RCVR. ELEV.
1589 M

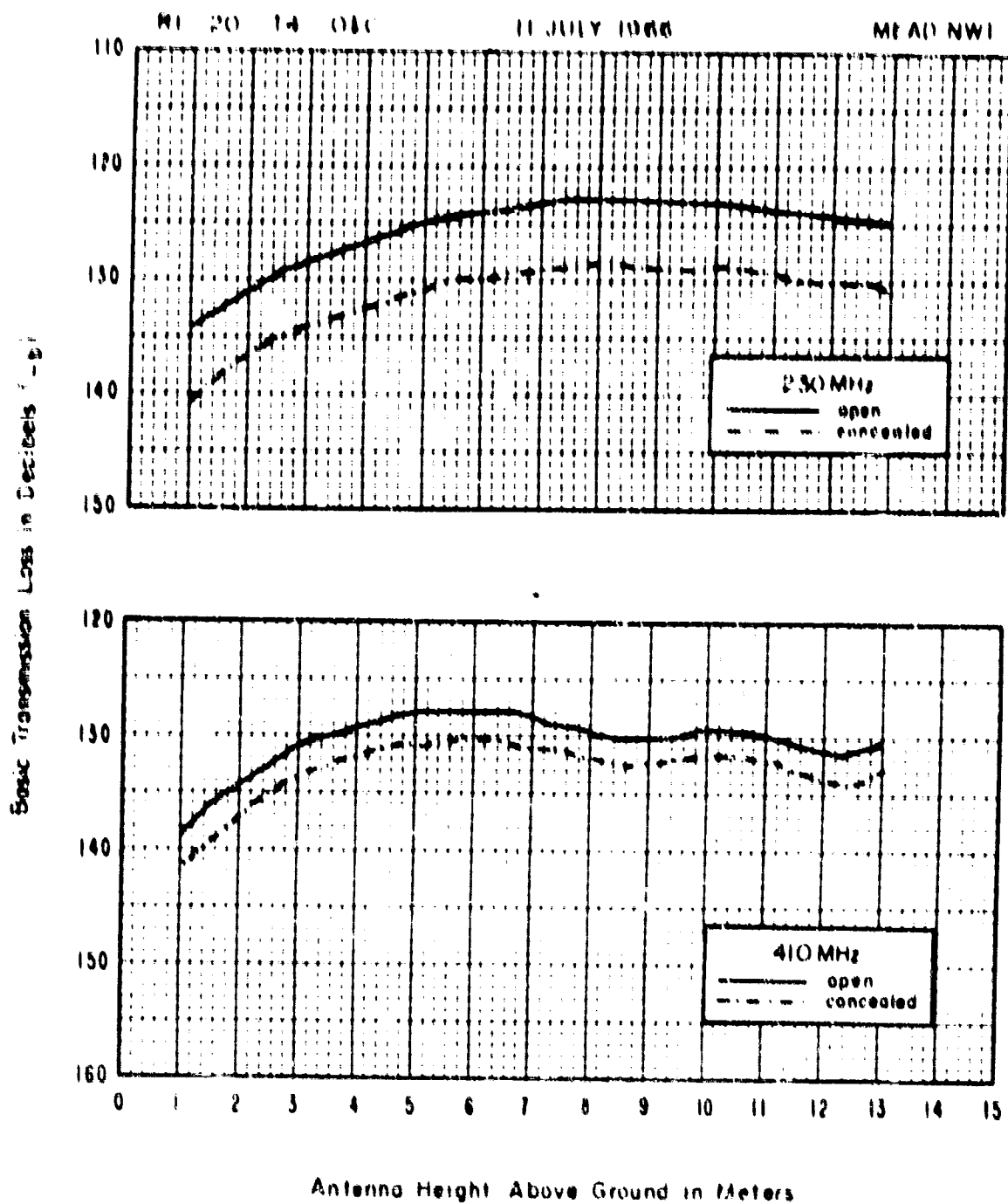
RI 20-T4
PATH LENGTH 20.74 km

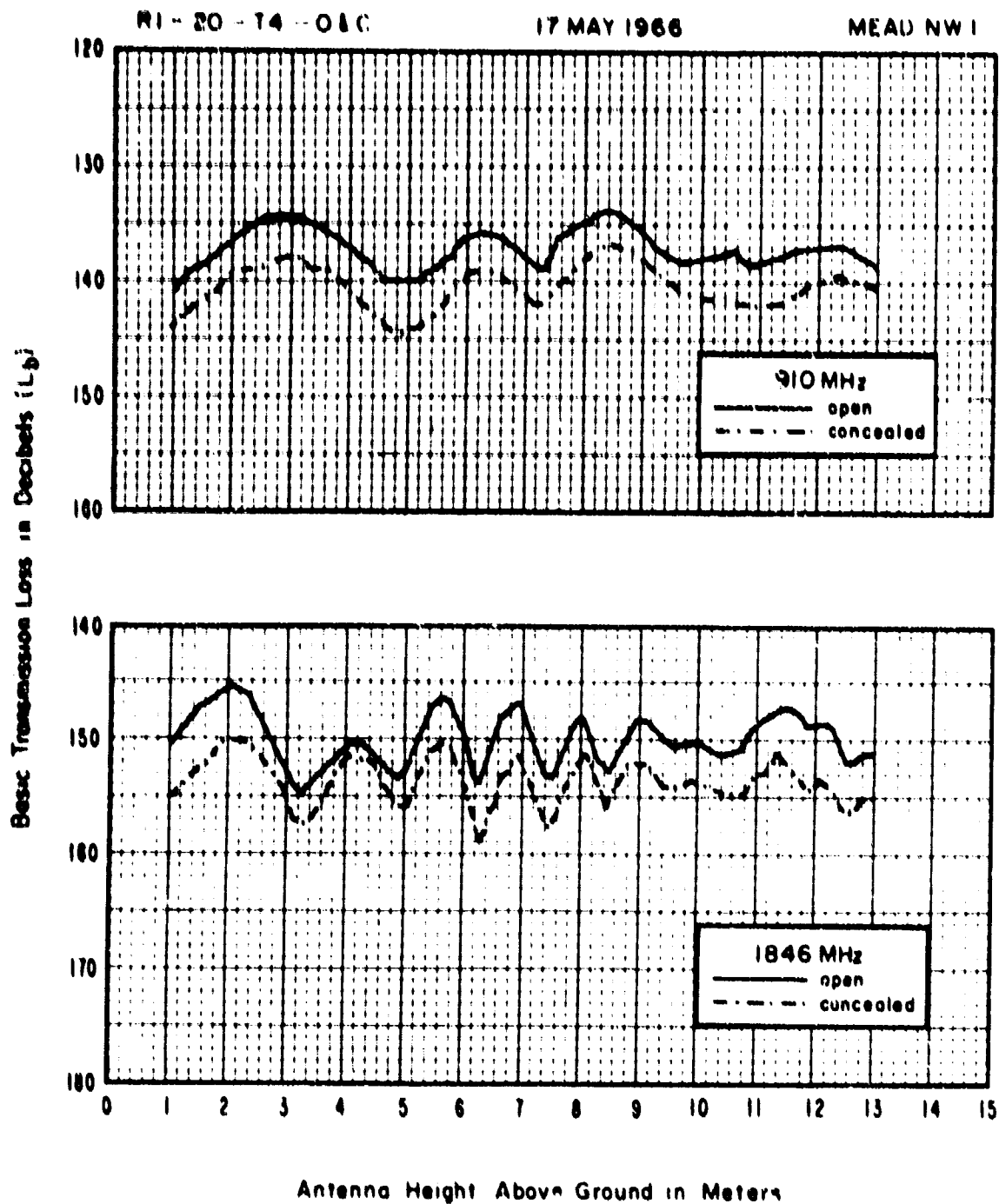
XMTR. ELEV.
1591 M

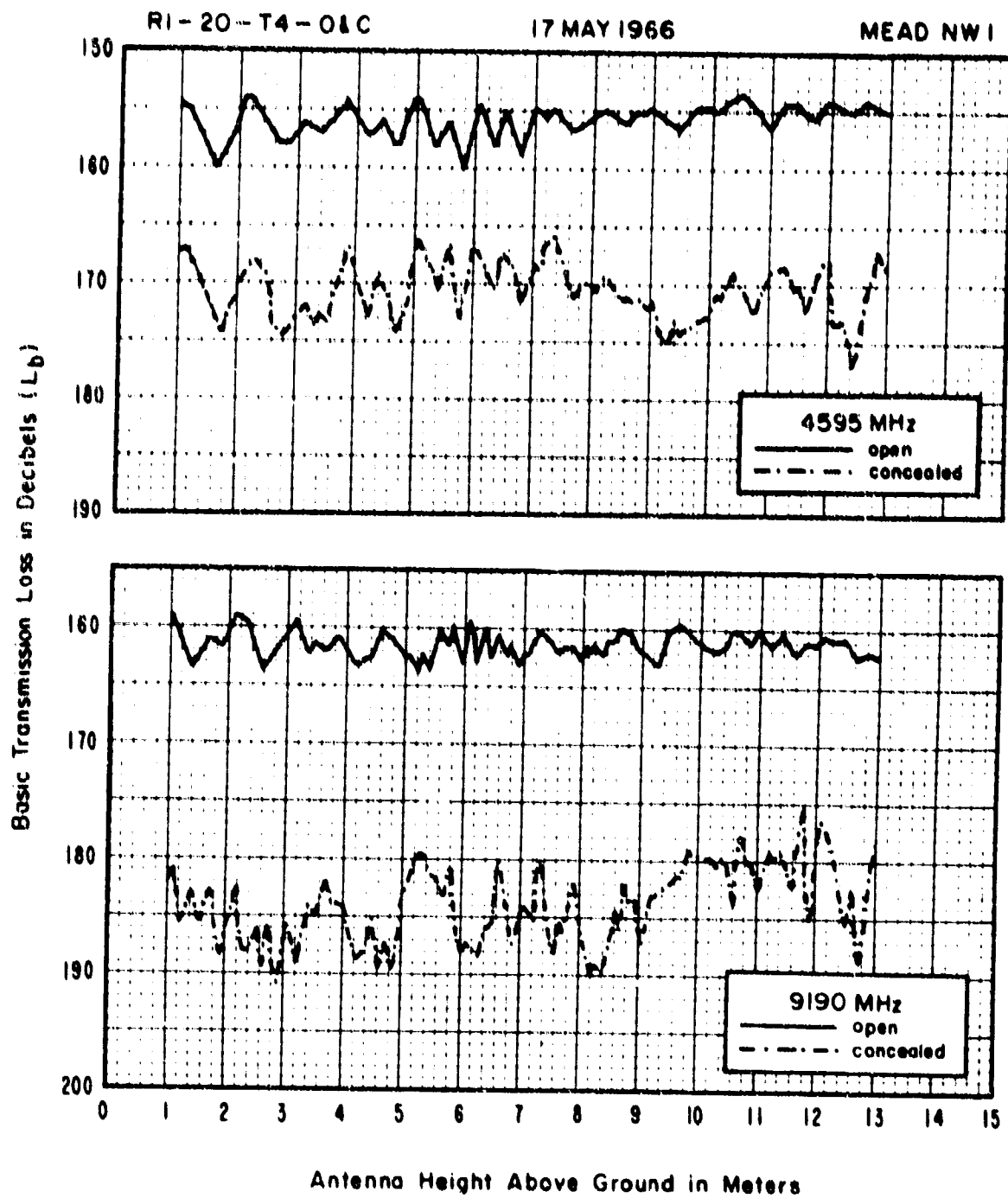


L _p (dB) SHORT TERM SIGNAL VARIABILITY						
Freq (MHz)	230	410	751	910	1846	4595 9190
7-11-66 at 13 M						
50%	124.1	129.7		138.4	152.0	156.1 162.9
Δ10%-90%	<3	<3		<3	<3	<3
5-17-66 at 13 M						
50%						
50%				138.2	153.9	155.8 162.9
Δ10%-90%				<3	<3	<3
5-17-66 at 7.3 M						
50%				141.7	150.2	155.3 160.1
Δ10%-90%				<3	<3	<3

The path is over open farmland and the horizon is 2-1/2 mi away.
There are no obstructions.



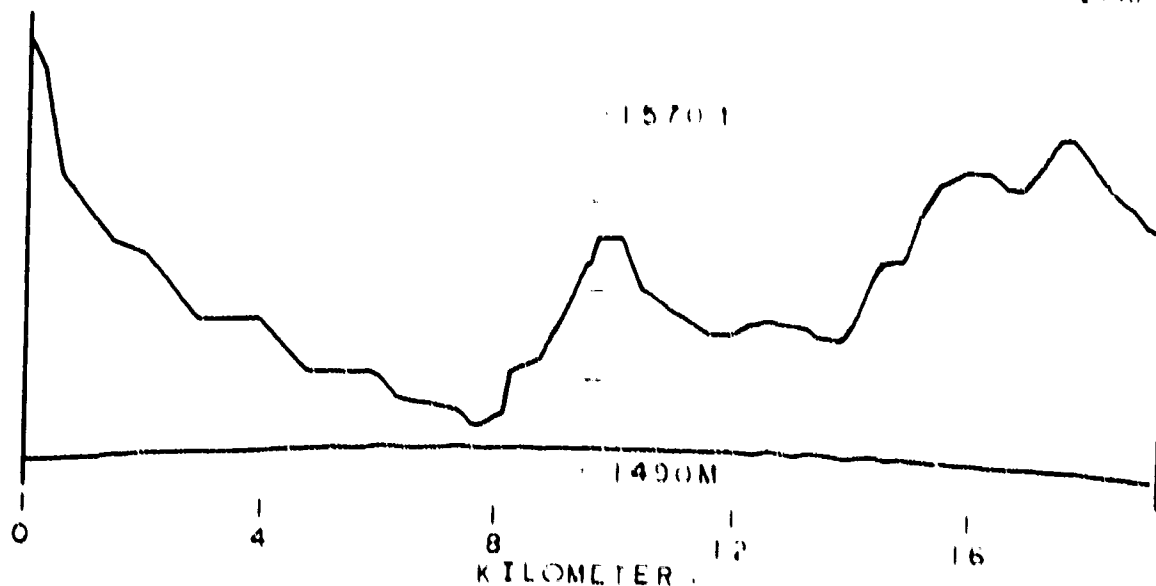




RCVR. ELEV.
1589 M

R1-20-T4 CONCEALED
PATH LENGTH 19.18 km

XMTR. ELEV.
1550 M

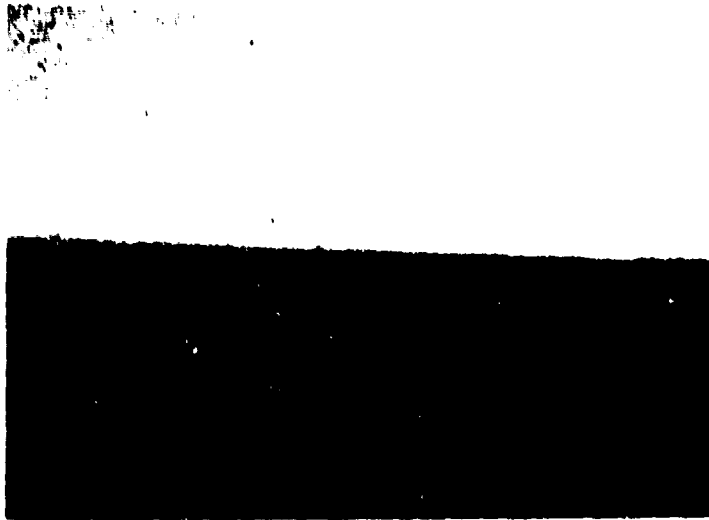


L_b (dB) SHORT TERM SIGNAL VARIABILITY

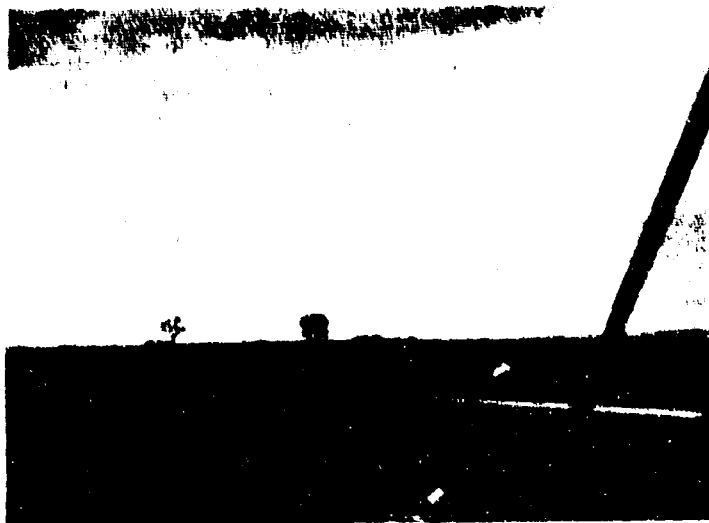
Freq (MHz)	230	410	751	910	1846	4595	9190
7-11-66 at 13 M				5-17-66 at 13 M			
50%	132.1	133.3		139.6	155.1	168.7	180.7
$\Delta 10\%-90\%$	< 3	< 3		< 3	< 3	< 3	7.6
				5-17-66 at 7.3 M			
50%				140.6	158.7	166.4	182.7
$\Delta 10\%-90\%$				< 3	< 3	< 3	6.7
				5-17-66 at 1 M			
50%				144.9	154.6	166.2	184.4
$\Delta 10\%-90\%$				< 3	< 3	< 3	9.8

The antennas at this site are concealed 30 ft behind a thicket of 50-ft high cottonwood trees, extending for 50 ft. Beyond, the path is over open pastures to the horizon, 2-1/2 mi away.

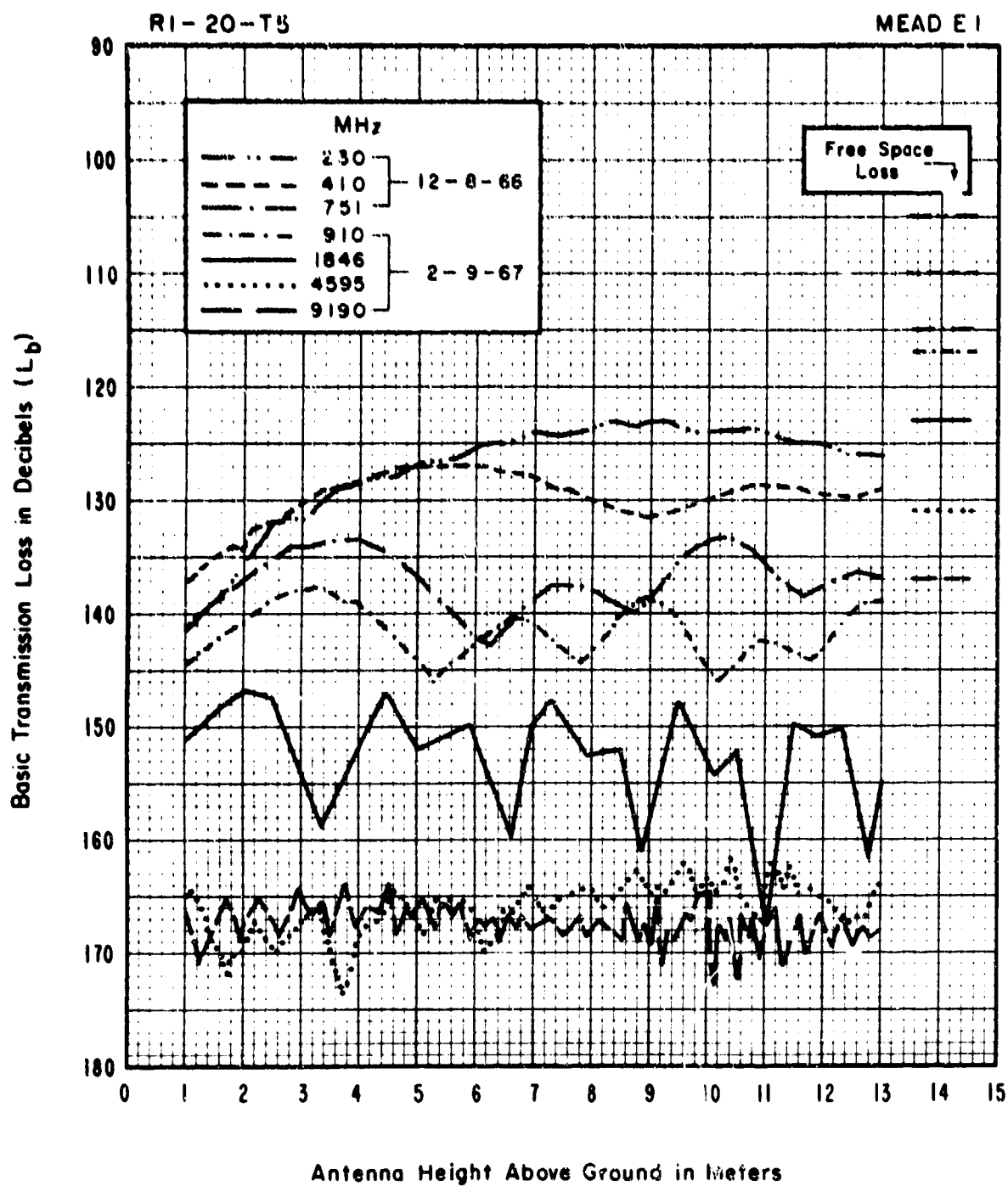
P1-20-T5
MEAD E1



PATH VIEW FROM RECEIVER



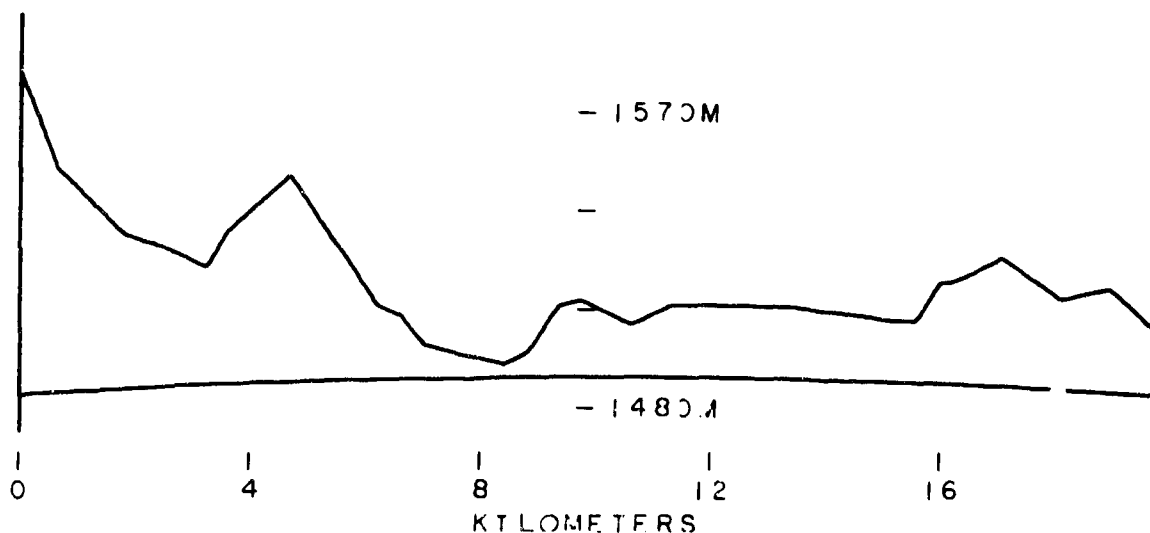
PATH VIEW FROM TRANSMITTER



RCVR. ELEV.
1589 M

R1-20-T5
PATH LENGTH 19.70 km

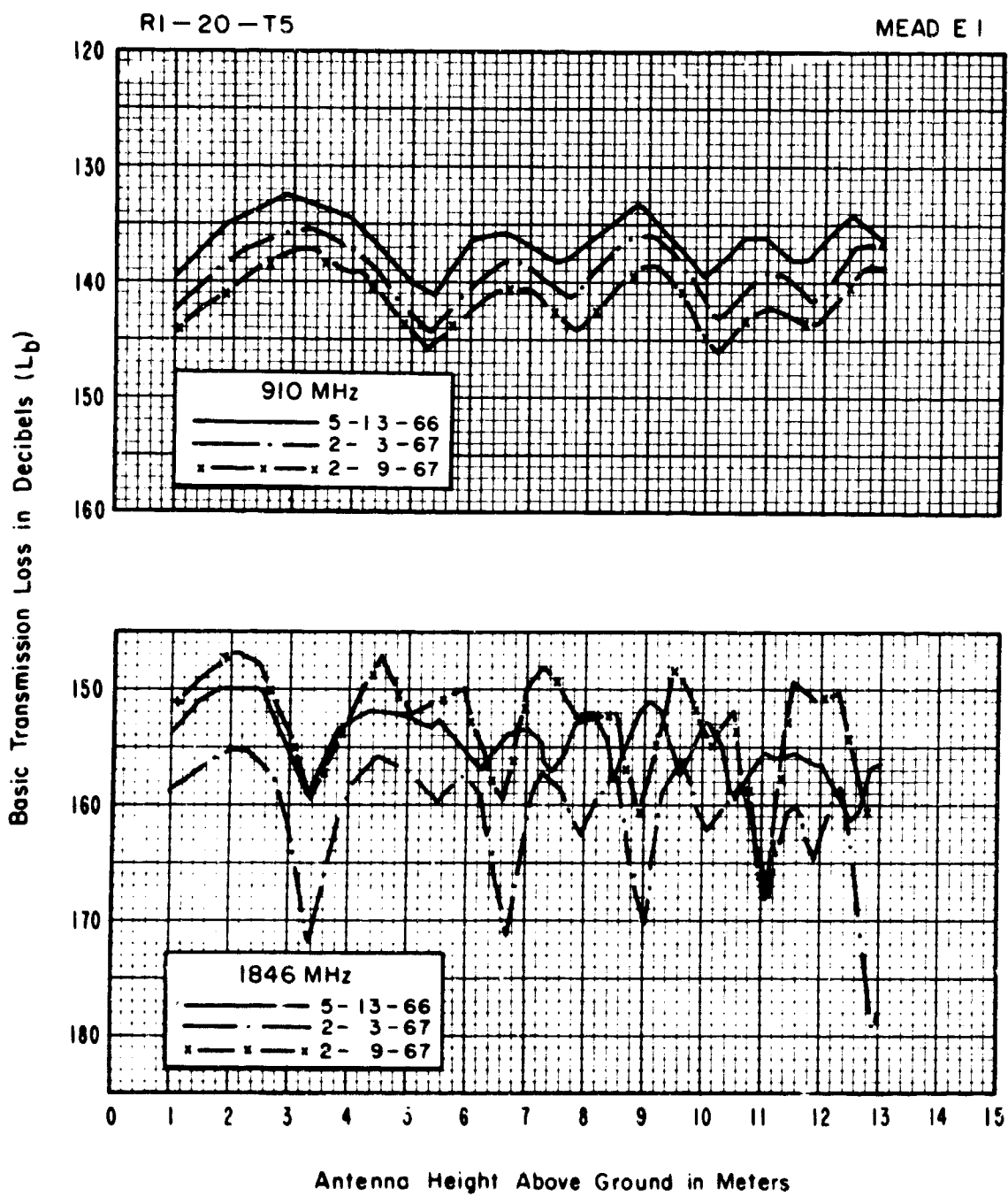
XMTR. ELEV.
1509 M

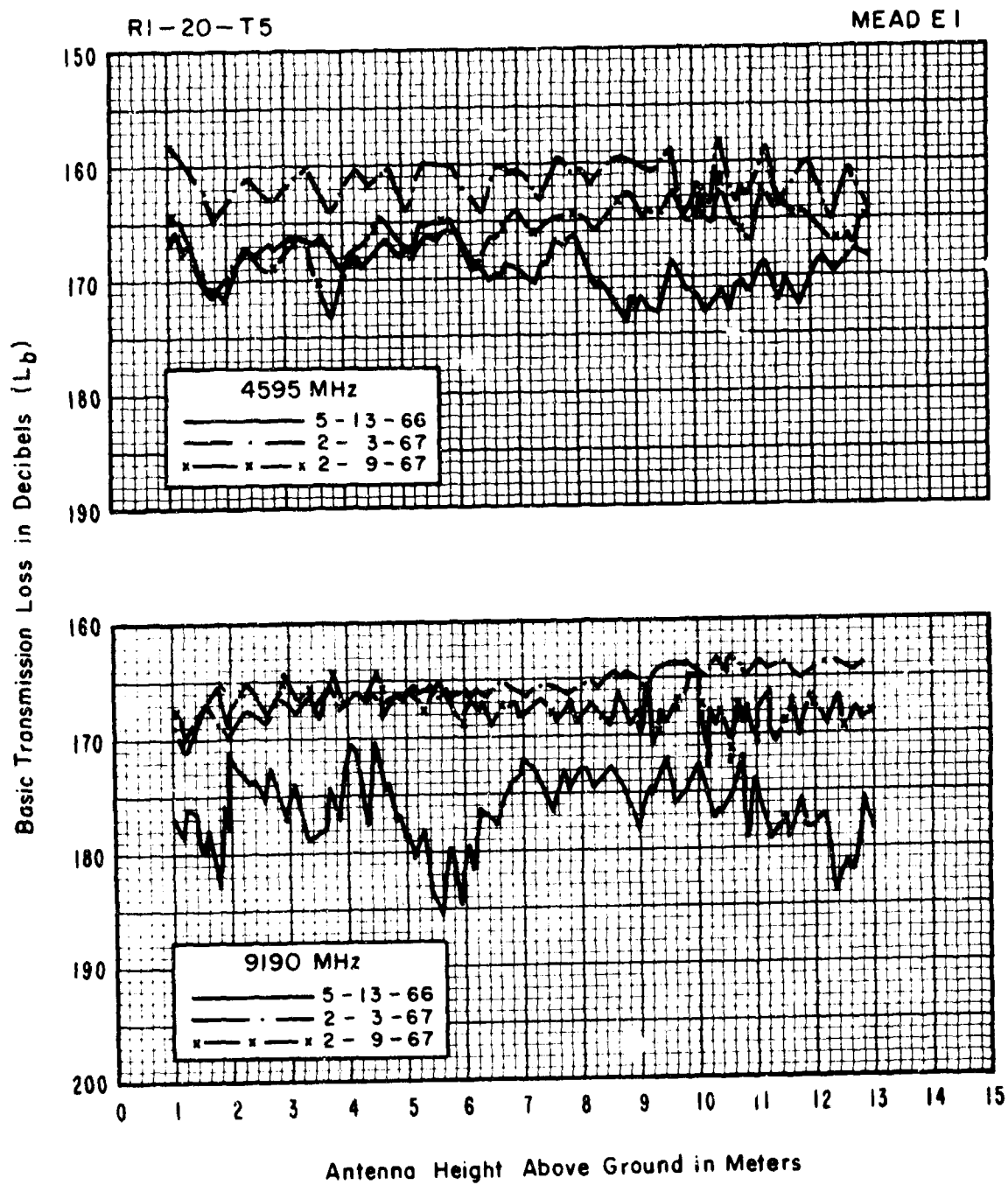


L_b (dB) SHORT TERM SIGNAL VARIABILITY

Freq (MHz)	230	410	751	910	1846	4595	9190
12-8-66 at 6.6 M				2-9-67 at 13 M			
50%	124.2	129.0	141.9	139.0	153.6	164.0	172.7
$\Delta 10\%-90\%$	< 3	< 3	< 3	< 3	< 3	< 3	< 3
				2-9-67 at 7.3 M			
50%				142.3	148.1	165.5	169.8
$\Delta 10\%-90\%$				< 3	< 3	< 3	4.0
				2-9-67 at 1 M			
50%				147.0	151.1	161.2	169.8
$\Delta 10\%-90\%$				< 3	< 3	< 3	4.8

The immediate foreground at this site is a four-lane, dual concrete highway with an access road at a distance of approximately 100 yd. Beyond is a low wire fence, perpendicular to the path and parallel to the roads, followed by grassland that extends 1 mi to the scattered trees at the horizon.





R1-20-T6
FIRESTONE E2



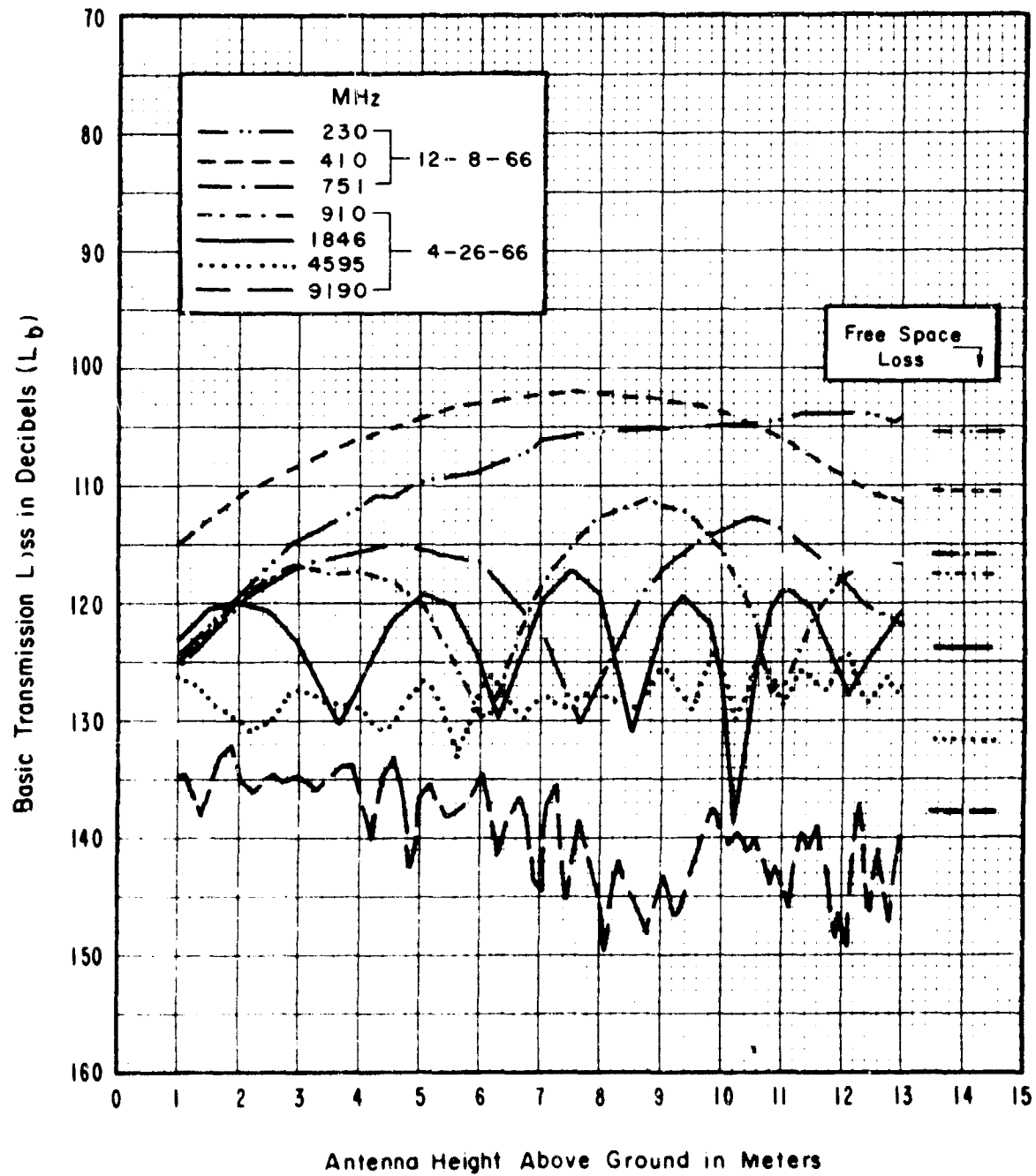
PATH VIEW FROM RECEIVER



PATH VIEW FROM TRANSMITTER

RI-20-T6

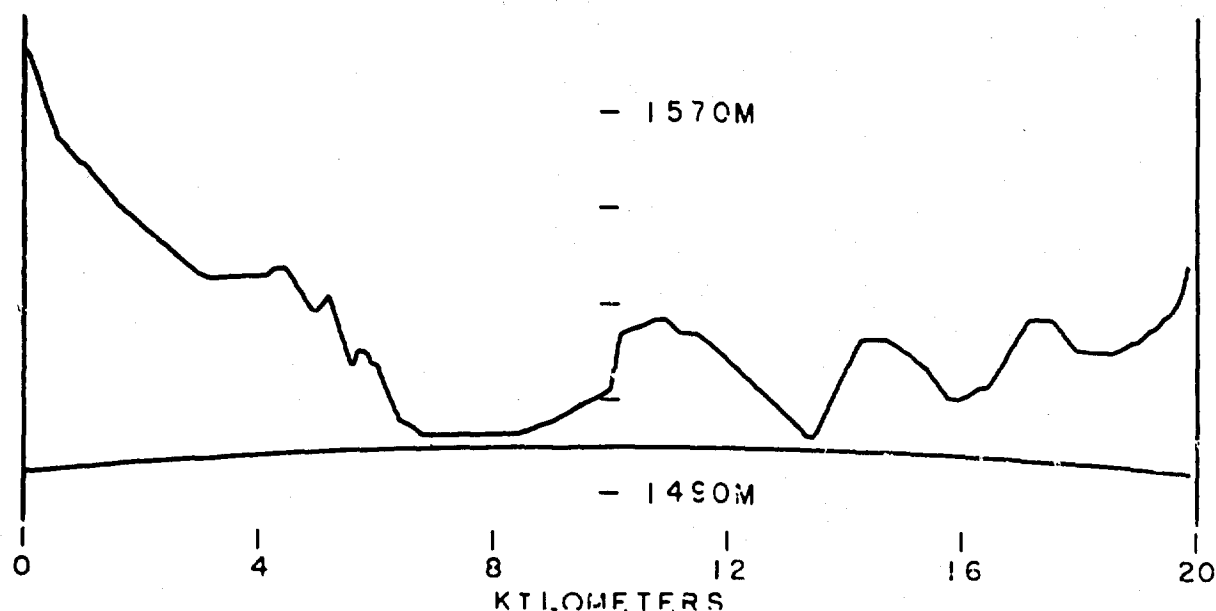
FIRESTONE E 2



RCVR. ELEV.
1589 M

RI-20-T6
PATH LENGTH 20.00 km

XMTR. ELEV.
1539 M



L_p (dB) SHORT TERM SIGNAL VARIABILITY

Freq (MHz)	230	410	751	910	1846	4595	9190
	12-8-66 at 6.6 M				4-26-66 at 7.3 M		
50%	106.8	102.7	119.9	115.2	116.6	127.9	145.7
$\Delta 10\% - 90\%$	<3	<3	<3	<3	<3	<3	<3

The path extends over pasture land with scattered single trees.

In the immediate foreground, a barbed-wire fence runs at 20° to the path and crosses it approximately 75 yd away.

RECEIVER
EAGLE ARK NT



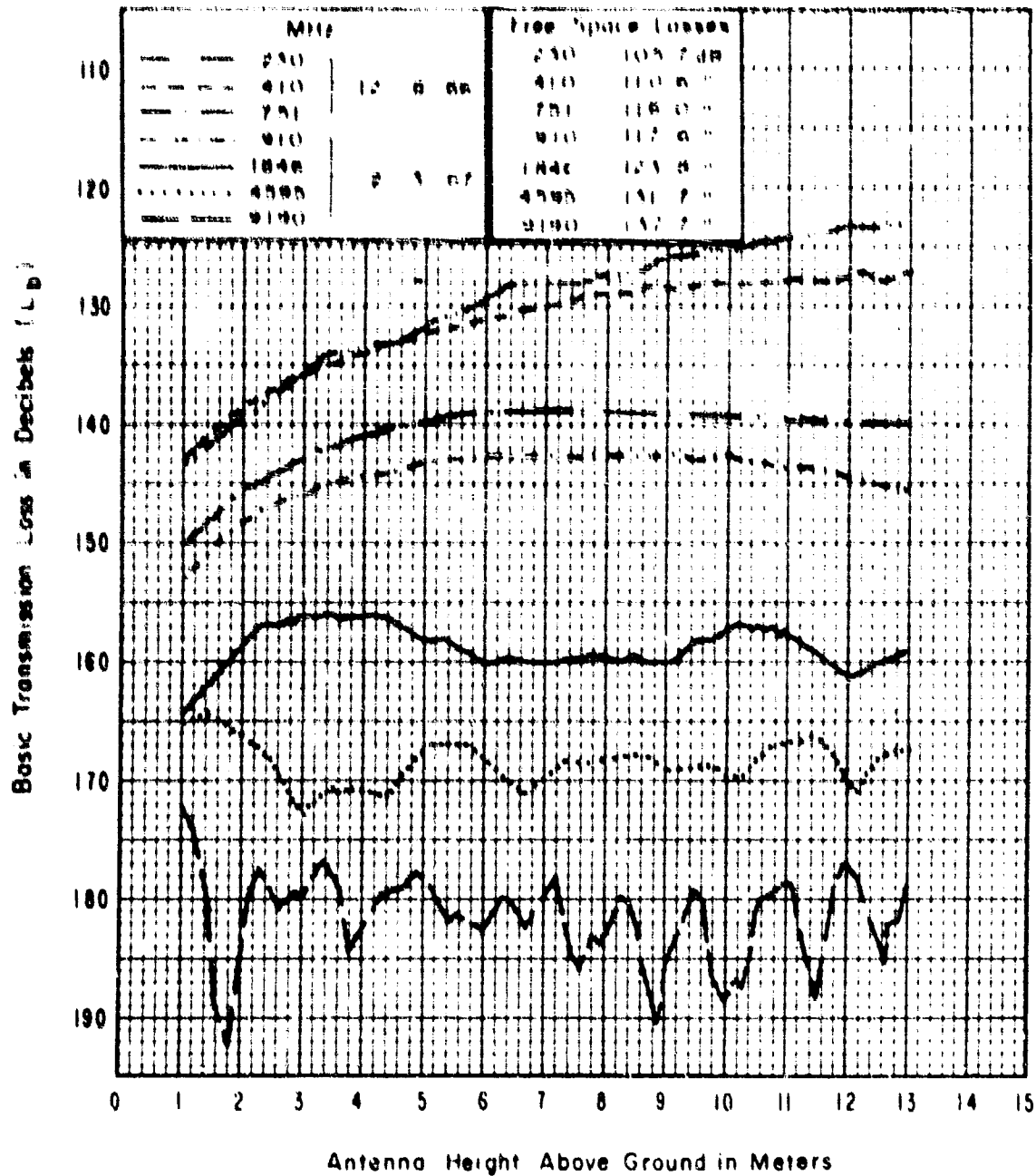
PATH VIEW FROM RECEIVER



PATH VIEW FROM TRANSMITTER

MI 20 17

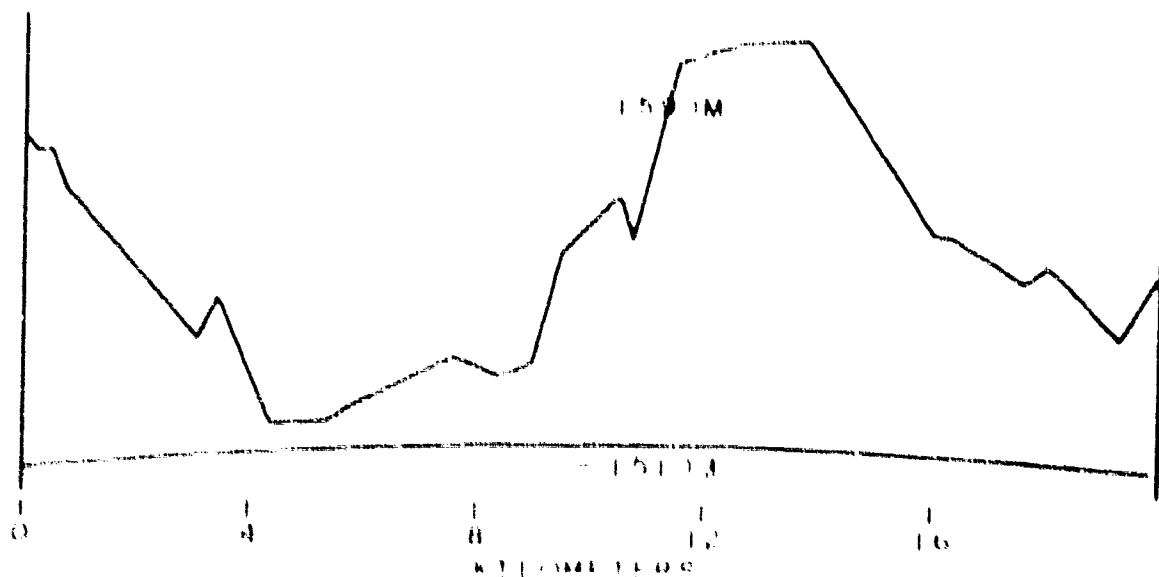
EASTLAKE N4



RCVR. ELEV.
1589 M

RT 20 T7
PATH LENGTH 10.92 km

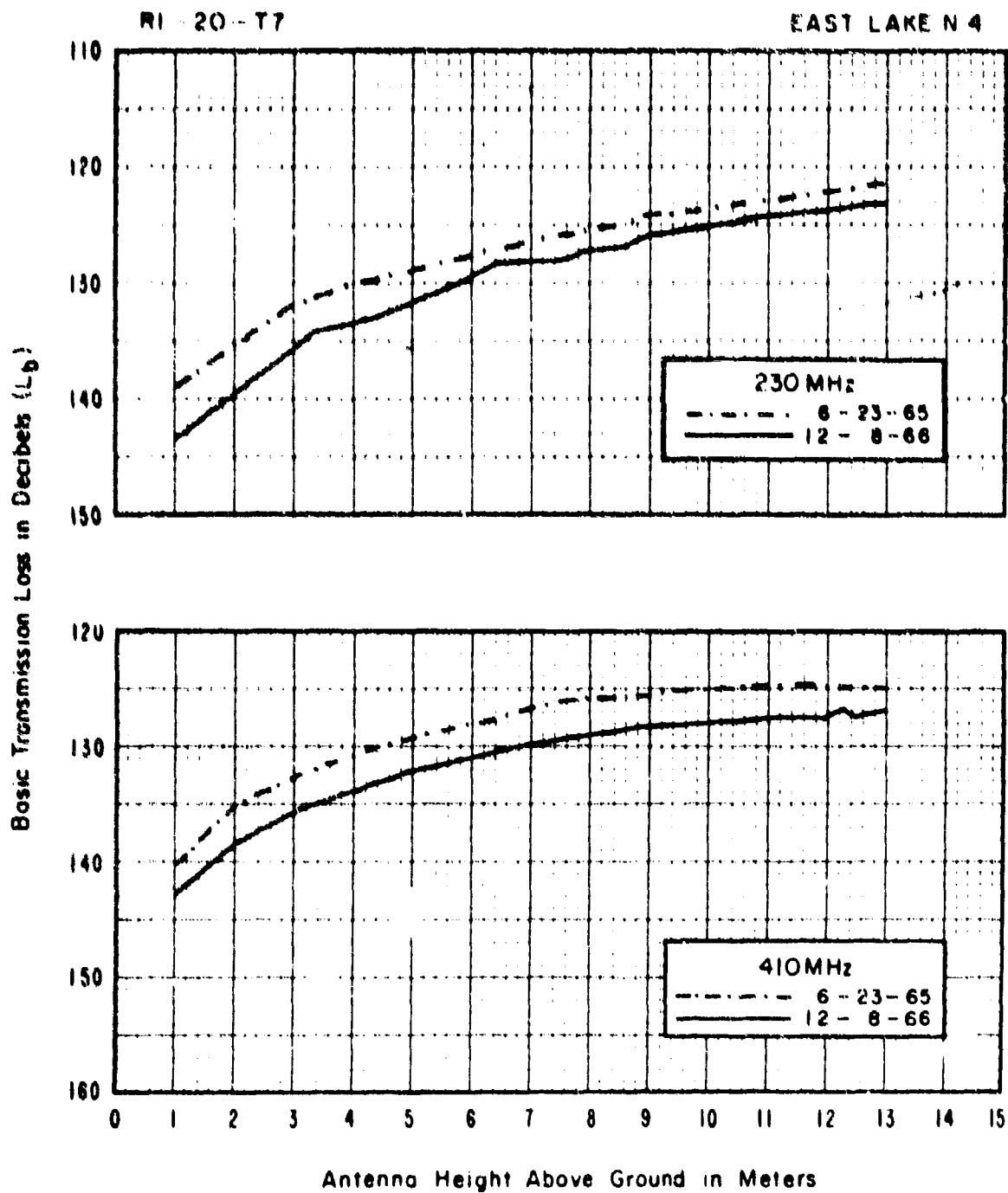
XMTR. ELEV.
1559 M



L_p (dB) SHORT TERM SIGNAL VARIABILITY

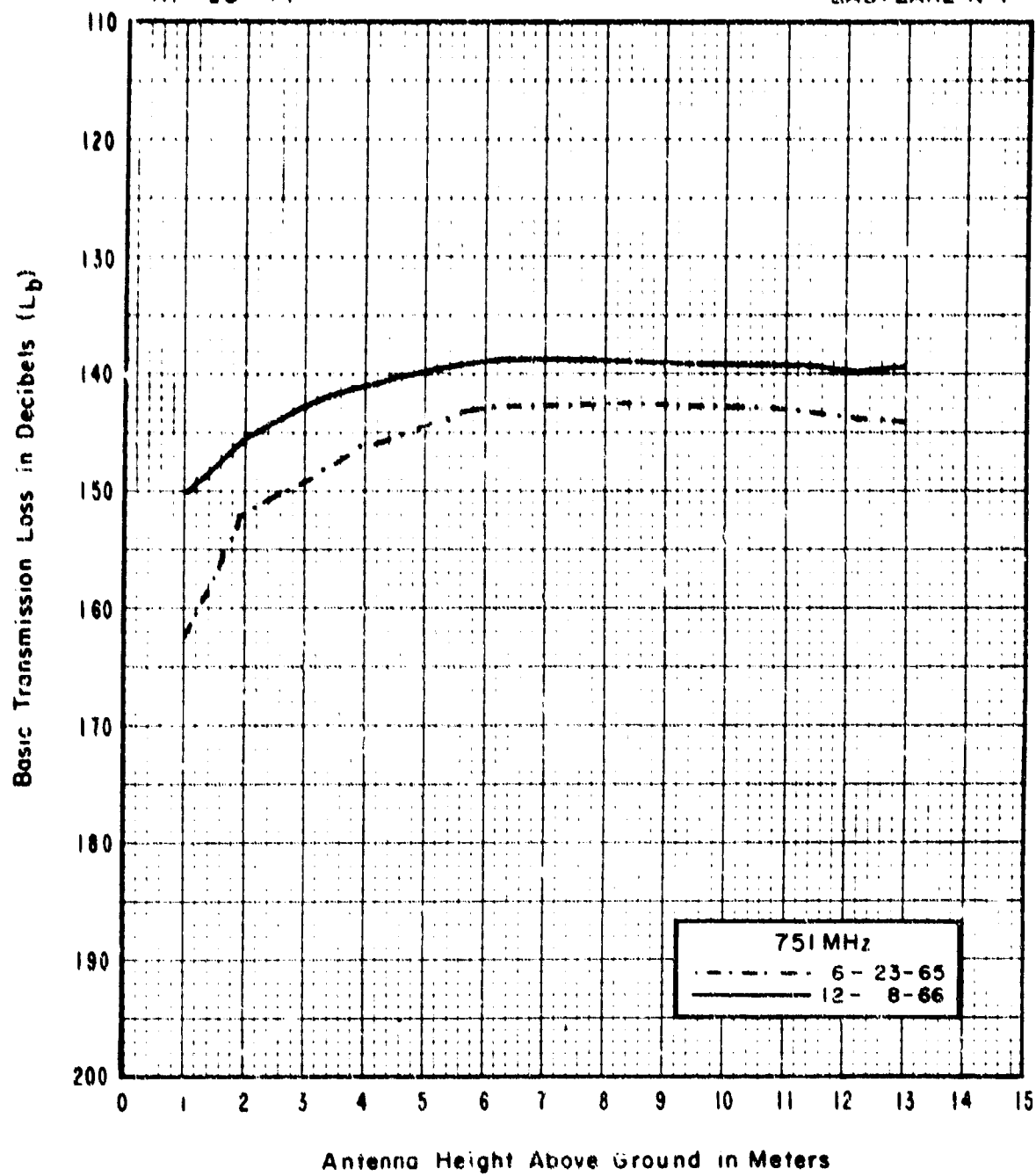
Freq (MHz)	230	410	751	910	1846	4595	9190
12-8-66 at 7.3 M				2-3-67 at 7.3 M			
50%	127.3	129.8	139.1	142.4	158.8	168.9	182.0
$\Delta 10\%-90\%$	<3	<3	<3	<3	<3	<3	<3

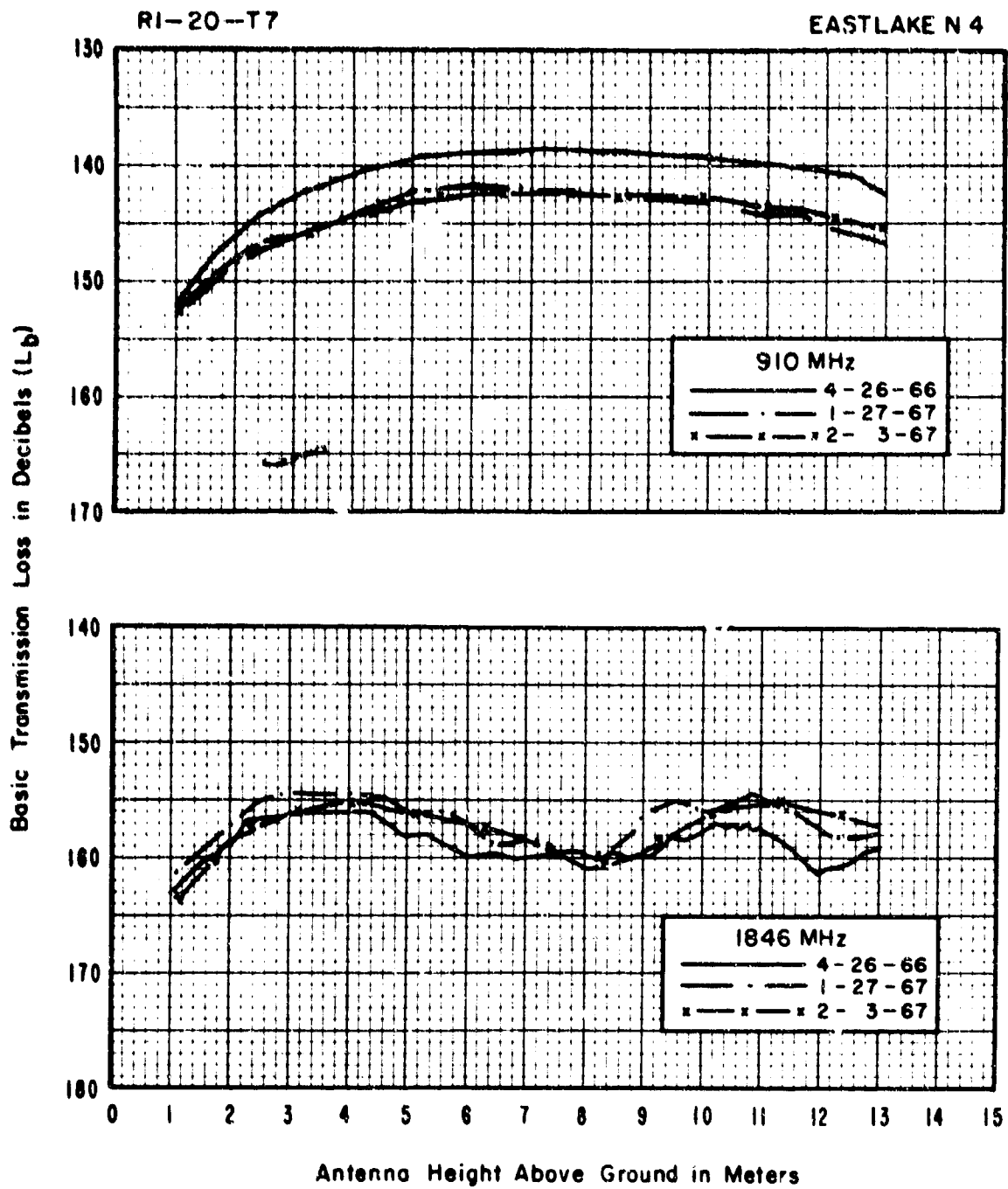
The path runs over sagebrush for 50 yd to a low, barbed-wire fence. Fifty feet beyond the fence, an 8-wire telephone line runs perpendicular to the path. The rest of the terrain to the horizon, 4 mi away, consists of rolling hills with scattered trees and farmhouses.



RI-20-Y7

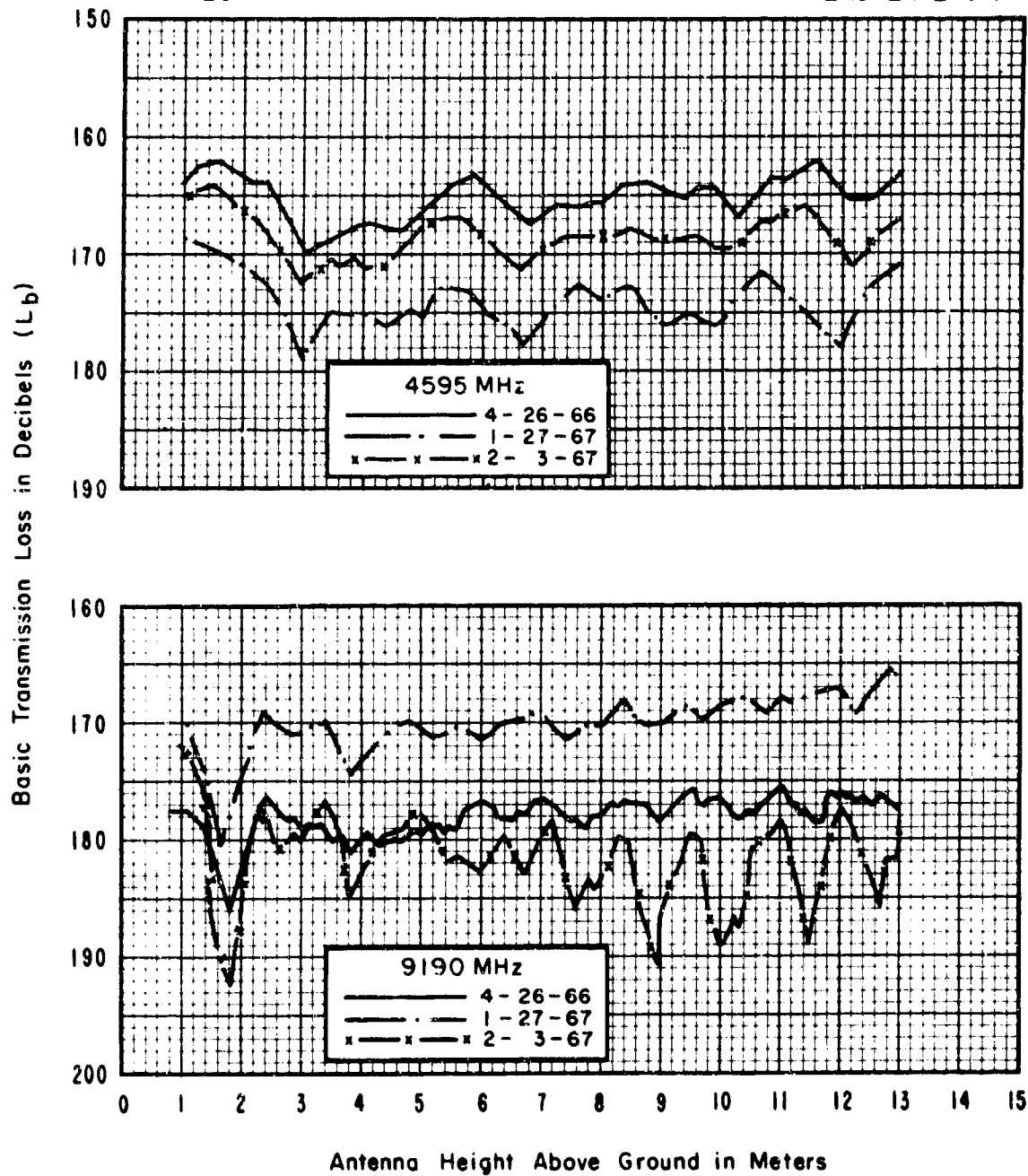
EASTLAKE N 4



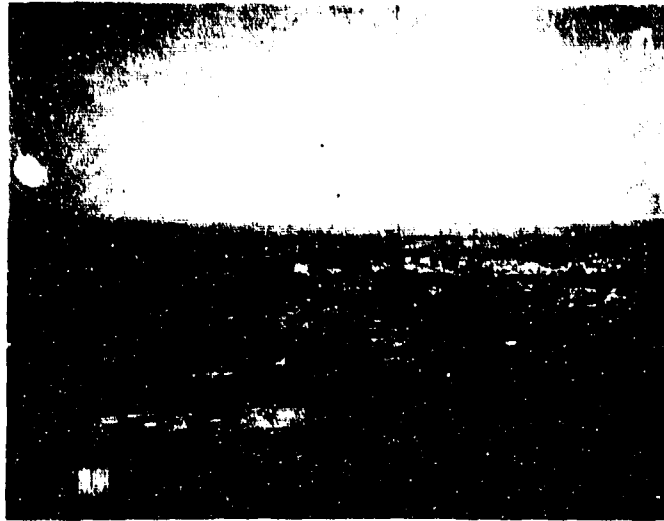


RI-20-T7

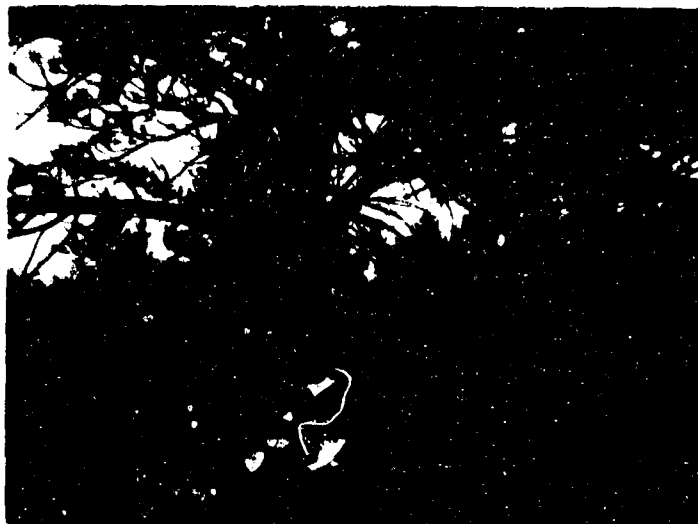
EASTLAKE N 4



RI-20-T8 OPEN AND CONCEALED
GREEN MOUNTAIN



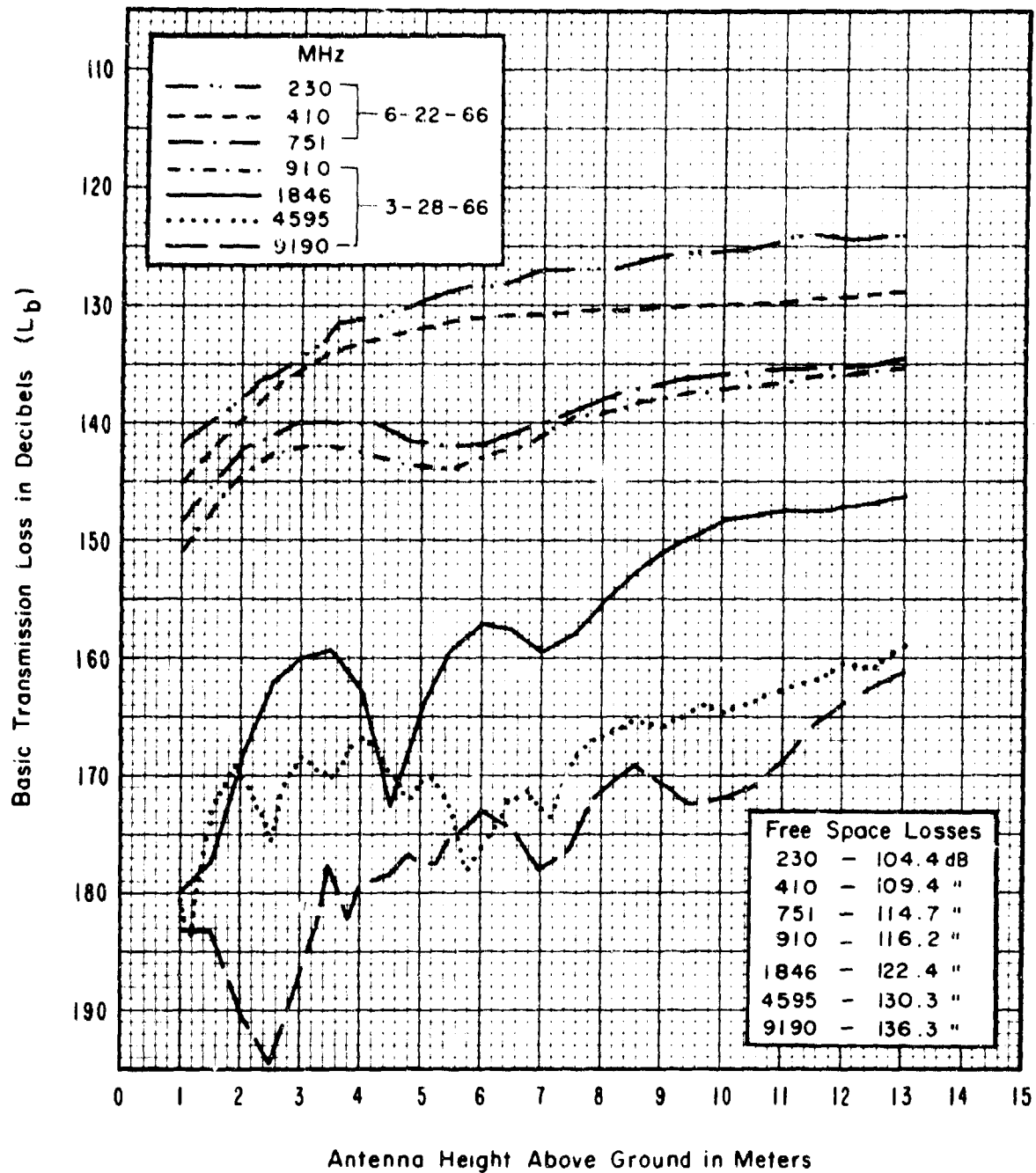
PATH VIEW FROM OPEN SITE



PATH VIEW FROM CONCEALED SITE

RI-20-T8-OPEN

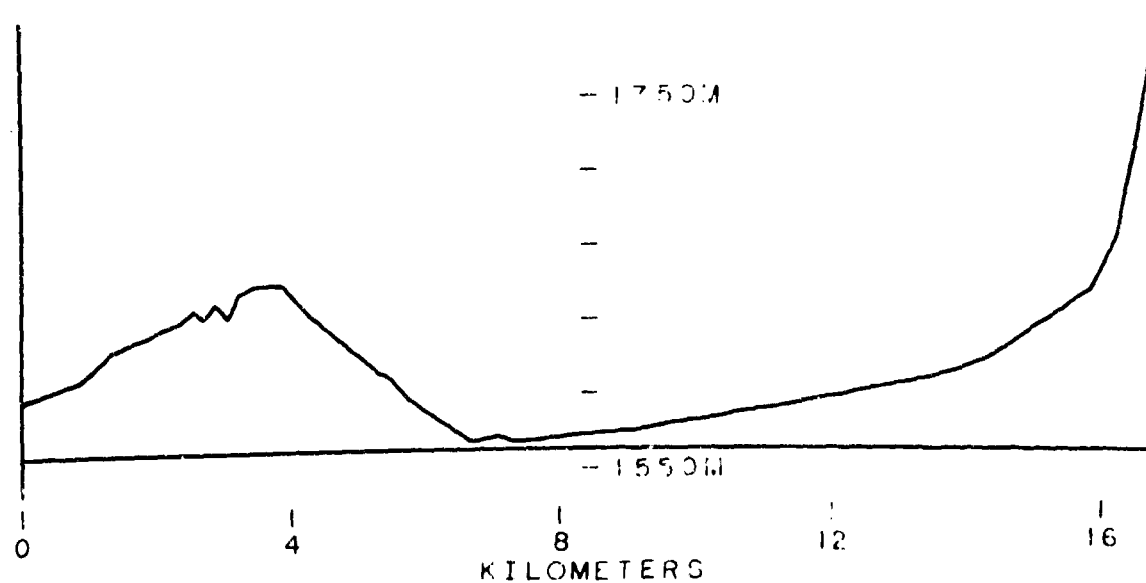
GREEN MOUNTAIN OPEN



RCVR. ELEV.
1589 M

R1-20-T8 OPEN
PATH LENGTH 16.88 km

XMTR. ELEV.
1786 M



L_p (dB) SHORT TERM SIGNAL VARIABILITY

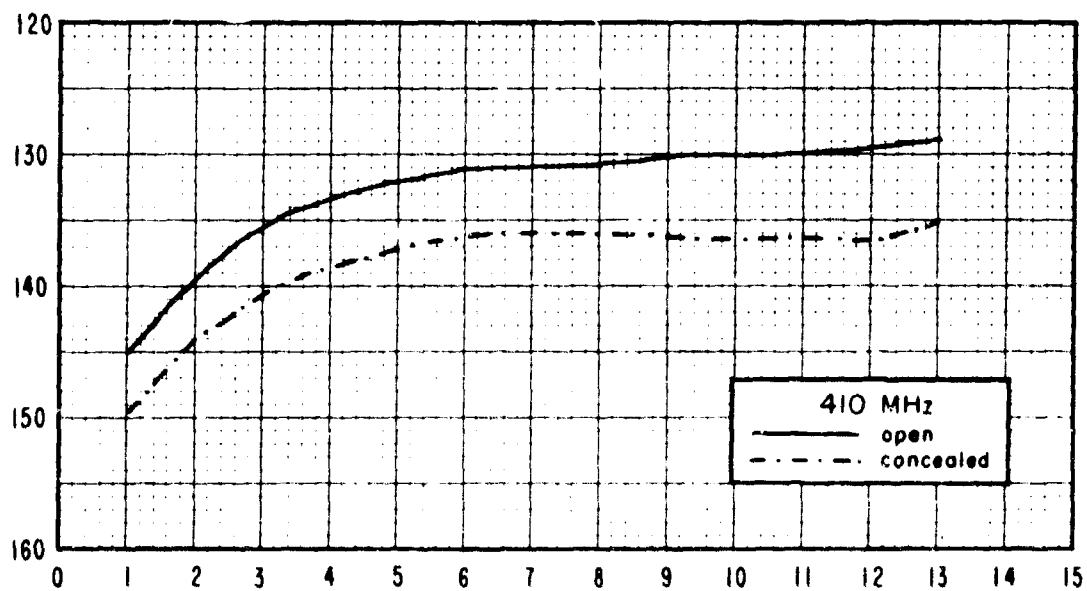
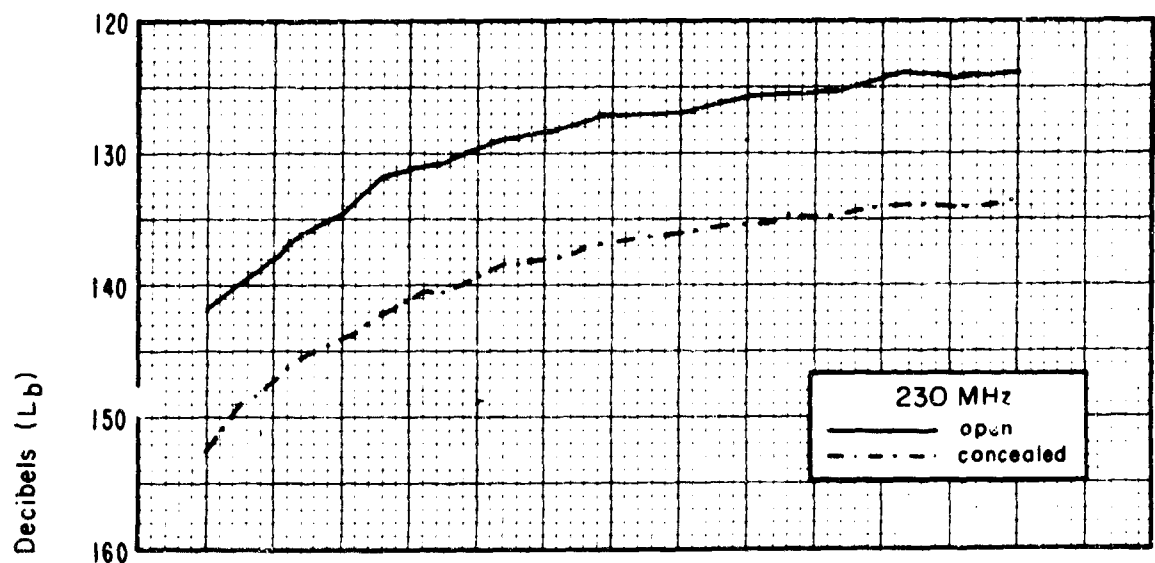
Freq (MHz)	230	410	751	910	1846	4595	9190
	6-22-66 at 13 M				3-28-66 at 13 M		
50%	123.7	128.0	134.2	135.7	99.5	105.8	92.7
$\Delta 10\%-90\%$	<3	<3	<3	<3	<3	<3	<3

The path extends over 75 ft of field grass, then drops very sharply toward the town of Boulder. The path is well above the town but across it. The horizon is about 9 mi away.

RI-20-T8-O&C

22 JUNE 1966

GREEN MOUNTAIN

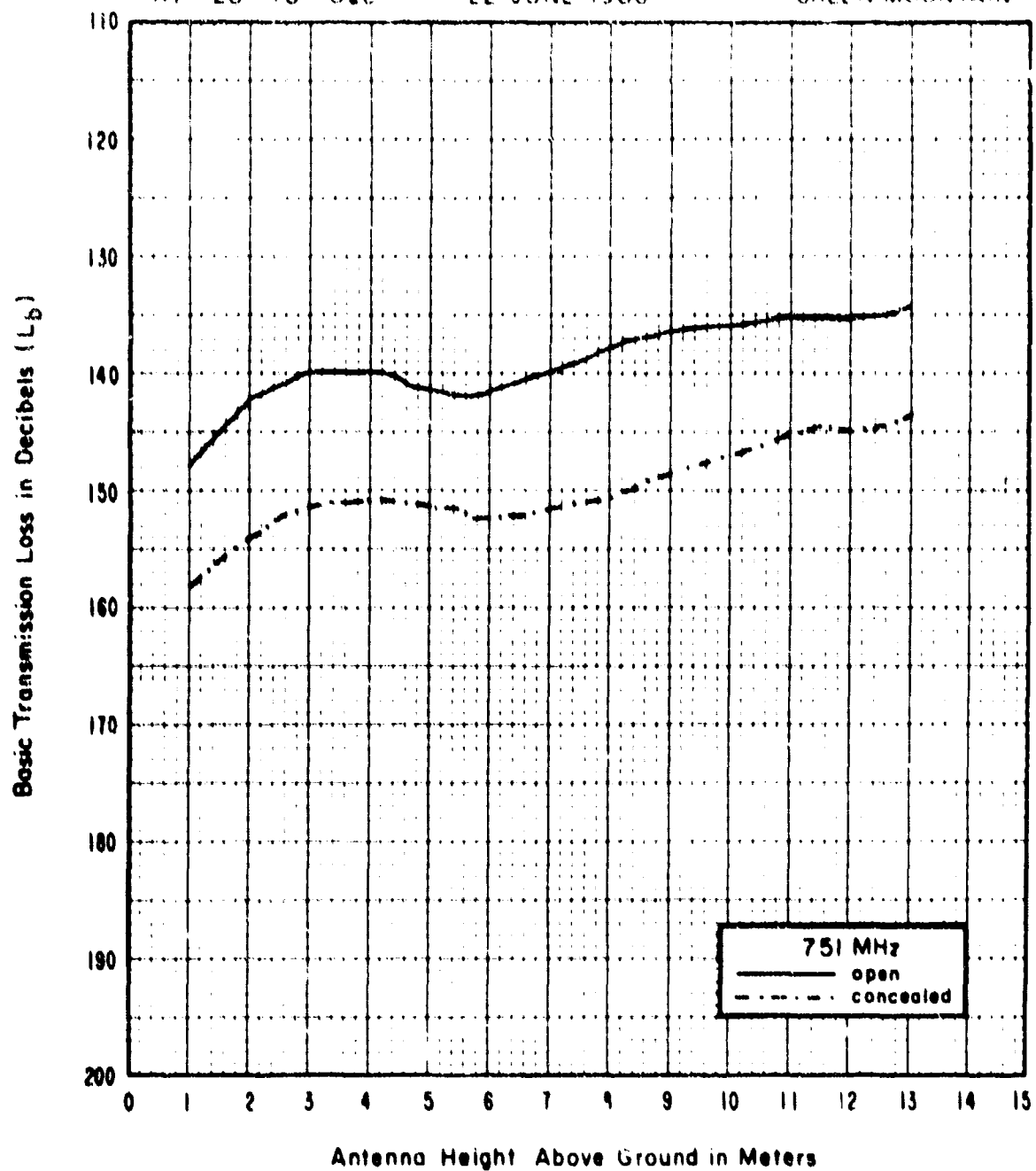


Antenna Height Above Ground in Meters

RI-20-T8-01C

22 JUNE 1966

GREEN MOUNTAIN

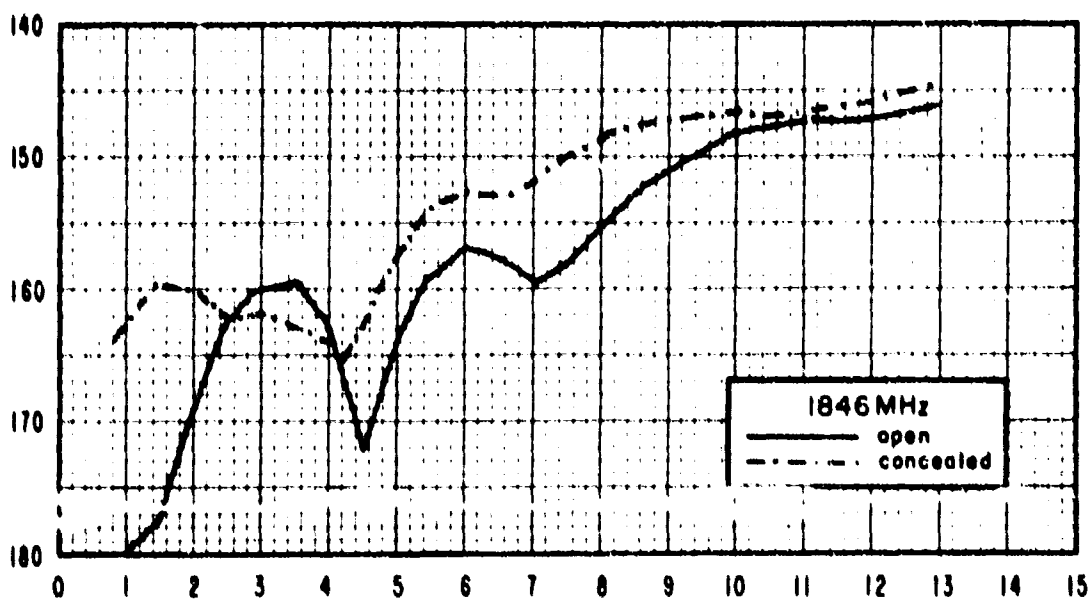
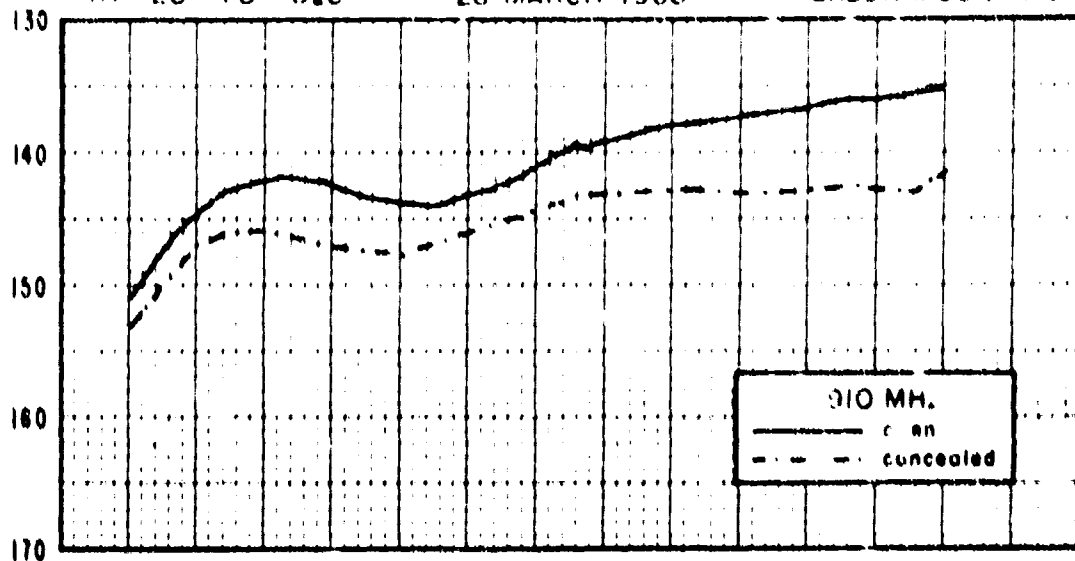


RI-20-T8-04C

28 MARCH 1966

GREEN MOUNTAIN

Basic Transmission Loss in Decibels (L_b)

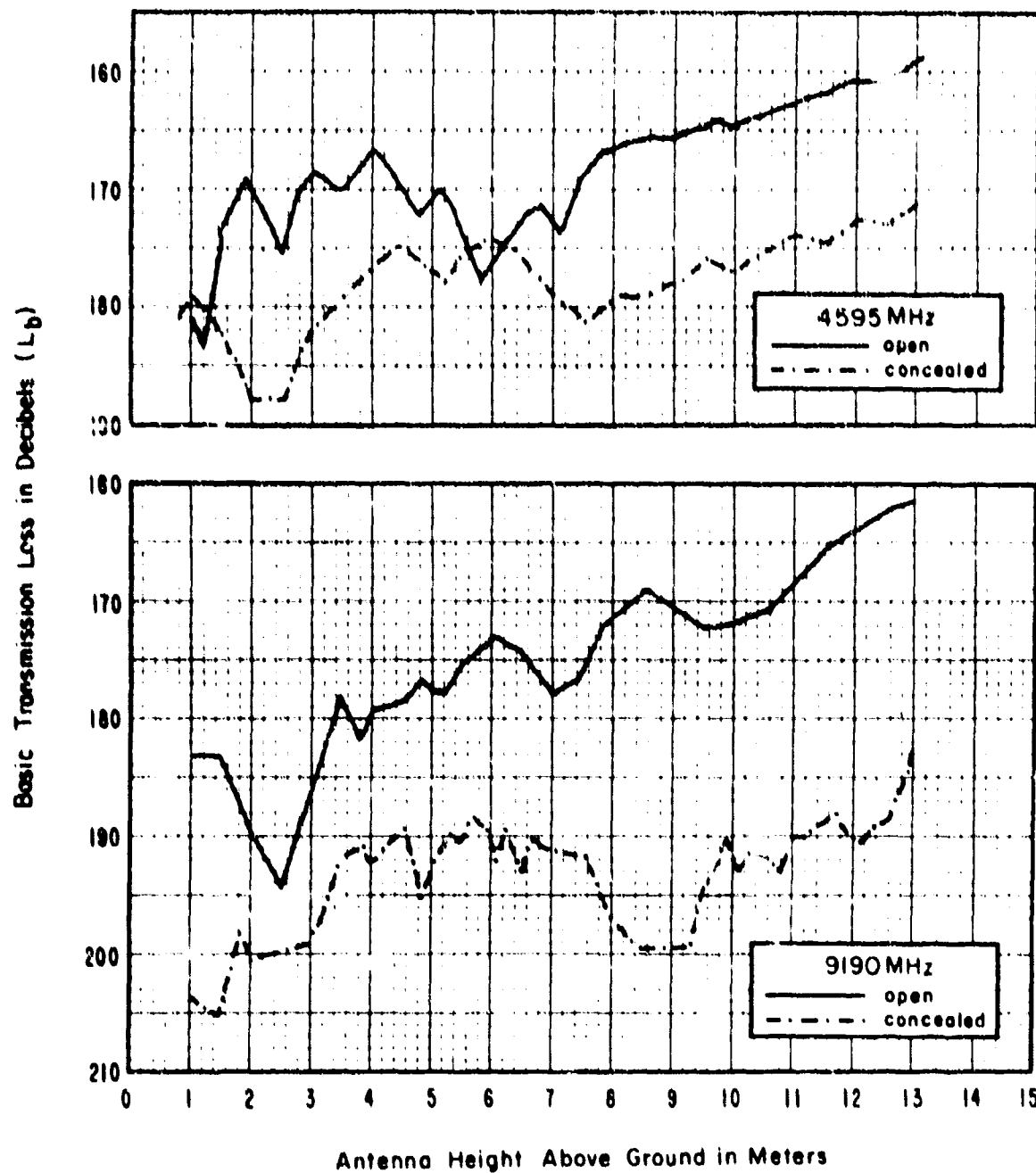


Antenna Height Above Ground in Meters

RI-20-T8-01C

28 MARCH 1966

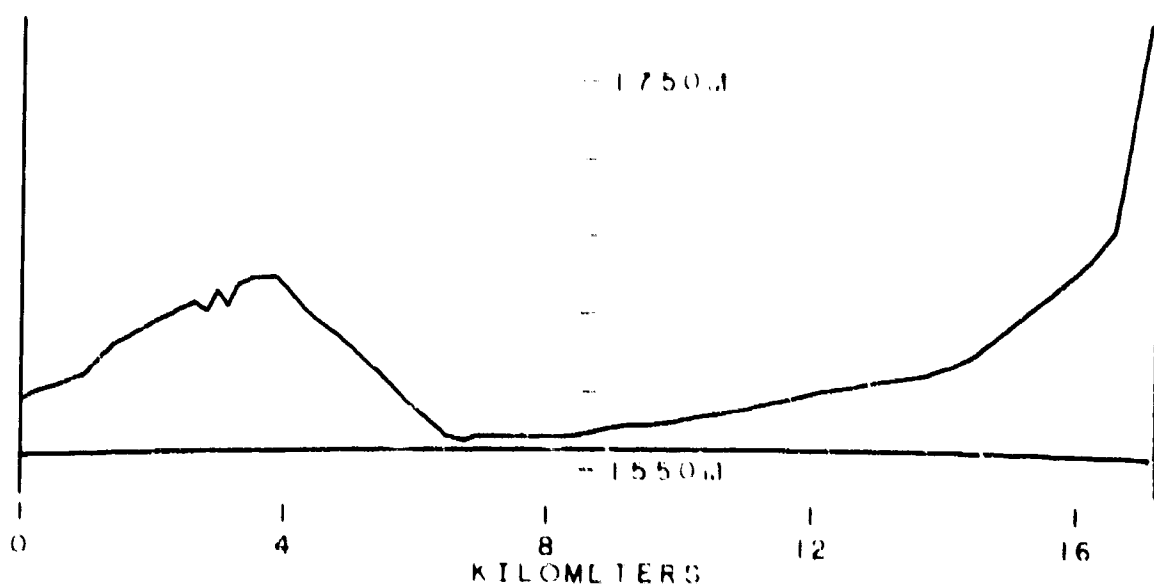
GREEN MOUNTAIN



RCVR. ELEV.
1589 M

RI-20-T8 CONCEALED
PATH LENGTH 17.24 km

XMTR. ELEV.
1783 M

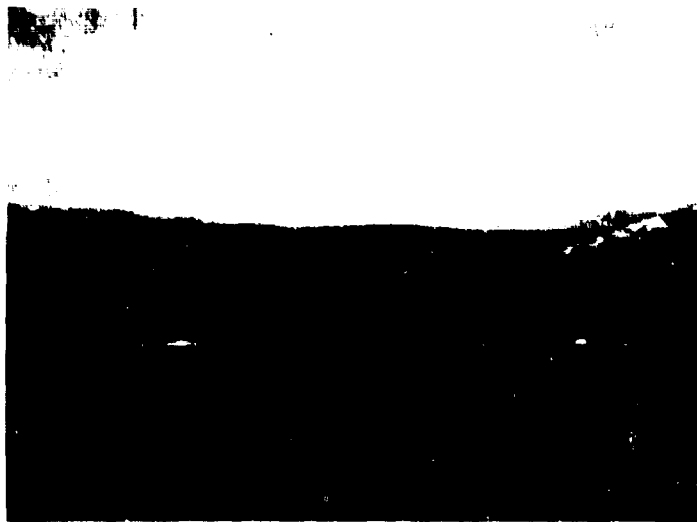


L_b (dB) SHORT TERM SIGNAL VARIABILITY

Freq (MHz)	230	410	751	910	1846	4595	9190
	6-22-66 at 13 M				3-28-66 at 13 M		
50%	132.9	132.8	143.4	140.7	143.3	170.6	182.0
$\Delta 10\%-90\%$	< 3	< 3	< 3	< 3	< 3	< 3	< 3

The antennas are concealed 10 ft behind two 30-ft pine trees. The path within the trees covers approximately 10 ft. After the next 200 yd of scattered pines and grass, the ground drops sharply towards the city of Boulder. The city and the pasture land beyond are below the line of sight to the horizon, 9 mi away.

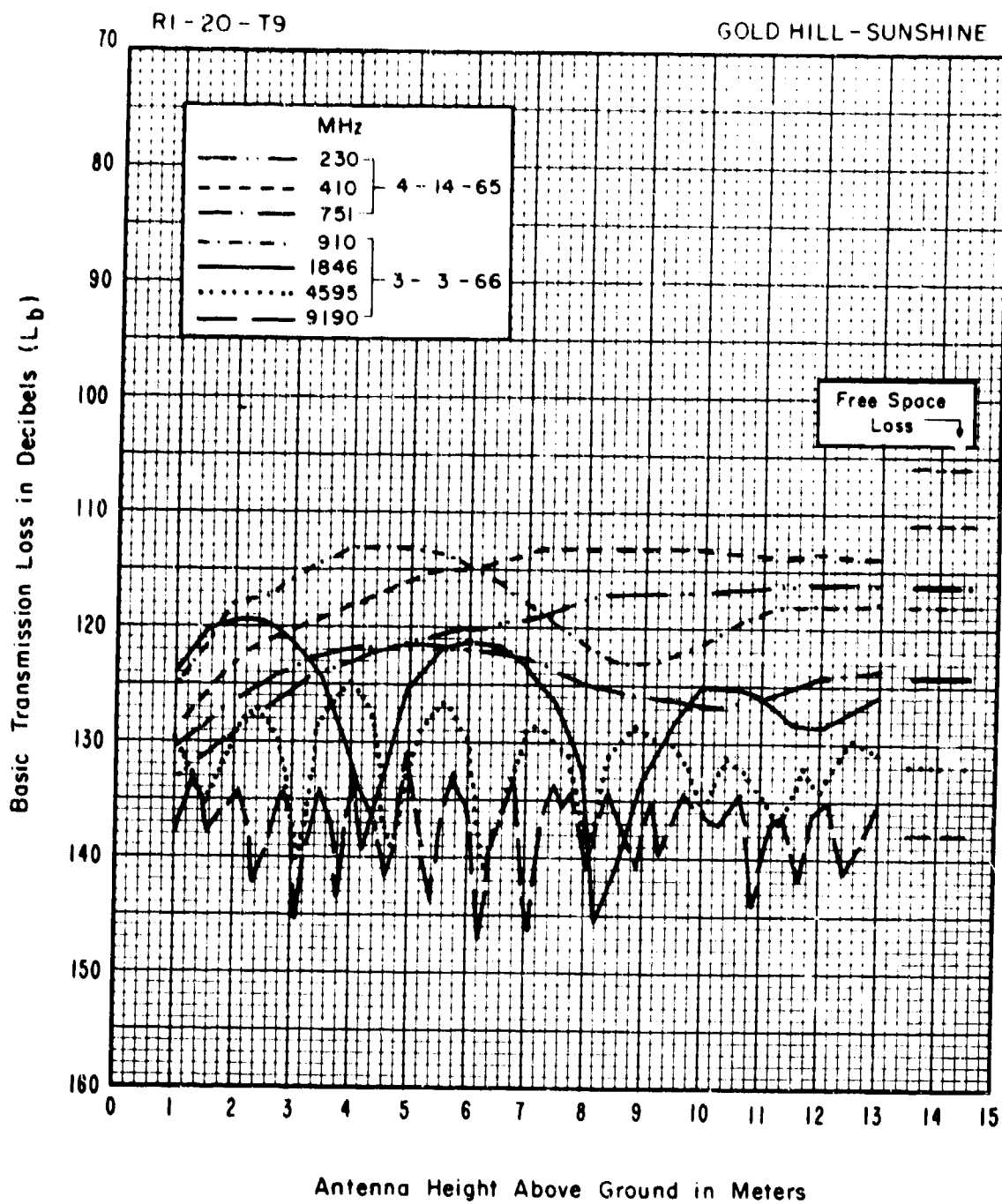
RI-20-10
SUNSHINE-GOLD HILL



PATH VIEW FROM RECEIVER



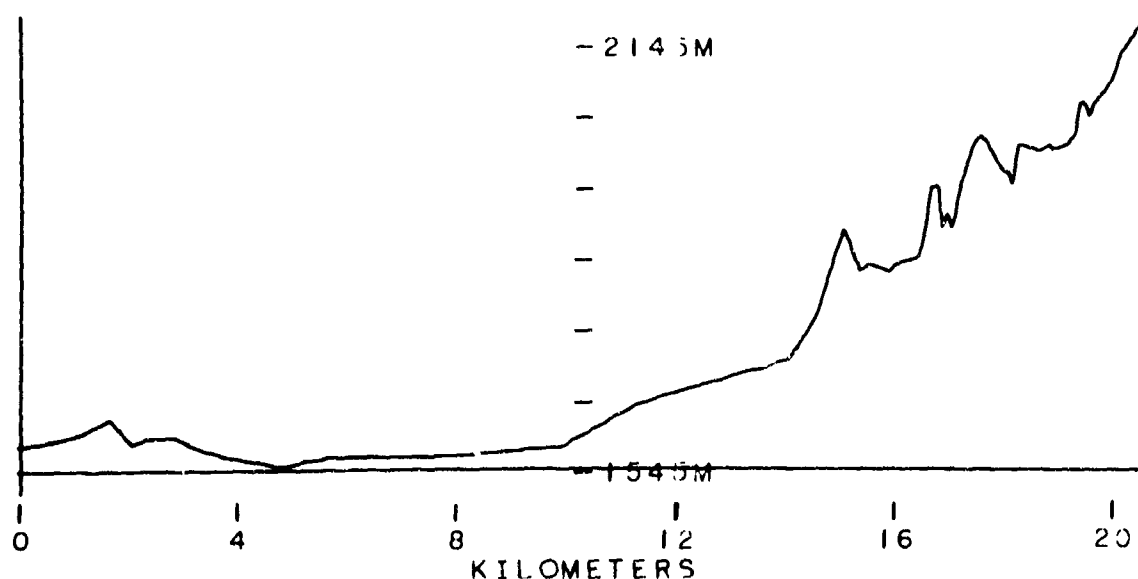
PATH VIEW FROM TRANSMITTER



RCVR. ELEV.
1589 M

RI-20-T9
PATH LENGTH 20.66 km

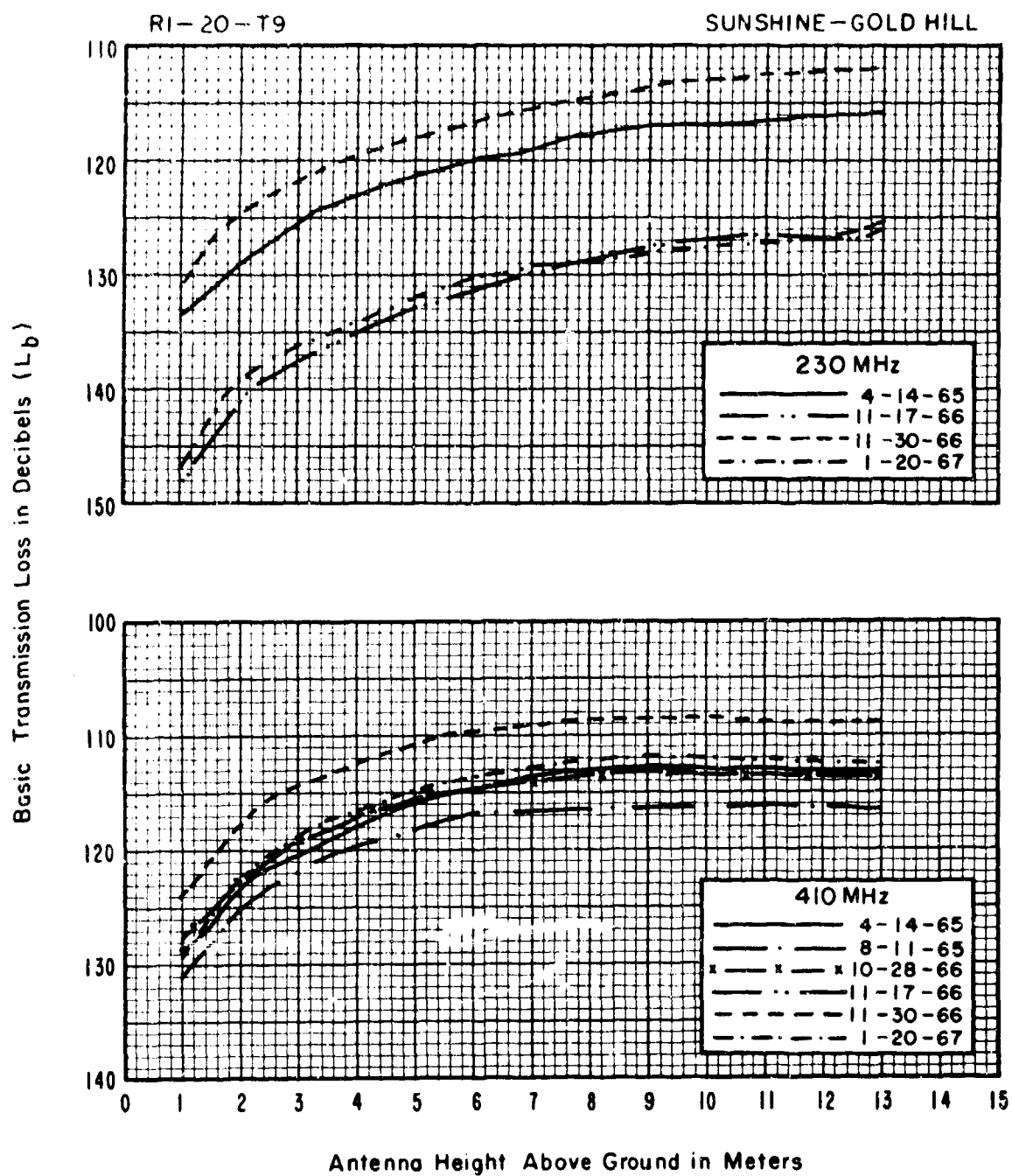
XMTR. ELEV.
2195 M

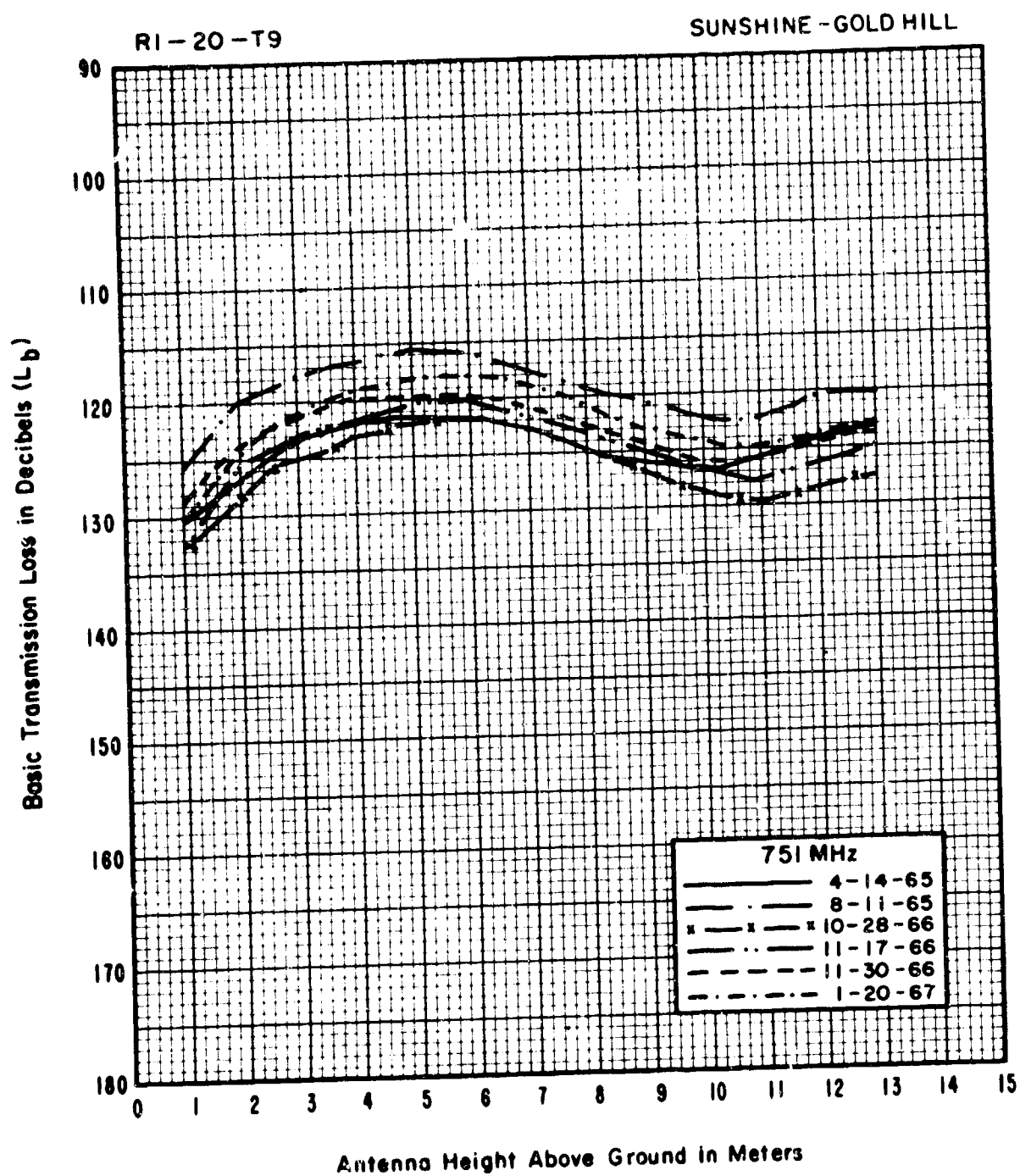


L (dB) SHORT TERM SIGNAL VARIABILITY
b

Freq (MHz)	230	410	751	910	1846	4595	9190
	4-14-65 at 13 M				3-3-66 at 7.3 M		
50%	115.8	112.7	124.1	120.2	125.2	127.9	133.3
$\Delta 10\%-90\%$	<3	<3	<3	<3	<3	<3	<3

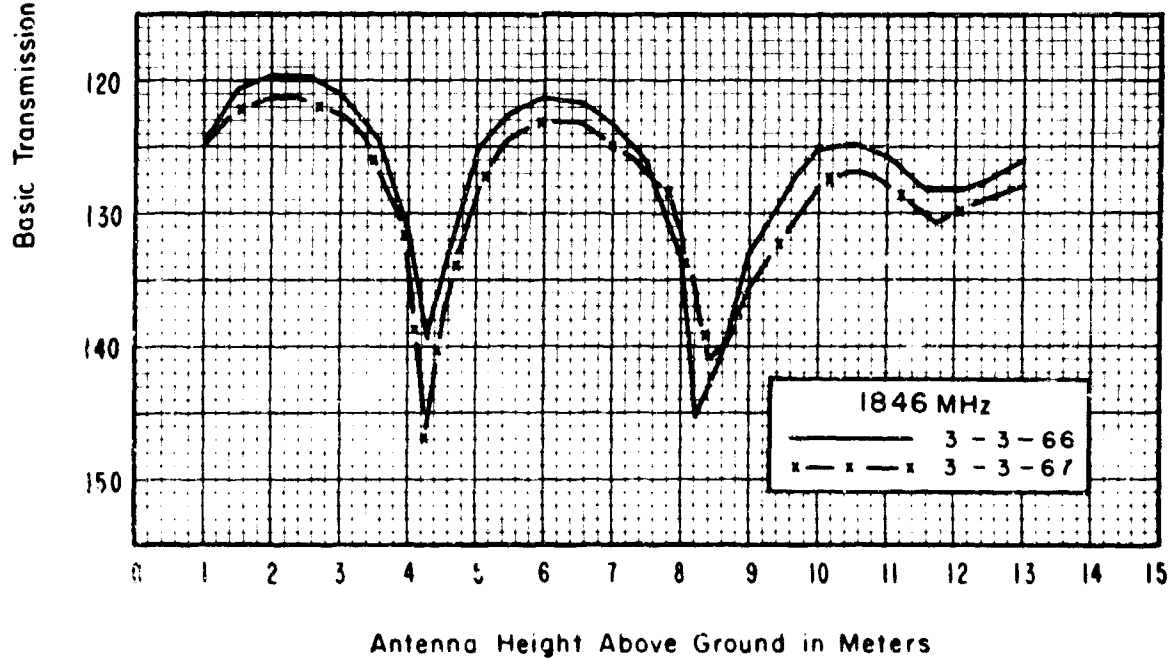
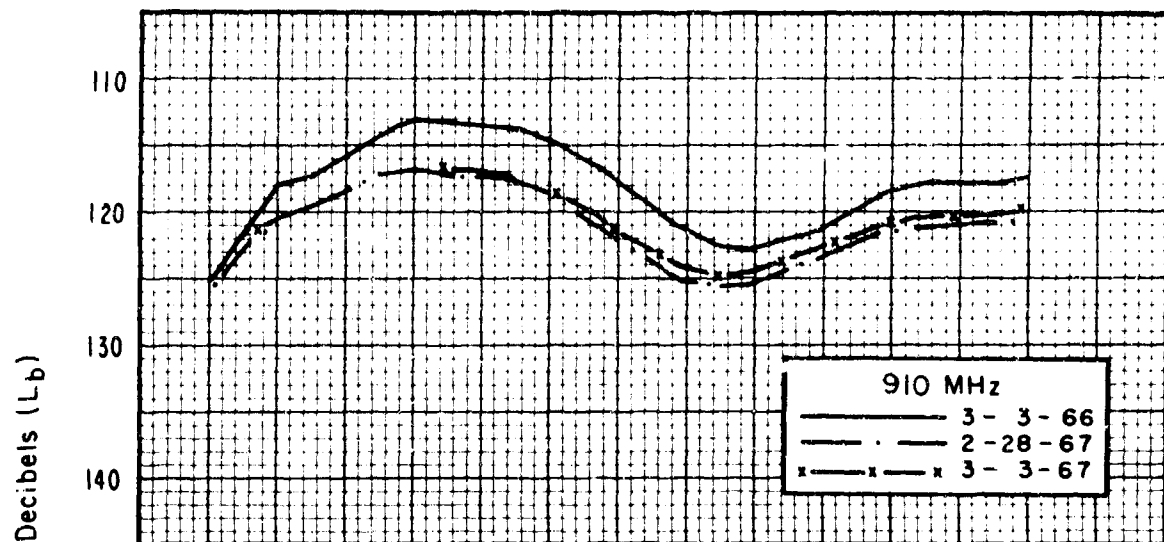
A dirt road forms the immediate foreground at this site. A grass-covered field extends 100 yd to a stand of 10- to 20- ft pine trees, beyond which, for 6 mi, run foothills spotted with pines and grasslands. The trees and foothills are below the line of sight to the receiver.

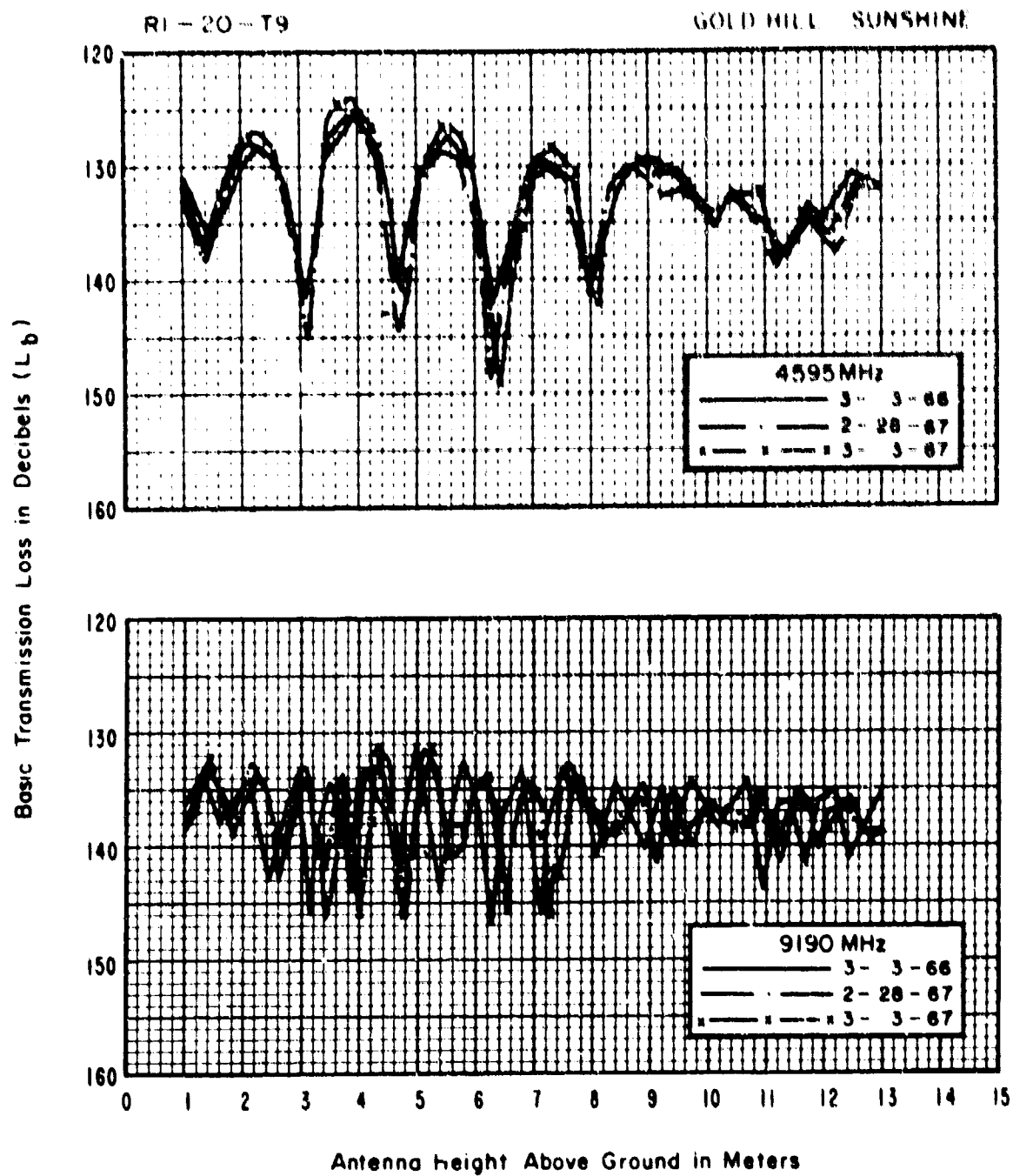




RI-20-T9

COLD HILL-SUNSHINE





RE 20 110
LYON



PATH VIEW FROM RECEIVER

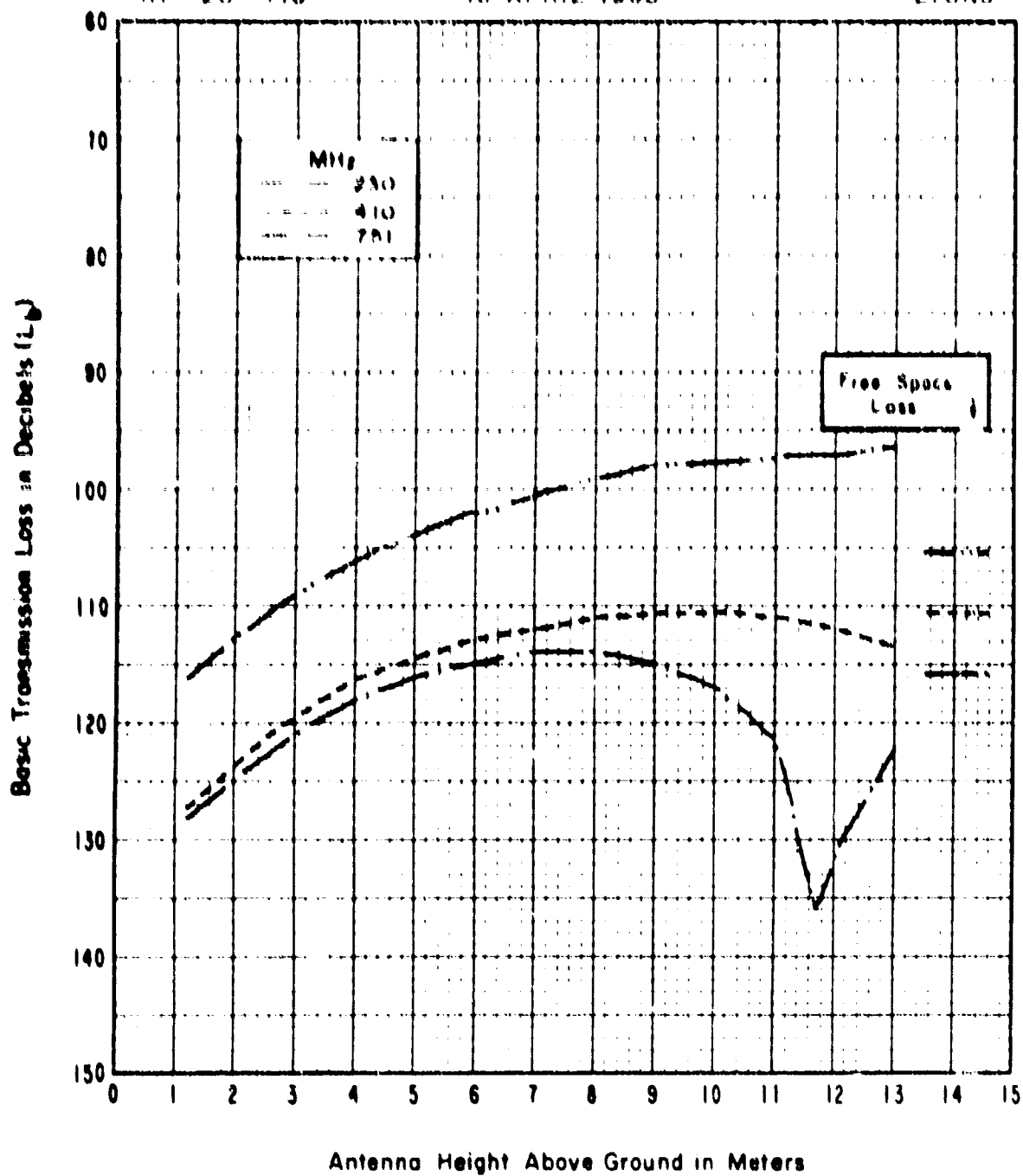


PATH VIEW FROM TRANSMITTER

MI-20-110

16 APRIL 1965

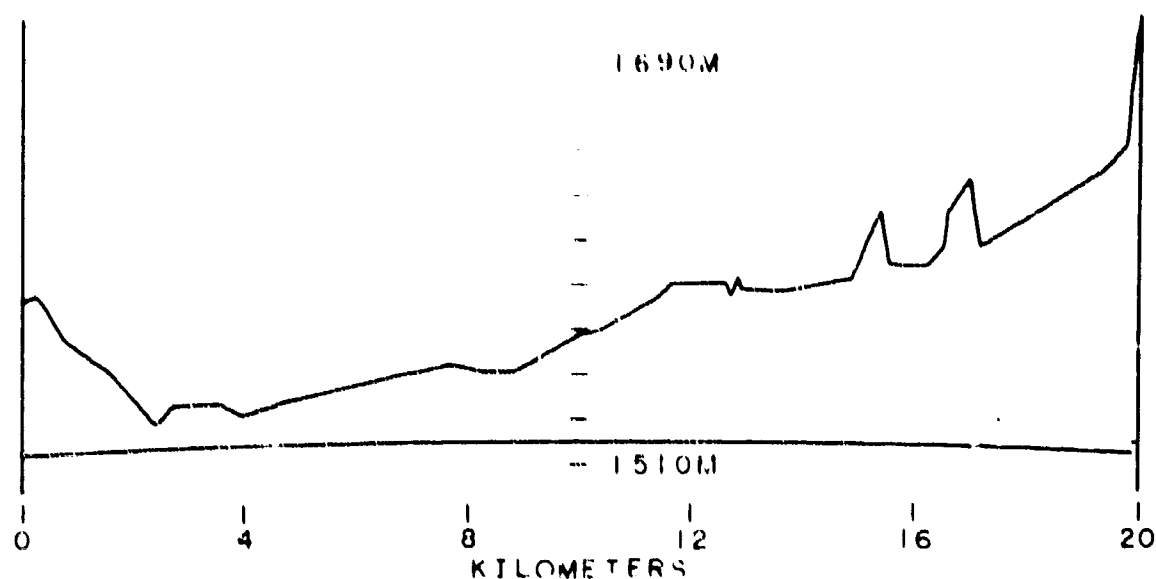
LYONS



RCVR. ELEV.
1589 M

R1-20-T10
PATH LENGTH 20.00 km

XMTR. ELEV.
1713 M

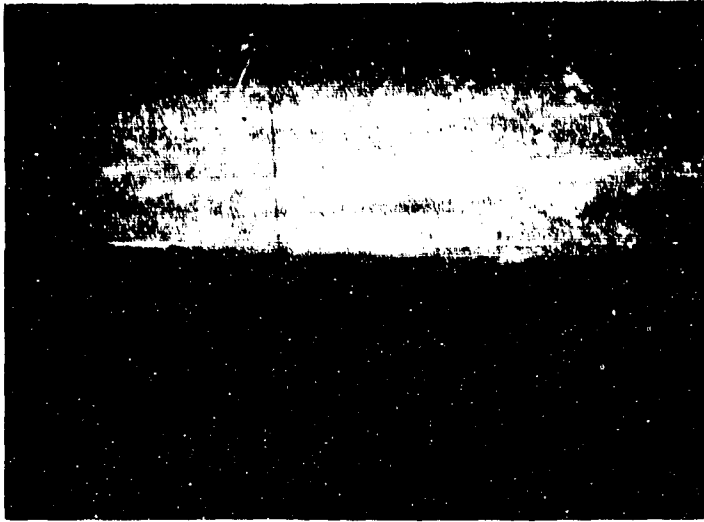


L_p (dB) SHORT TERM SIGNAL VARIABILITY

Freq (MHz)	230	410	751	910	1846	4595	9190
4-16-65 at 13 M							
50%	96.0	114.9	120.8				
$\Delta 10\%-90\%$	<3	<3	<3				

This transmitter site is located approximately 40 ft from the edge of a 200-ft cliff. The immediate foreground is covered by broken rock scraped from the surrounding area. The rest of the path is in line of sight through a gap, with sloping foothills to the right and left.

R1-20-T10-A
LYONS



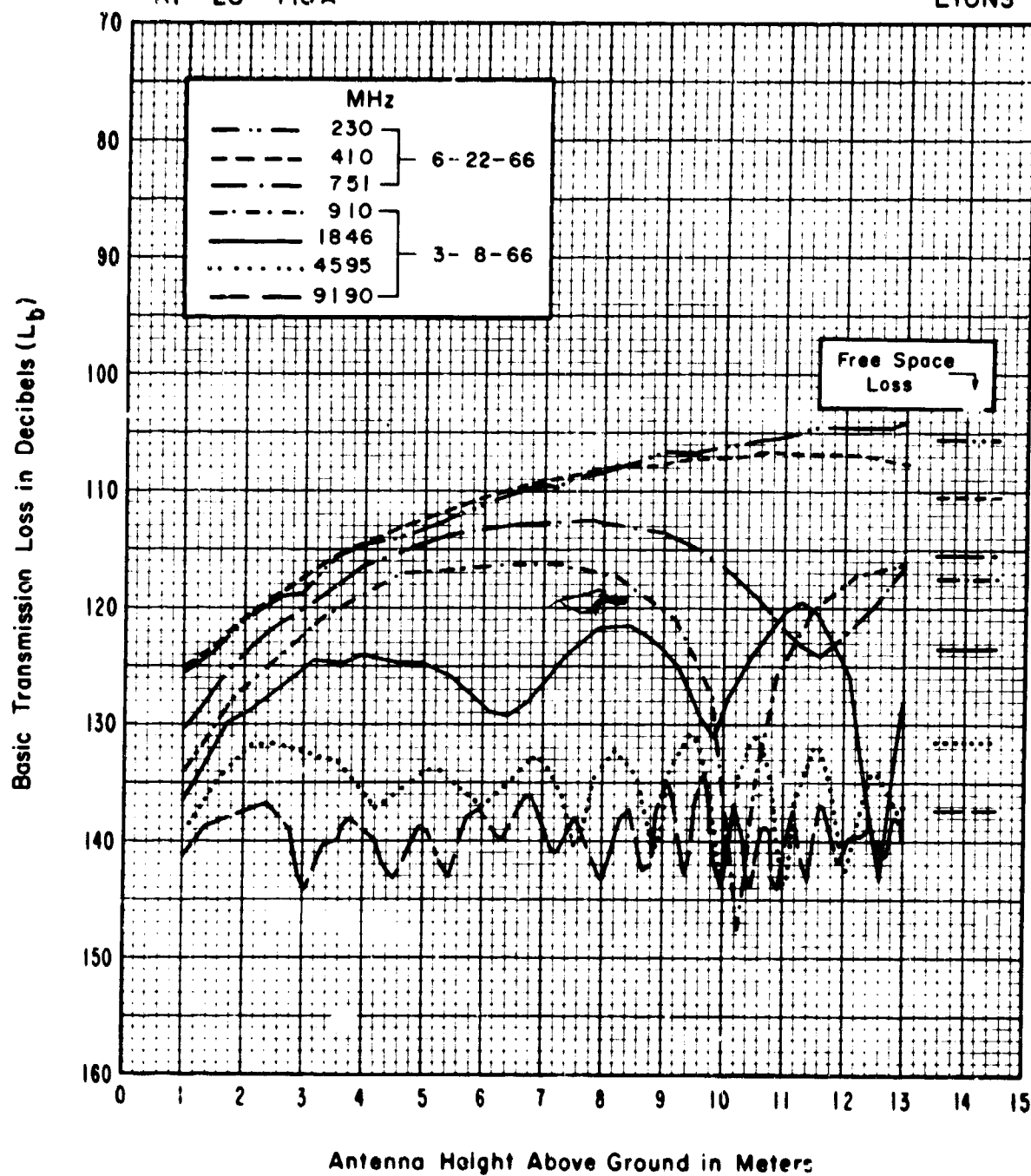
PATH VIEW FROM RECEIVER



PATH VIEW FROM TRANSMITTER

RI-20-T10A

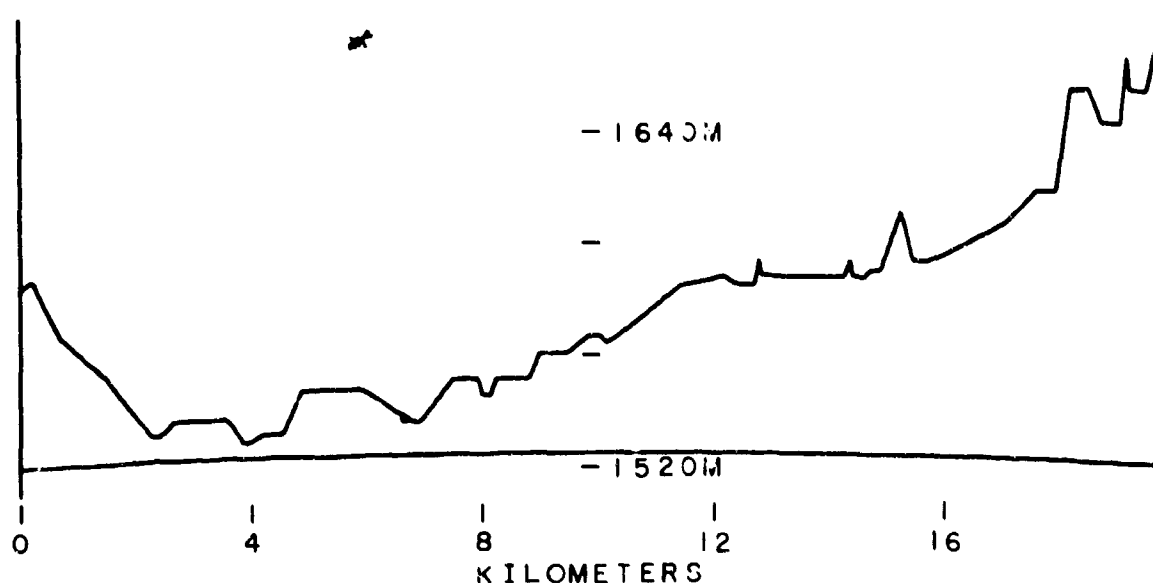
LYONS



RCVR. ELEV.
1589 M

RI-20-T10A
PATH LENGTH 19.70 km

XMTR. ELEV.
1676 M

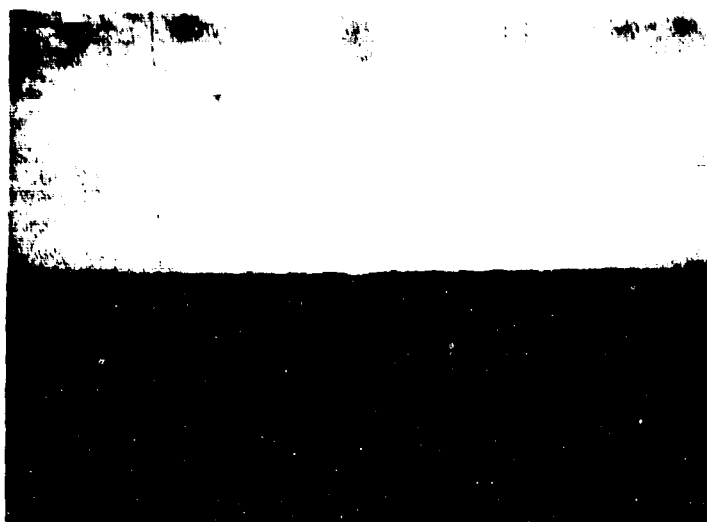


L_b (dB) SHORT TERM SIGNAL VARIABILITY

Freq (MHz)	230	410	751	910	1846	4595	9190
	6-22-66 at 13 M				3-8-66 at 7.3 M		
50%	103.2	108.6	117.0	116.1	123.0	135.2	137.4
$\Delta 10\%-90\%$	< 3	< 3	< 3	< 3	< 3	< 3	< 3

This radio path is between two downslopes over partly grass-covered, partly rocky terrain. Approximately 500 yd away, a 5-wire power line crosses the path, below the line of sight, at 45° . About $1/2$ mi away to the left is a 40-ft water tank.

R1-50-T1
KERSEY SW4



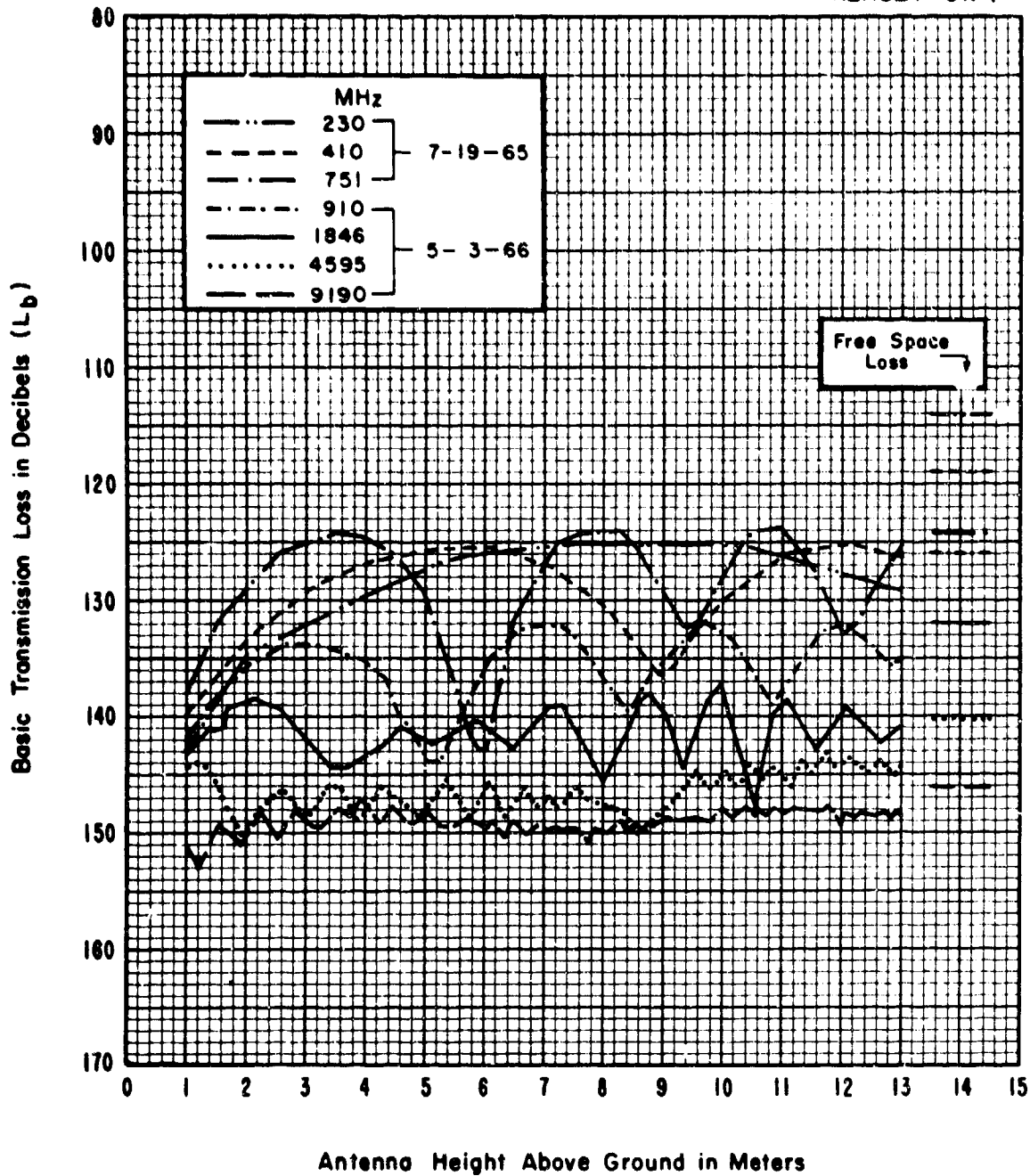
PATH VIEW FROM RECEIVER



PATH VIEW FROM TRANSMITTER

RI-50-TI

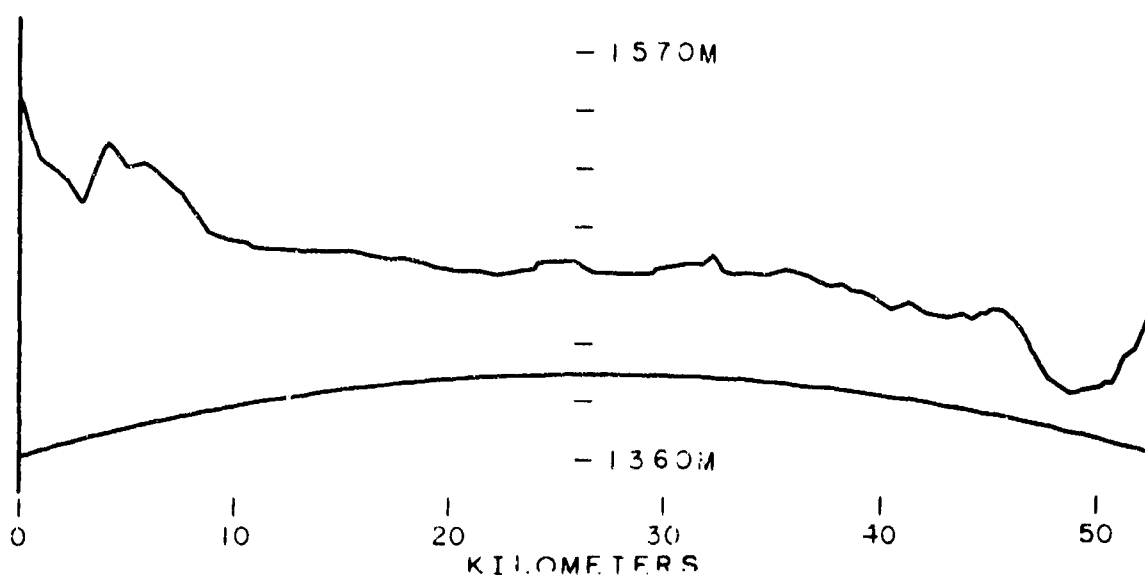
KERSEY SW4



RCVR. ELEV.
1589 M

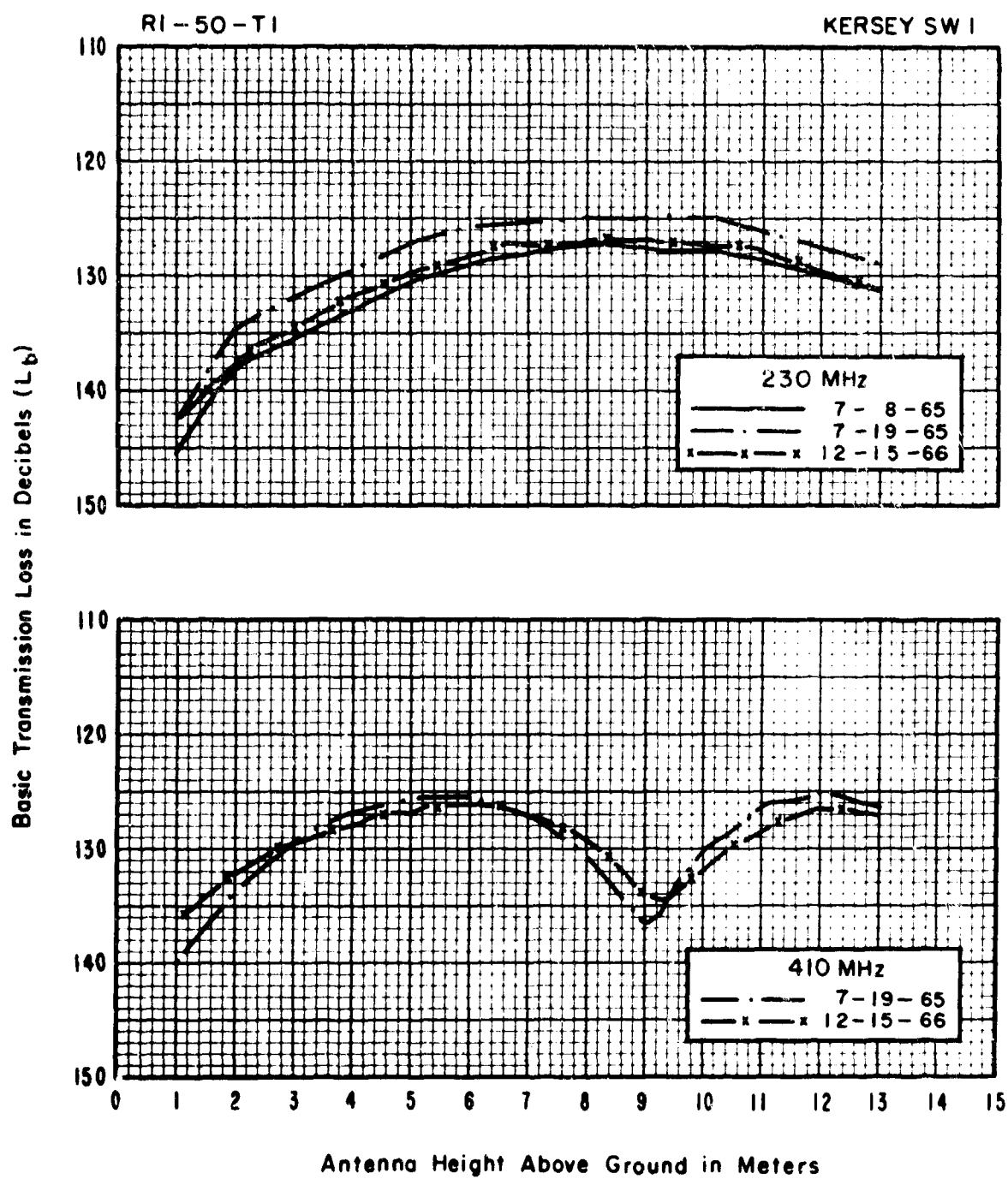
R1-50-T1
PATH LENGTH 52.56 km

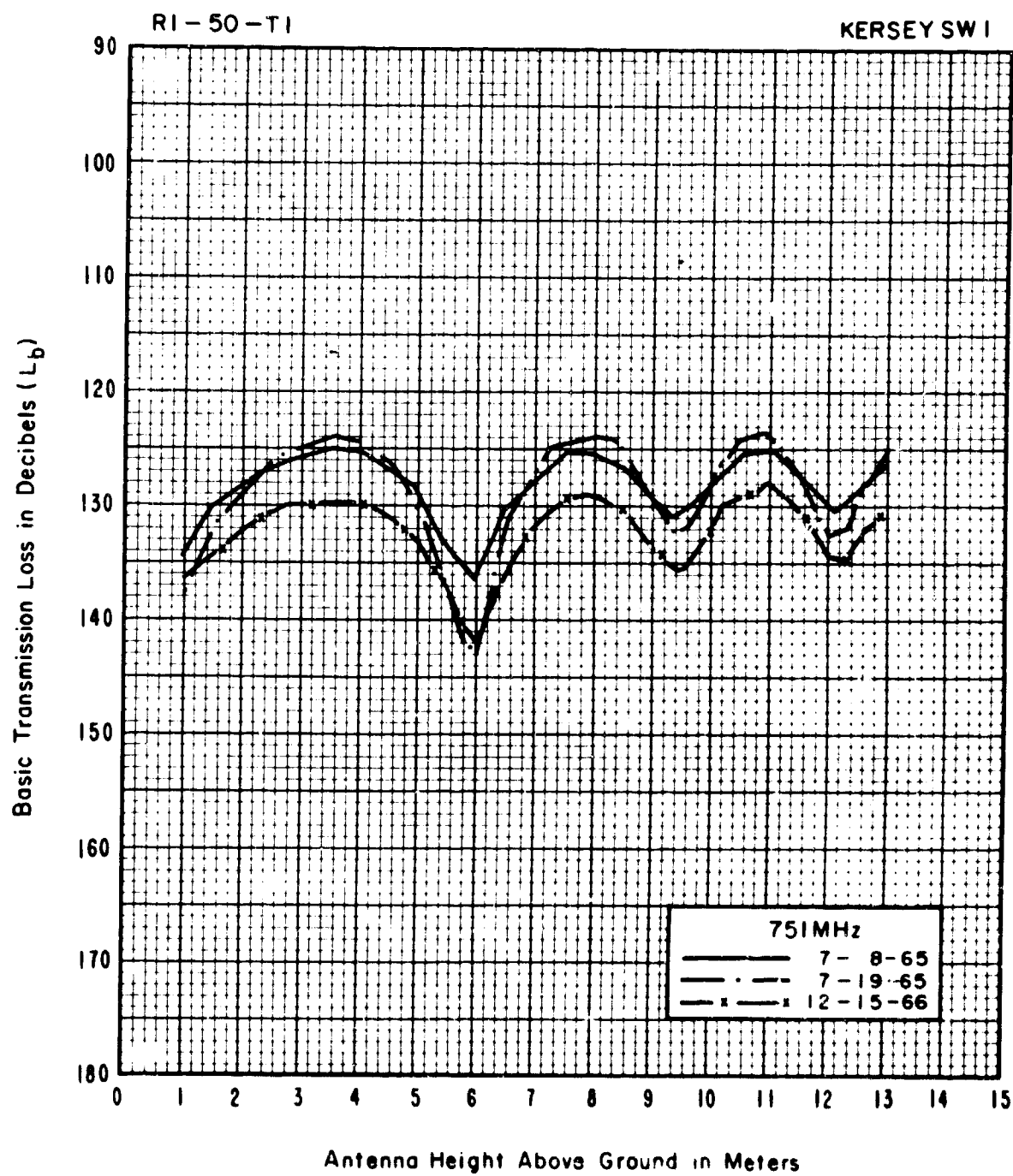
XM
13.0 M



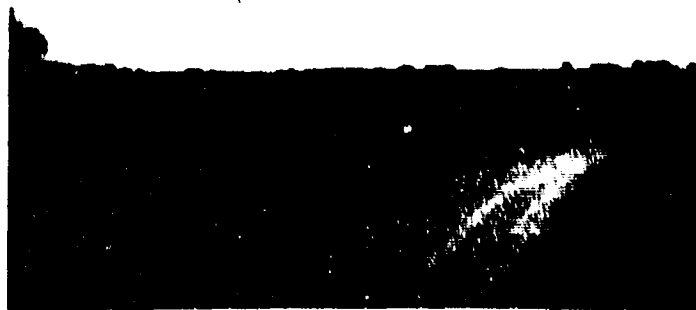
L _b (dB) SHORT TERM SIGNAL VARIABILITY							
Freq (MHz)	230	410	751	910	1846	4595	9190
7-19-65 at 13 M				5-3-66 at 13 M			
50%	130.9	126.4	124.6	134.9	140.0	143.2	148.6
Δ10%-90%	< 3	< 3	< 3	< 3	< 3	< 3	< 3
				5-3-66 at 7.3 M			
50%				133.4	138.2	146.4	148.7
Δ10%-90%				< 3	< 3	< 3	< 3
				5-3-66 at 1 M			
50%				140.9	142.0	143.0	154.2
Δ10%-90%				< 3	< 3	< 3	3

In the immediate foreground at this site are plowed fields with clumps of field grass that extend to a thin line of cottonwood trees 1/2 mi away. The next 1/2 mi is another field, followed by another windbreak of cottonwoods. Beyond are gently rolling hills and fields.

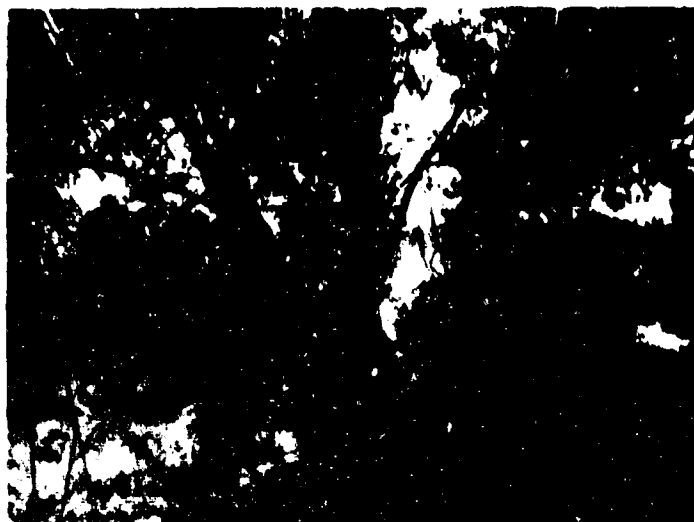




RI-50-T2 OPEN AND CONCEALED
MILLIKEN F2



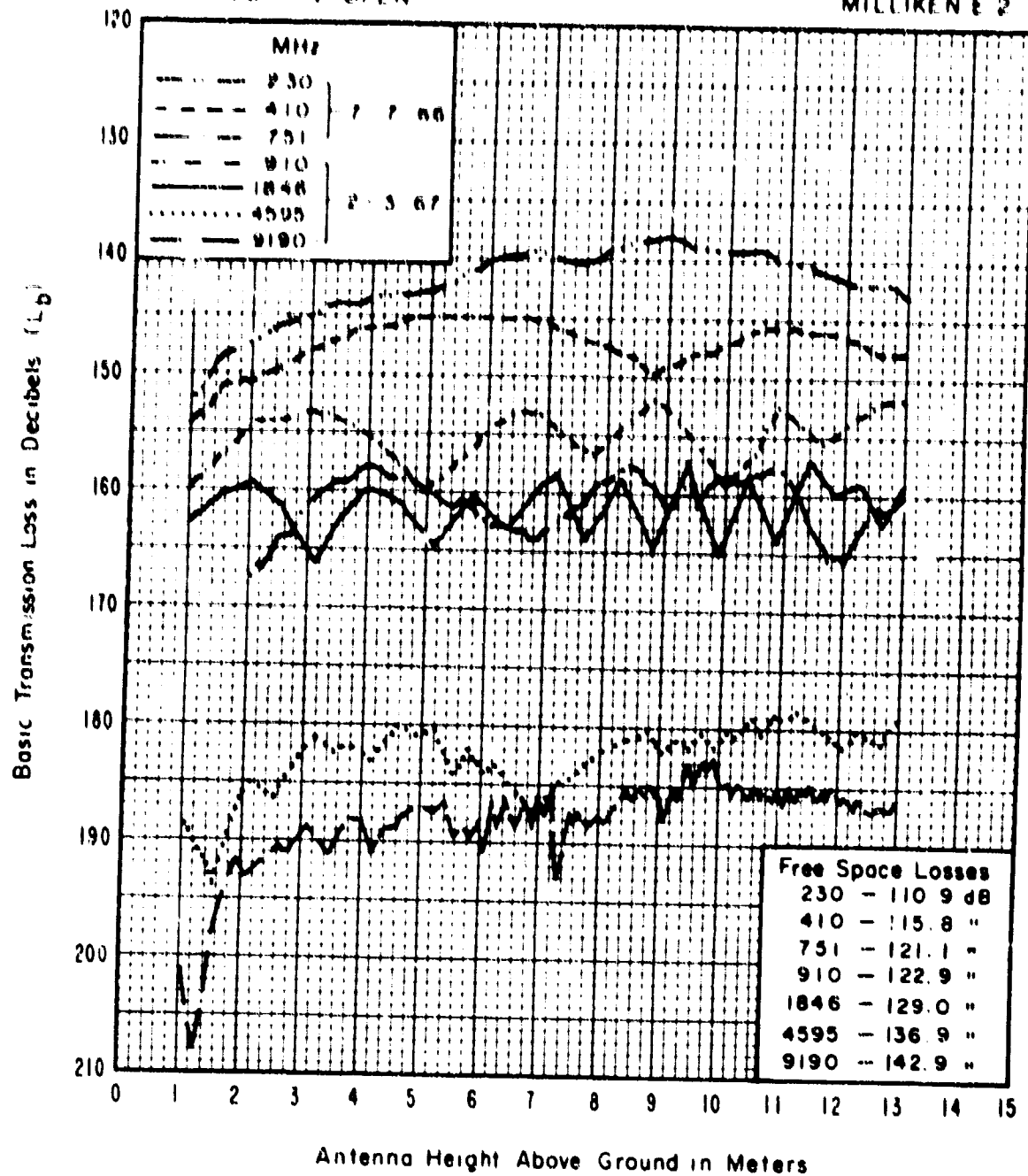
PATH VIEW FROM OPEN SITE



PATH VIEW FROM CONCEALED SITE

NI 50 12 OPEN

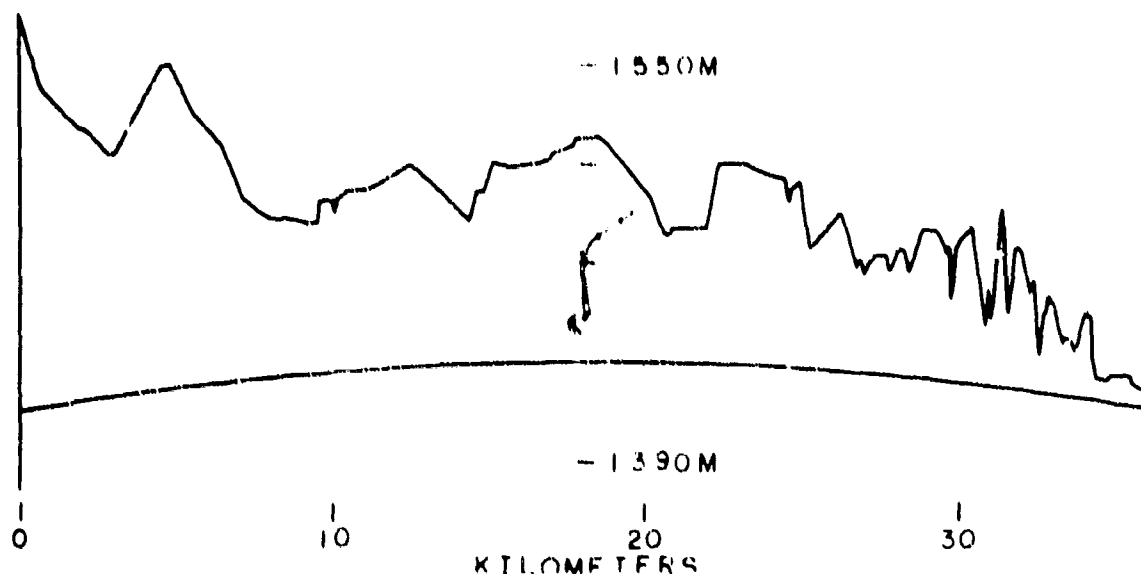
MILLIKEN & 2



RCVR. ELEV.
1589 M

R1-S0-T2 OPEN
PATH LENGTH 36.22 km

XMTR. ELEV.
1436 M



L_p (dB) SHORT TERM SIGNAL VARIABILITY

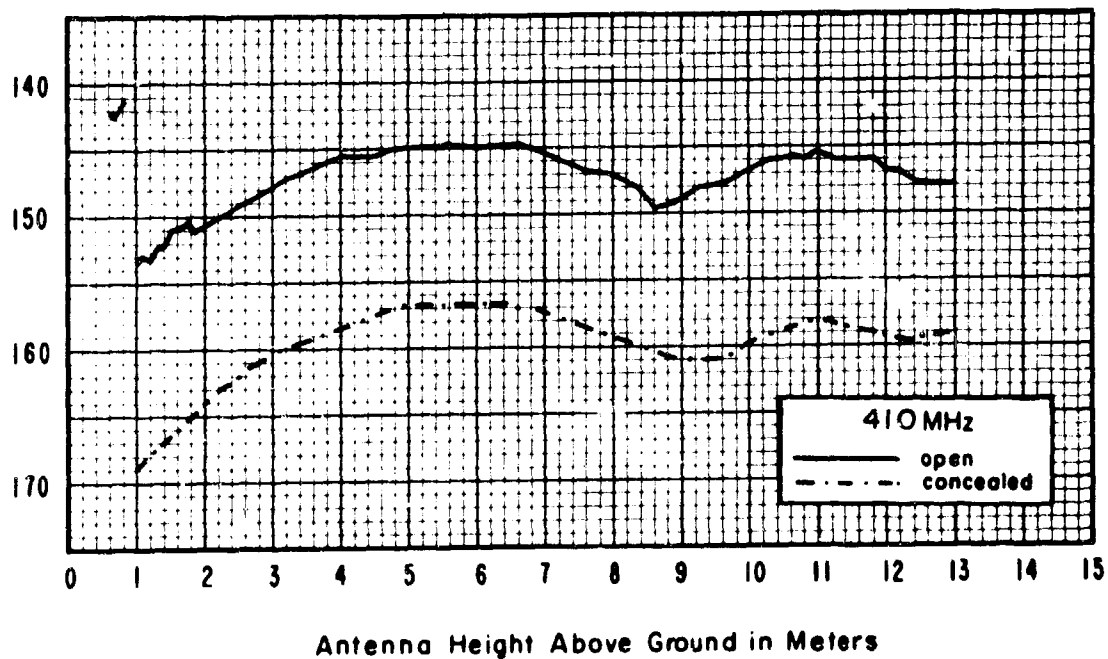
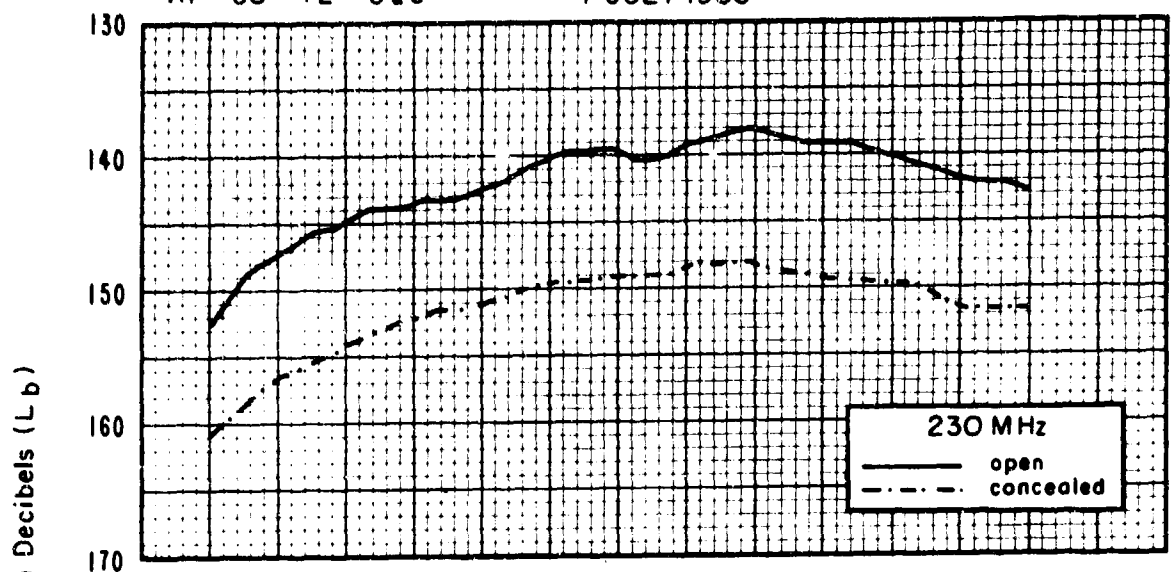
Freq (MHz)	230	410	751	910	1846	4595	9190
7-7-66 at 13 M				2-3-67 at 13 M			
50%	142.5	145.7	160.8	154.0	161.5	179.5	186.5
$\Delta 10\%-90\%$	< 3	< 3	< 3	< 3	< 3	3.6	6.4
7-7-66 at 7.3 M				2-3-67 at 7.3 M			
50%		147.4	161.1	158.0	162.3	183.0	178.8
$\Delta 10\%-90\%$		< 3	< 3	< 3	< 3	6.6	8.6
7-7-66 at 1 M				2-3-67 at 1 M			
50%		155.3	168.3	164.6	167.5	183.8	196.1
$\Delta 10\%-90\%$		< 3	4.5	5.6	3.3	7.9	6.1

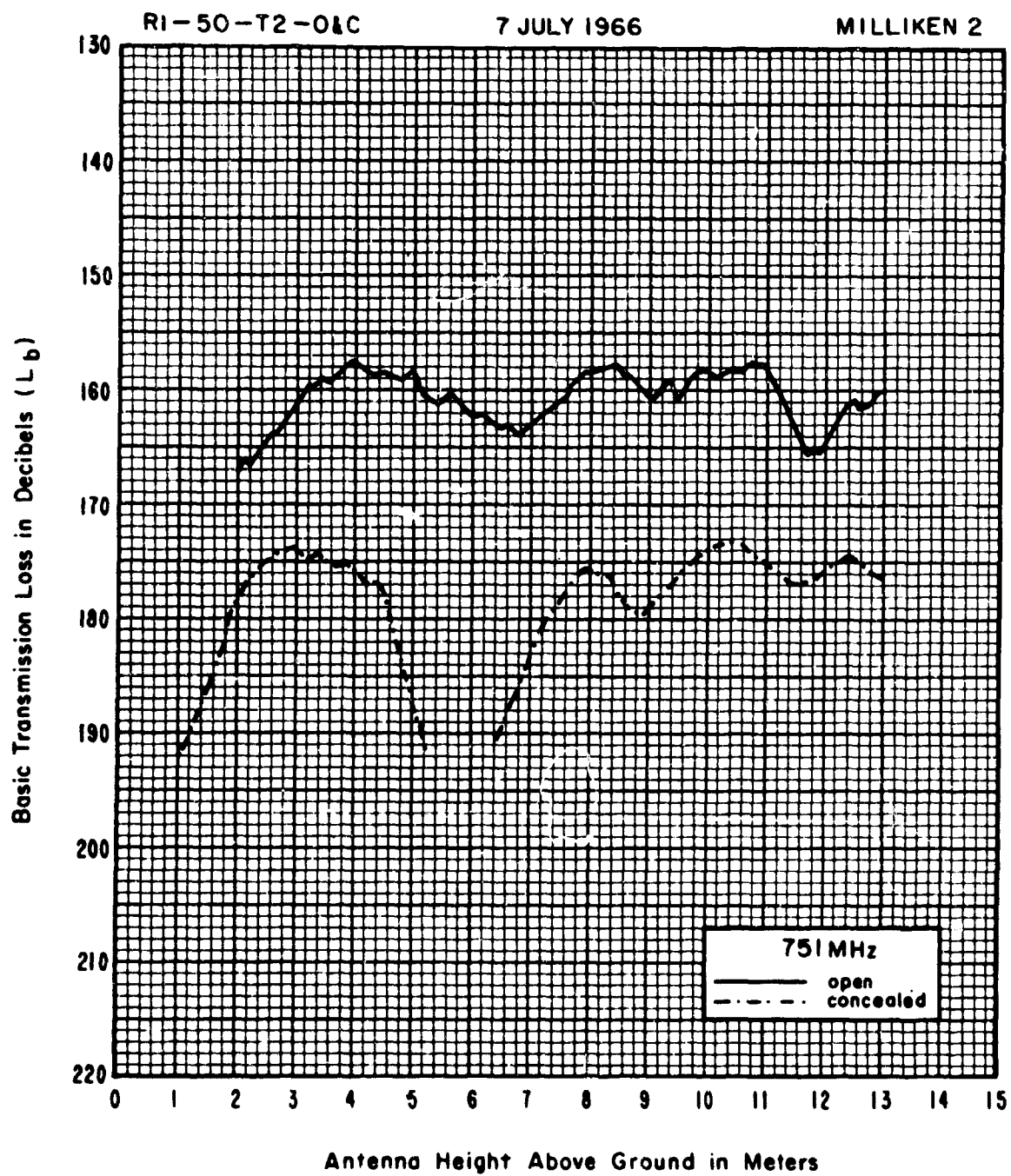
The path crosses 1/2 mi of open flat farmland to a small group of farm buildings. Beyond are trees to the horizon 3 mi away.

RI-50-T2-O&C

7 JULY 1966

MILLIKEN E 2

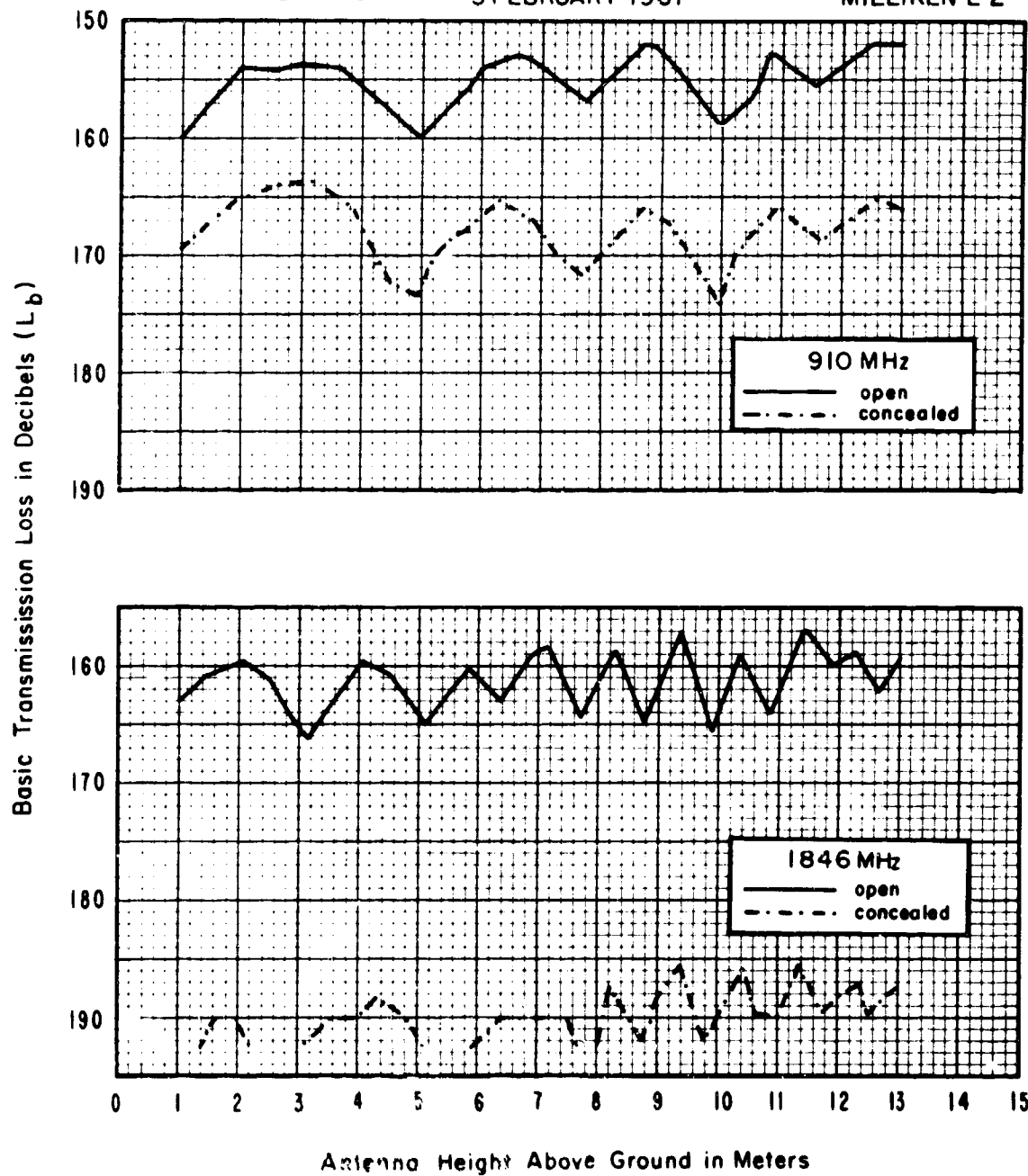




RI-50-T2-O&C

3 FEBRUARY 1967

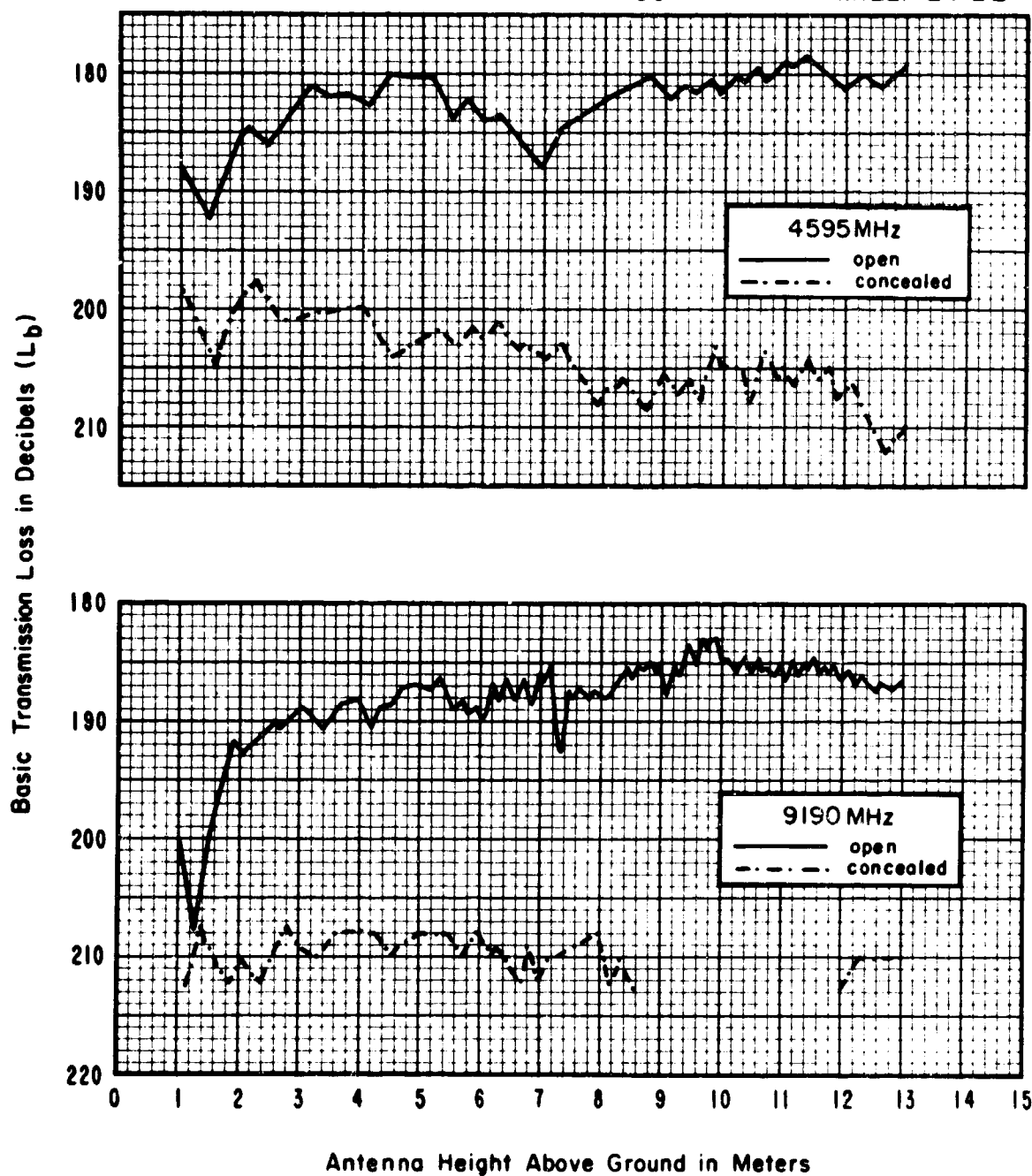
MILLIKEN E 2



RI-50-T2-0&C

3 FEBRUARY 1967

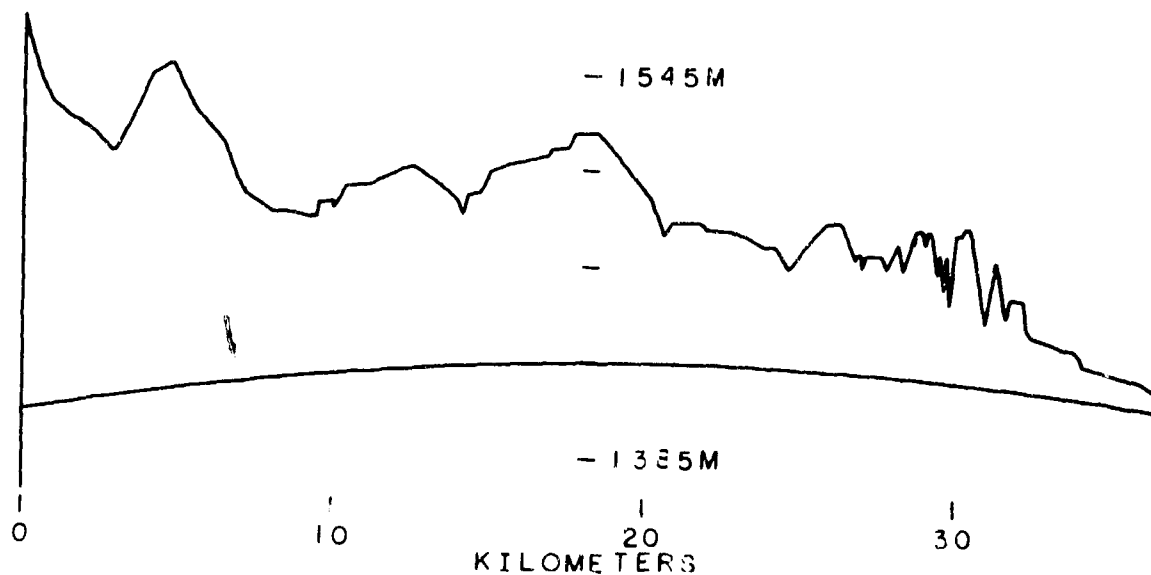
MILLIKEN E 2



RCVR. ELEV.
1589 M

R1-50-T2 CONCEALED
PATH LENGTH 36.46 km

XMTR. ELEV.
1433 M

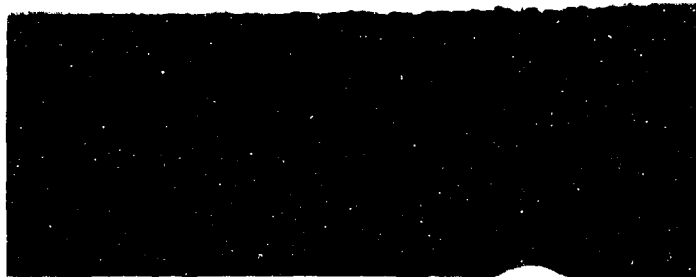


L_p (dB) SHORT TERM SIGNAL VARIABILITY

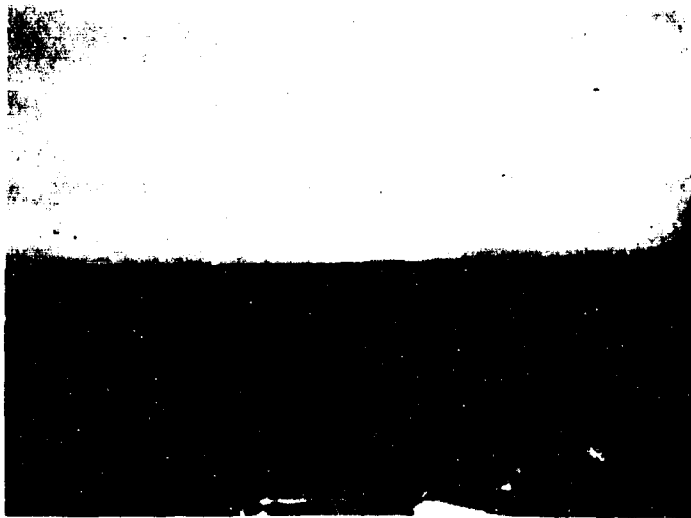
Freq (MHz)	230	410	751	910	1846	4595	9190
7-7-66 at 13 M				2-3-67 at 13 M			
50%	151.5	159.6	175.0	160.7	188.1	202.5	206.2
$\Delta 10\%-90\%$	< 3	< 3	< 3	4.0	< 3	9.1	< 3
				2-3-67 at 7.3 M			
50%				166.8	189.1	205.7	209.1
$\Delta 10\%-90\%$				< 3	< 3	7.0	< 3
				2-3-67 at 1.0 M			
50%				169.8	192.1	201.7	
$\Delta 10\%-90\%$				4.4	< 3	7.2	

The antennas are concealed approximately 10 ft behind a dense, approximately 200 ft deep, thicket of cottonwood trees. Beyond, rolling hills and grass-covered fields extend to the horizon, 5-1/2 mi away.

R1-50-T3
KEENSBURG SW



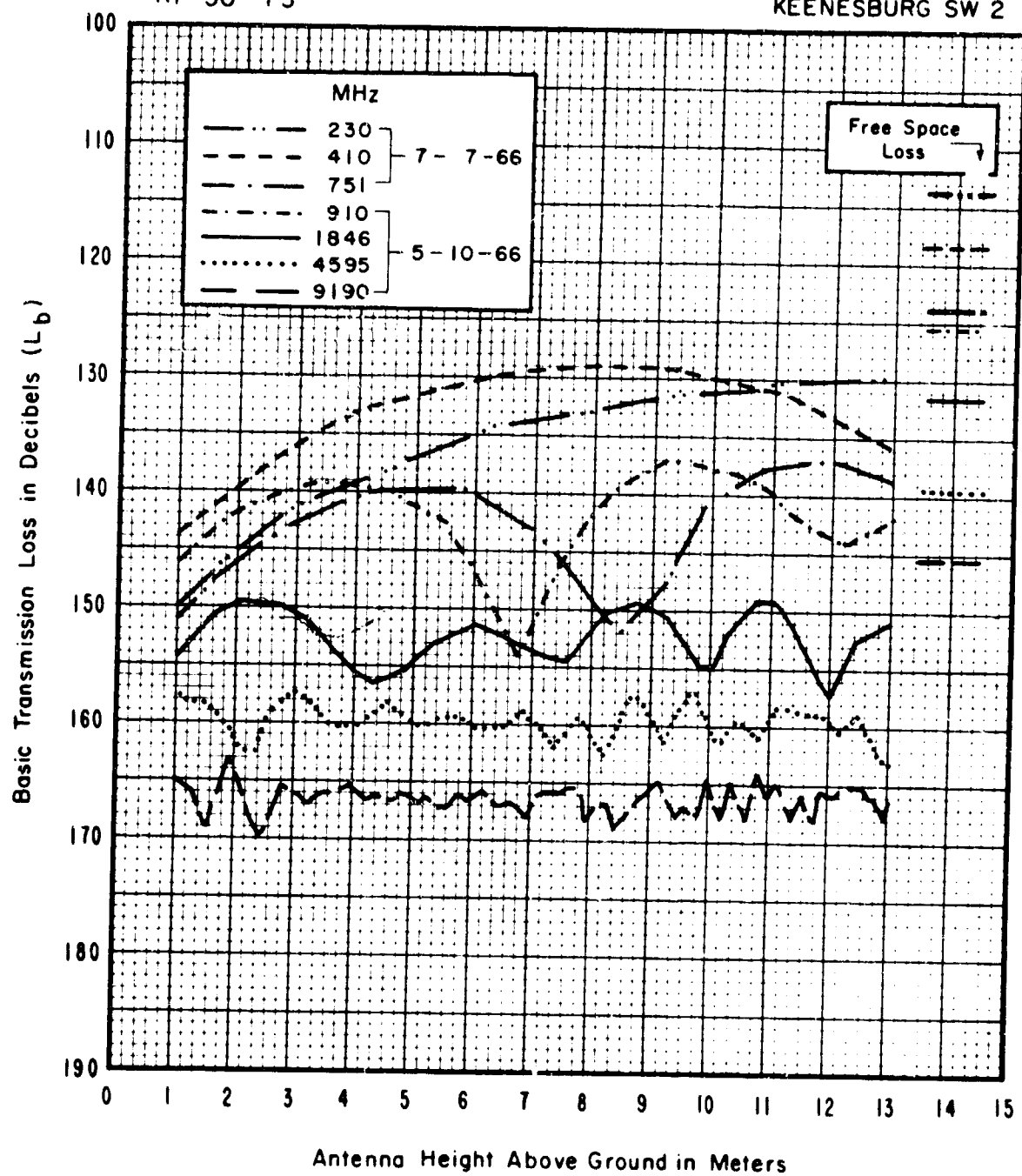
PATH VIEW FROM RECEIVER



PATH VIEW FROM TRANSMITTER

RI-50-T3

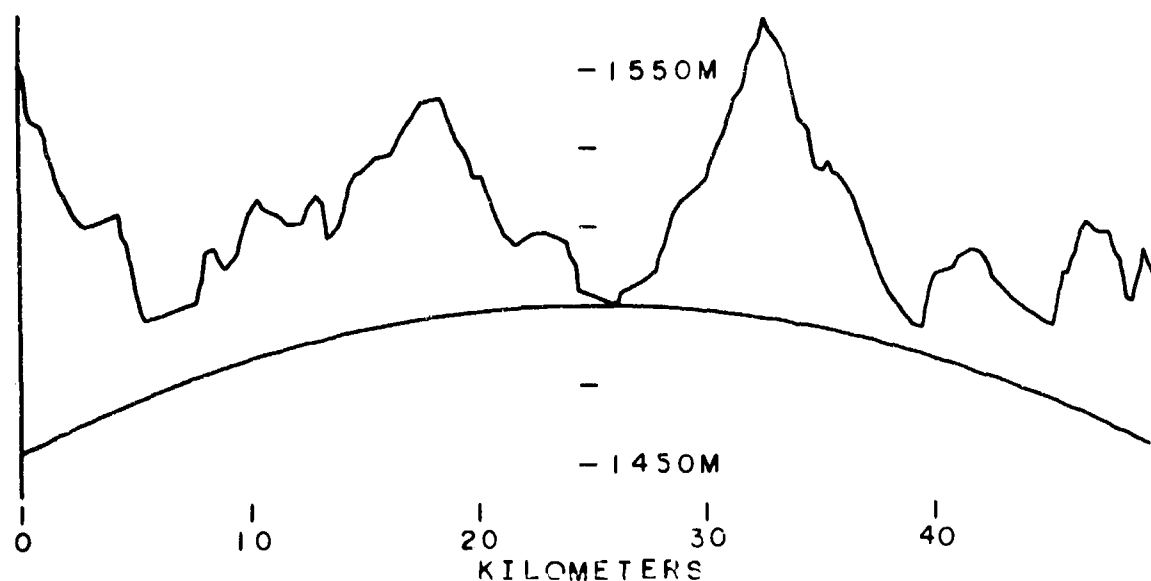
KEENESBURG SW 2



RCVR. ELEV.
1589 M

R1-50-T3 A
PATH LENGTH 49.66 km

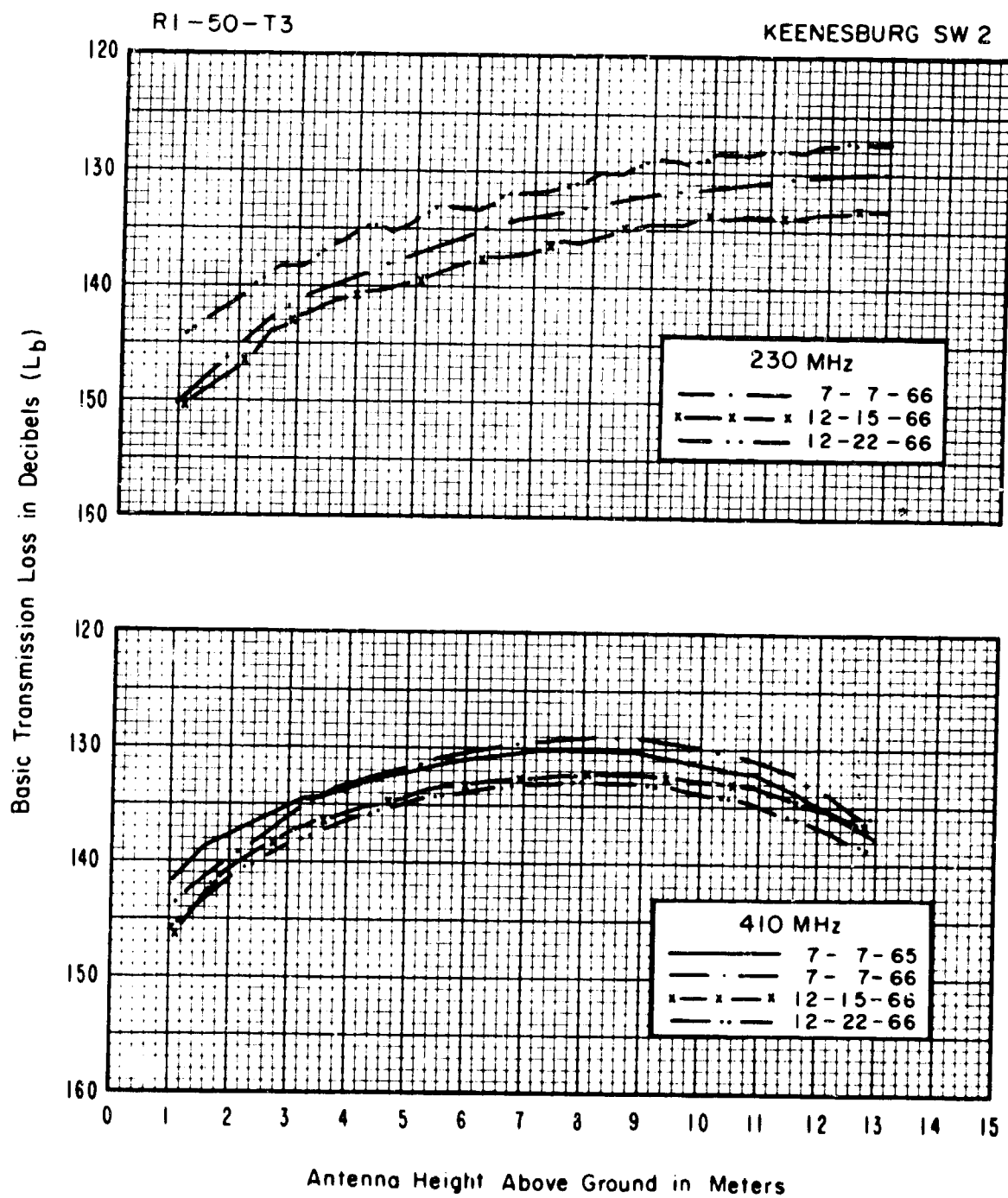
XMTR. ELEV.
1533 M



L_p (dB) SHORT TERM SIGNAL VARIABILITY

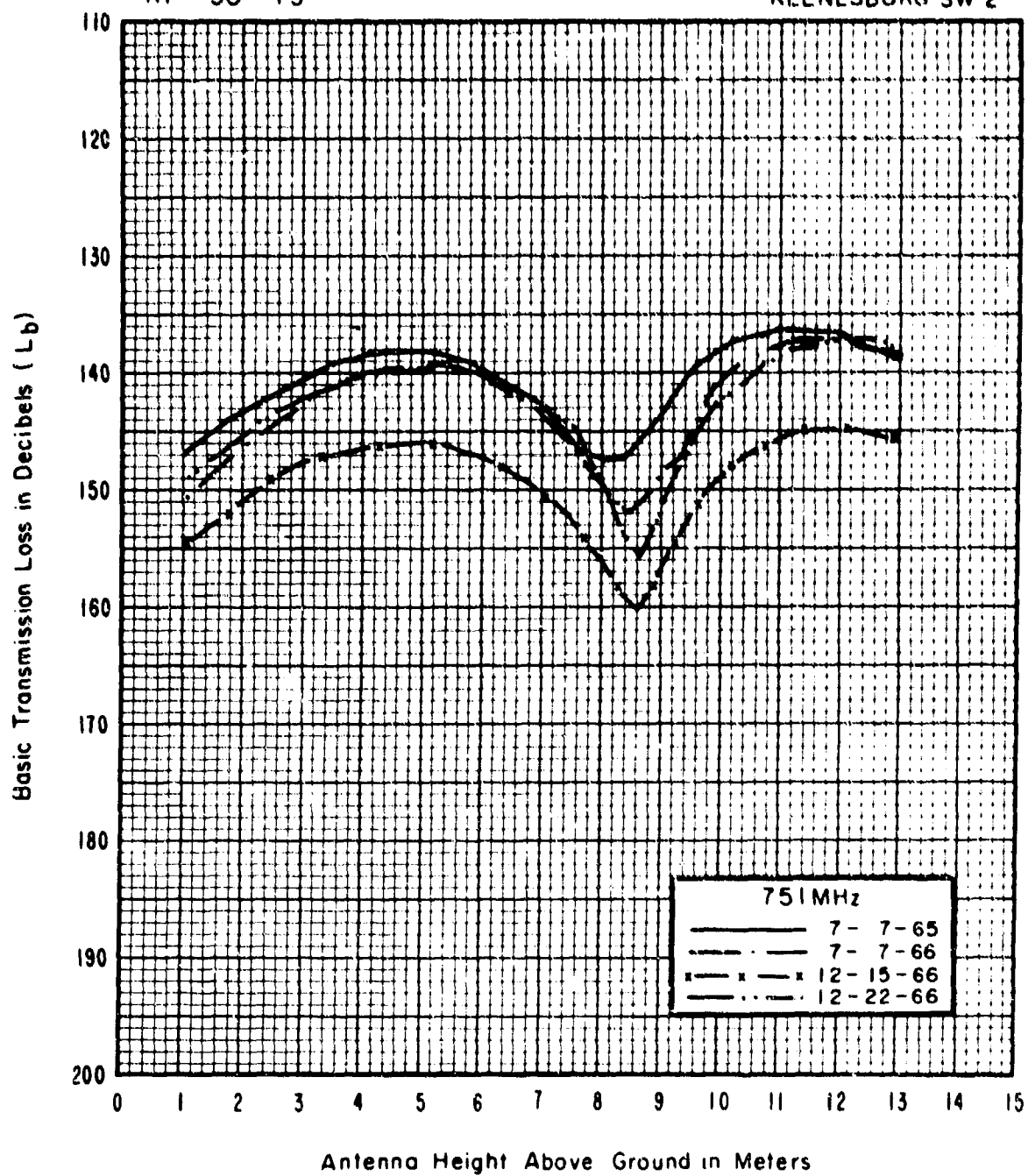
Freq (MHz)	230	410	751	910	1846	4595	9190
7-7-66 at 13 M				5-10-66 at 13 M			
50%	130.6	136.6	138.9	142.6	151.3	160.8	163.7
$\Delta 10\%-90\%$	<3	<3	<3	<3	<3	<3	<3
				5-10-66 at 7.3 M			
50%				147.7	153.9	160.0	165.0
$\Delta 10\%-90\%$				<3	<3	<3	<3
				5-10-66 at 1 M			
50%				146.8	153.2	156.7	165.0
$\Delta 10\%-90\%$				<3	<3	<3	<3

The path is over grass-covered fields and rolling hills that extend to the horizon, approximately 12 mi away. Parallel to the path runs a moderately busy highway, with a multi-wire telephone line on one side, and a 3-phase power line on the other.



R1-50-T3

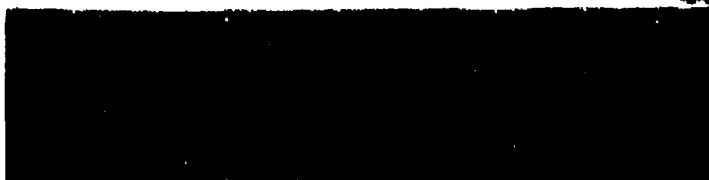
KEENESBURG SW 2



R1-50-T4
HORSECREEK RESERVOIR



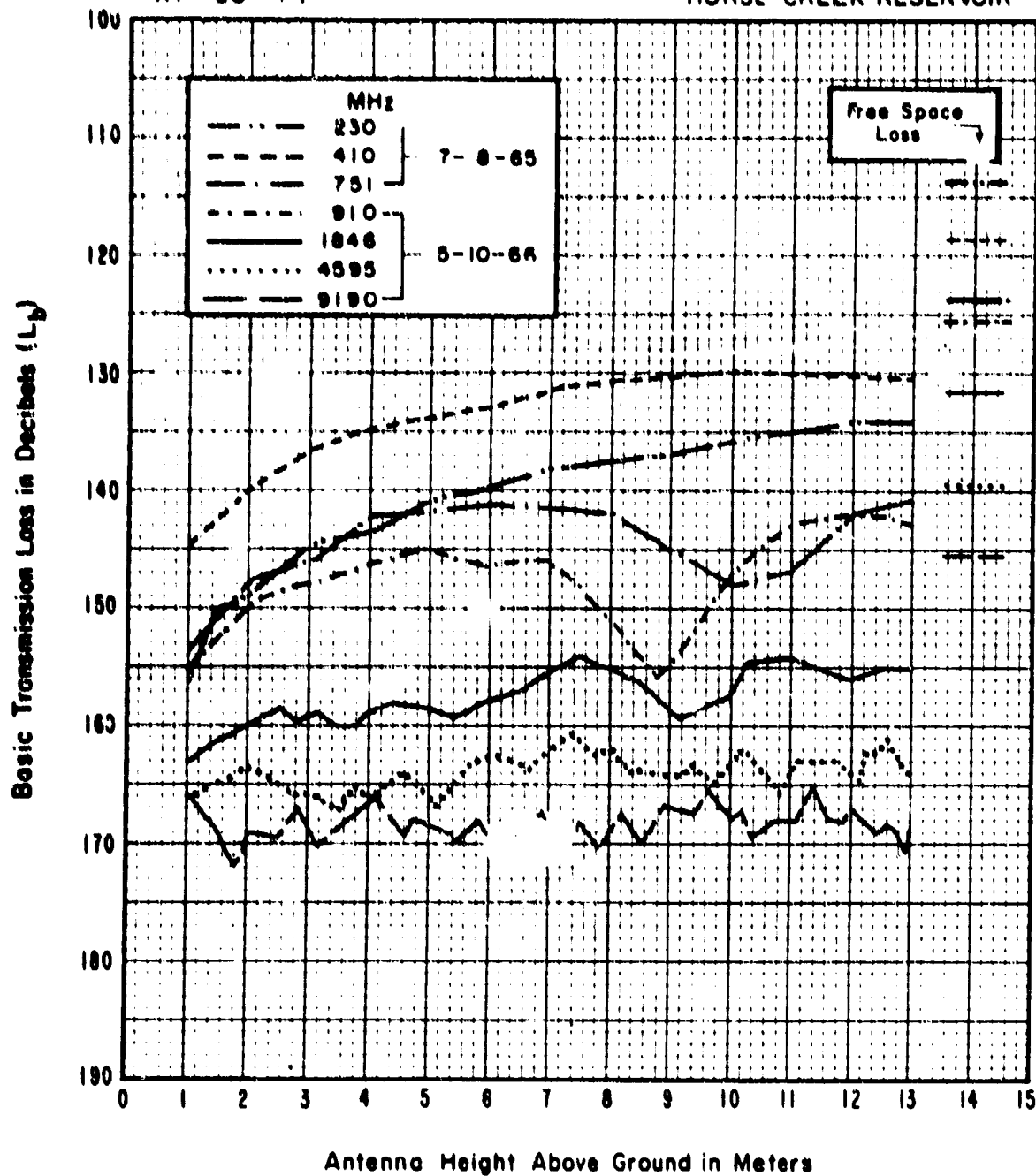
PATH VIEW FROM RECEIVER



PATH VIEW FROM TRANSMITTER

RI-50-T4

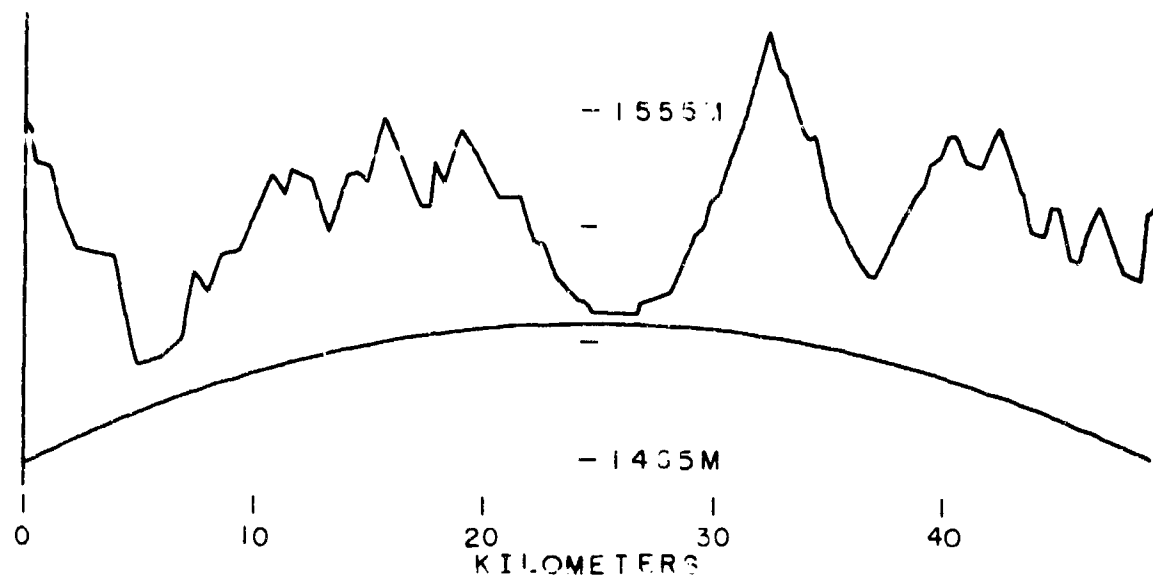
HORSE CREEK RESERVOIR



RCVR. ELEV.
1589 M

R1-50-T4
PATH LENGTH 49.07 km

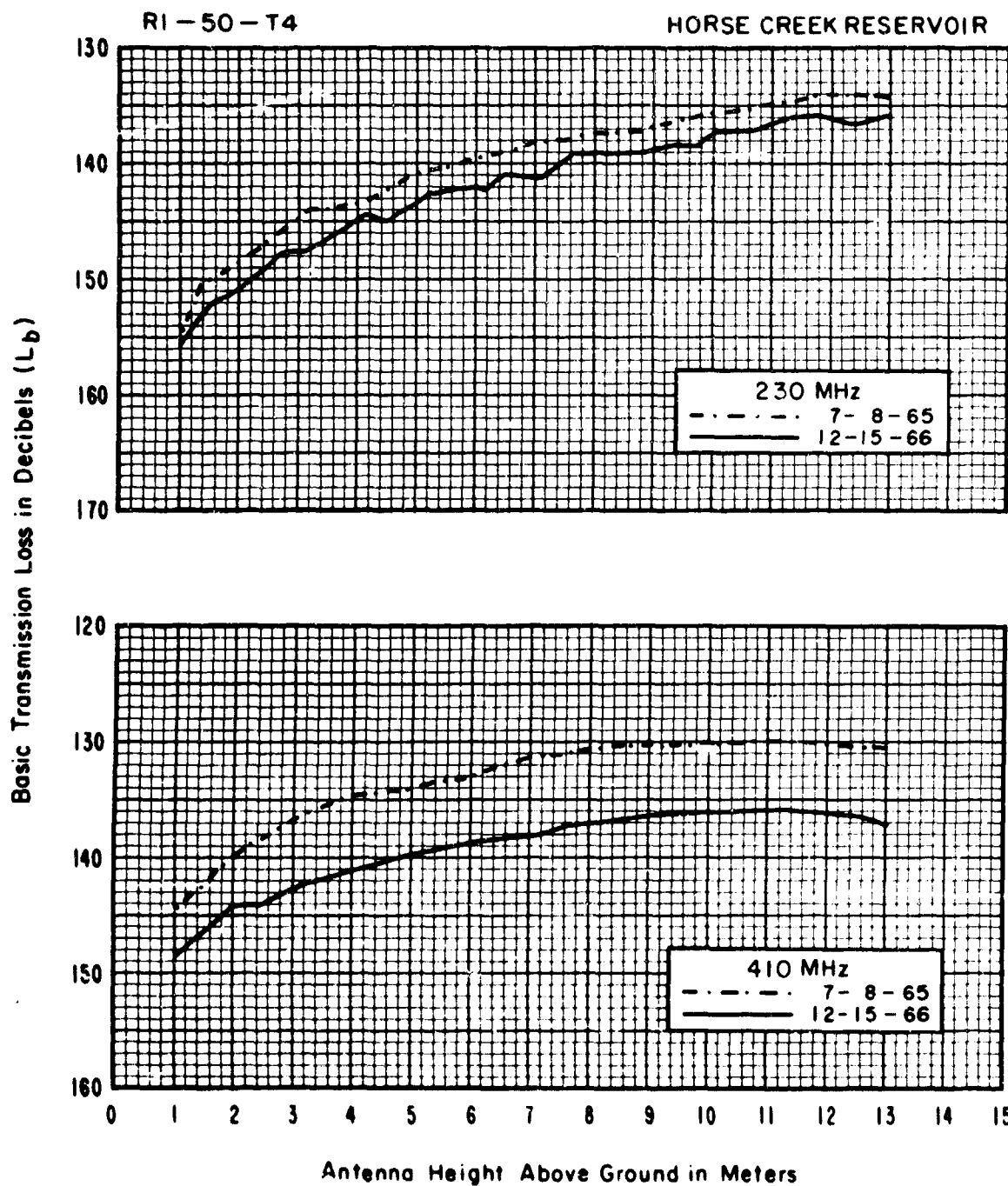
XMTR. ELEV.
1567 M



L_b (dB) SHORT TERM SIGNAL VARIABILITY

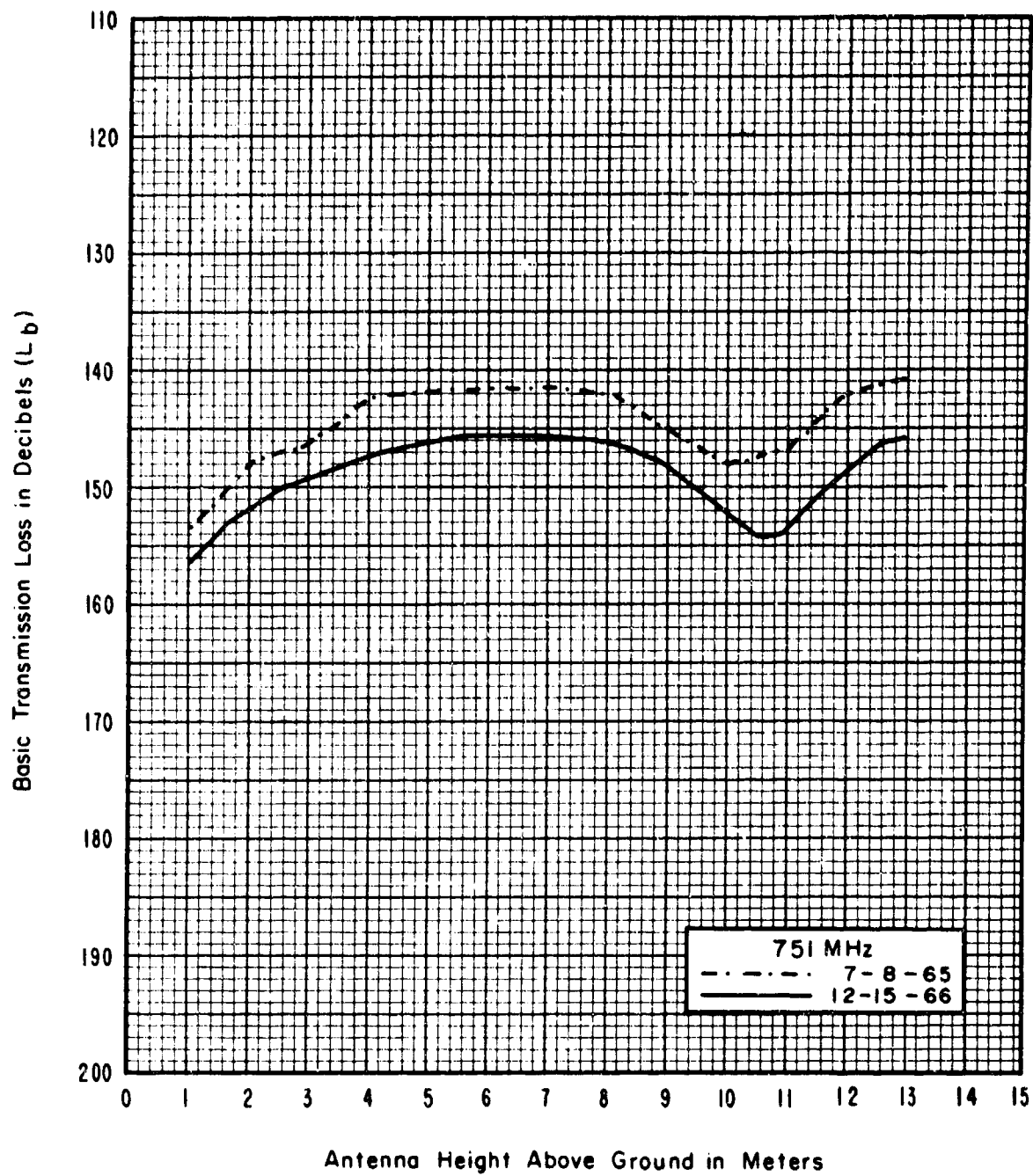
Freq (MHz)	230	410	751	910	1846	4595	9190
7-8-65 at 13 M				5-10-66 at 13 M			
50%	132.8	131.4	140.0	141.7	153.0	162.0	166.6
$\Delta 10\%-90\%$	< 3	< 3	< 3	< 3	< 3	< 3	< 3
				5-10-66 7.3 M			
50%				147.5	153.5	161.6	169.5
$\Delta 10\%-90\%$				< 3	< 3	< 3	< 3
				5-10-66 at 1 M			
50%				153.6	161.0	163.1	165.7
$\Delta 10\%-90\%$				< 3	< 3	3.1	< 3

The terrain at this site consists of gently rolling farmland. The horizon is 11 mi away. The only apparent obstruction is a thin line of trees at a distance of about 1 mi from the transmitter.

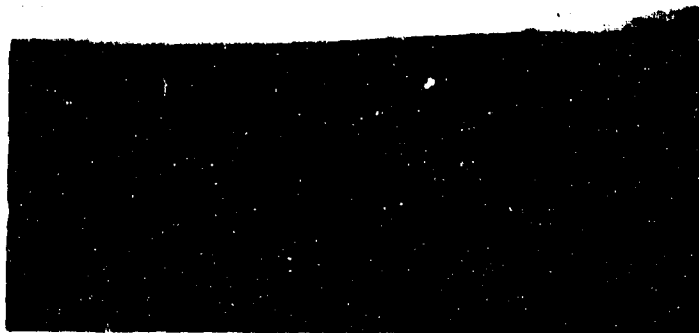


RI-50-T4

HORSE CREEK RESERVOIR



R1-50-T5
ECHO LAKE



PATH VIEW FROM RECEIVER

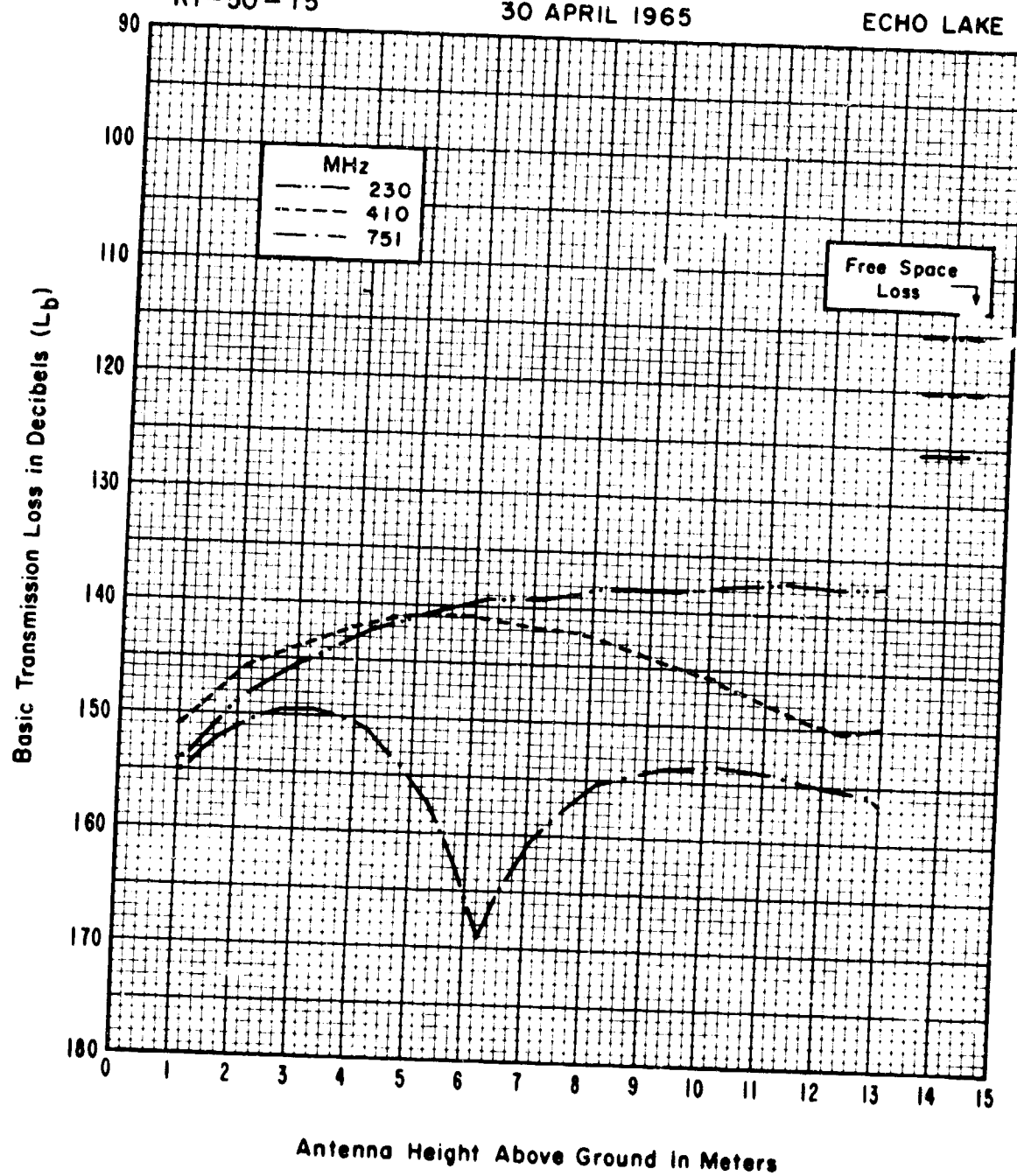


PATH VIEW FROM TRANSMITTER

RI-50-T5

30 APRIL 1965

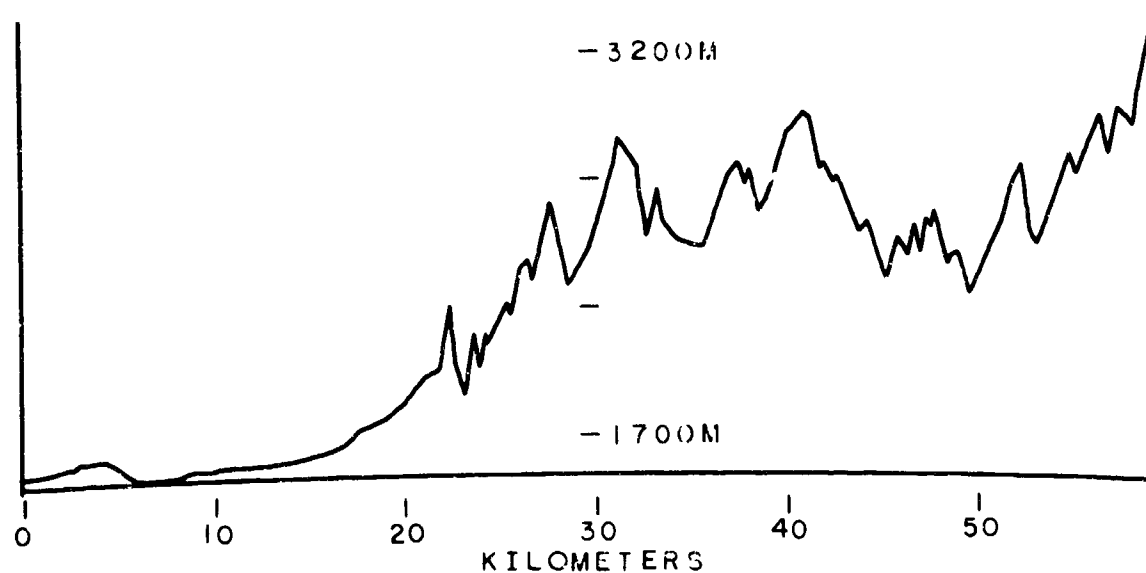
ECHO LAKE



RCVR. ELEV.
1589 M

R1-50-T5
PATH LENGTH 59.24 km

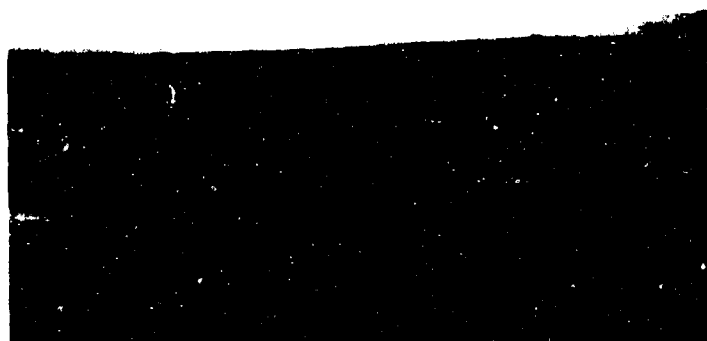
XMTR. ELEV.
3392 M



L _p (dB) SHORT TERM SIGNAL VARIABILITY							
Freq (MHz)	230	410	751	910	1846	4595	9190
4-30-65 at 13 M							
50%	137.2	149.1	157.5				
Δ10%-90%	<3	<3	<3				

In the immediate foreground at this site is a slope, beyond which dense pine trees partially obscure the line of sight to the horizon, 18 mi away.

R1-50-T5-A
ECHO LAKE



PATH VIEW FROM RECEIVER

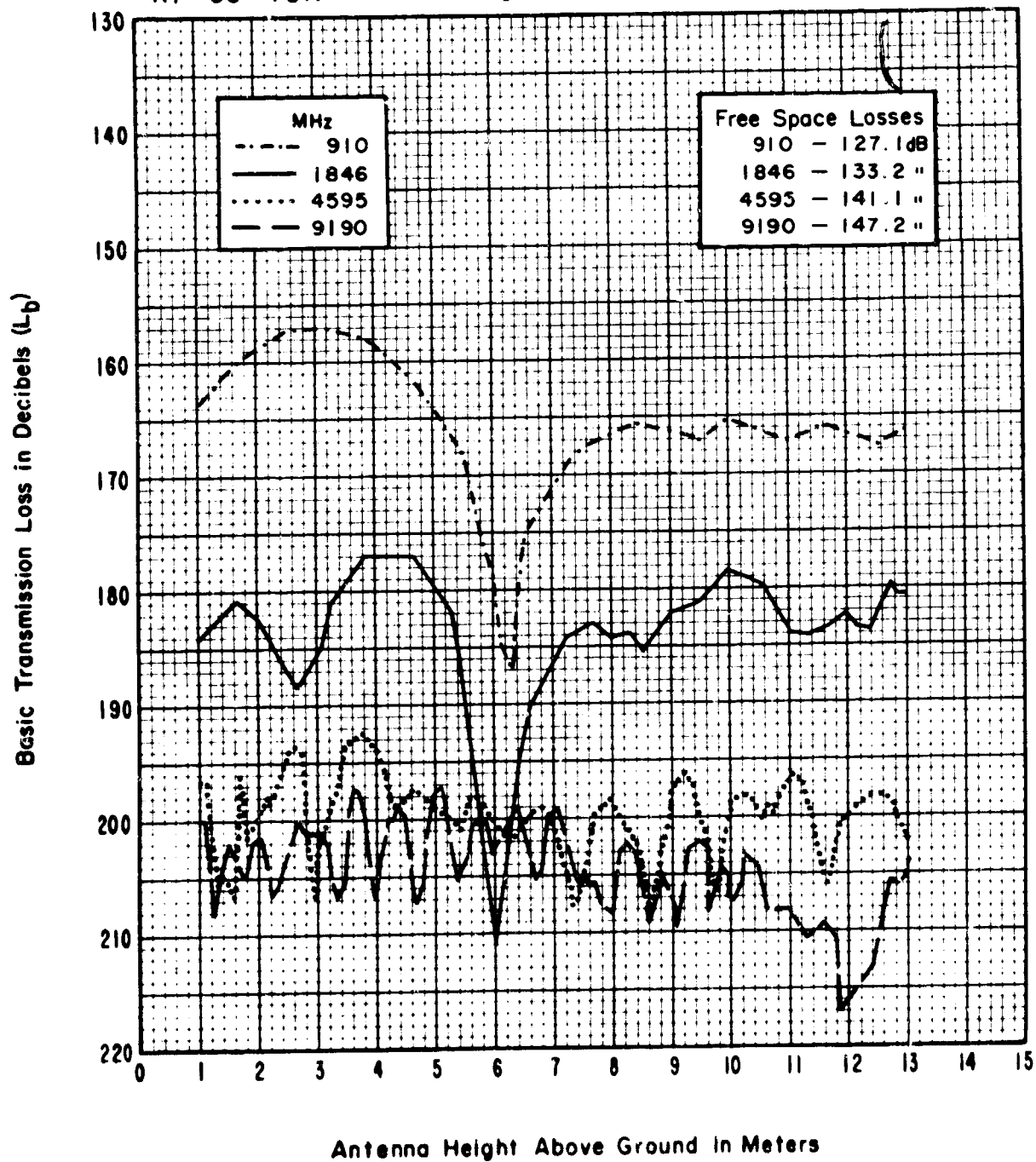


PATH VIEW FROM TRANSMITTER

RI-50-T5A

9 MARCH 1966

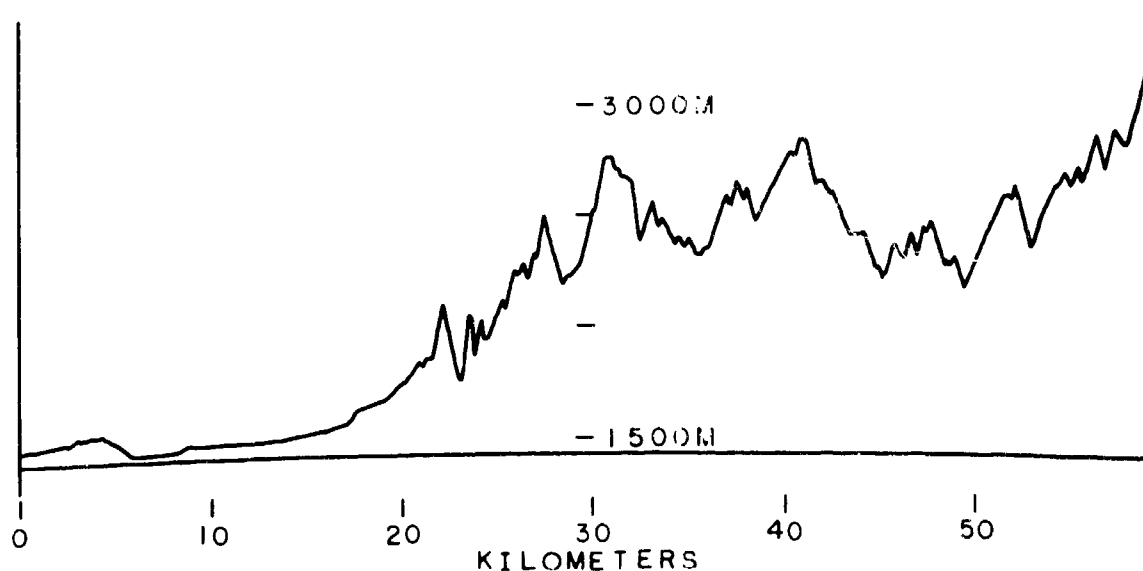
ECHO LAKE



RCVR. ELEV.
1589 M

RI-50-T5A
PATH LENGTH 59.22 km

XMTR. ELEV.
3392 M



L_b (dB) SHORT TERM SIGNAL VARIABILITY

Freq (MHz)	230	410	751	910	1846	4595	9190
3-9-66 at 7.3 M							
50%				171.4	187.1	206.4	214.0
$\Delta 10\%-90\%$				<3	<3	4.5	5.5

For the first 40 ft, the path lies over a moderately busy highway, at both sides of which, and at a distance of about 80 ft from the antennas, are many pine trees. The horizon is 18 mi away.

R1-50-16
TRAIL RIDGE



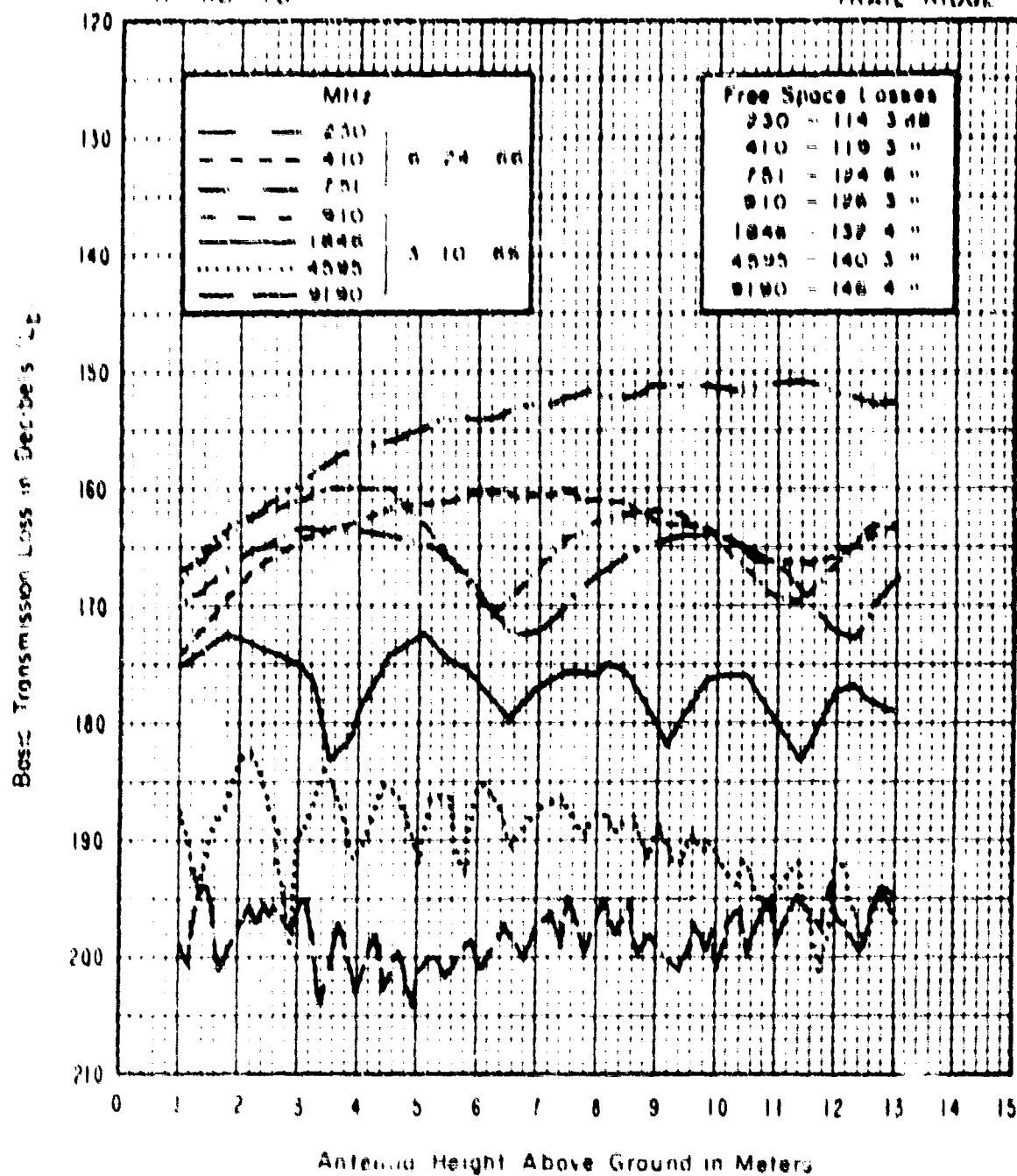
PATH VIEW FROM RECEIVER



PATH VIEW FROM TRANSMITTER

RI 50 16

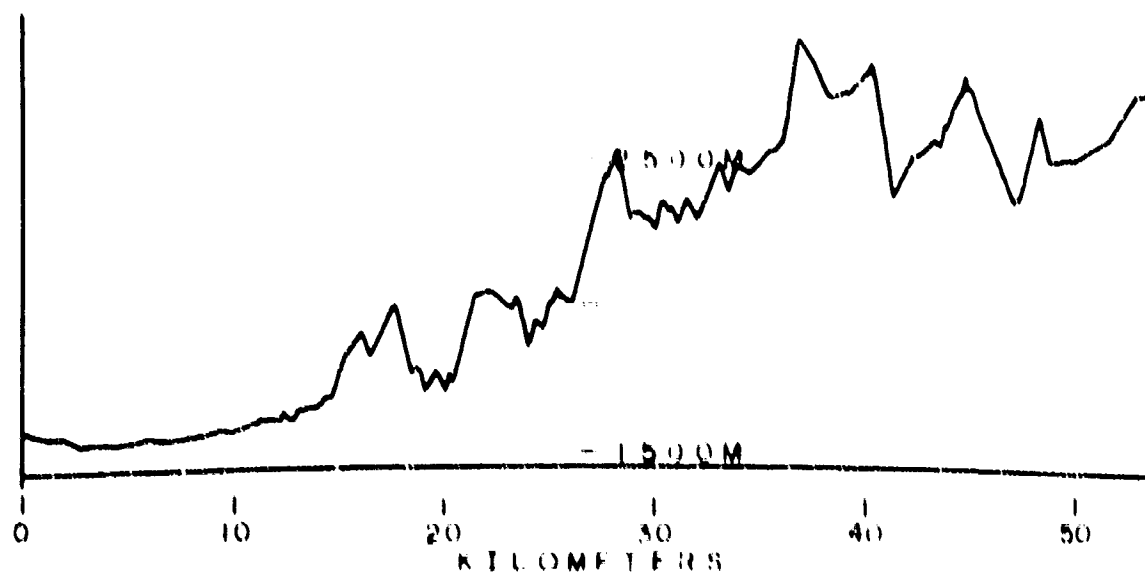
TRAIL RIDGE



RCVR. ELEV.
1589 M

RI-50 T6
PATH LENGTH 53.84 km

XMTR. ELEV.
2926 M



I_p (dB) SHORT TERM SIGNAL VARIABILITY

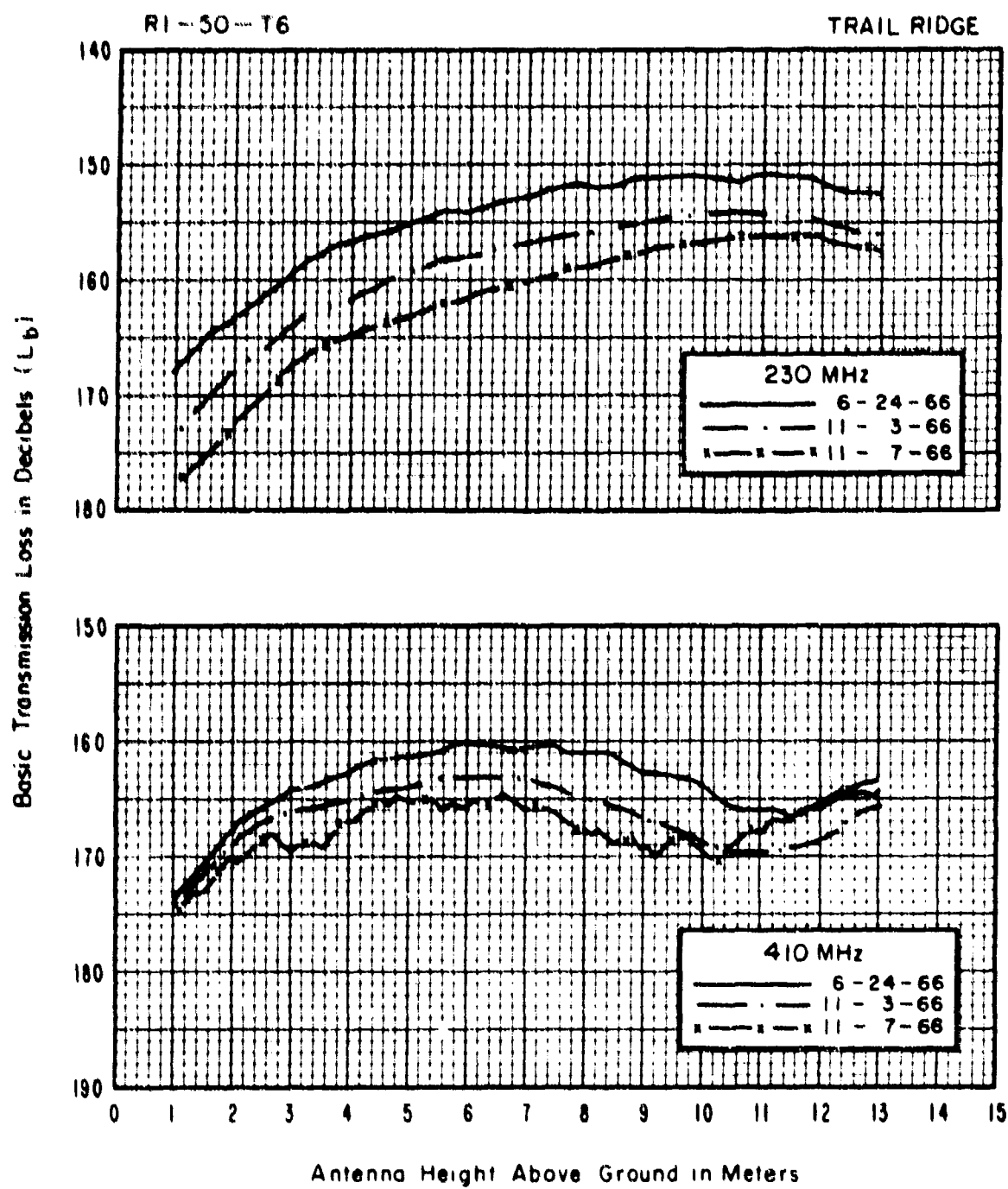
Freq (MHz)	230	410	751	910	1846	4595	9190

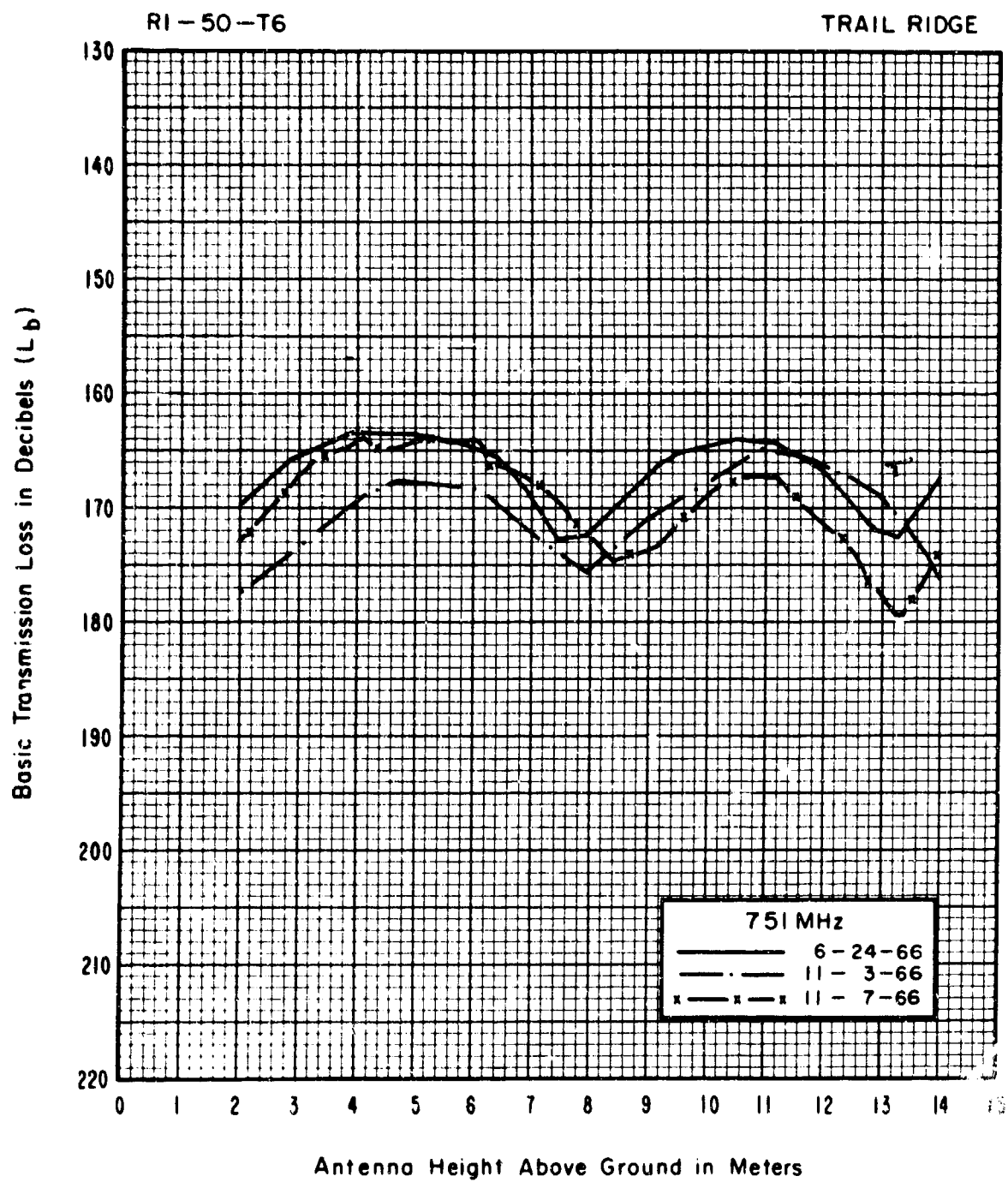
6-24-66 at 6.6 M

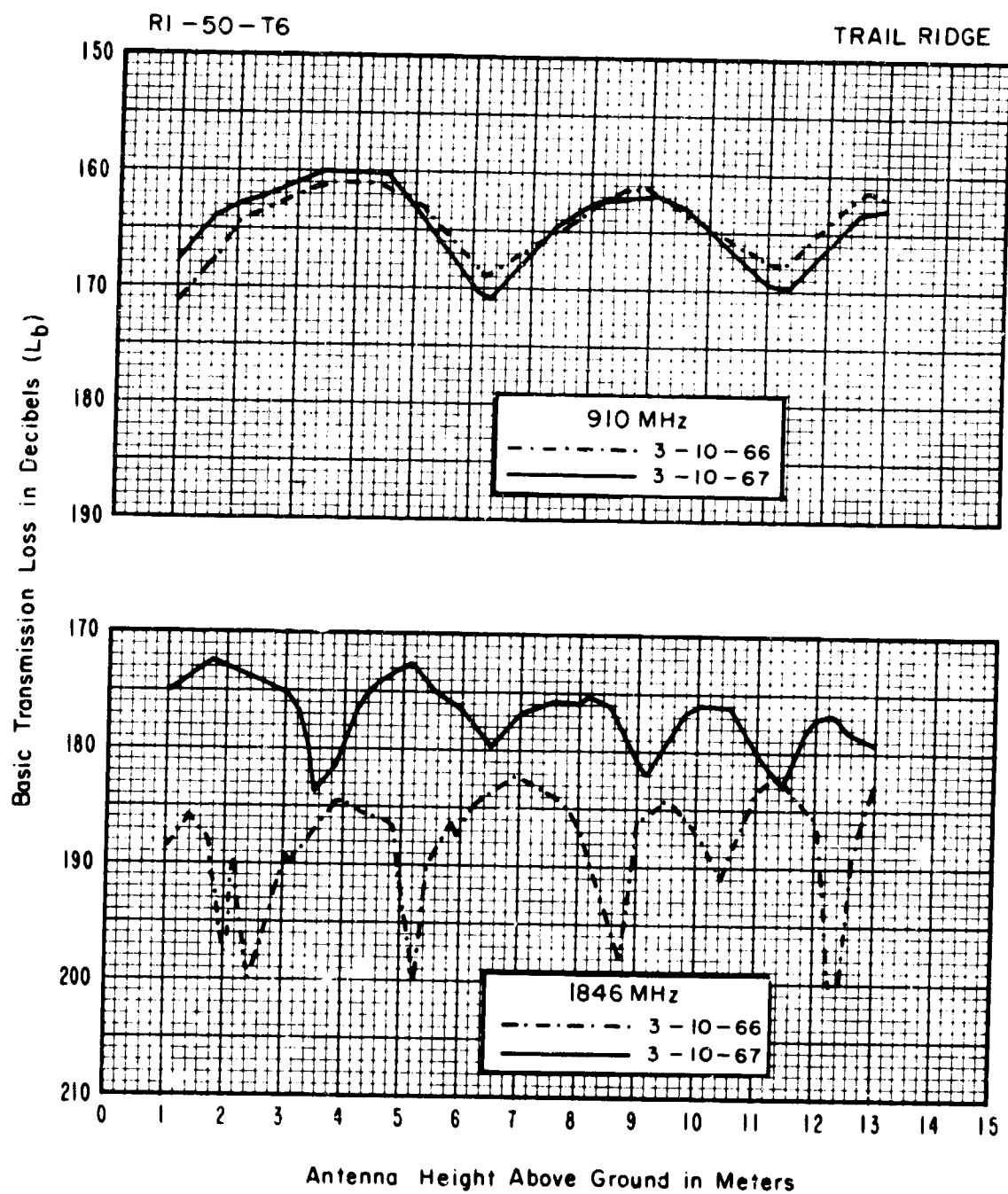
3-10-66 at 7.3 M

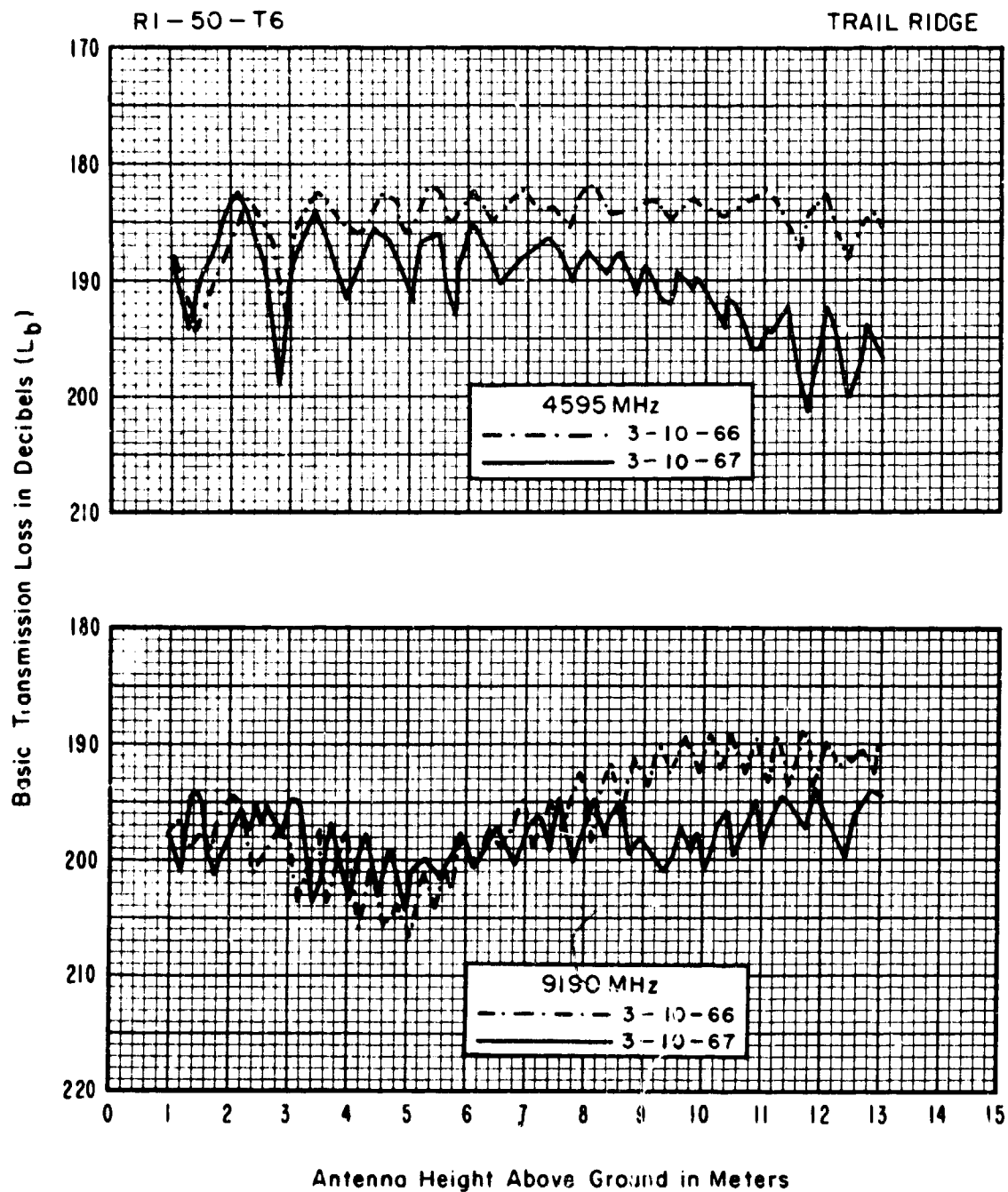
50%	154.4	163.4	165.8	163.8	181.3	184.4	191.6
$\Delta 10\%-90\%$	<3	4.7	<3	<3	<3	<3	8.8

The path at this site extends across a deep valley. In the immediate foreground is a thick cover of pine trees, none of which are in the line of sight. The horizon is 12 mi away.









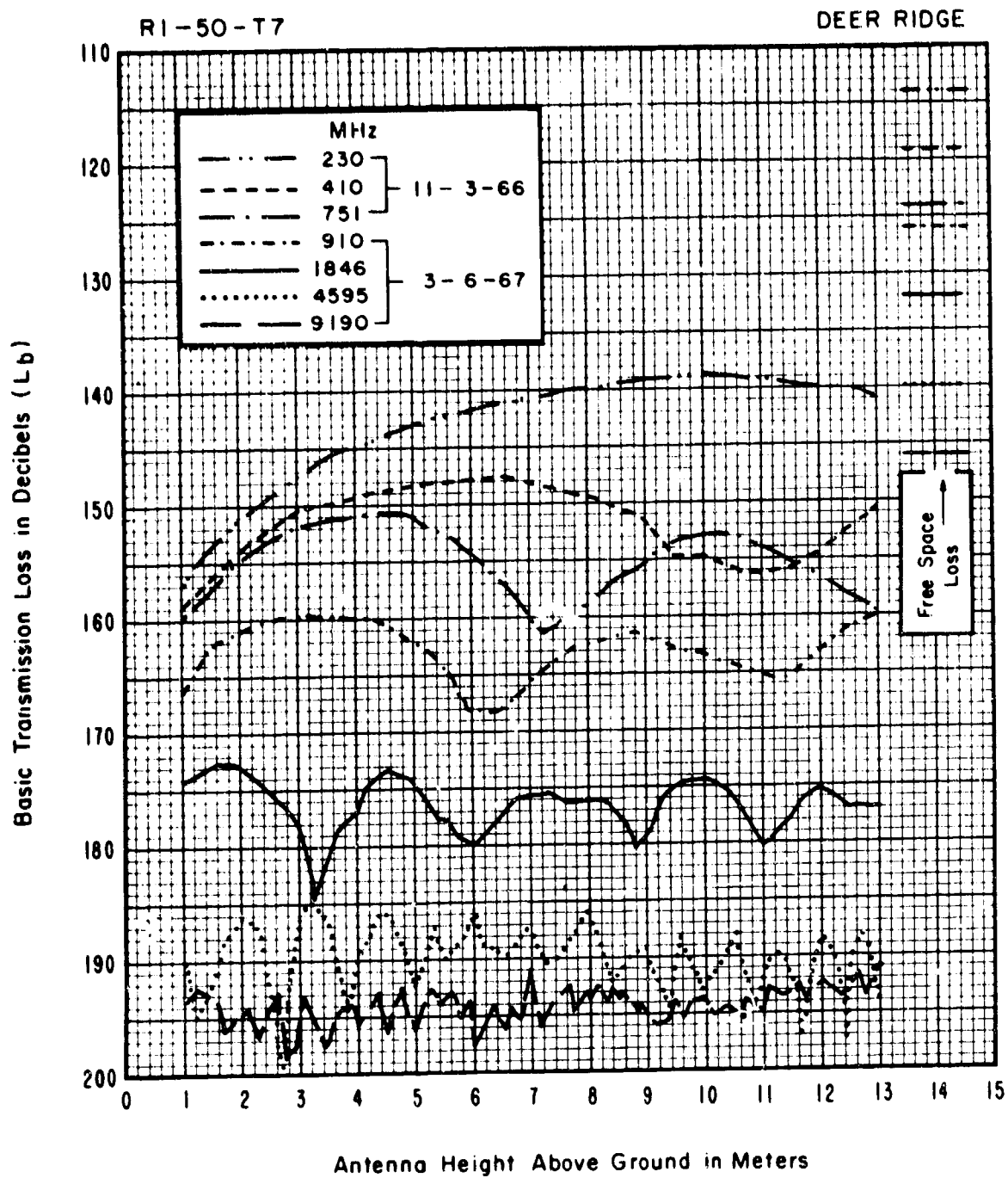
R1-50-T7
DEER RIDGE



PATH VIEW FROM RECEIVER



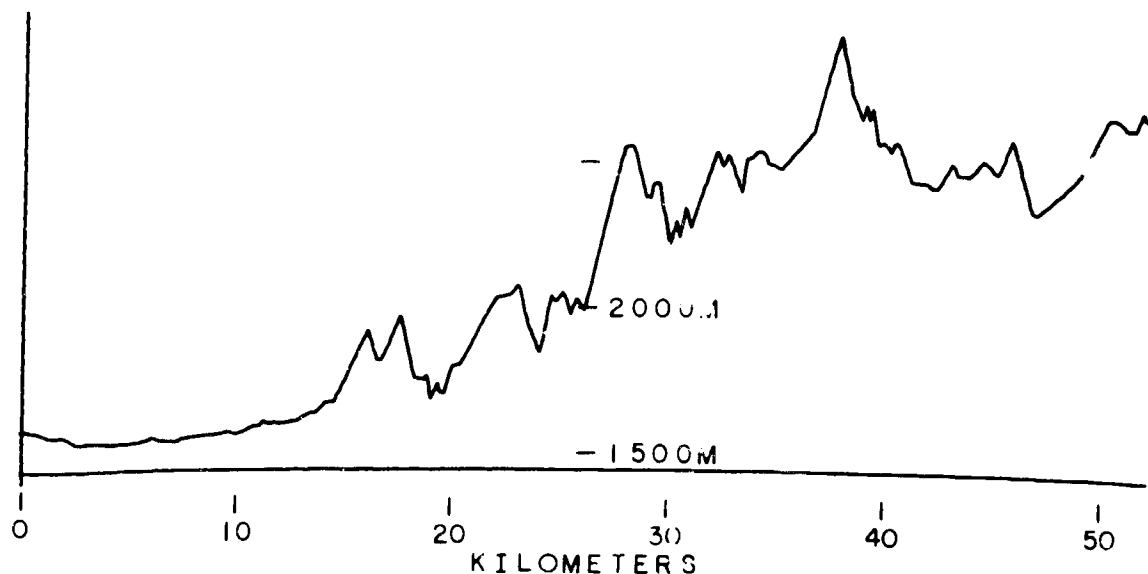
PATH VIEW FROM TRANSMITTER



RCVR. ELEV.
1589 M

R1-50-T7
PATH LENGTH 52.50 km

XMTR. ELEV.
2719 M



L_p (dB) SHORT TERM SIGNAL VARIABILITY

Freq (MHz)	230	410	751	910	1846	4595	9190

11-3-66 at 6.6 M

3-6-67 at 13 M

50%	141.2	147.8	157.3	160.5	177.8	191.4	191.2

$\Delta 10\%-90\%$	<3	<3	<3	<3	<3	<3	<3

3-6-67 at 7.3 M

50%				165.7	176.1	188	194.8

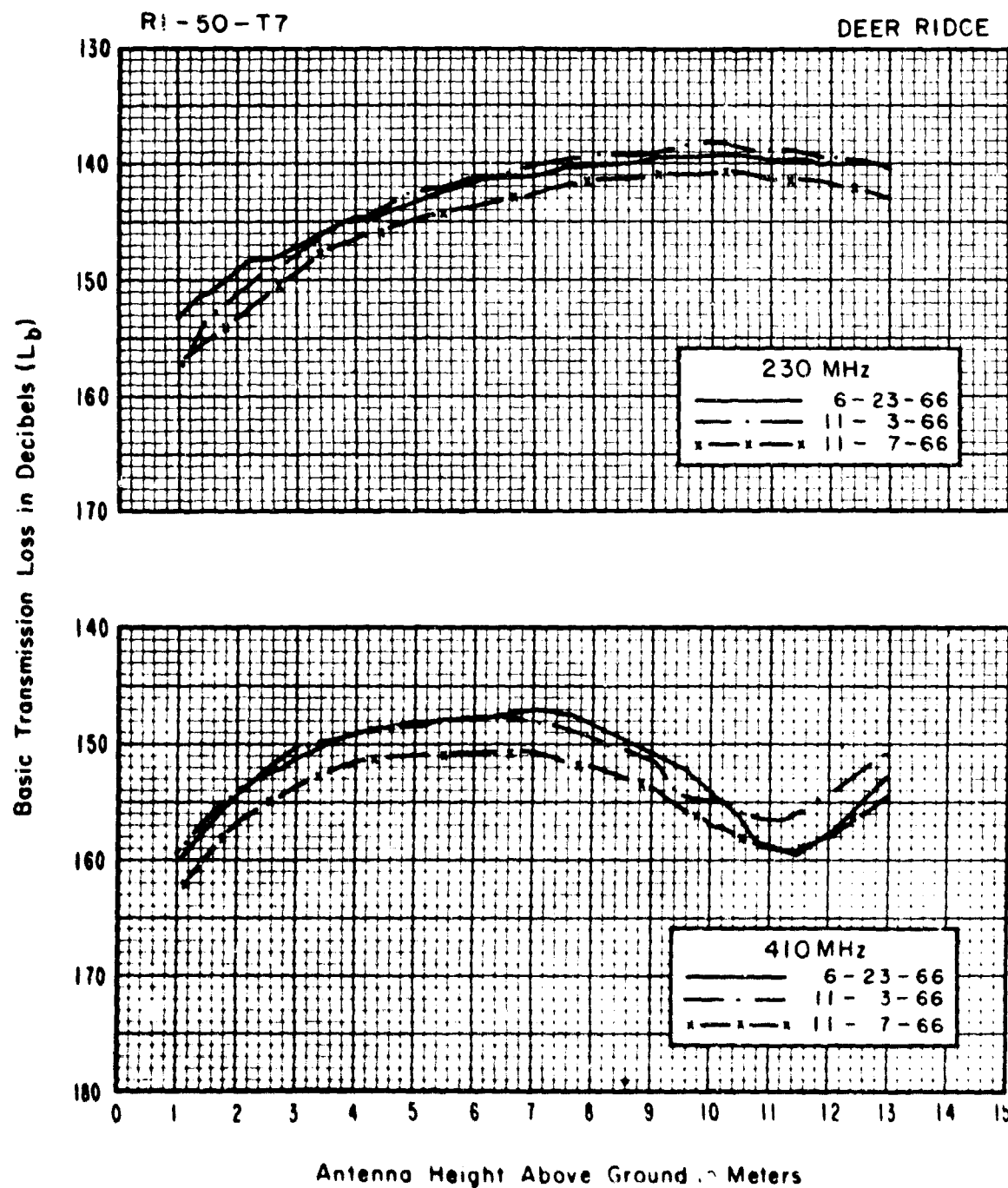
$\Delta 10\%-90\%$				<3	<3	<3	3.4

3-6-67 at 1 M

50%				167.7	175.9	187.4	193.6

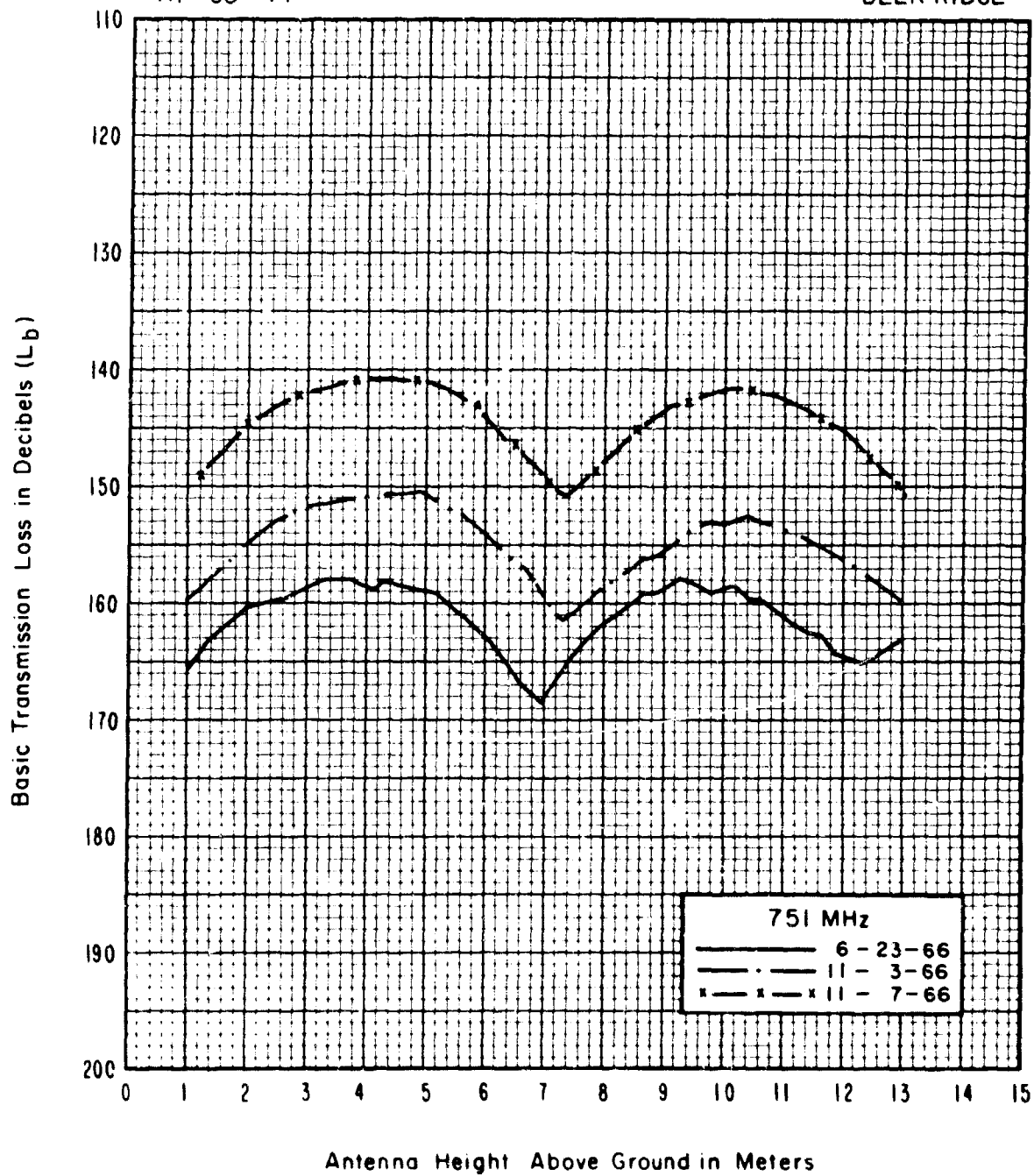
$\Delta 10\%-90\%$				<3	<3	<3	<3

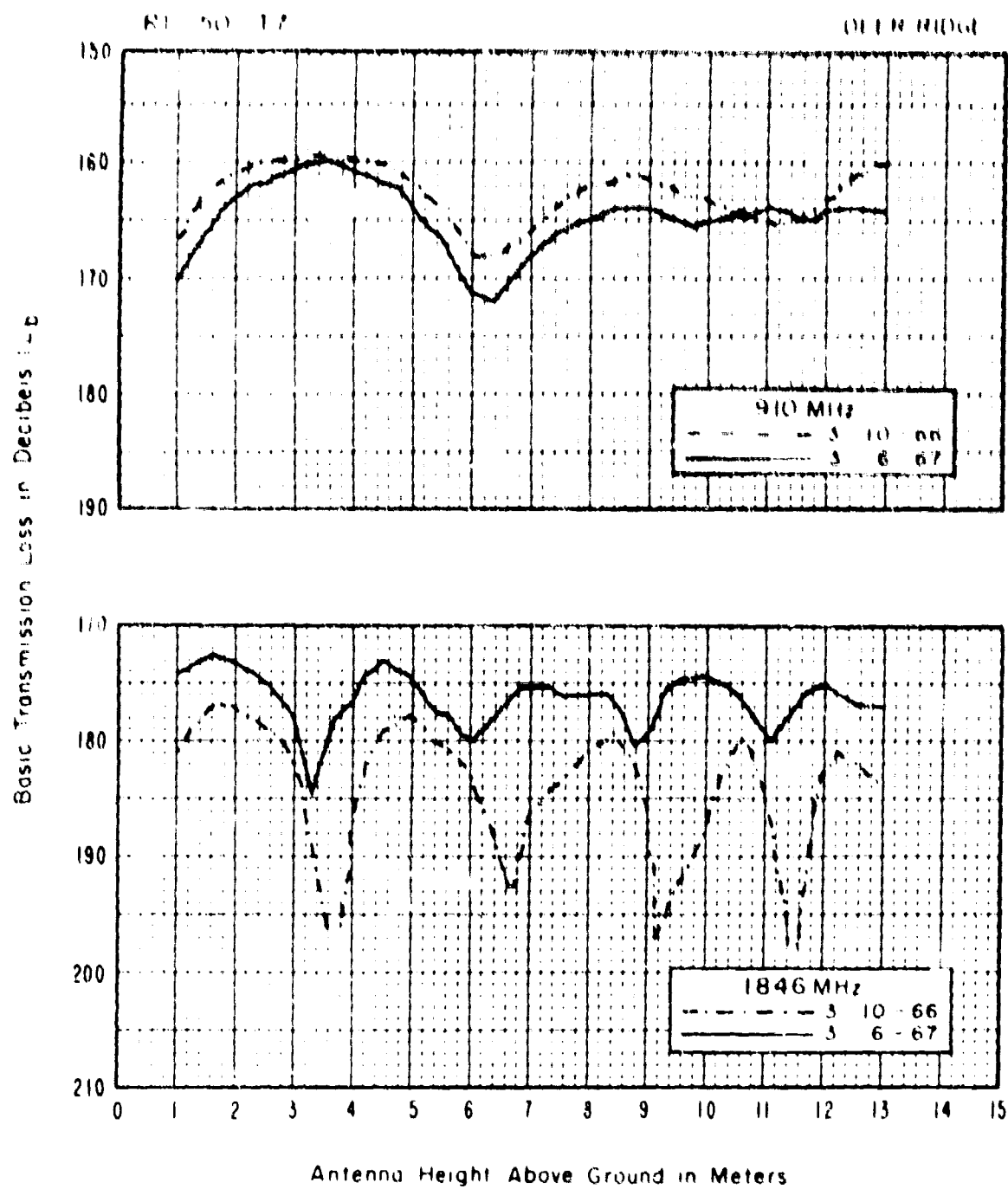
For the first 500 yd, the path is over a terrain of field grass with scattered pine trees. At a distance of 6 mi, it runs through a gap, with sloping hills to the right and left, framing a high hill in the center at the horizon, 9 mi away.

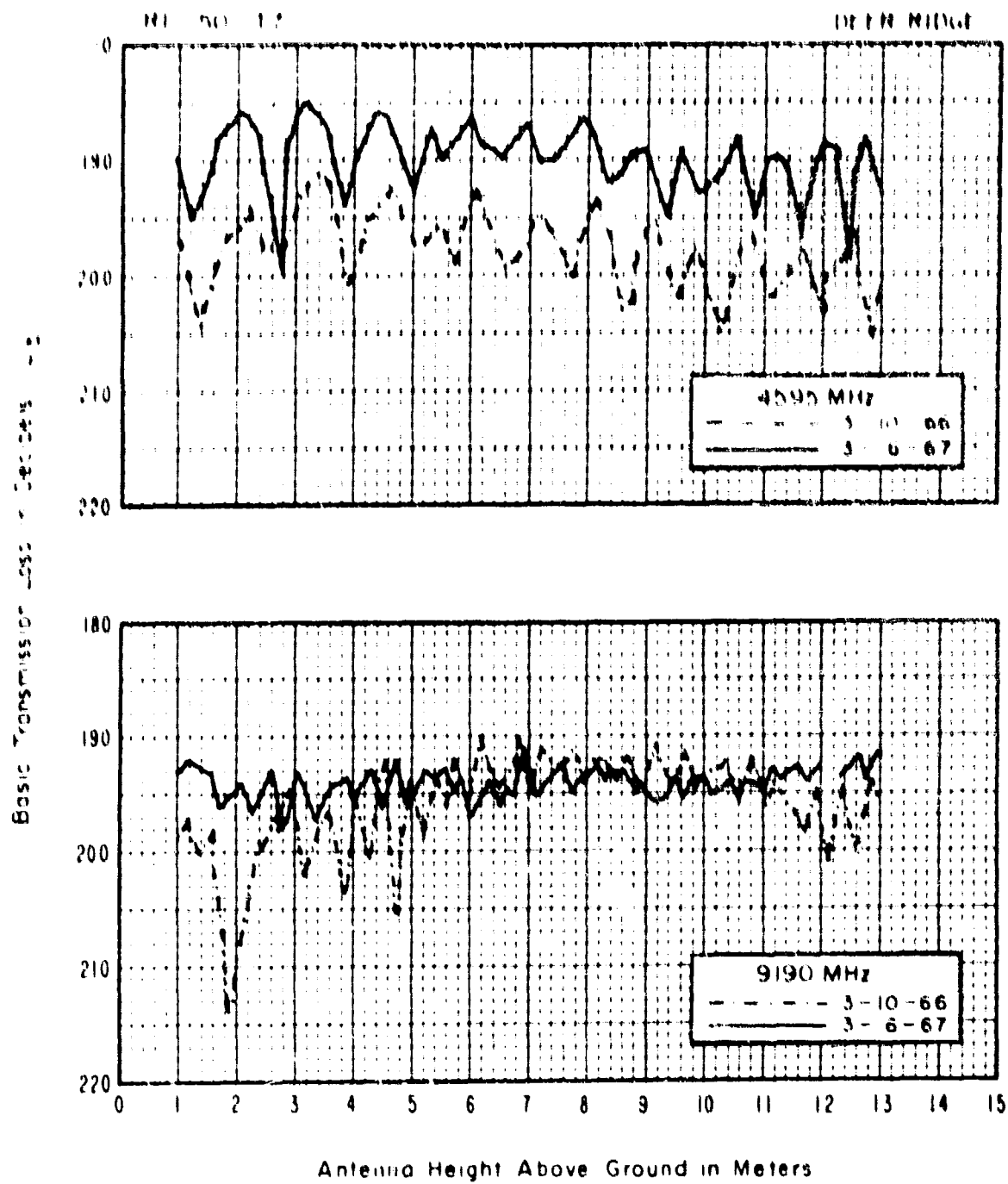


RI-50-T7

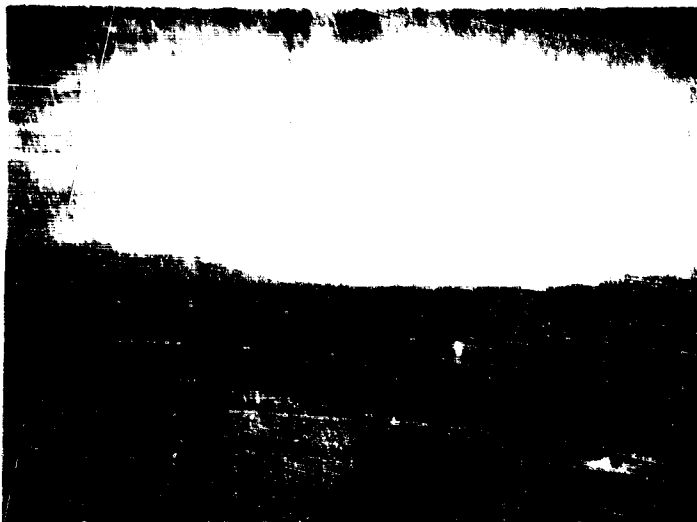
DEER RIDGE







RT-50-1B
RECEIVING PARK NEA



PATH VIEW FROM RECEIVER

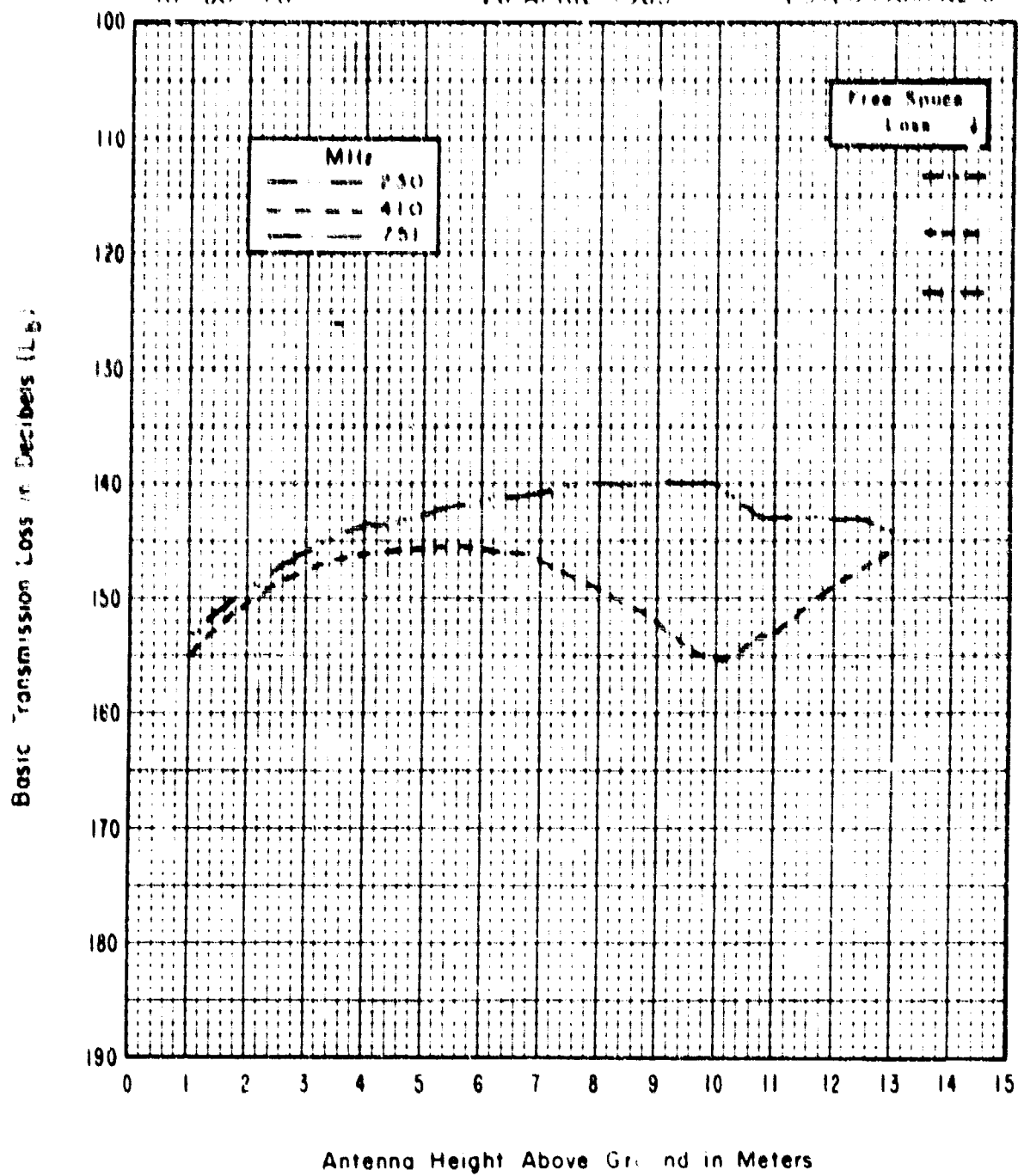


PATH VIEW FROM TRANSMITTER

RI 50 18

28 APRIL 1965

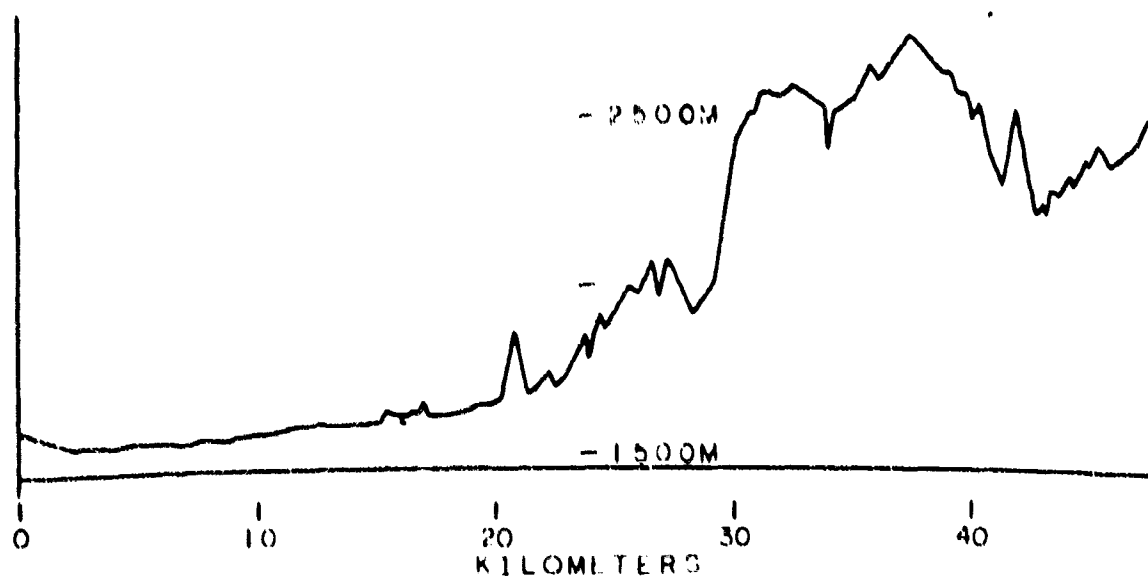
ESTES PARK NE 3



RCVR. ELEV.
1589 M

RI-50-T8
PATH LENGTH 47.76 km

XMTR. ELEV.
2553 M



L_b (dB) SHORT TERM SIGNAL VARIABILITY

Freq (MHz)	230	410	751	910	1846	4595	9190

4-28-65 at 1° M

50%	144.2	146.1

$\Delta 10\%-90\%$	< 3	< 3

In the immediate foreground at this site is wild grass, scattered pine trees, and a 3-ft fence at 90° to the path. Beyond, a denser growth of pines extends to a low ridge 2-1/2 mi distant. The ground then slopes upward to the horizon 6 mi away, with dense pines covering the entire area.

R1-50-T9
DEVIL'S GULCH ROAD



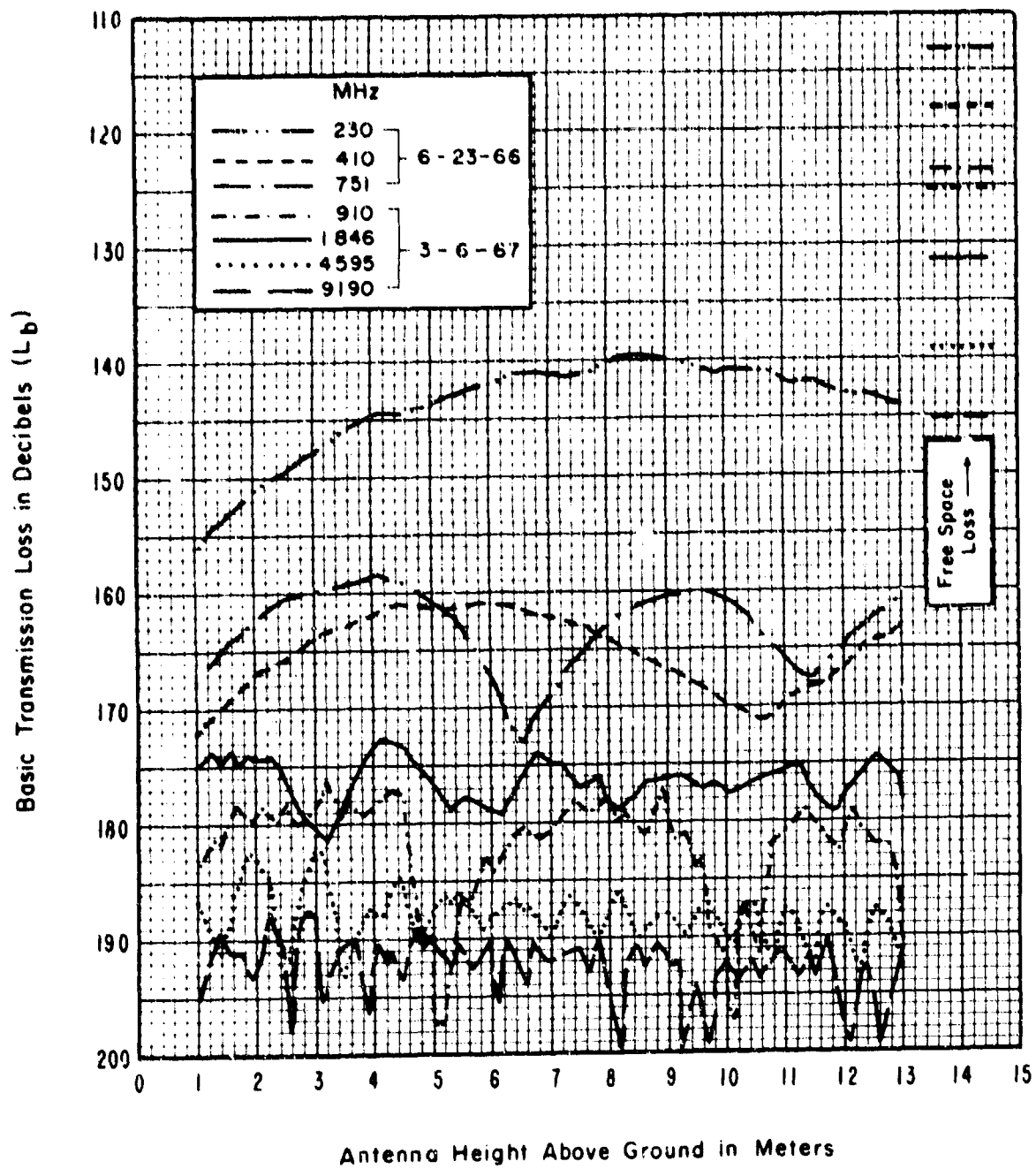
PATH VIEW FROM RECEIVER

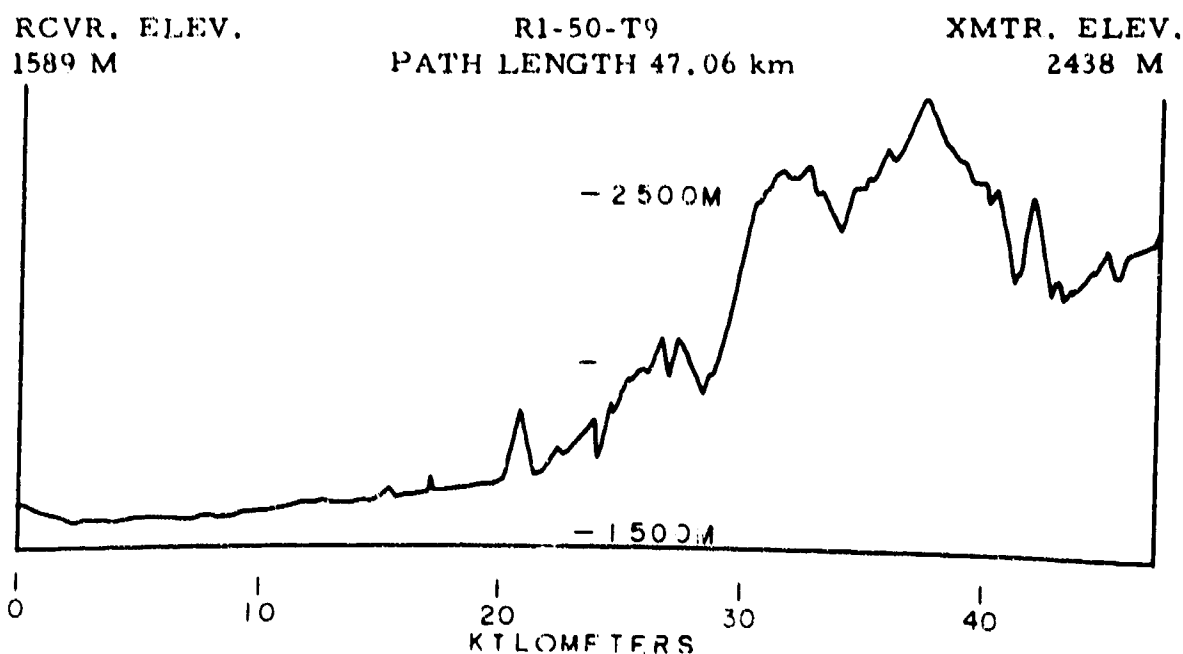


PATH VIEW FROM TRANSMITTER

RI-50-T9

ESTES PARK-DEVILS GULCH RD.

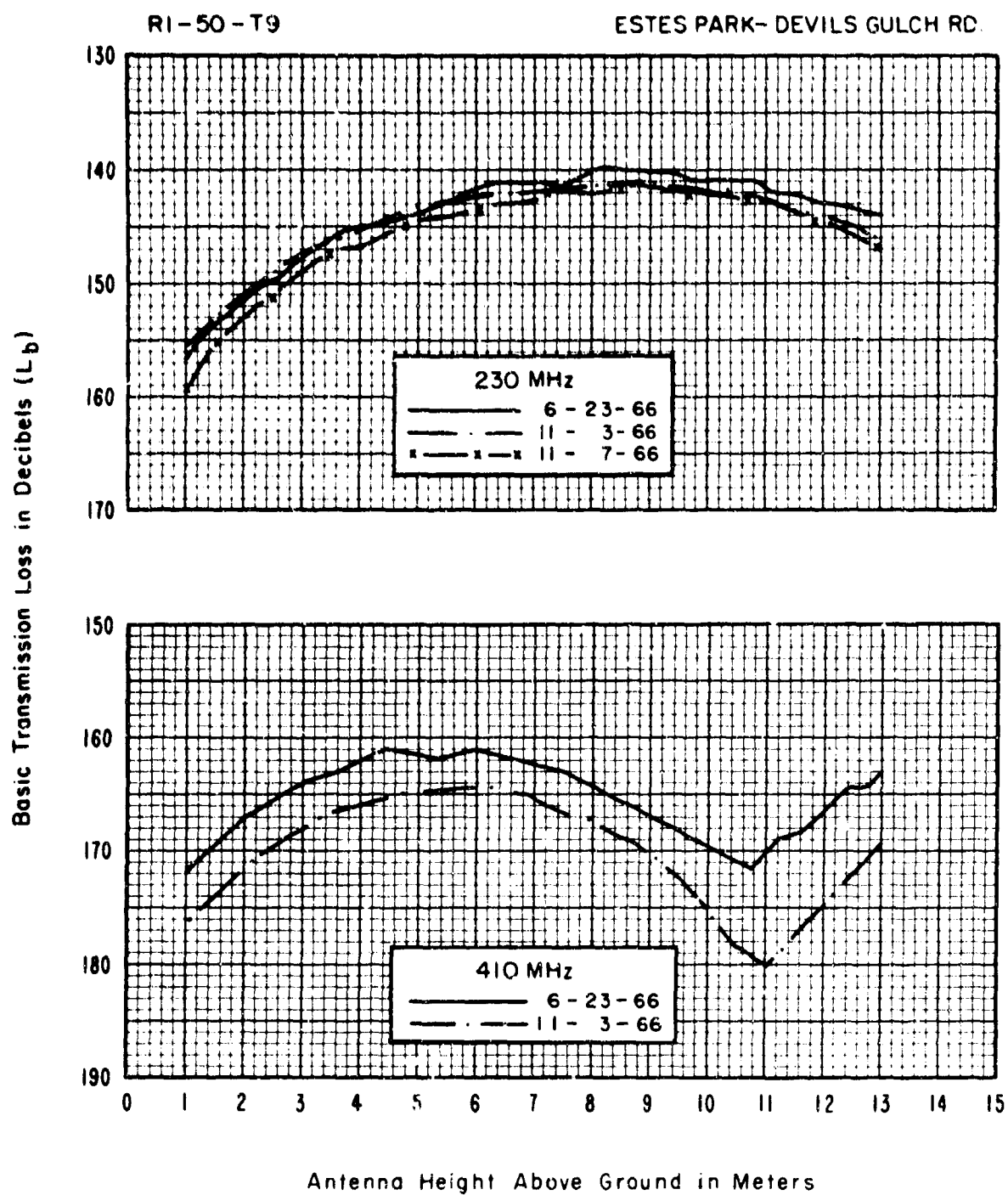




L_b (dB) SHORT TERM SIGNAL VARIABILITY

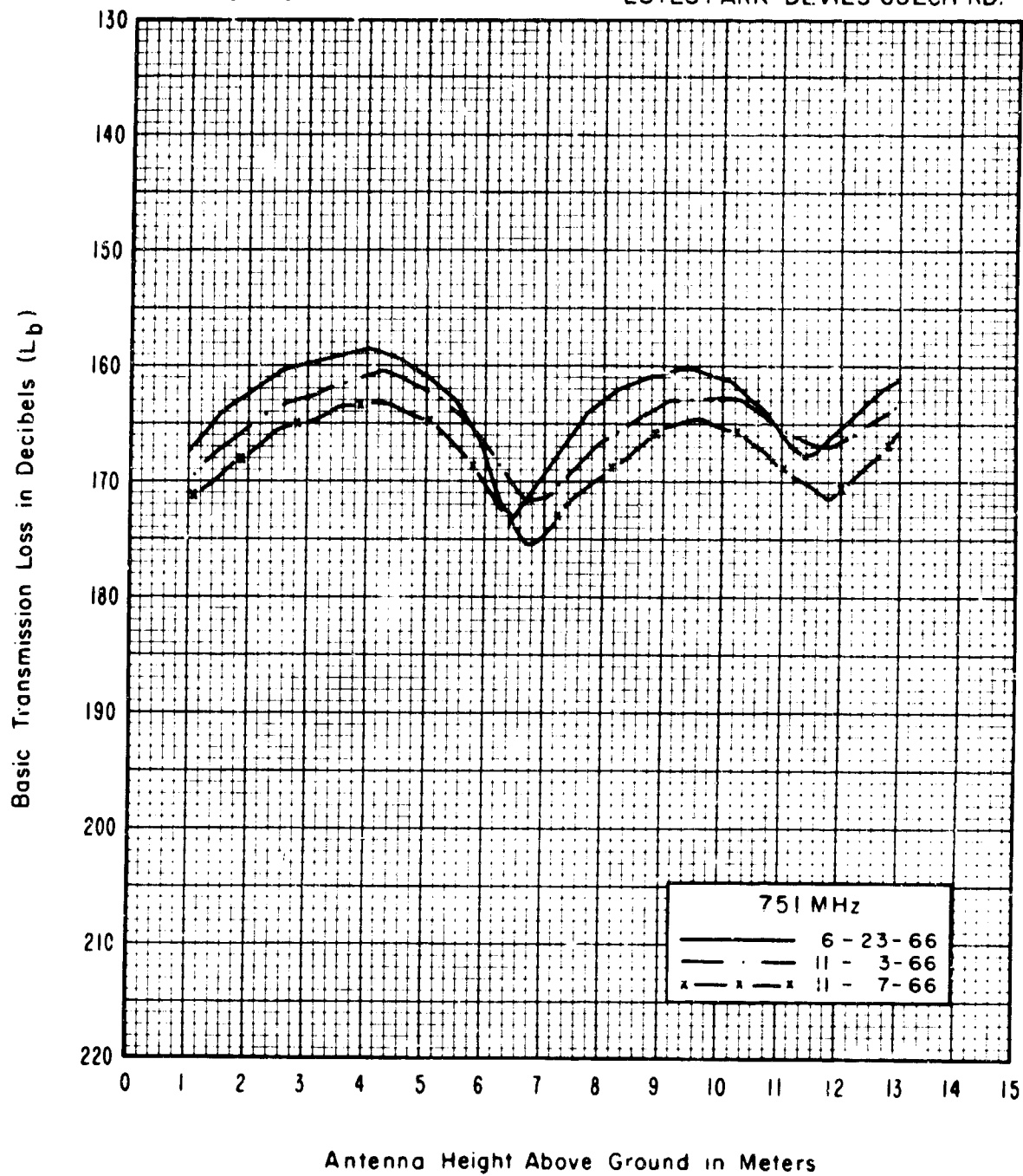
Freq (MHz)	230	410	751	910	1846	4595	9190
6-23-66 at 13 M				3-6-67 at 13 M			
50%	144.7	162.1	159.6	185.5	179.8	192.0	197.7
$\Delta 10\%-90\%$	< 3	< 3	< 3	9.4	< 3	< 3	< 3
11-3-66 at 6.6 M							
50%	143.6	168.4					
$\Delta 10\%-90\%$	< 3	< 3					
				3-6-67 at 7.3 M			
50%				180.9	177.5	186.5	191.1
$\Delta 10\%-90\%$				7.3	< 3	< 3	< 3
				3-6-67 at 1 M			
50%				182.4	177.8	185.3	193.3
$\Delta 10\%-90\%$				4.6	< 3	< 3	< 3

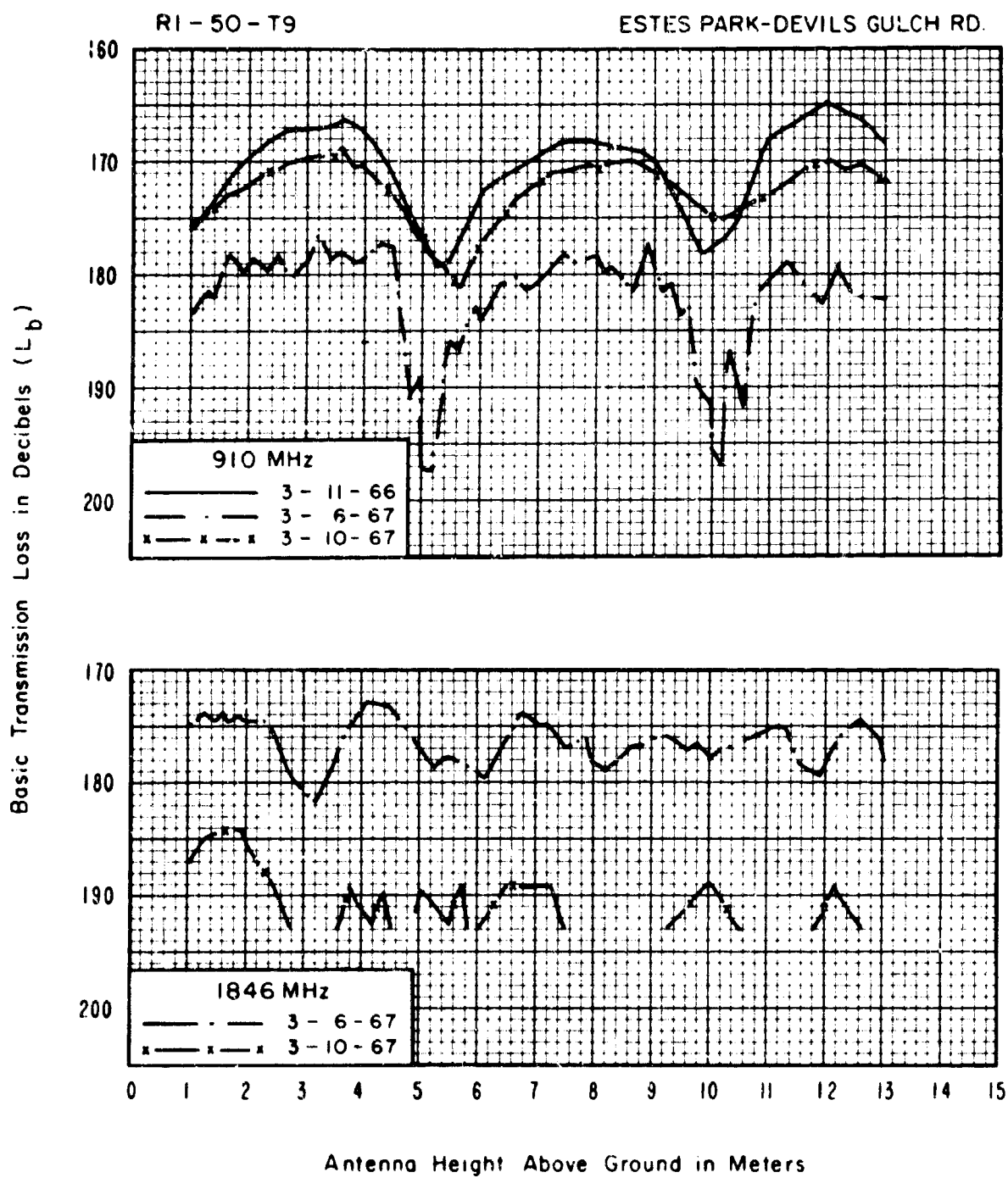
Field grass covers the ground for approximately 300 ft, after which there is a dense growth of pine trees for 5 mi to a low-lying ridge. A high ridge at the horizon is 7-1/2 mi away. There are no telephone or power lines in the area.



RI-50-T9

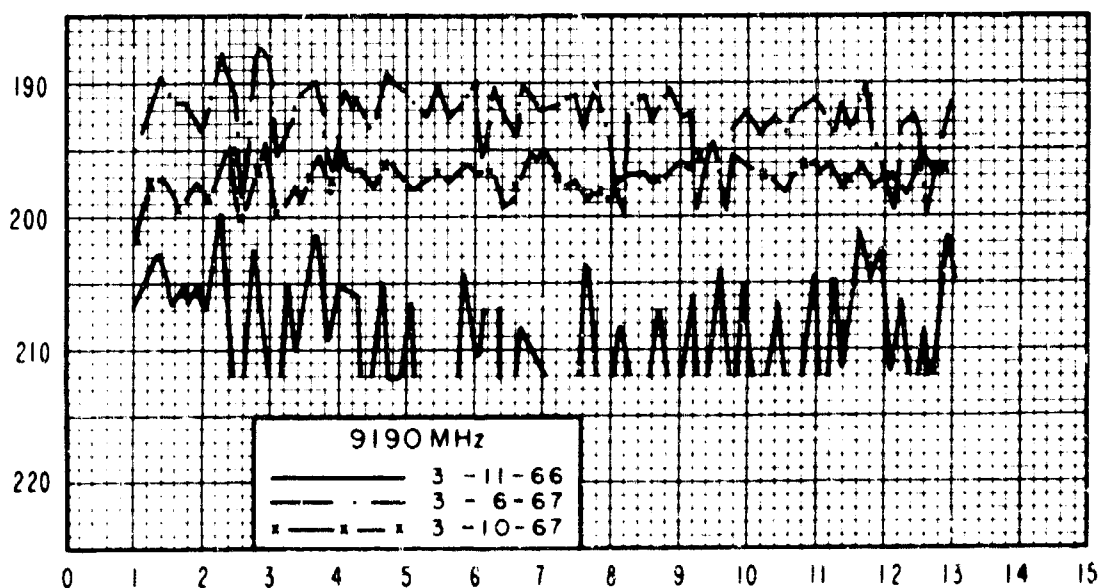
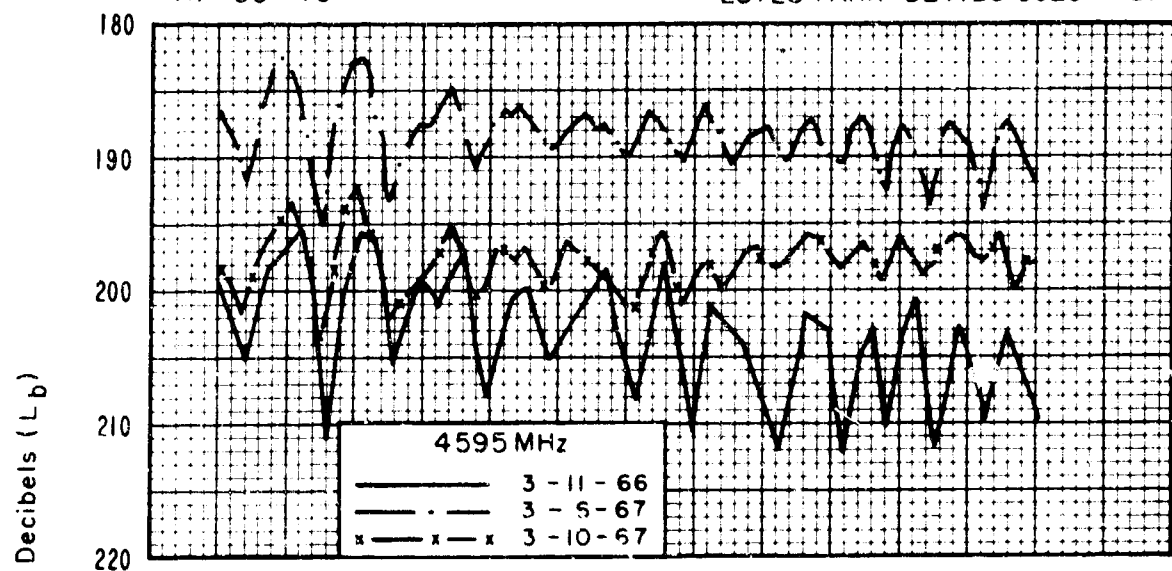
ESTES PARK-DEVILS GULCH RD.





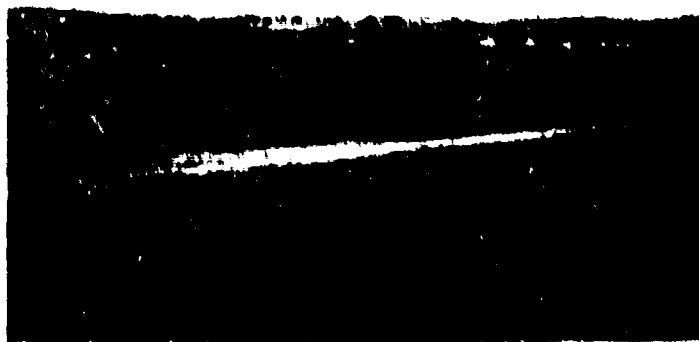
RI-50-T9

ESTES PARK-DEVILS GULCH RD.

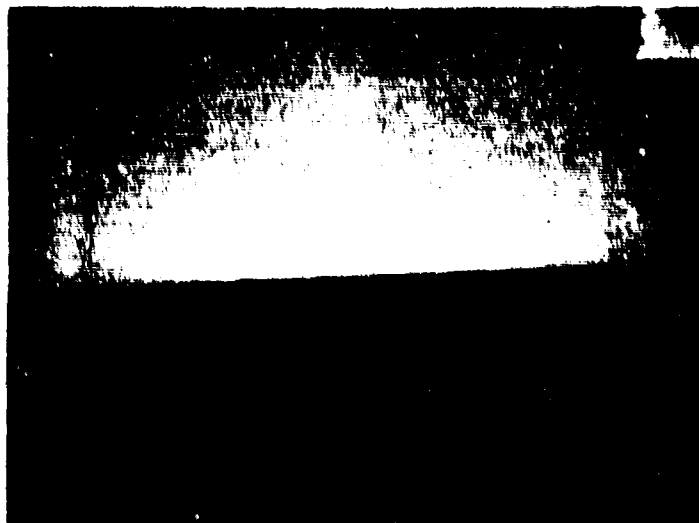


Antenna Height Above Ground in Meters

R1-80-11
PURCELL, EA



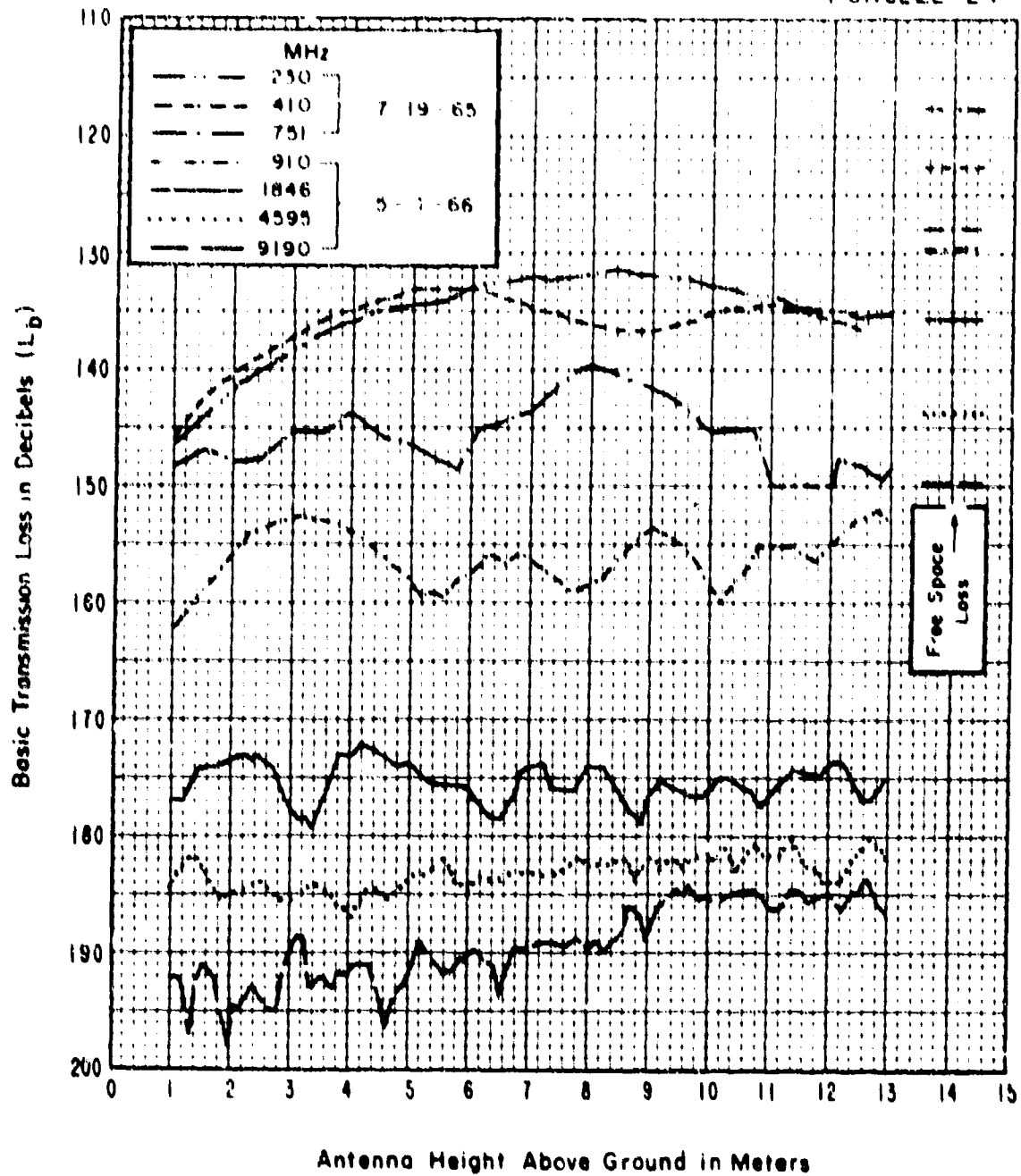
PATH VIEW FROM RECEIVER



PATH VIEW FROM TRANSMITTER

RI-80-T1

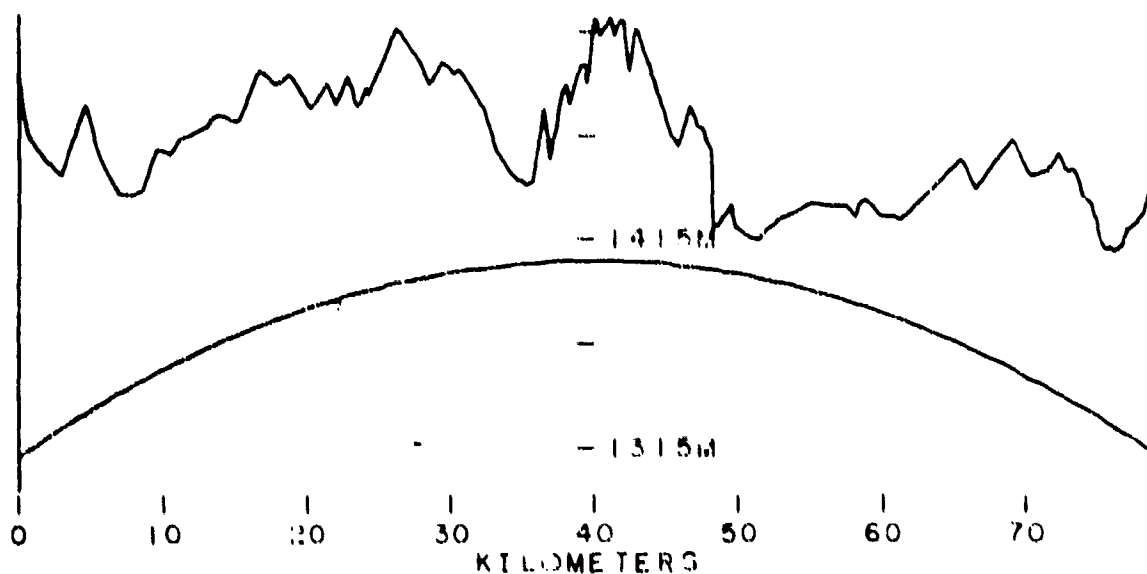
PURCELL E4



RCVR, ELEV.
1589 M

R1-80-T1
PATH LENGTH 78.86 km

XMTR, ELEV.
1536 M



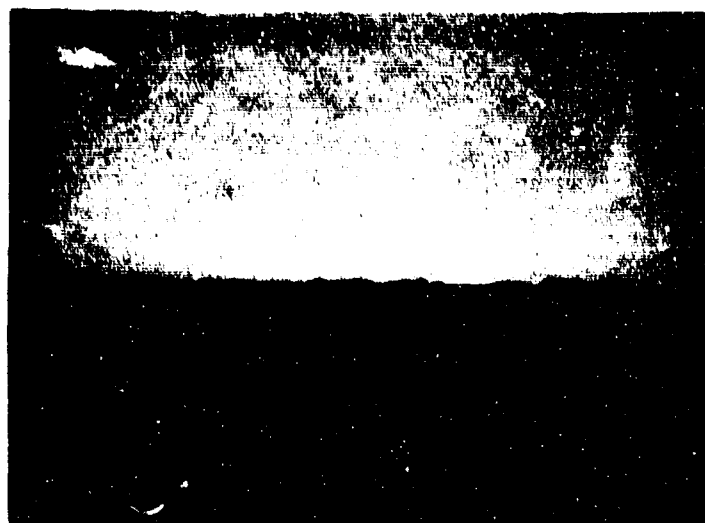
L _p (dB) SHORT TERM SIGNAL VARIABILITY							
Freq (MHz)	230	410	751	910	1846	4595	9190
5-4-66 at 13 M							
50%				154.3	175.4	184.7	182.5
Δ10%-90%				<3	4.3	5.9	6.3
5-4-66 at 7.3 M							
				158.4	177.5	188.4	188.5
				<3	4.5	6.6	7.4
5-4-66 at 1.0 M							
				161.0	177.2	186.3	190.0
				<3	6.7	9.0	9.3

The path at this site is free of obstructions and is over rolling grass-covered plains.

R1-80-T2
MASTERS N3



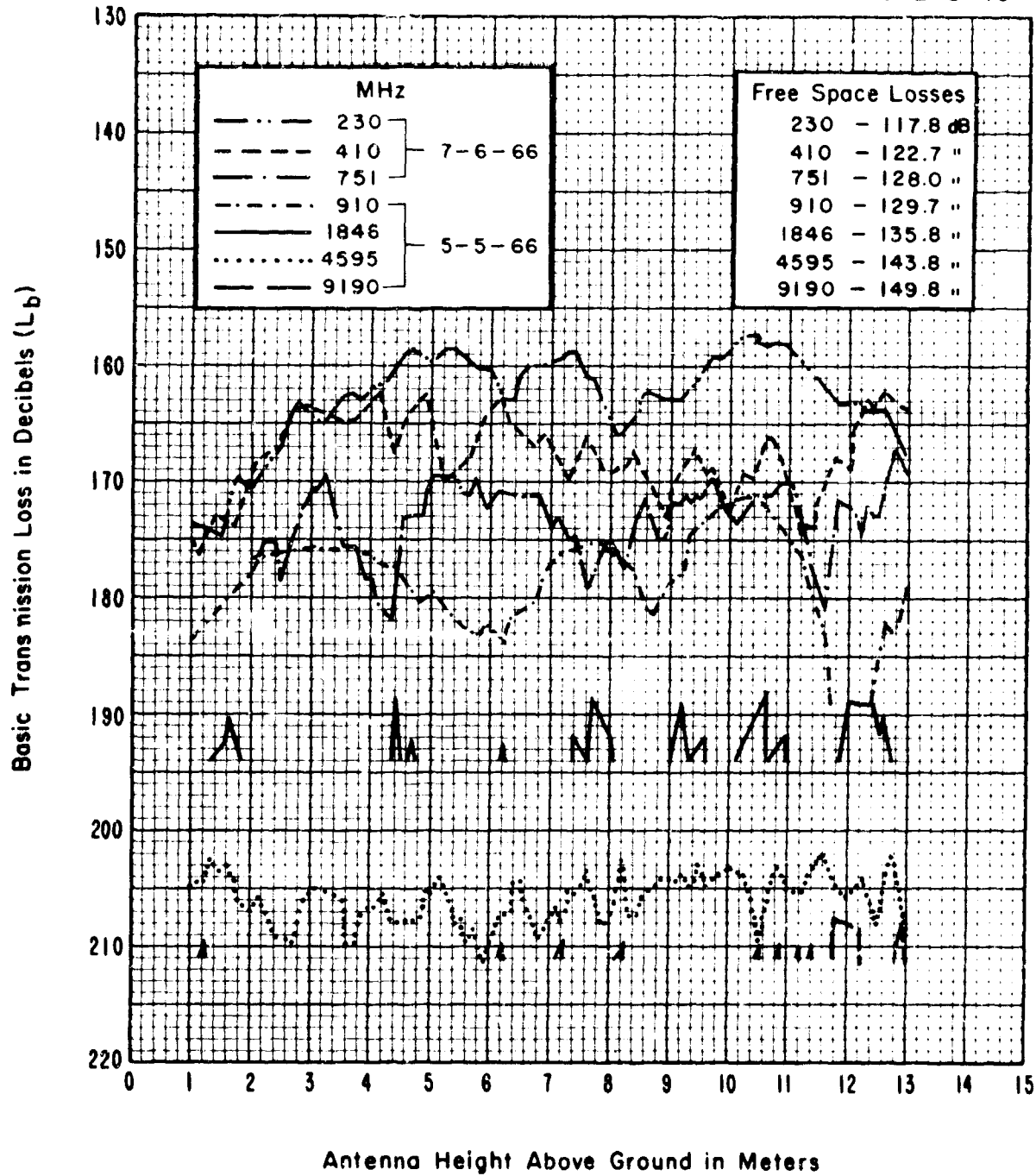
PATH VIEW FROM RECEIVER



PATH VIEW FROM TRANSMITTER

R1-80-T2

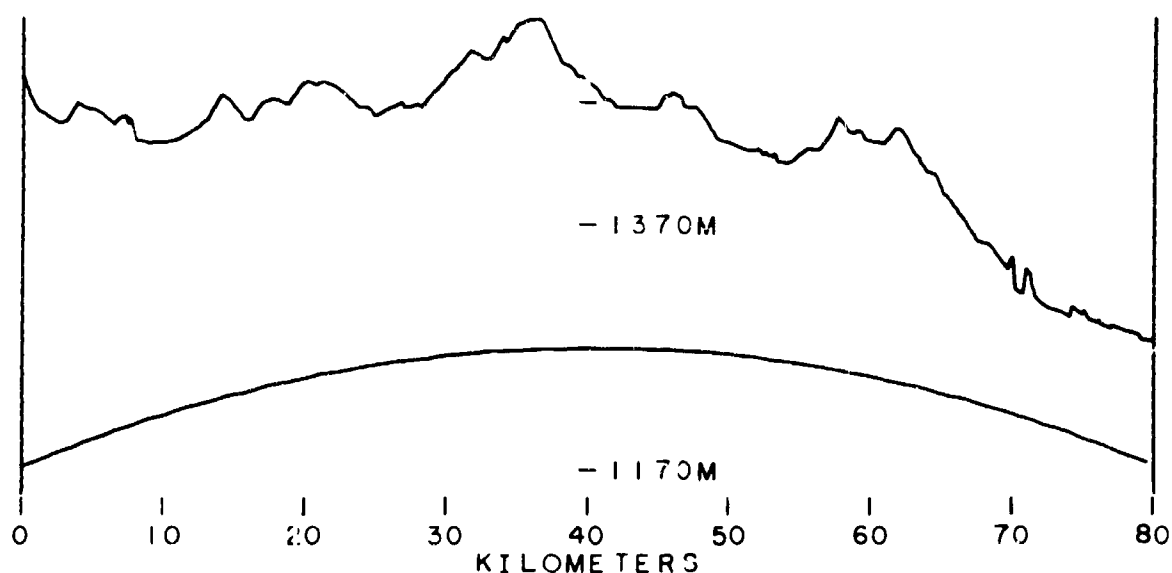
MASTERS N3



RCVR. ELEV.
1589 M

RI-80-T2
PATH LENGTH 80.08 km

XMTR. ELEV.
1372 M

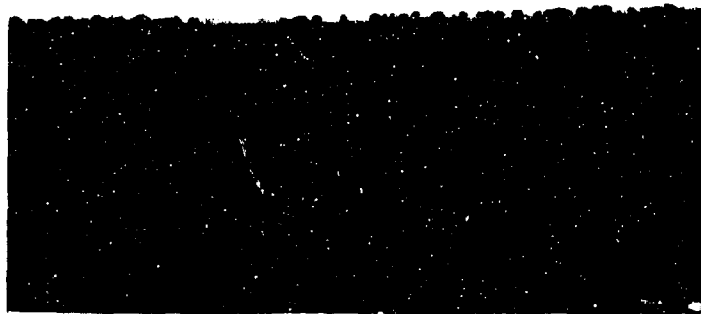


L_b (dB) SHORT TERM SIGNAL VARIABILITY

Freq (MHz)	230	410	751	910	1846	4595	9190
7-6-66 at 13 M				5-5-66 at 13 M			
50%	162.2	165.5	174.2	178.5		204.3	
$\Delta 10\%-90\%$	7.2	5.6	8.0	<3		<3	
7-6-66 at 7.3 M				5-5-66 at 7.3 M			
50%	159.9	163.3	171.5	172.6		206.0	
$\Delta 10\%-90\%$	6.5	5.8	6.2	<3		3.0	
7-6-66 at 1 M				5-5-66 at 1 M			
50%	172.7	175.1	178.0	182.8		202.1	
$\Delta 10\%-90\%$	3.4	7.6	7.8	4.0		3.4	

The 12-mi path to a ridge at the horizon extends over grassland, with a small area of dense tree growth, approximately 1 mi from the transmitter, at the right edge of the path.

R1-80-T3
STRASBURG NE1



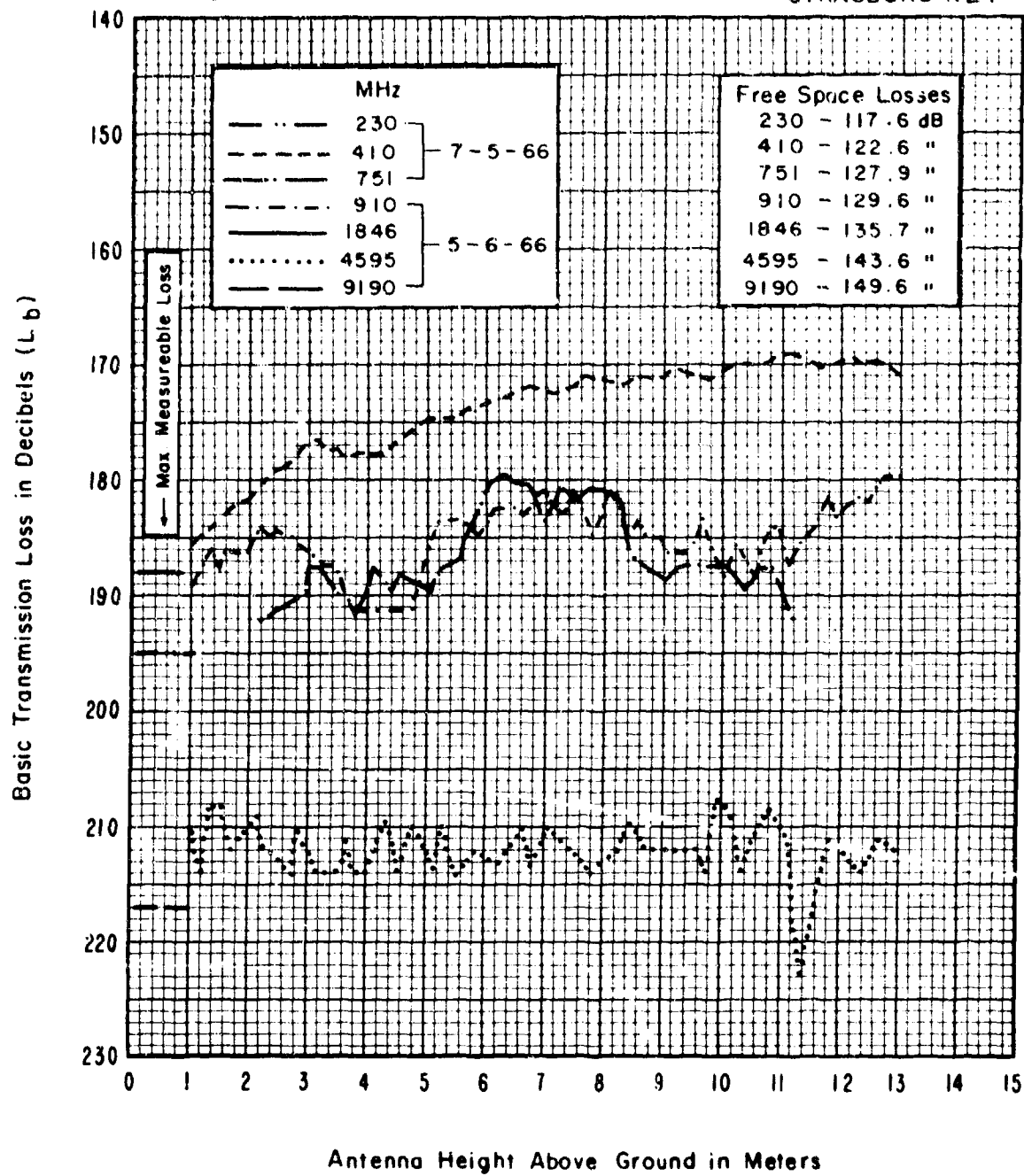
PATH VIEW FROM RECEIVER



PATH VIEW FROM TRANSMITTER

RI-80-T3

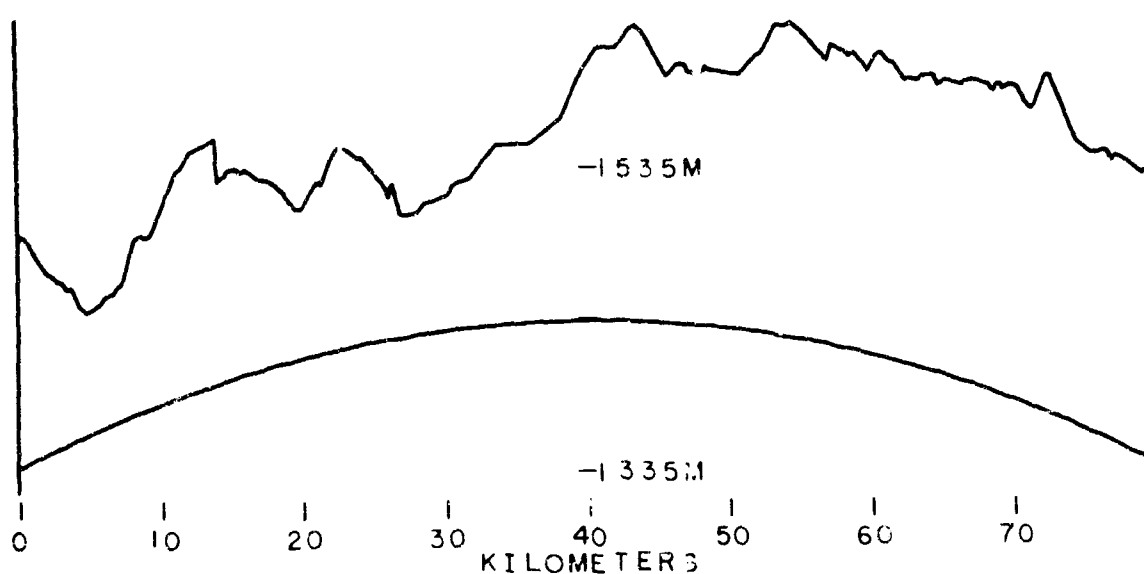
STRASBURG NE 1



RCVR. ELEV.
1589 M

R1-80-T3
PATH LENGTH 79.81 km

XMTR. ELEV.
1633 M



L_p (dB) SHORT TERM SIGNAL VARIABILITY

Freq (MHz)	230	410	751	910	1846	4595	9190

7-5-66 at 7.3 M

5-6-66 at 13 M

50%

178.6 178.1

209.5

$\Delta 10\%-90\%$

<3 <3

7.0

5-6-66 at 7.3 M

50%

178.3

212.0

$\Delta 10\%-90\%$

<3

<3

5-6-66 at 1 M

50%

207.6

$\Delta 10\%-90\%$

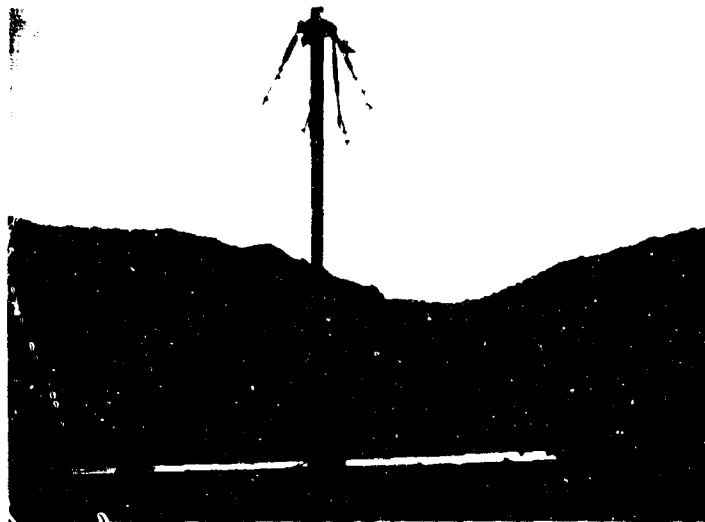
<3

The immediate foreground is a dirt road 40 ft wide, along which a 3-ft high fence runs at 45° to the path. Beyond, plowed fields alternating with strips of grass extend to the horizon, 6 mi away.

R1-80-T4
GRANBY W5



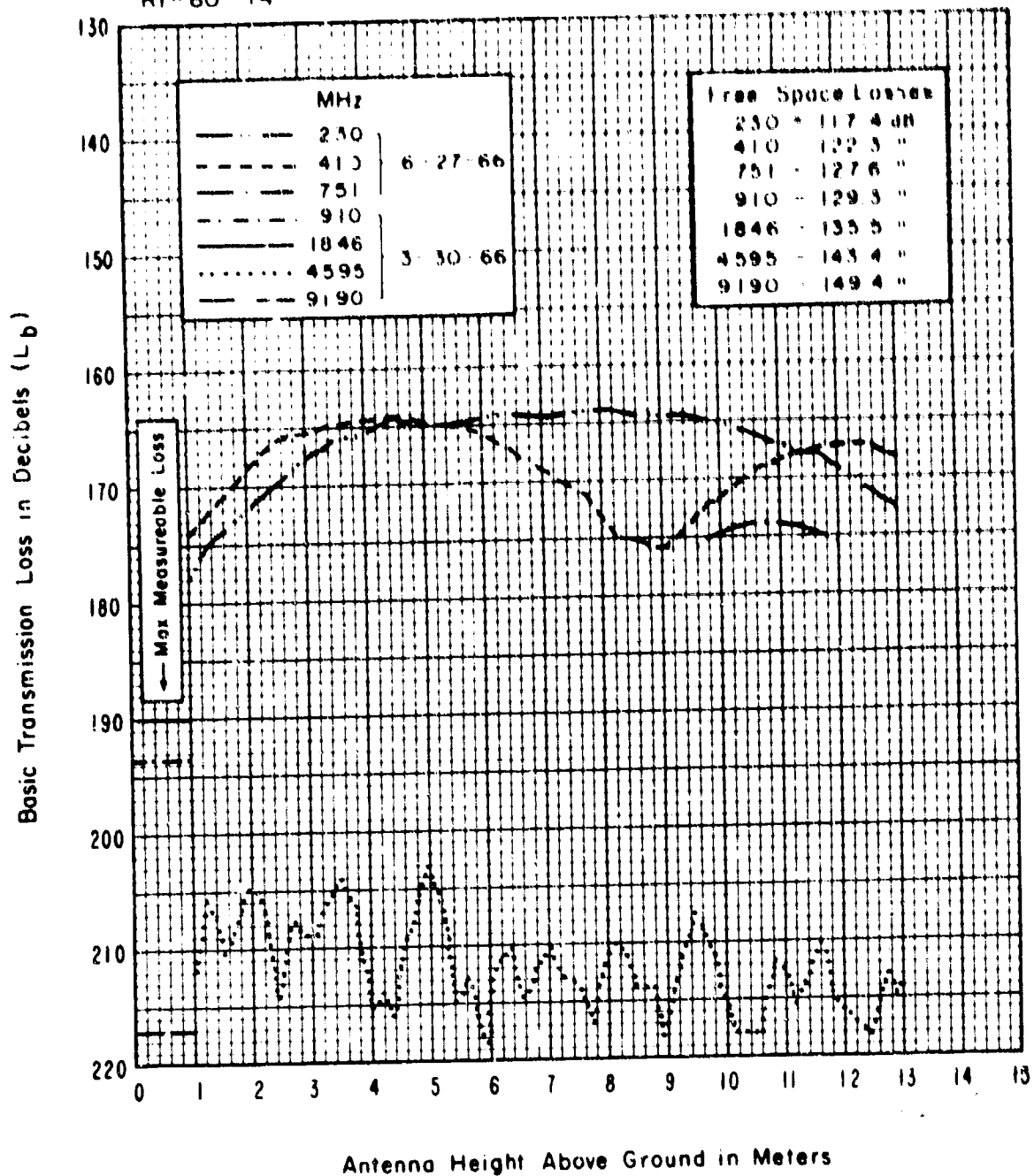
PATH VIEW FROM RECEIVER



PATH VIEW FROM TRANSMITTER

RI-80-T4

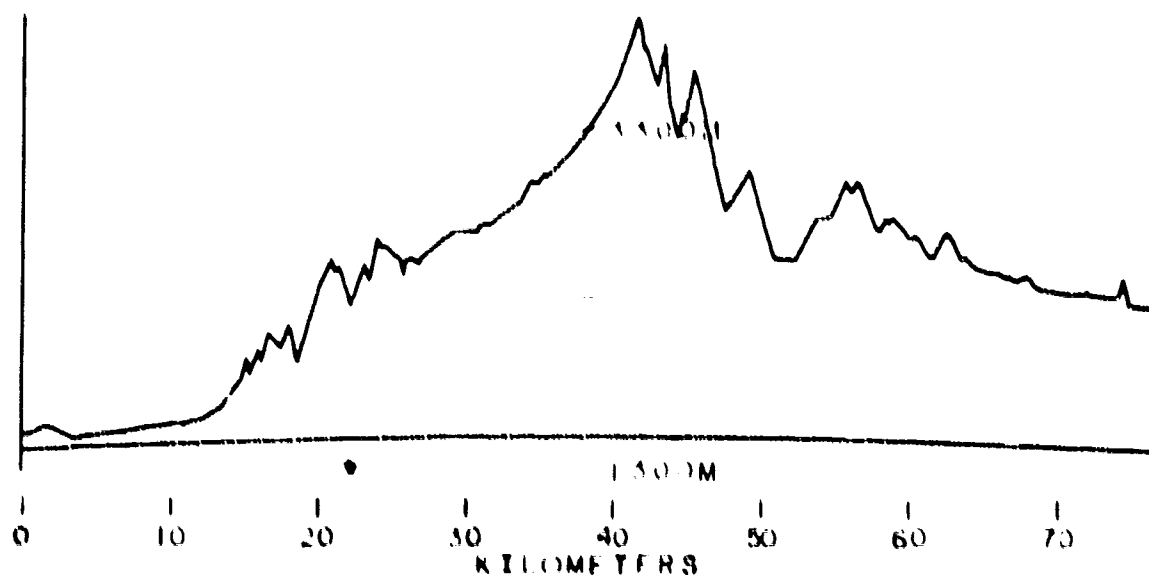
GRANHY W5



RCVR, ELEV.
1589 M

RE 80 T4
PATH LENGTH 76.50 km

XMTR, ELEV.
2091 M



L_p (dB) SHORT TERM SIGNAL VARIABILITY

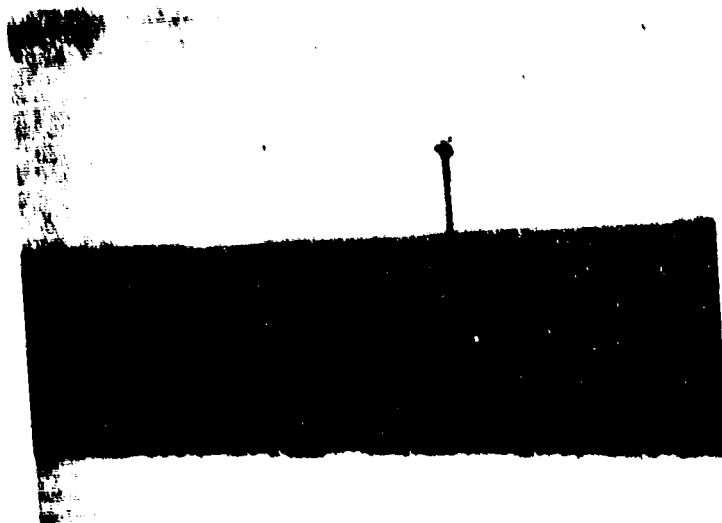
Freq (MHz)	230	410	751	910	1846	4595	9190
	6-27-66 at 13 M			3-30-66 at 13 M			
50%		169.7				198.8	
$\Delta 10\%-90\%$		< 3				< 3	
	6-27-66 at 11 M			3-30-66 at 7.3 M			
50%			174.2			200.9	
$\Delta 10\%-90\%$			< 3			< 3	
	6-27-66 at 7 M			3-30-66 at 1 M			
50%	164.4					199.3	
$\Delta 10\%-90\%$	< 3					< 3	

Grassland extends for approximately 150 ft from the transmitter to a grove of pines. Beyond the pines about 1 mi away at the horizon is a low hill.

RI-120-11
BUCKINGHAM



PATH VIEW FROM RECEIVER

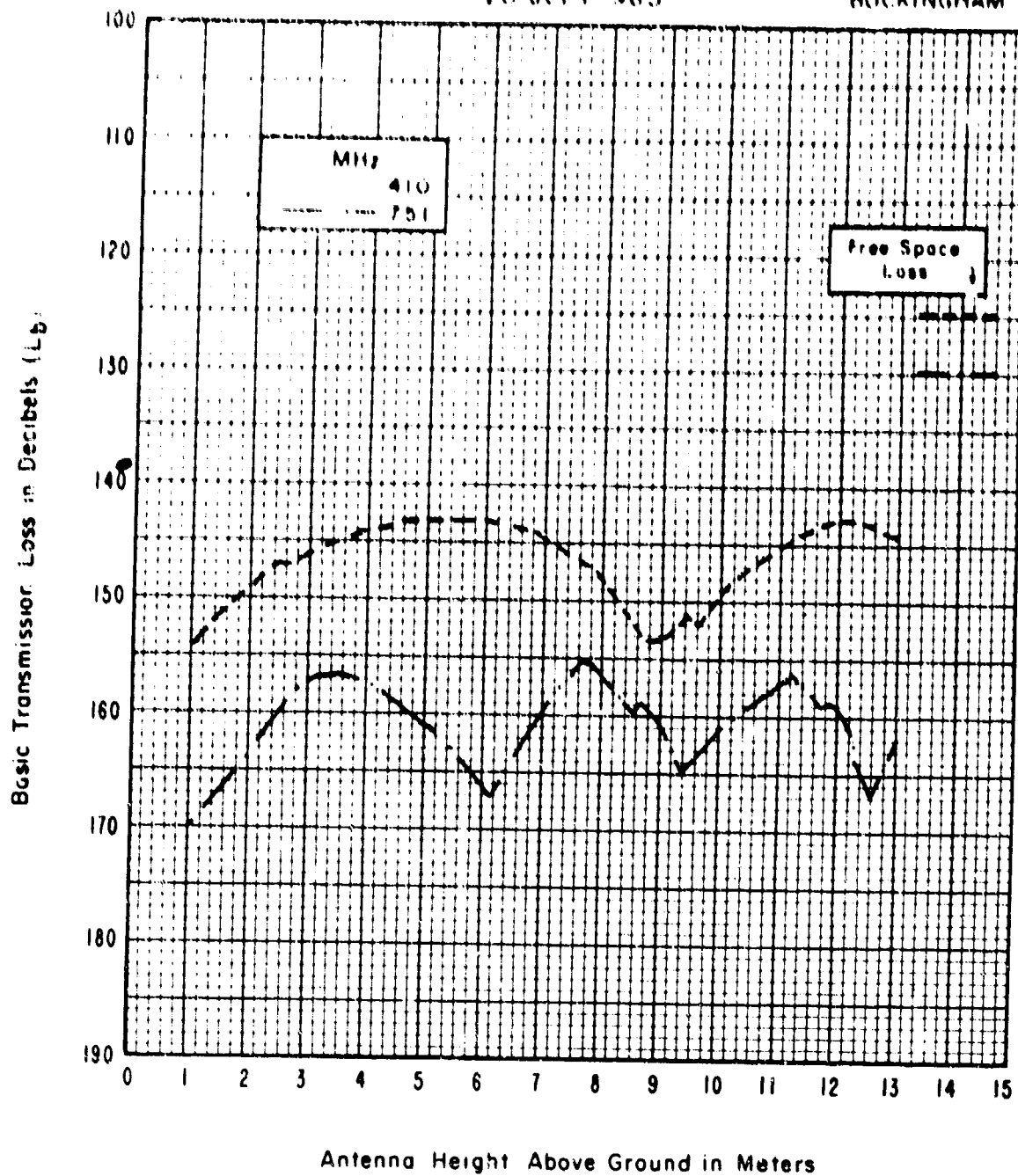


PATH VIEW FROM TRANSMITTER

RT 120 11

20 JULY 1965

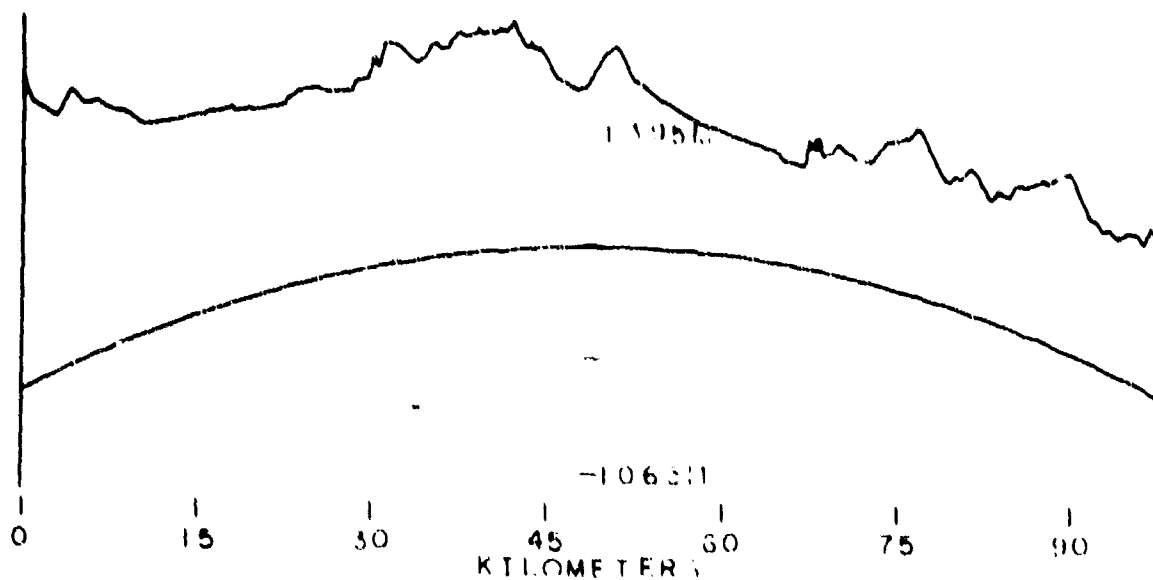
HUCKINGHAM



RCVR. ELEV.
1589 M

RI 120-T1
PATH LENGTH 97.36 km

XMTR. ELEV.
1449 M



L_p (dB) SHORT TERM SIGNAL VARIABILITY

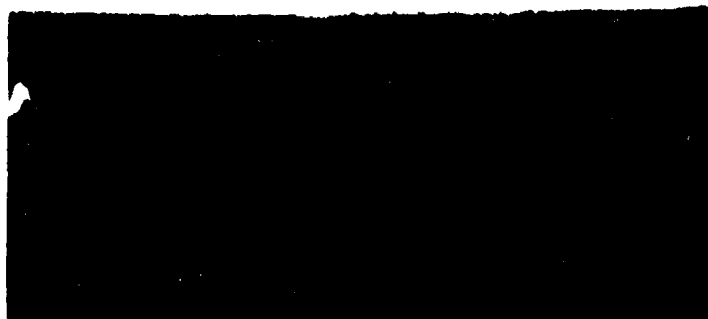
Freq (MHz)	230	410	751	910	1846	4595	9190

7-20-65 at 7.3M

50%	146.6	146.2	155.2
$\Delta 10\%-90\%$	3.8	3.6	< 3

The entire path is over rolling grassland to the horizon, 5 mi away. A 6-wire power line crosses the path at 90° , approximately 60 ft from the antennas.

R1-120-T2
FORT MORGAN N12



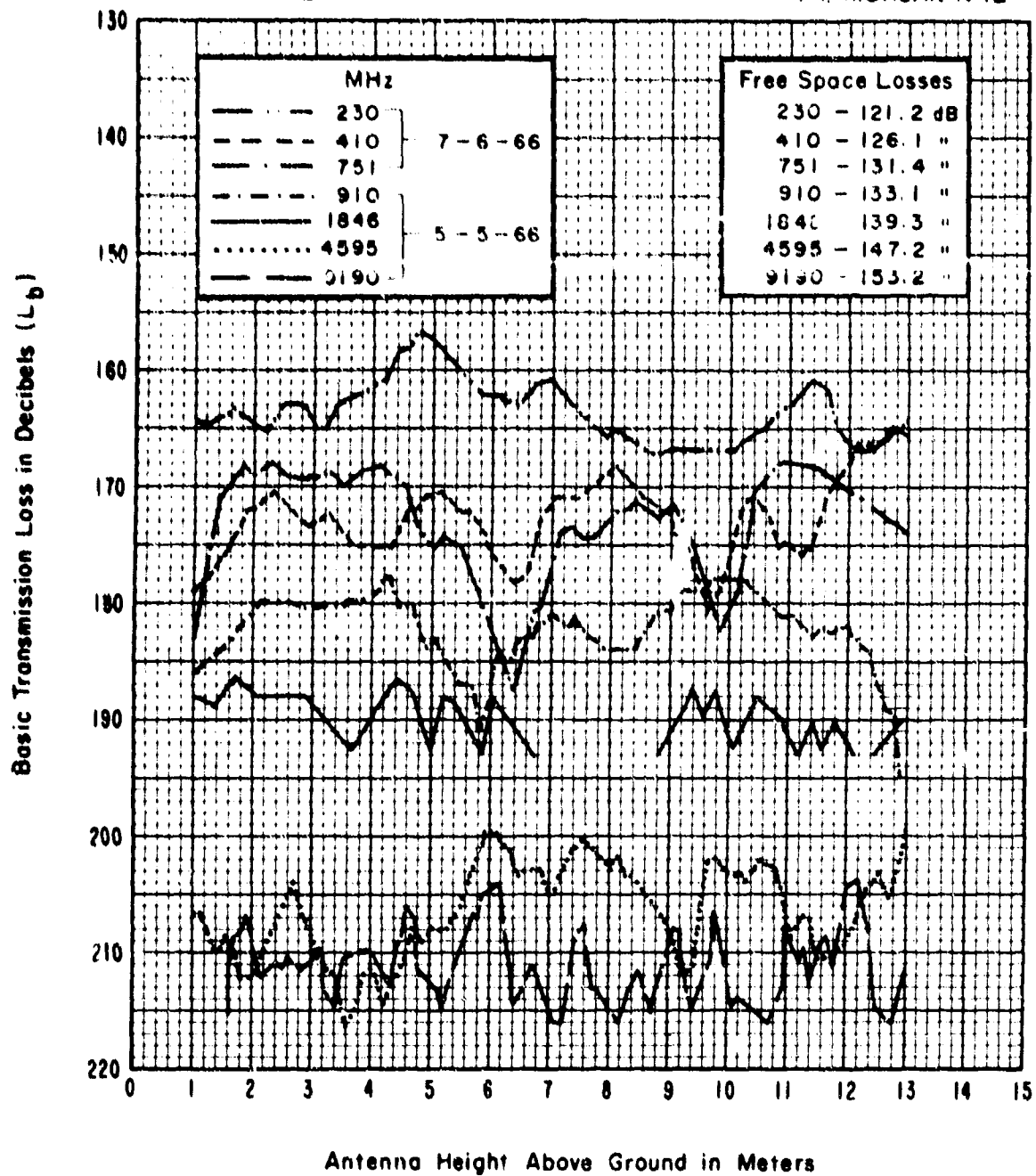
PATH VIEW FROM RECEIVER



PATH VIEW FROM TRANSMITTER

RI-120-T2

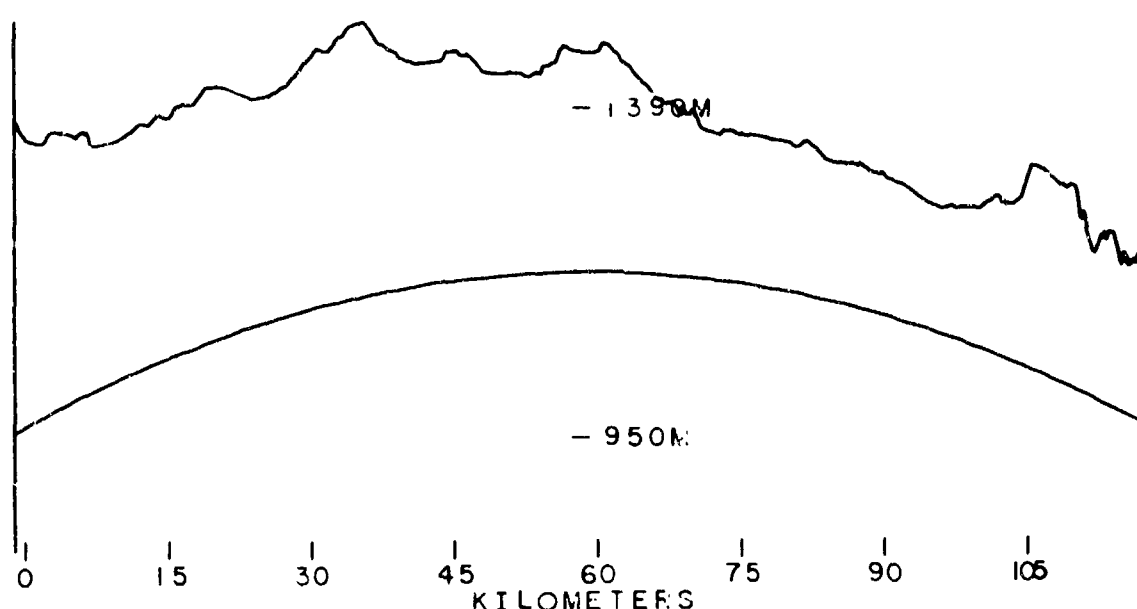
FT. MORGAN N-12



RCVR. ELEV.
1589 M

R1-120-T2
PATH LENGTH 118.76 km

XMTR. ELEV.
1433 M

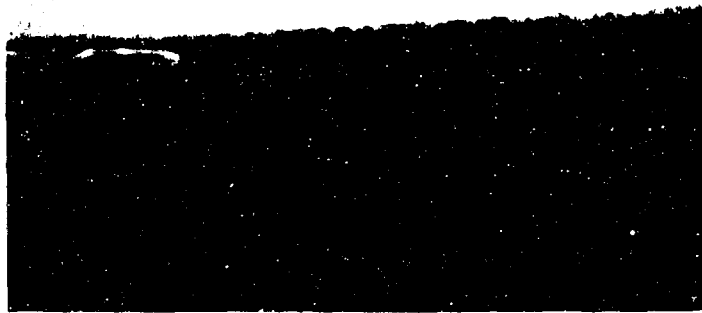


L_b (dB) SHORT TERM SIGNAL VARIABILITY

Freq (MHz)	230	410	751	910	1846	4595	9190
7-6-66 at 13 M				5-5-66 at 13 M			
50%	164.0	169.5	174.7	184.4	182.1	186.3	212.4
$\Delta 10\%-90\%$	13.8	10.8	6.9	17.4	<3	9.1	14.2
				5-5-66 at 7.3 M			
50%	160.1	173.1	175.2	187.8	184.2	189.1	212.2
$\Delta 10\%-90\%$	10.8	11.4	6.6	11.8	<3	8.9	17.5
				5-5-66 at 1 M			
50%	165.9	182.2	181.0	185.0	181.7	189.7	217.8
$\Delta 10\%-90\%$	<3	8.9	6.2	23.6	<3	7.6	18.7

The terrain at this transmitter site is rolling grassland to the horizon approximately 9 mi away. There are no obstructions.

R1-120-T3
DEER TRAIL



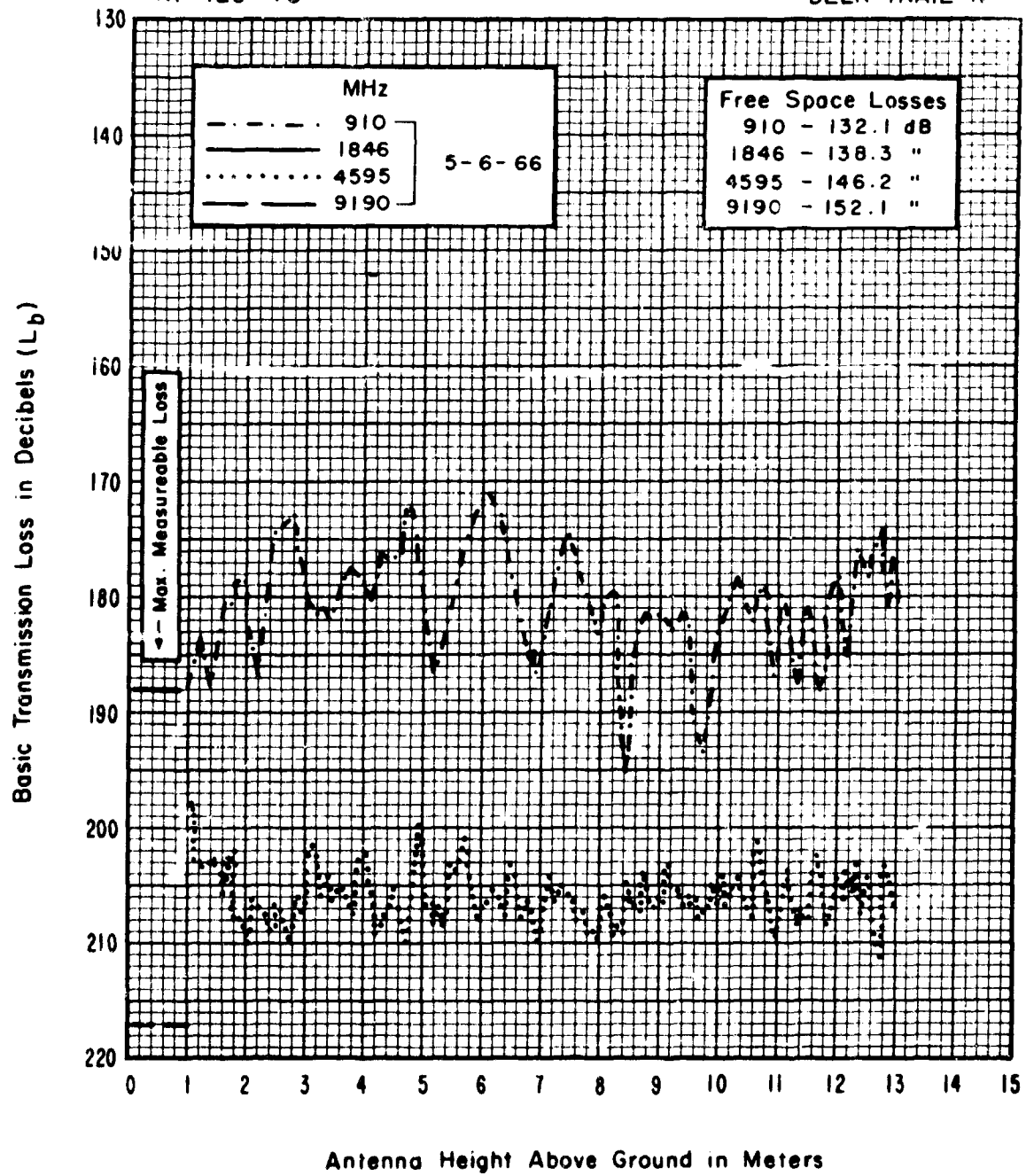
PATH VIEW FROM RECEIVER



PATH VIEW FROM TRANSMITTER

RI-120-T3

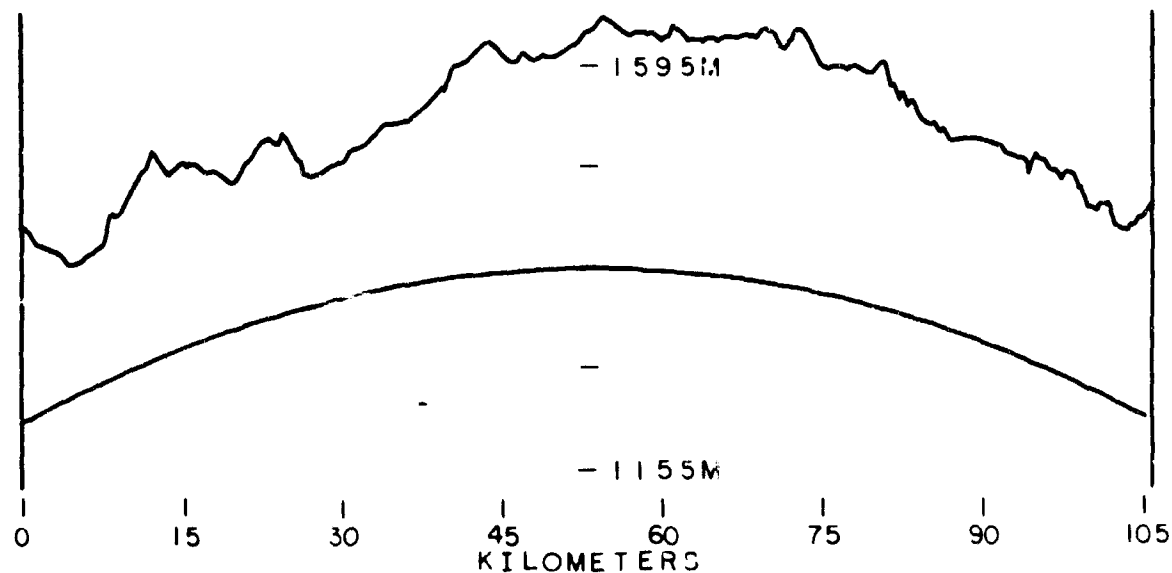
DEER TRAIL N.



RCVR. ELEV.
1589 M

RI-120-T3
PATH LENGTH 105.84 km

XMTR. ELEV.
1612 M



L_p (dB) SHORT TERM SIGNAL VARIABILITY

Freq (MHz)	230	410	751	910	1846	4595	9190
					5-6-66 at 13 M		
50%				182.0		205.0	
$\Delta 10\%-90\%$				9.1		4.9	
					5-6-66 at 7.3 M		
				182.0		205.5	
				9.8		5.2	
					5-6-66 at 1.0 M		
						205.2	
						5.9	

The path is over plowed ground for 1/2 mi, then over a 1/2-mi strip of grassland, continuing over terrain where wheat fields and grasslands alternate.

R1-120-T4
FAIRPLAY E3



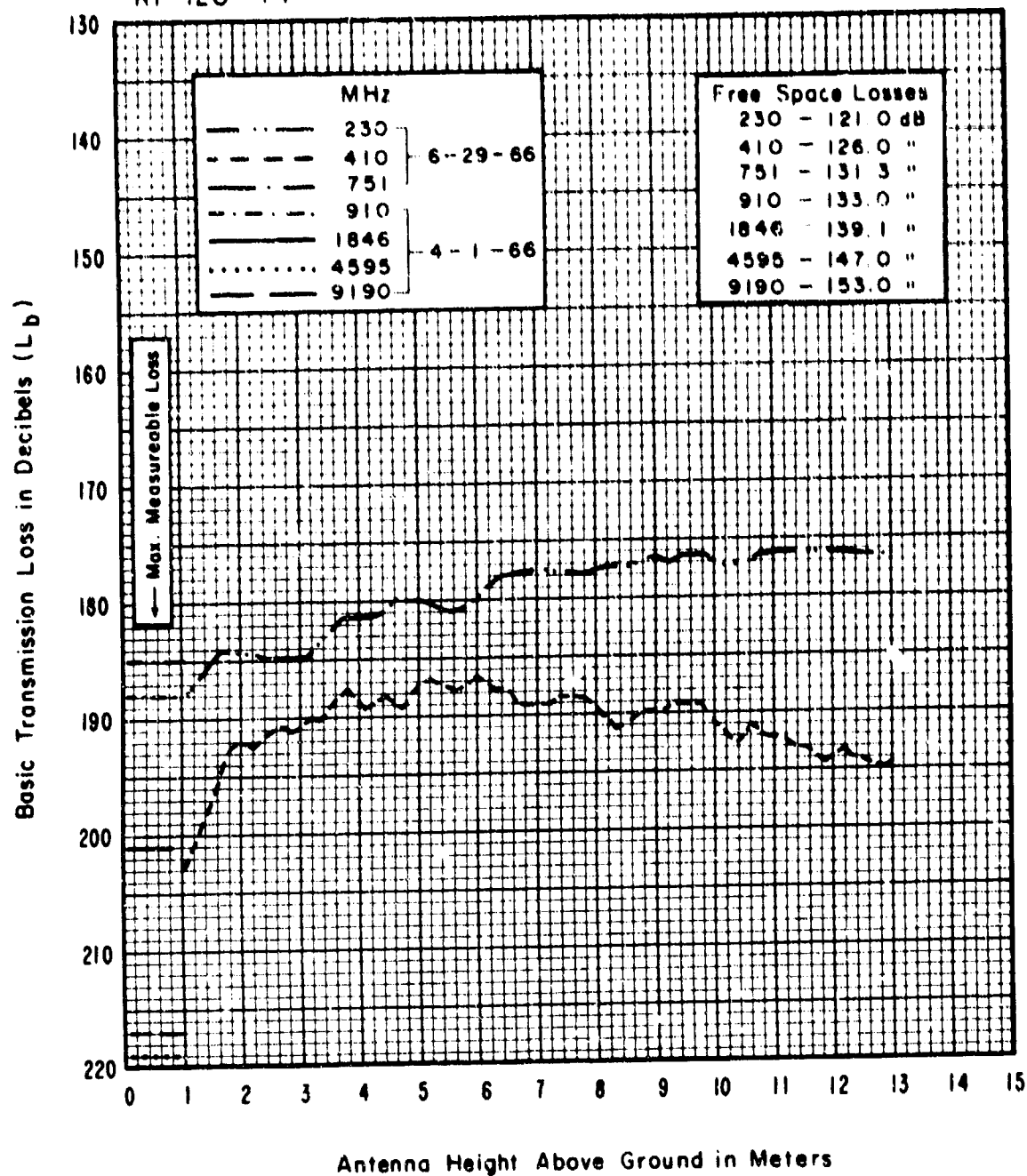
PATH VIEW FROM RECEIVER



PATH VIEW FROM TRANSMITTER

RI-120-T4

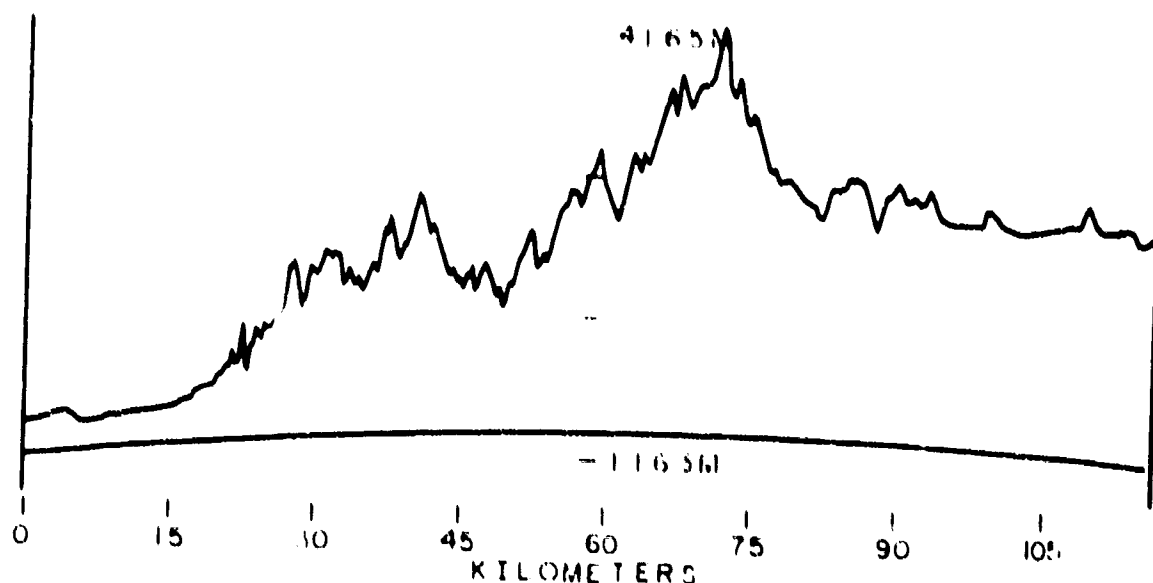
FAIRPLAY



RCVR. ELEV.
1589 M

RI-120-T4
PATH LENGTH 116.56 km

XMTR. ELEV.
3011 M



L_p (dB) SHORT TERM SIGNAL VARIABILITY

Freq (MHz)	230	410	751	910	1846	4595	9190

6-29-66 at 13 M

50%	179.1	196.1

$\Delta 10\%-90\%$	< 3	4.6

6-29-66 at 7.3 M

50%	189.2

$\Delta 10\%-90\%$	< 3

6-29-66 at 1 M

50%	194.5

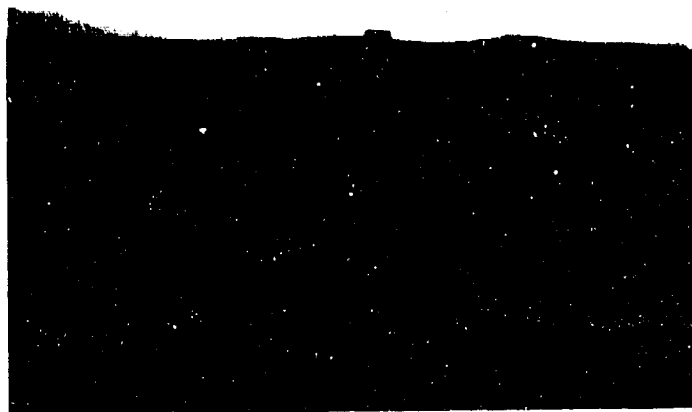
$\Delta 10\%-90\%$	3.8

The path at this site is over a downslope into a small valley, beyond which is a small mesa below the line of sight. The ground cover to the horizon, 28 mi away, is rolling grassland, spotted with pine trees.

R1-120-T5
WALDEN NE5



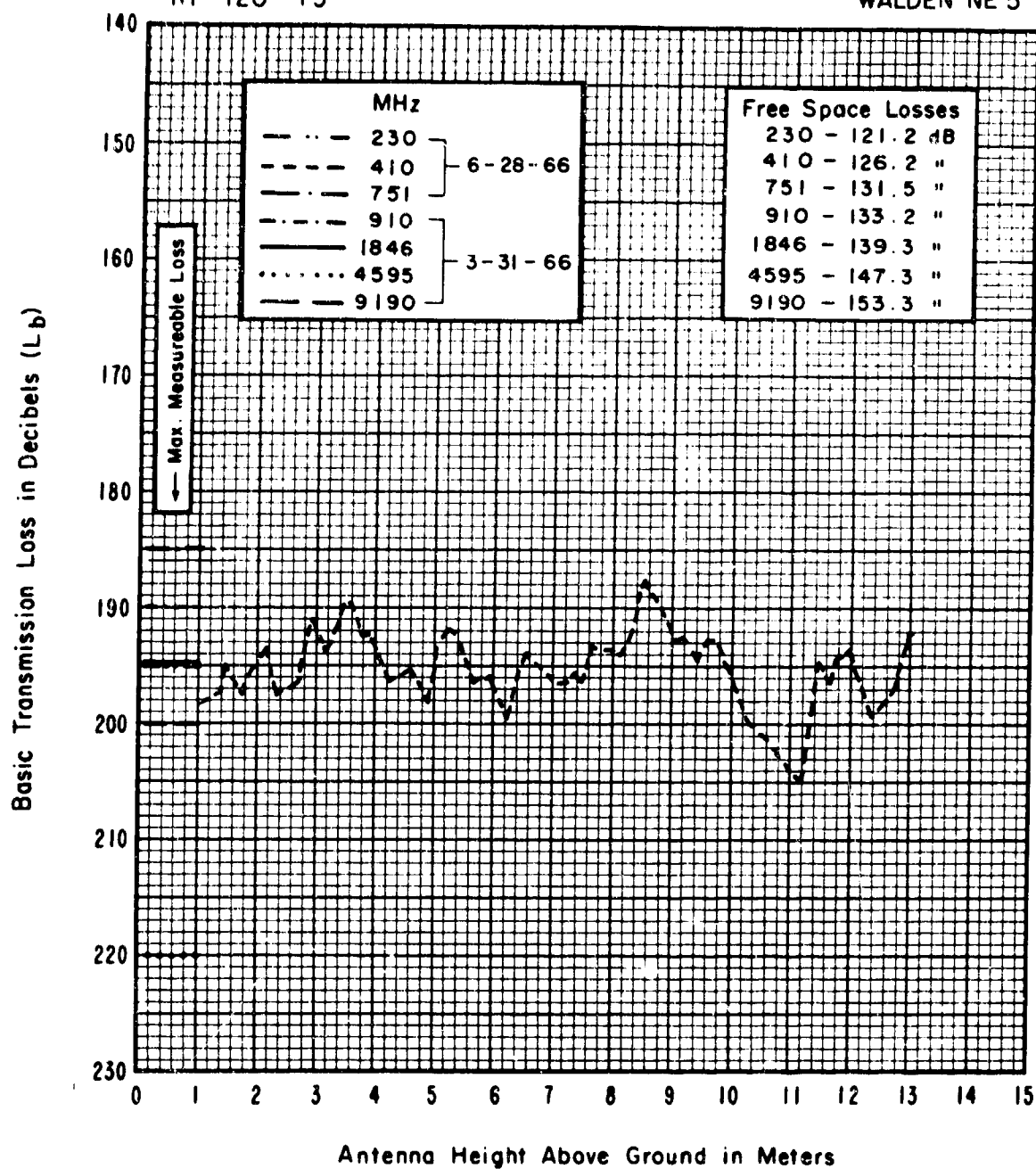
PATH VIEW FROM RECEIVER



PATH VIEW FROM TRANSMITTER

RI-120-T5

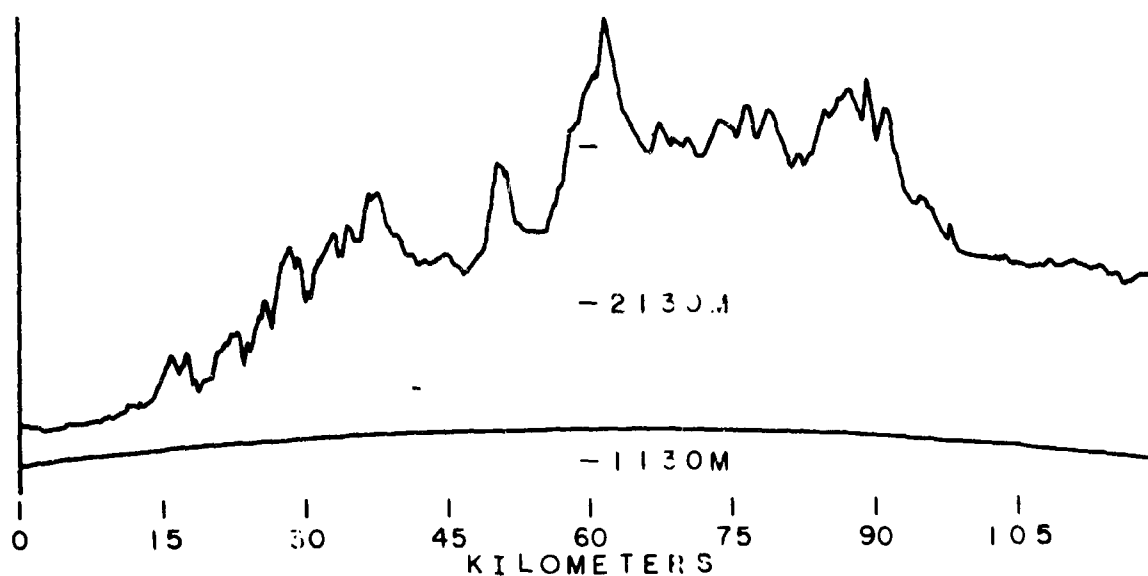
WALDEN NE 5



RCVR. ELEV.
1589 M

R1-120-T5
PATH LENGTH 119.66 km

XMTR. ELEV.
2506 M



L_p (dB) SHORT TERM SIGNAL VARIABILITY

Freq (MHz)	230	410	751	910	1846	4595	9190

6-28-66 at 7.3 M

50%	198.5
$\Delta 10\%-90\%$	8.7

This site is in open, rolling terrain, with the Continental Divide at the horizon. A 40-ft high storage tank is located approximately 4° to the right, $1/2$ mi from the transmitter.

Meteorological Information

Type of Site	Dry Bulb Temp C	Wet Bulb Temp C	Atmos. Press. mb	% Rel. Humid.	Cloud Type	% Cloud Cover	Wind Speed & Dir.	Term- inal

R1-0.5-T1 R1E

UHF June 2, 1965

No data available

SHF April 18, 1966

OPEN	1.7	1.7	824.2	100	L5	100	8 NW	Rcvr
	3.9	2.8	828.5	85	Fog	100	5	Xmtr

SHF April 21, 1966

No data available

R1-0.5-T2 R1W

UHF March 31, 1965

No data available

SHF February 10, 1966

No data available

R1-3-T1 Niwot El

UHF April 1, 1965

No data available

UHF December 1, 1966

OPEN	-6.2	-6.5	833.6	37	M2	100	Calm	Rcvr
	-5.0	-6.1	846.6	76	H6	100	Calm	Xmtr

SHF February 25, 1966

No data available

SHF March 3, 1967

OPEN	3.3	0.2	830.9	55	H6	80	3-8 NW	Rcvr
	6.1	2.8	837.0	59	M1	--	5 N	Xmtr

R1-3-T2 Baller Lake NW1

UHF June 2, 1965

No data available

SHF April 25, 1966

OPEN	22.8	10.0	836.5	18	L1	40	Calm	Rcvr
	25.0	12.2	846.5	22	L1	20	5 E	Xmtr

R1-3-T3 Baller Lake N

UHF June 2, 1965

No data available

UHF June 24, 1965

No data available

UHF July 13, 1965

No data available

SHF April 25, 1966

OPEN	22.0	10.0	838.7	20	H3	10	Calm	Rcvr
	23.9	11.1	847.0	20	L1	10	Calm	Xmtr

UHF December 14, 1966

OPEN	7.2	4.2	831.2	67	H7	85	10 NW	Rcvr
	11.7	3.3	845.0	22	--	--	--	Xmtr

R1-3-T4 Lookout Road at U. S. 287

UHF June 7, 1965

No data available

SHF May 13, 1966

OPEN	14.4	7.7	838.3	39	H1, L1	25	7 W	Rcvr
	15.0	8.9	845.1	36	H2, L2	30	5-10 NW	Xmtr

UHF December 7, 1966

OPEN	6.2	--	817.4	--	M3	75	--	Rcvr
	7.2	4.4	829.5	67	L9	50	2 SW	Xmtr

UHF Decmber 22, 1966

OPEN	3.3	-3.3	854.2	8	L2	50	5 NE	Rcvr
	3.3	-3.3	854.2	8	L2	50	5 NE	Xmtr

UHF January 17, 1967

OPEN	-2.2	-2.6	817.4	89	H1	2	--	Rcvr
	2.2	-3.3	850.1	21	H9	30	5 SE	Xmtr

SHF January 25, 1967

OPEN	-2.6	-2.8	830.9	100	--	100	Calm	Rcvr
	0.0	0.0	836.7	100	Fog	100	5 N	Xmtr

SHF February 1, 1967

OPEN	3.7	1.5	840.4	70	L1	15	2-5 SE	Rcvr
	3.3	0.6	846.5	62	L9	10	5 N	Xmtr

R1-3-T5 Gun Barrel Hill Summit

SHF February 24, 1966

No data available

UHF March 31, 1966

No data available

UHF October 28, 1966

OPEN	16.8	11.7	849.6	57	H6	50	Calm	Rcvr
	13.9	8.9	--	54	H6, H9	40	Calm	Xmtr

UHF October 31, 1966

OPEN	0.8	0.6	842.8	100	L6	100	Calm	Rcvr
	0.6	0.0	847.1	91	L6	100	2 S	Xmtr

UHF November 1, 1966

OPEN	4.4	1.8	842.4	58	--	--	--	Rcvr
	3.3	0.0	848.0	55	H2	3	0-5 SW	Xmtr

UHF November 23, 1966

OPEN	9.9	6.2	831.3	62	L1	5	--	Rcvr
	7.7	4.4	836.8	23	L2	10	3 SE	Xmtr

UHF November 29, 1966

OPEN	12.8	9.0	835.7	77	M2	90	--	Rcvr
	10.6	4.4	839.9	63	L2	80	3 NE	Xmtr

UHF January 23, 1967

OPEN	3.5	1.5	824.8	59	H2	70	--	Rcvr
	3.9	1.5	830.2	57	H6	90	5-10 NW	Xmtr

UHF March 15, 1967

OPEN	7.2	2.1	845.8	29	M1, H6	30	0-2 SE	Rcvr
	6.1	2.8	848.2	59	L9	70	0-5 S	Xmtr

SHF March 15, 1967

OPEN	1.6	0.2	848.2	75	L6	100	0-2	Rcvr
	1.7	0.6	845.8	83	L9	100	Calm	Xmtr

R1-5-T1 Baller Lake NE1

UHF June 9, 1965

No data available

SHF April 21, 1966

OPEN	12.2	6.7	838.3	47	H1	50	6	Rcvr
	10.0	4.4	847.0	43	H6	95	3 ESE	Xmtr

R1-5-T2 Baller Lake S

UHF June 9, 1965

No data available

UHF April 28, 1966

OPEN	5.6	0.6	841.0	39	L1	10	5 SW	Rcvr
	7.2	2.2	849.4	43	H2	10	Calm	XMTR

UHF December 14, 1966

OPEN	7.2	4.2	831.3	67	H7	85	--	Rcvr
	8.9	4.4	845.2	52	L9	85	Calm	Xmtr

UHF January 17, 1967

OPEN	-2.2	-2.6	838.0	89	H1	2	--	Rcvr
	-1.7	-5.0	850.0	40	H9	80	10-15 SE	Xmtr

UHF January 18, 1967

OPEN	-3.6	-3.6	834.6	100	H1	10	0-5 W	Rcvr
	-3.0	-5.0	849.0	67	H9	5	Calm	Xmtr

SHF January 27, 1967

OPEN	5.6	1.1	838.3	46	L1, L5	1	2-5 W	Rcvr
	6.7	0.0	846.5	24	L1	5	Calm	Xmtr

SHF February 8, 1967

OPEN	9.1	0.0	837.7	10	H6	20-30	Calm	Rcvr
	11.7	3.3	844.8	22	H1	30	2 S	Xmtr

R1-5-T3-O&C Erie NW1

SHF April 28, 1966

OPEN	8.9	2.6	839.0	46	H1, M2, L1	55	2-5 NW	Rcvr
	12.2	5.6	848.6	35	H2, L2	20	Calm	Xmtr

CONC.	13.3	5.6	837.5	28	H1, M1, L1	60	Calm	Rcvr
	13.9	6.1	847.6	30	L2	80	Calm	Xmtr

UHF June 30, 1966

OPEN	27.8	16.7	837.0	32	L2, M6	60	--	Rcvr
	27.8	17.7	838.7	39	L1, L5, H9	40	10 NE	Xmtr

CONC.	23.3	16.1	838.0	49	L2, M2	80	--	Rcvr
	22.8	16.7	842.8	56	L1	90	10 NWSE	Xmtr

UHF January 19, 1967

OPEN	--	--	834.3	--	H7	70	--	Rcvr
	5.6	-0.6	850.2	39	H9	80	0-5 NW	Xmtr

CONC.	--	--	843.3	--	H7	70	--	Rcvr
	6.7	0.0	850.0	24	H9	80	Calm	Xmtr

R1-5-T4 Gun Barrel Green

UHF April 12, 1967

No data available

SHF February 21, 1966

No data available

UHF November 2, 1966

OPEN	No data available							Rcvr
	17.7	7.7	840.4	24	L1	35	Calm	Xmtr

UHF November 29, 1966

OPEN	9.8	8.6	834.6	88	M2	90	0-5 NW	Rcvr
	9.4	4.4	839.0	47	L2	80	Calm	Xmtr

UHF January 19, 1967

OPEN	--	--	832.3	--	H2	80	0-10 W	Rcvr
	9.4	1.1	841.0	16	H9	95	5-20 W	Xmtr

UHF January 23, 1967

OPEN	3.4	2.2	826.9	84	H2	70	--	Rcvr
	4.4	1.1	834.8	57	H6	90	5-10 W	Xmtr

UHF February 27, 1967

OPEN	13.3	3.9	844.1	18	--	--	2-5 E	Rcvr
	13.9	7.2	846.2	40	--	--	5 NE	XMTR

R1-5-T5 Niwot W1

UHF April 2, 1965

No data available

R1-5-T5A Niwot W1

SHF April 2, 1965

No data available

UHF November 30, 1966

OPEN	8.1	6.2	837.4	74	H9, L1	80	--	Rcvr
	5.6	2.8	851.2	65	H6	10	0-5 S	Xmtr

R1-5-T6 Niwot N1

UHF April 2, 1965

No data available

R1-5-T6A Niwot N1

SHF February 25, 1966

No data available

UHF November 30, 1966

OPEN	7.0	3.9	838.7	64	H9	70	--	Rcvr
	3.3	1.7	853.3	77	H6	10	1-2 S	Xmtr

SHF February 27, 1967

OPEN	13.7	4.0	843.4	15	--	--	0-3 E	Rcvr
	13.9	5.0	851.2	23	--	--	5 NE	Xmtr

R1-10-T1 Idaho Creek

UHF June 21, 1965

No data available

SHF April 25, 1966

OPEN	16.7	8.9	842.7	37	--	--	Calm	Rcvr
	16.1	3.3	855.0	3	Clear	--	Calm	Xmtr

UHF December 14, 1966

OPEN	9.8	5.4	855.0	51	H7	85	--	Rcvr
	7.7	3.3	849.0	50	--	--	Calm	Xmtr

UHF January 18, 1967

OPEN	-3.8	-5.0	854.6	77	L1	2	--	Rcvr
	-2.2	-4.4	853.4	59	Clear	--	Calm	Xmtr

SHF January 27, 1967

OPEN	7.3	2.0	838.3	43	H6	40	2-5 SE	Rcvr
	5.6	3.3	850.6	72	H6, H9	80	Calm	Xmtr

SHF February 8, 1967

OPEN	8.7	-0.2	838.0	10	H6	60	Calm	Rcvr
	13.3	3.3	850.6	22	H1, H6	40	3 S	Xmtr

R1-10-T2 Boulder Reservoir

UHF April 6, 1965

No data available

R1-10-T2A Boulder Reservoir

SHF March 4, 1966

OPEN	0.6	-4.4	842.0	23	M9	10	15 NNW	Rcvr
	0.0	-5.6	845.5	10	--	10	15 WNW	Xmtr

UHF June 21, 1966

OPEN	24.4	15.0	833.0	38	H7	60	--	Rcvr
	26.1	15.0	838.4	32	H1, H2, L1, L2	50	5 SW	Xmtr

UHF November 1, 1966

OPEN	1.7	0.2	845.1	75	--	--	Calm	Rcvr
	4.4	1.1	854.4	49	Clear	--	3-5	Xmtr

R1-10-T3 Erie NE1

UHF June 9, 1965

No data available

SHF May 11, 1966

OPEN	12.2	5.6	835.7	37	L5	90	15-20 NE Rcvr
	13.9	6.7	841.2	36	L5, M3, H9	70	25-30 NE Xmtr

UHF December 8, 1966

OPEN	4.1	1.2	823.1	63	L1, M3	15	2-10 N Rcvr
	7.7	1.7	834.3	33	L2	30	5 N Xmtr

UHF December 15, 1966

OPEN	No data available						Rcvr
	6.1	0.6	858.0	34	Clear	--	Calm Xmtr

UHF December 22, 1966

OPEN	No data available						Rcvr
	-0.6	-3.9	852.0	44	L2	50	5 NE Xmtr

UHF January 18, 1967

OPEN	-3.6	-3.6	834.6	89	H1	10	0-5 W Rcvr
	-2.2	-4.4	845.0	59	H9	5	20-25 N Xmtr

SHF January 27, 1967

OPEN	8.4	3.8	838.4	51	H6	40	Calm Rcvr
	11.7	5.0	842.8	36	L1	20	Calm Xmtr

SHF February 1, 1967

OPEN	5.1	-0.4	839.7	31	L1	40	0-5 NE Rcvr
	6.1	2.2	844.8	53	L9	40	5 NE Xmtr

SHF February 9, 1967

OPEN	4.8	-1.5	843.5	18	M3	90	5-15 E	Rcvr
	6.1	1.7	834.0	47	L9	90	10 SE	Xmtr

R1-10-T4 Valmont

UHF April 13, 1965

No data available

UHF August 12, 1965

OPEN	No data available	Rcvr

SHF March 4, 1966

OPEN	2.2	-3.3	841.5	68	M4	5	35 NW	Rcvr
	-2.8	-6.7	840.6	27	--	20	20 WNW	Xmtr

R1-10-T5 Haystack East

SHF March 25, 1966

OPEN	13.9	5.0	840.5	23	H1	10	0-2 NE	Rcvr
	14.4	5.0	838.5	21	--	Clear	Calm	Xmtr

UHF June 20, 1966

OPEN	28.9	15.0	838.0	23	M2, L9	100	0-5 S	Rcvr
	31.7	15.6	836.7	19	L5	98	Calm	Xmtr

UHF January 20, 1967

OPEN	No data available	Rcvr						
	12.8	3.9	833.1	21	H6	80	10-15 W	Xmtr

SHF March 3, 1967

OPEN	-1.0	-2.3	834.0	80	L6	100	2-5 N	Rcvr
	0.6	-1.1	837.0	73	L6	100	2-3 N	Xmtr

SHF March 13, 1967

OPEN	14.6	9.5	827.2	55	M1, H6	25	2-5 NW Rcvr
	13.9	7.2	830.2	40	H2	20	Calm Xmtr

SHF March 15, 1967

OPEN	6.2	2.1	846.5	53	L9, H6, M3	65	Calm Rcvr
	7.2	4.4	851.2	67	L9	90	Calm Xmtr

R1-10-T6-0 and C Haystack West

SHF March 21, 1966

CONC.	18.3	6.7	825.2	15	M2, M9	80	10-40 W Rcvr
	18.3	6.7	827.0	15	M2	75	15-25 NNW Xmtr

SHF March 24, 1966

OPEN	15.6	5.6	838.3	43	H6	60	0-5 NE Rcvr
	No data available						Xmtr

CONC.	16.7	6.1	837.8	18	H6	50	0-3 E Rcvr
	No data available						Xmtr

UHF June 17, 1966

OPEN	16.7	14.4	844.0	80	M2, L9	99	-- Rcvr
	16.7	13.3	840.4	71	L5	100	Calm Xmtr

CONC.	13.3	12.8	844.0	94	M2, L9	99	0-5 Rcvr
	14.4	12.2	840.4	79	L5	100	Calm Xmtr

R1-10-T7 Table Mountain E

UHF April 15, 1965

No data available

UHF August 11, 1965

No data available

SHF March 7, 1966

OPEN	14.4	5.6	834.7	25	H8	80	10-20 W	Rcvr
	13.3	4.4	840.0	22	--	85	10 W	Xmtr

UHF January 23, 1967

OPEN	No data available							Rcvr
	7.2	2.8	828.2	38	H6	90	0-5 N	Xmtr

RI-20-T1-0 and C Berthoud NE2

SHF May 19, 1966

OPEN	17.7	7.7	840.0	24	M4	0.5	Calm	Rcvr
	17.2	8.9	846.4	34	M2	2	15-20 S	Xmtr

CONC.	13.3	7.2	841.3	44	M4	0.5	Calm	Rcvr
	16.1	9.4	848.8	28	Clear	--	Calm	Xmtr

UHF July 11, 1966

OPEN	29.4	17.2	840.5	30	L2, M6	50	--	Rcvr
	27.8	18.9	839.1	45	L1, L2	65	3 NE	Xmtr

CONC.	28.3	15.6	841.0	27	L2, H2	60	--	Rcvr
	27.2	20.6	843.1	56	M3	50	Calm	Xmtr

SHF February 8, 1967

OPEN	2.4	-2.5	841.4	36	--	--	--	Rcvr
	3.3	0.6	846.8	62	Clear	--	Calm	Xmtr

CONC.	5.2	-1.8	839.7	18	H6	10	Calm	Rcvr
	6.1	0.6	846.2	34	H6	5	2 NE	Xmtr

RI-20-T2 Ish Reservoir

UHF June 24, 1965

No data available

SHF May 18, 1966

OPEN	15.0	7.7	859.3	38	L1	15	0-5 E	Rcvr
	16.7	8.9	851.8	37	L1	15	5 NE	Xmtr

SHF February 8, 1967

OPEN	-1.1	-5.0	841.8	33	--	--	Calm	Rcvr
	-0.6	-2.8	848.9	62	Clear	--	1 E	Xmtr

SHF February 21, 1967

OPEN	No data available							Rcvr
	7.2	0.0	837.0	20	H6	80	15-20 NW	Xmtr

SHF February 23, 1967

OPEN	-1.6	-4.3	838.4	50	M1	100	3-10 NE	Rcvr
	-1.1	-3.3	845.8	61	M1	100	3 ENE	Xmtr

R1-20-T3-0 and -C Mead NE1

SHF May 17, 1966

OPEN	19.4	11.1	839.2	38	L1, L2	90	10 E	Rcvr
	20.0	11.1	848.5	38	L1, L9	80	10 NE	Xmtr

CONC.	26.7	11.1	839.7	12	L1	85	5 E	Rcvr
	18.3	10.6	844.3	38	L1, L9	50	15 N	Xmtr

UHF July 1, 1966

OPEN	28.9	17.7	839.0	35	L2, M6	70	0-10 NE	Rcvr
	28.9	20.0	--	46	L1, L3, H9	10	Calm	Xmtr

CONC.	25.6	16.7	838.0	42	L2, H2	40	--	Rcvr
	25.6	18.3	841.4	52	M3	10	Calm	Xmtr

R1-20-T4-0 and -C Mead NW1

SHF May 17, 1966

OPEN	21.1	11.7	838.5	33	L1, L2	70	Calm	Rcvr
	20.6	11.1	845.8	32	L2, L5	90	Calm	Xmtr
CONC.	21.1	11.1	838.7	28	L2	85	3 NE	Rcvr
	20.0	11.1	846.0	35	L2, L5	70	15 NE	Xmtr

UHF July 11, 1966

OPEN	31.1	17.2	840.0	26	L2, H2	80	--	Rcvr
	31.7	17.7	840.4	26	M3	60	Calm	Xmtr
CONC.	32.2	17.7	839.5	25	L2, H2	60	--	Rcvr
	31.1	20.6	840.1	40	M3	85	Calm	Xmtr

R1-20-T5 Mead E1

UHF June 23, 1965

No data available

SHF May 13, 1966

OPEN	18.3	8.3	836.7	25	L1, H1, M9	90	Calm	Rcvr
	21.1	10.0	847.3	24	H9, L2	55	10 S	Xmtr

UHF December 8, 1966

OPEN	4.0	1.2	823.5	63	L1, M3	10	5-10 W	Rcvr
	5.6	1.1	840.4	46	L2	20	5 SW	Xmtr

SHF February 3, 1967

OPEN	6.7	1.1	837.4	36	M3, H6	90	Calm	Rcvr
	6.1	1.7	847.9	47	L9	80	2 SW	Xmtr

SHF February 9, 1967

OPEN	9.7	1.3	828.9	16	H6	15	2-5 E	Rcvr
	11.1	5.6	838.7	45	L1, H7	70	4 S	Xmtr

R1-20-T6 Firestone E2

UHF June 21, 1965

No data available

SHF April 26, 1966

OPEN	21.1	8.9	831.3	10	M3	65	7 SE	Rcvr
	21.1	10.0	839.4	22	H6, L1	75	0-10 SSW	Xmtr

UHF December 8, 1966

OPEN	3.6	1.0	824.2	69	M3	20	15 W	Rcvr
	4.4	0.6	838.3	50	L2	10	10-15 SW	Xmtr

R1-20-T7 East Lake N4

UHF June 23, 1965

No data available

SHF April 26, 1966

OPEN	25.0	10.0	826.4	12	L1	75	9 S	Rcvr
	27.8	12.2	833.3	14	L1	40	10-15 S	Xmtr

UHF December 8, 1966

OPEN	2.7	1.0	825.8	77	L1, M3	25	15 W	Rcvr
	1.7	0.6	837.4	83	H9, L1	40	10-15 SW	Xmtr

SHF January 27, 1967

OPEN	7.5	2.2	837.7	38	H6	40	Calm	Rcvr
	12.2	5.6	843.5	37	L1	10	Calm	Xmtr

SHF February 3, 1967

OPEN	12.2	3.1	836.7	19	M3, H6	45	2-5 W	Rcvr
	13.3	4.4	842.1	22	L9, H9	50	Calm	Xmtr

R1-20-T8-0 and -C Green Mountain

SHF March 28, 1966

OPEN	15.6	6.7	839.7	27	H1	5	2 NW	Rcvr
	11.7	3.9	--	27	--	Clear	Calm	Xmtr

CONC.	16.7	6.7	842.0	22	--	--	5 N	Rcvr
	No data available							Xmtr

R1-20-T9 Gold Hill-Sunshine Intersection

UHF April 14, 1965

No data available

UHF July 11, 1965

No data available

SHF March 3, 1966

OPEN	-2.8	-6.7	822.0	27	M2	100	5-50 W	Rcvr
	-6.7	-9.4	--	35	--	100	0-20	Xmtr

UHF June 22, 1966

OPEN	23.3	15.6	850.0	43	L2, H2	30	--	Rcvr
	23.3	15.6	817.4	43	H9, M1, L1	50	6 E	Xmtr

CONC.	28.9	17.7	832.0	36	L2, H2	50	--	Rcvr
	25.0	15.6	814.0	39	L3, L2, H1	40	Calm	Xmtr

UHF October 28, 1966

OPEN	11.8	9.6	849.5	77	H6	50	Calm	Rcvr
	12.2	4.4	--	31	M3	80	--	Xmtr

UHF November 17, 1966

OPEN	10.2	6.9	838.3	64	M2	100	0-5 NW	Rcvr
	6.1	1.1	788.3	43	L6	100	Calm	Xmtr

UHF November 17, 1966

OPEN	10.2	6.9	838.3	64	M2	100	0-5 NW	Rcvr
	6.1	1.1	788.3	43	L6	100	Calm	Xmtr

UHF November 30, 1966

OPEN	7.8	5.8	836.3	74	H9, L1	80	--	Rcvr
	8.3	2.8	785.2	42	H6	10	0.5 W	Xmtr

UHF January 20, 1967

OPEN	9.2	5.8	822.8	63	L2, H2	80	0-3 W	Rcvr
	1.1	0.0	773.8	84	H6	75	--	Xmtr

SHF February 28, 1967

OPEN	19.2	6.3	841.1	8	--	--	1-3 W	Rcvr
	13.3	3.9	785.9	21	--	--	5 NW	Xmtr

SHF March 3, 1967

OPEN	5.2	1.3	829.9	51	H6, M1	90	2-5 NW	Rcvr
	3.9	1.1	771.3	65	--	--	--	Xmtr

R1-20-T10 Lyons

UHF April 16, 1965

No data available

R1-20-T10A Lyons

SHF March 8, 1966

OPEN	14.4	5.0	828.8	21	M2	80	15 SE	Rcvr
	15.6	5.6	850.8	5	H1, L1	95	--	Xmtr

UHF June 22, 1966

OPEN	25.6	16.1	831.0	34	L2, H2	60	15 NNW	Rcvr
	22.8	17.7	822.5	59	M1, L2	95	5-10 N	Xmtr

R1-50-T1 Kersey SW4

UHF July 8, 1965

No data available

UHF July 19, 1965

No data available

SHF May 3, 1966

OPEN	24.4	9.4	849.0	11	L1	20	Calm	Rcvr
	25.0	12.2	863.3	22	L1, L2	10	10-15 E	Xmtr

UHF December 15, 1966

OPEN	5.4	1.0	961.6	44	--	--	--	Rcvr
	8.9	2.8	857.2	35	Clear	--	Calm	Xmtr

R1-50-T2-0 and -C Milliken E2

SHF May 16, 1966

OPEN	26.7	11.1	834.8	12	L1, M1	40	10-15 W	Rcvr
	27.2	13.3	853.0	20	L1, L5	70	5 SW	Xmtr

CONC.	25.0	11.1	835.7	17	M3, L1	85	15 W	Rcvr
	25.0	12.2	853.9	22	L5, M1	90	8-20 W	Xmtr

UHF July 7, 1966

OPEN	30.6	18.3	836.0	32	L2, H2	60	0-5 NE	Rcvr
	31.1	22.2	848.2	43	L1, L2	70	5 NE	Xmtr

CONC.	28.3	17.7	838.5	37	L2, H2	50	--	Rcvr
	31.1	20.0	849.5	38	H6, M2, L1	90	Calm	Xmtr

SHF February 3, 1967

OPEN	1.9	-1.5	839.7	50	M3	100	Calm	Rcvr
	0.6	-1.7	858.0	57	L9	80	--	Xmtr

CONC.	3.0	-0.9	838.0	46	M3, H6	100	Calm	Revr
	3.3	0.6	857.3	69	L9	80	Calm	Xmtr

R1-50-T3 Keenesburg SW 2

UHF July 7, 1965

No data available

SHF May 10, 1966

OPEN	17.7	8.9	825.6	10	L2, M6	90	5-15	Revr
	20.0	10.6	832.3	29	H2, L5, L2	80	15 NW	Xmtr

UHF July 7, 1966

OPEN	21.1	15.6	840.0	58	--	--	--	Revr
	21.7	15.0	842.1	51	--	Clear	2 SW	Xmtr

UHF December 15, 1966

OPEN	5.0	2.0	842.1	64	--	--	--	Revr
	6.1	3.9	855.6	72	Clear	--	Calm	Xmtr

UHF December 22, 1966

OPEN	4.2	-1.0	841.1	29	L6	70	--	Revr
	-3.9	-5.0	853.9	77	L2	80	20-30 NE	Xmtr

R1-50-T4 Horse Creek Reservoir

UHF July 8, 1965

No data available

SHF May 10, 1966

OPEN	18.3	11.7	825.7	47	L1, M4	60	5 NE	Revr
	18.9	11.7	831.8	44	L2	25	8 E	Xmtr

UHF December 15, 1965

OPEN	5.0	2.0	842.1	64	--	--	--	Revr
	5.6	1.1	853.0	59	Clear	--	Calm	Xmtr

R1-50-T5 Echo Lake

UHF April 10, 1966

No data available

R1-50-T5A Echo Lake

SHF March 9, 1966

OPEN	17.2	6.7	838.9	19	L1, H1	90	5 NW	Rcvr
	3.9	-1.7	881.3	28	H9, L2	70	--	Xmtr

R1-50-T6 Trail Ridge

SHF March 10, 1966

OPEN	10.0	3.3	838.1	33	M2	95	--	Rcvr
	7.7	1.1	885.7	24	H1, M1, L5	60	15 SE	Xmtr

UHF June 24, 1966

OPEN	22.8	15.6	832.5	49	L1	5	--	Rcvr
	18.3	6.1	--	--	--	--	10-20 W	Xmtr

UHF November 3, 1966

OPEN	8.8	4.8	831.6	57	L1, M1, H6	100	--	Rcvr
	5.6	-1.1	885.2	17	H9, L1	70	0-8 N	Xmtr

UHF November 7, 1966

OPEN	16.8	10.0	825.8	45	L1, M1	6	3-10 W	Rcvr
	4.4	-1.1	885.5	26	L2, H2	30	10-25 SW	Xmtr

SHF March 10, 1967

OPEN	16.2	3.9	830.6	6	M3	20	2-5 W	Rcvr
	3.9	-1.7	707.7	31	H2	20	0-5 NW	Xmtr

R1-50-T7 Deer Ridge

SHF March 10, 1966

OPEN	10.0	3.3	838.1	33	M2	95	--	Rcvr
	8.9	2.2	886.5	27	H9, L5	80	15 SW	Xmtr

UHF June 23, 1966

OPEN	23.9	14.4	835.7	37	L2, H2	70	0-10 S	Rcvr
	19.4	7.2	735.4	17	L1	70	Calm	Xmtr

UHF November 3, 1966

OPEN	8.2	5.2	832.2	62	L1, M1, H6	100	Calm	Rcvr
	11.1	1.7	886.8	9	H9, L1	70	0-8 N	Xmtr

UHF November 7, 1966

OPEN	17.6	10.0	824.5	39	M1	15	10-20 W	Rcvr
	6.7	0.0	886.8	21	H2, L2	30	18 NW	Xmtr

SHF March 6, 1967

OPEN	2.4	0.6	831.6	76	L1, M1	6	Calm	Rcvr
	1.7	0.0	723.2	76	--	--	30 NW	Xmtr

R1-50-T8 Estes Park NE3

UHF April 28, 1965

No data available

R1-50-T9 Devil's Gulch

SHF March 11, 1966

OPEN	13.3	4.4	842.4	22	L1	1	0-5 NW	Rcvr
	6.7	0.0	762.1	27	L1	20	25 W	Xmtr

UHF June 23, 1966

OPEN	23.3	14.4	837.0	40	L1	50	0-10 SE	Rcvr
	20.0	11.1	761.2	37	L1	70	5 E	Xmtr

UHF November 3, 1966

OPEN	8.5	5.3	833.6	68	L1, H6, M1	52	Calm	Rcvr
	14.4	3.9	758.9	16	L1, H9	20	3 NW	Xmtr

UHF November 7, 1966

OPEN	18.8	11.6	822.5	44	L1, M1, H6	65	15-25 W	Rcvr
	10.6	1.7	751.3	18	H2, L2	20	10-20 NW	Xmtr

SHF March 6, 1967

OPEN	-1.5	-4.5	833.0	50	L1, M1	2	Calm	Rcvr
	0.0	-3.9	750.0	40	L1	15	5-10 NW	Xmtr

SHF March 10, 1967

OPEN	17.4	10.2	830.2	42	M3	5	2-6 NE	Rcvr
	9.4	1.7	752.7	24	H2	5	10 S	Xmtr

R1-80-T1 Purcell E4

UHF July 19, 1965

No data available

SHF May 4, 1966

OPEN	26.1	11.7	846.0	21	L1	10	Calm	Rcvr
	28.3	12.8	854.1	39	L1, L2	15	5-10 SE	Xmtr

R1-80-T2 Masters N3

SHF May 5, 1966

OPEN	27.8	11.7	844.0	12	L1	10	Calm	Rcvr
	31.1	12.8	869.2	9	L1	15	Calm	Xmtr

UHF July 6, 1966

OPEN	28.9	17.7	840.0	36	L1	20	0-5 NW	Rcvr
	36.7	21.1	856.7	26	L1	5	5 S	Xmtr

R1-80-T3 Strasburg NE1

SHF May 6, 1966

OPEN	25.6	11.1	844.0	15	L1	30	Calm	Rcvr
	28.3	11.7	843.8	9	H6	5	10 SSE	Xmtr

UHF July 5, 1966

OPEN	32.8	15.0	840.0	14	L1	10	0-5 N	Rcvr
	32.8	13.9	834.6	10	L2	3	10 NE	Xmtr

R1-80-T4 Granby W5

SHF March 30, 1966

OPEN	25.0	10.0	837.3	12	H5	20	0-1 N	Rcvr
	16.7	5.6	767.0	17	--	Clear	5 WSW	Xmtr

UHF June 27, 1966

OPEN	27.8	15.6	841.5	29	L1	20	--	Rcvr
	26.1	13.3	771.7	26	L1	20	Calm	Xmtr

R1-120-T1 Buckingham

UHF July 20, 1965

No data available

R1-120-T2 Fort Morgan N12

SHF May 5, 1966

OPEN	28.3	11.1	845.3	9	L1	10	Calm	Rcvr
	20.6	10.0	865.2	26	Clear	--	5 WSW	Xmtr

UHF July 6, 1966

OPEN	26.7	18.9	841.5	47	L1	10	0-5 NE	Rcvr
	24.4	18.9	853.6	57	Clear	--	Calm	Xmtr

R1-120-T3 Deer Trail N1

SHF May 6, 1966

OPEN	22.8	10.6	845.0	21	L1	1	Calm	Rcvr
	21.1	10.0	846.4	24	H6	10	5 SW	Xmtr

R1-120T4 Fairplay NE5

SHF April 1, 1966

OPEN	11.1	4.4	843.5	35	M3	0.5	2 S	Rcvr
	9.4	1.1	885.5	13	--	Clear	5 SE	Xmtr

UHF June 29, 1966

OPEN	25.0	15.0	841.0	36	L2, H2	60	--	Rcvr
	20.6	10.6	--	--	--	--	5 W	Xmtr

R1-120-T5 Walden NE5

SHF March 30, 1966

OPEN	22.2	8.3	837.5	12	H9	60	--	Rcvr
	7.7	1.1	908.2	24	H1, H6	30	8 W	Xmtr

UHF June 28, 1966

OPEN	23.3	12.8	843.0	30	L1	20	--	Rcvr
	21.7	10.6	762.2	27	L1, H2, H6	50	5 W	Xmtr

USGS QUADRANGLES AND GREAT CIRCLE COURSE INTERCEPTS
FROM RECEIVER TO TRANSMITTER

<u>Quadrangle</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Distance</u>
<u>R1-0.5-T1 R1E</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 05 38.160	105 07 30.0	0.048 km
Erie	40 05 38.160	105 07 30.0	0.048 km
	40 50 39.9	105 07 08.3	0.563 km XMTR
<u>R1-0.5-T2 R1W</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 50 40.0	105 07 52.0	0.477 km XMTR
<u>R1-3-T1 Niwot El</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 06 31.0	105 09 32.0	3.274 km XMTR
<u>R1-3-T2 Baller Lake NW1</u>			
Niwot	40 50 38.0	105 07 32.0	0.000 km RCVR
	40 05 40.166	105 07 30.0	0.082 km
Erie	40 05 40.166	105 07 30.0	0.082 km
	40 06 58.0	105 06 18.1	3.026 km XMTR
<u>R1-3-T3 Baller Lake N</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 05 38.528	105 07 30.0	0.050 km
	40 50 38.528	105 07 30.0	0.050 km
	40 06 11.8	105 05 23.9	1.202 km XMTR

<u>Quadrangle</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Distance</u>
<u>R1-3-T4 Lookout Road at U.S. 287</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 05 36.530	105 07 30.0	0.066 km
	40 05 36.530	105 07 30.0	0.066 km
	40 04 23.2	105 05 50.3	3.334 km XMTR
<u>R1-3-T5 Gun Barrel Hill Summit</u>			
Niwot	40 50 38.0	105 07 32.0	0.000 km RCVR
	40 04 22.0	105 09 00.0	3.136 km XMTR
<u>R1-5-T1 Baller Lake NE1</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 05 38.944	105 07 30.0	0.056 km
Erie	40 05 38.944	105 07 30.0	0.056 km
	40 07 06.2	105 04 25.0	5.190 km XMTR
<u>R1-5-T2 Baller Lake S</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 05 37.330	105 07 30.0	0.052 km
Erie	40 05 37.330	105 07 30.0	0.052 km
	40 04 47.2	105 05 00.5	3.909 km XMTR
<u>R1-5-T3-0 Erie NW1 open</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 05 37.222	105 07 30.0	0.053 km
	40 05 37.222	105 07 30.0	0.053 km
	40 04 10.4	105 03 47.0	5.966 km XMTR
<u>R1-5-T3-C Erie NW1 concealed</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 05 37.229	105 07 30.0	0.053 km
Erie	40 05 37.229	105 07 30.0	0.053 km
	40 04 10.4	105 03 45.0	6.009 km XMTR

<u>Quadrangle</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Distance</u>
<u>R1-5-T4 Gun Barrel Green</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 40 22.0	105 10 50.0	5.235 km XMTR
<u>R1-5-T5 Niwot W1</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 06 17.0	105 10 59.0	5.037 km XMTR
<u>R1-5-T5A Niwot W1</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 06 12.8	105 11 00.0	5.031 km XMTR
<u>R1-5-T6 Niwot N1</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 06 44.0	105 10 24.9	4.565 km XMTR
<u>R1-5-T6A Niwot N1</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 06 50.0	105 10 24.0	4.632 km XMTR
<u>R1-10-T1 Idaho Creek</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 05 38.479	105 07 30.0	0.050 km
Erie	40 05 38.479	105 07 30.0	0.050 km
	40 07 14.5	105 00 48.1	9.997 km XMTR
<u>R1-10-T2 Boulder Reservoir</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 03 54.6	105 14 03.9	9.797 km XMTR
<u>R1-10-T2A Boulder Reservoir</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 03 55.0	105 14 05.0	9.818 km XMTR

<u>Quadrangle</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Distance</u>
<u>R1-10-T3 Erie NE1</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 05 37.314	105 07 30.0	0.052 km
Erie	40 05 37.314	105 07 30.0	0.052 km
	40 03 30.0	105 01 19.5	9.651 km XMTR
<u>R1-10-T4 Valmont</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 01 00.0	105 11 18.5	10.120 km XMTR
<u>R1-10-T5 Haystack East</u>			
Niwot	40 05 38.0	105 07 30.0	0.000 km RCVR
	40 06 25.9	105 12 22.9	7.031 km XMTR
<u>R1-10-T6-0 Haystack West open</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 06 43.2	105 14 23.1	9.919 km XMTR
<u>R1-10-T6-C Haystack West concealed</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 06 41.3	105 14 22.9	9.903 km XMTR
<u>R1-10-T7 Table Mountain E</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 07 30.0	105 12 20.494	7.643 km
Hygiene	40 07 30.0	105 12 20.494	7.643 km
	40 07 56.9	105 13 29.9	9.481 km XMTR

<u>Quadrangle</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Distance</u>
	<u>R1-20-T1-0 Berthoud NE2 open</u>		
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 05 43.780	105 07 30.0	0.185 km
Erie	40 05 43.780	105 07 30.0	0.185 km
	40 07 30.0	105 06 53.230	3.579 km
Longmont	40 07 30.0	105 06 53.230	3.579 km
	40 15 00.0	105 04 17.085	17.958 km
Berthoud	40 15 00.0	105 04 17.085	17.958 km
	40 20 05.9	105 02 30.6	27.735 km XMTR
	<u>R1-20-T1-C Berthoud NE2 concealed</u>		
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 05 43.414	105 07 30.0	0.174 km
Erie	40 05 43.414	105 07 30.0	0.174 km
	40 07 30.0	105 06 50.603	3.595 km
Longmont	40 07 30.0	105 06 50.603	3.595 km
	40 15 00.0	105 04 03.880	18.041 km
Berthoud	40 15 00.0	105 04 03.880	18.041 km
	40 20 00.2	105 02 12.3	27.679 km XMTR
	<u>R1-20-T2 Ish Reservoir</u>		
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 05 45.016	105 07 30.0	0.222 km
Erie	40 05 45.016	105 07 30.0	0.222 km
	40 07 30.0	105 07 00.057	3.541 km
Longmont	40 07 30.0	105 07 00.057	3.541 km
	40 15 00.0	105 04 51.410	17.768 km
Berthoud	40 15 00.0	105 04 51.410	17.768 km
	40 16 07.4	105 04 32.1	19.899 km XMTR

<u>Quadrangle</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Distance</u>
	<u>R1-20-T3-0 Mead NEI open</u>		
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 05 40.117	105 07 30.0	0.081 km
Erie	40 05 40.117	105 07 30.0	0.081 km
	40 07 30.0	105 05 46.115	4.269 km
Longmont	40 07 30.0	105 05 46.115	4.269 km
	40 13 35.205	105 00 00.0	18.197 km
Gowanda	40 13 35.205	105 00 00.0	18.197 km
	40 14 59.0	104 58 40.4	21.394 km XMTR
	<u>R1-20-T3-C Mead NEI concealed</u>		
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 05 40.106	105 07 30.0	0.080 km
Erie	40 05 40.106	105 07 30.0	0.080 km
	40 07 30.0	105 05 45.598	4.276 km
Longmont	40 07 30.0	105 05 45.598	4.276 km
	40 13 32.839	105 00 00.0	18.139 km
Gowanda	40 13 32.839	105 00 00.0	18.139 km
	40 15 00.0	104 58 36.846	21.468 km
Johnstown	40 15 00.0	104 58 36.846	21.468 km
	40 15 01.2	104 58 35.7	21.514 km XMTR
	<u>R1-20-T4-0 Mead NWI open</u>		
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 05 41.057	105 07 30.0	0.106 km
Erie	40 05 41.057	105 07 30.0	0.106 km
	40 07 30.0	105 06 18.682	3.869 km
Longmont	40 07 30.0	105 06 18.682	3.869 km
	40 14 52.0	105 01 28.6	19.141 km XMTR

<u>Quadrangle</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Distance</u>
<u>R1-20-T4-C Mead NW1 concealed</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 05 41.043	105 07 30.0	0.105 km
Erie	40 05 41.043	105 07 30.0	0.105 km
	40 07 30.0	105 06 18.346	3.872 km
Longmont	40 07 30.0	105 06 18.346	3.872 km
	40 14 52.5	105 01 26.6	19.176 km XMTR
<u>R1-20-T5 Mead E1</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 05 39.793	105 07 30.0	0.073 km
Erie	40 05 39.793	105 07 30.0	0.073 km
	40 07 30.0	105 07 27.009	4.548 km
Longmont	40 07 30.0	105 07 27.009	4.548 km
	40 12 22.361	105 00 00.0	16.428 km
Gowanda	40 12 22.361	105 00 00.0	16.428 km
	40 13 15.9	104 59 00.0	18.605 km XMTR
<u>R1-20-T6 Firestone E2</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 05 38.196	105 07 30.0	0.048 km
Erie	40 05 38.196	105 07 30.0	0.048 km
	40 06 22.058	105 00 00.0	10.766 km
Frederick	40 06 22.058	105 00 00.0	10.766 km
	50 06 58.9	104 53 38.0	19.801 km XMTR

Quadrangle	Latitude	Longitude	Distance
<u>RI-20-T7 East Lake N4</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 05 36.836	105 07 30.0	0.059 km
Frie	40 05 36.836	105 07 30.0	0.059 km
	40 01 14.322	105 00 00.0	13.436 km
Frederick	40 01 14.322	105 00 00.0	13.436 km
	40 00 00.0	104 57 52.922	17.219 km
East Lake	40 00 00.0	104 57 52.922	17.219 km
	39 59 07.3	104 56 22.9	19.900 km XMTR

RI-20-T8-0 Green Mountain open

Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 00 27.427	105 15 00.0	14.291 km
Boulder	40 00 27.427	105 15 00.0	14.291 km
	40 00 00.0	105 15 39.476	15.552 km
Eldorado Springs	40 00 00.0	105 15 39.476	15.552 km
	39 59 31.0	105 16 21.2	16.885 km XMTR

RI-20-T8-C Green Mountain concealed

Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 00 34.463	105 15 00.0	14.146 km
Boulder	40 00 34.463	105 15 00.0	14.146 km
	40 00 00.0	105 15 50.750	15.751 km
Eldorado Springs	40 00 00.0	105 15 50.750	15.751 km
	39 59 27.9	105 16 38.0	17.245 km XMTR

RI-20-T9 Gold Hill-Sunshine Intersection

Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 04 27.062	105 15 00.0	10.812 km
Boulder	40 04 27.062	105 15 00.0	10.812 km
	40 03 22.5	105 21 44.9	20.589 km XMTR

Quadrangle	Latitude	Longitude	Distance
<u>RI-20-T10 Lyons</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 07 30.0	105 09 32.665	4.483 km
Hygiene	40 07 30.0	105 09 32.665	5.583 km
	40 12 33.138	105 15 00.0	16.622 km
Lyons	40 12 33.138	105 15 00.0	16.622 km
	40 13 55.2	105 16 28.8	19.910 km XMTR

<u>RI-20-T10A Lyons</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 07 30.0	105 09 30.742	4.454 km
Hygiene	40 07 30.0	105 09 30.742	4.454 km
	40 12 39.851	105 15 00.0	16.783 km
Lyons	40 12 39.851	105 15 00.0	16.783 km
	40 13 53.1	105 16 18.0	19.699 km XMTR

<u>RI-50-T1 Kersey SW4</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 05 38.967	105 07 30.0	0.056 km
Erie	40 05 38.967	105 07 30.0	0.056 km
	40 07 30.0	105 03 40.086	6.480 km
Longmont	40 07 30.0	105 03 40.086	6.480
	40 09 16.074	105 00 00.0	12.623 km
Gowanda	40 09 16.074	105 00 00.0	12.623 km
	40 12 52.313	104 52 30.0	25.168 km
Platteville	40 12 52.313	104 52 30.0	25.168 km
	40 15 00.0	104 48 03.430	32.589 km
Milliken	40 15 00.0	104 48 03.430	32.589 km
	40 16 27.687	104 45 00.0	37.691 km

<u>Quadrangle</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Distance</u>
LaSalle	40 16 27.687	104 45 00.0	37.691 km
	40 20 02.196	104 37 30.0	50.192 km
Valley View School	40 20 02.196	104 37 30.0	50.192 km
	40 20 42.0	104 36 06.3	52.514 km XMTR

R1-50-T2-0 Milliken E2 open

Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 05 39.477	105 07 30.0	0.066 km
Erie	40 05 39.477	105 07 30.0	0.066 km
	40 07 30.0	105 05 00.220	4.982 km
Longmont	40 07 30.0	105 05 00.220	4.982 km
	40 11 11.071	105 00 00.0	14.824 km
Gowanda	40 11 11.071	105 00 00.0	14.824 km
	40 15 00.0	104 54 48.225	25.026 km
Johnstown	40 15 00.0	104 54 48.225	25.026 km
	40 16 41.284	104 52 30.0	29.543 km
Milliken	40 16 41.284	104 52 30.0	29.543 km
	40 19 10.6	104 49 05.9	36.206 km XMTR

R1-50-T2-C Milliken E2 concealed

Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 05 39.463	105 07 30.0	0.065 km
Erie	40 05 39.463	105 07 30.0	0.065 km
	40 07 30.0	105 04 58.790	5.007 km
Longmont	40 07 30.0	105 04 58.790	5.007 km
	40 11 07.966	105 00 00.0	14.758 km
Gowanda	40 11 07.966	105 00 00.0	14.758 km
	40 15 00.0	104 54 41.016	25.149 km
Johnstown	40 15 00.0	104 54 41.016	25.149 km
	40 16 35.105	104 52 30.0	29.411 km

<u>Quadrangle</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Distance</u>
Milliken	40 16 35.105	104 52 30.0	29.411 km
	40 19 12.3	104 48 53.1	36.460 km XMTR
<u>R1-20-T3 Keenesburg SW2</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 05 37.933	105 07 30.0	0.047 km
Erie	40 05 37.933	105 07 30.0	0.047 km
	40 05 22.545	105 00 00.0	10.691 km
Frederick	40 05 22.545	105 00 00.0	10.691 km
	40 05 06.671	104 52 30.0	21.337 km
Fort Lupton	40 05 06.671	104 52 30.0	21.337 km
	40 04 50.311	104 45 00.0	31.984 km
Hudson	40 04 50.311	104 45 00.0	31.984 km
	40 04 33.466	104 37 30.0	42.632 km
Keenesburg	40 04 33.466	104 37 30.0	42.632 km
	40 04 22.6	104 32 46.4	49.344 km XMTR
<u>R1-50-T4 Horse Creek Reservoir</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 05 37.933	105 07 30.0	0.049 km
Erie	40 05 37.625	105 07 30.0	0.049 km
	40 04 13.066	105 00 00.0	11.000 km
Frederick	40 04 13.066	105 00 00.0	11.000 km
	40 02 47.965	104 52 30.0	21.958 km
Fort Lupton	40 02 47.965	104 52 30.0	21.958 km
	40 01 22.320	104 45 00.0	32.925 km
Hudson	40 01 22.320	104 45 00.0	32.925 km
	40 00 00.0	104 37 50.133	43.407 km

<u>Quadrangle</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Distance</u>
Keenesburg	40 00 00.0	104 37 50.133	43.407 km
	39 59 56.132	104 37 30.0	43.899 km
Horse Creek	39 59 56.132	104 37 30.0	43.899 km
	39 59 14.8	104 33 55.2	49.140 km XMTR

R1-50-T5 Echo Lake

Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 00 00.0	105 13 25.032	13.367 km
Louisville	40 00 00.0	105 13 25.032	13.367 km
	39 58 28.860	105 15 00.0	16.969 km
Eldorado	39 58 28.860	105 15 00.0	16.969 km
Springs	39 52 30.0	105 21 13.062	31.146 km
Ralston Buttes	39 52 30.0	105 21 13.062	31.146 km
	39 51 15.819	105 22 30.0	34.074 km
Black Hawk	39 51 15.819	105 22 30.0	34.074 km
	39 45 00.0	105 28 58.852	48.903 km
Squaw Pass	39 45 00.0	105 28 58.852	48.903 km
	39 44 00.764	105 30 00.0	51.240 km
Idaho Springs	39 44 00.764	105 30 00.0	51.240 km
	39 40 32.0	105 33 35.2	59.470 km XMTR

R1-50-T5A Echo Lake

Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 00 00.0	105 13 24.312	13.357 km
Louisville	40 00 00.0	105 13 24.312	13.357 km
	39 58 27.988	105 15 00.0	16.991 km
Eldorado	39 58 27.988	105 15 00.0	16.991 km
Springs	39 52 30.0	105 21 11.391	31.121 km

<u>Quadrangle</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Distance</u>
Ralston Buttes	39 52 30.0	105 21 11.391	31.121 km
	39 51 14.053	105 22 30.0	34.117 km
Black Hawk	39 51 14.053	105 22 30.0	48.865 km
	39 45 00.0	105 28 56.236	48.865 km
Squaw Pass	39 45 00.0	105 28 56.236	48.865 km
	39 43 58.104	105 30 00.0	51.304 km
Idaho Springs	39 43 58.104	105 30 00.0	51.304 km
	39 40 36.5	105 33 27.4	59.246 km XMTR
R1-50-T6 Trail Ridge			
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 07 30.0	105 10 42.90	5.684 km
Hygiene	40 07 30.0	105 10 42.906	5.685 km
	40 10 00.532	105 15 00.0	13.330 km
Lyons	40 10 00.532	105 15 00.0	13.330 km
	40 14 23.187	105 22 30.0	26.692 km
Raymond	40 14 23.187	105 22 30.0	26.692 km
	40 15 00.0	105 23 33.214	28.566 km
Panorama Peak	40 15 00.0	105 23 33.214	28.566 km
	40 18 44.975	105 30 00.0	40.024 km
Longs Peak	40 18 44.975	105 30 00.0	40.024 km
	40 22 30.0	105 36 28.831	51.521 km
Estes Park	40 22 30.0	105 36 28.831	51.521 km
	40 23 05.357	105 37 30.0	53.328 km
Trail Ridge	40 23 05.357	105 37 30.0	53.328 km
	40 23 15.7	105 37 47.9	53.857 km XMTR

<u>Quadrangle</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Distance</u>
<u>R1-50-T7 Deer Ridge</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km
	40 07 30.0	105 10 35.589	5.548 km
Hygiene	40 07 30.0	105 10 35.589	5.548 km
	40 10 10.985	105 15 00.0	13.529 km
Lyons	40 10 10.985	105 15 00.0	13.529 km
	40 14 44.094	105 22 30.0	27.088 km
Raymond	40 14 44.094	105 22 30.0	27.088 km
	40 15 00.0	105 22 56.264	27.879 km
Panorama Park	40 15 00.0	105 22 56.264	27.879 km
	40 19 16.109	105 30 00.0	40.617 km
Longs Peak	40 19 16.109	105 30 00.0	40.617 km
	40 22 30.0	105 35 21.865	50.275 km
Estes Park	40 22 30.0	105 35 21.865	50.275 km
	40 23 14.7	105 36 36.2	52.504 km XMTR

<u>R1-50-T8 Estes Park</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km
	40 07 30.0	105 09 34.846	4.516 km
Hygiene	40 07 30.0	105 09 34.846	4.516 km
	40 12 25.777	105 15 00.0	16.448 km
Lyons	40 12 25.777	105 15 00.0	16.448 km
	40 15 00.0	105 17 49.965	22.673 km
Rattlesnake Reservoir	40 15 00.0	105 17 49.965	22.673 km
	40 19 13.525	105 22 30.0	32.913 km
Panorama Peak	40 19 13.525	105 22 30.0	32.913 km
	40 22 30.0	105 26 07.566	40.855 km
Glen Haven	40 22 30.0	105 26 07.566	40.855 km
	40 25 20.9	105 29 17.2	47.766 km XMTR

<u>Quadrangle</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Distance</u>
	<u>R1-50-T9 Estes Park NE3</u>		
Niwot	40 05 38.0	105 07 32.0	0.000 km
	40 07 30.0	105 09 35.084	4.519 km
Hygiene	40 07 30.0	105 09 35.084	4.519 km
	40 12 24.991	105 15 00.0	16.429 km
Lyons	40 12 24.991	105 15 00.0	16.429 km
	40 15 00.0	105 17 51.160	22.691 km
Rattlesnake Reservoir	40 15 00.0	105 17 51.160	22.691 km
	40 19 11.956	105 22 30.0	32.876 km
Panorama Peak	40 19 11.956	105 22 30.0	32.876 km
	40 22 30.0	105 26 09.727	40.887 km
Glen Haven	40 22 30.0	105 26 09.727	40.887 km
	40 25 02.0	105 28 58.7	47.039 km XMTR
	<u>R1-80-T1 Purcell E4</u>		
Niwot	40 05 38.0	105 07 32.0	0.000 km
	40 05 39.847	105 07 30.0	0.074 km
Erie	40 05 39.847	105 07 30.0	0.074 km
	40 07 30.0	105 05 30.635	4.493 km
Longmont	40 07 30.0	105 05 30.635	4.493 km
	40 12 34.423	105 00 00.0	16.713 km
Gowanda	40 12 34.423	105 00 00.0	16.713 km
	40 15 00.0	104 57 21.496	22.560 km
Johnstown	40 15 00.0	104 57 21.496	22.560 km
	40 19 27.112	104 52 30.0	33.296 km
Milliken	40 19 27.112	104 52 30.0	33.296 km
	40 22 30.0	104 49 09.919	40.651 km

<u>Quadrangle</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Distance</u>
Bracewell	40 22 30.0	104 49 09.919	40.651 km
	40 26 17.922	104 45 00.0	49.822 km
Greeley	40 26 17.922	104 45 00.0	49.822 km
	40 30 00.0	104 40 55.878	58.764 km
Eaton	40 30 00.0	104 40 55.878	58.764 km
	40 33 06.859	104 37 30.0	66.293 km
Galeton	40 33 06.859	104 37 30.0	66.293 km
	40 37 30.0	104 32 39.344	76.902 km
Purcell	40 37 30.0	104 32 39.344	76.902 km
	40 38 18.3	104 31 45.9	78.850 km XMTR

R1-80-T2 Masters N3

Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 05 38.532	105 07 30.0	0.050 km
Erie	40 05 38.532	105 07 30.0	0.050 km
	40 07 30.0	105 00 30.380	10.544 km
Longmont	40 07 30.0	105 00 30.380	10.544 km
	40 07 38.050	105 00 00.0	11.303 km
Gowanda	40 07 38.050	105 00 00.0	11.303 km
	40 09 36.967	104 52 30.0	22.546 km
Platteville	40 09 36.967	104 52 30.0	22.546 km
	40 11 35.286	104 45 00.0	33.777 km
Milton	40 11 35.286	104 45 00.0	33.777 km
Reservoir	40 13 33.006	104 37 30.0	44.998 km
Klug Ranch	40 13 33.006	104 37 30.0	44.998 km
	40 15 00.0	104 31 55.978	53.320 km
Valley View	40 15 00.0	104 31 55.978	53.320 km
School	40 15 30.129	104 30 00.0	56.208 km

<u>Quadrangle</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Distance</u>
Hardin	40 15 30.129	104 30 00.0	56.206 km
	40 17 26.656	104 22 30.0	67.407 km
Dearfield	40 17 26.656	104 22 30.0	67.407 km
	40 19 22.587	104 15 00.0	78.595 km
Masters	40 19 22.587	104 15 00.0	78.595 km
	40 19 38.0	104 14 00.0	80.086 km XMTR
<u>R1-80-T3 Strasburg NE1</u>			
Niwt	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 05 37.184	105 07 30.0	0.054 km
Erir	40 05 37.184	105 07 30.0	0.054 km
	40 02 33.091	105 00 00.0	12.115 km
Frederick	40 02 33.091	105 00 00.0	12.115 km
	40 00 00.0	104 53 47.191	22.122 km
East Lake	40 00 00.0	104 53 47.191	22.122 km
	39 59 28.237	104 52 30.0	24.195 km
Brighton	39 59 28.237	104 52 30.0	24.195 km
	39 56 22.621	104 45 00.0	36.293 km
Mile High Lakes	39 56 22.621	104 45 00.0	36.293 km
	39 53 16.240	104 37 30.0	48.409 km
Horse Creek	39 53 16.240	104 37 30.0	48.409 km
	39 52 30.0	104 35 38.641	51.411 km
Manila	39 52 30.0	104 35 38.641	51.411 km
	39 50 09.094	104 30 00.0	60.544 km
Bennett	39 50 09.094	104 30 00.0	60.544 km
	39 47 01.181	104 22 30.0	72.697 km
Roper School	39 47 01.181	104 22 30.0	72.697 km
	39 45 11.0	104 18 07.0	79.809 km XMTR

<u>Quadrangle</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Distance</u>
<u>R1-80-T4 Granby W5</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 05 45.278	105 15 00.0	10.588 km
Boulder	40 05 45.278	105 15 00.0	10.588 km
	40 05 52.105	105 22 30.0	21.223 km
Gold Hill	40 05 52.105	105 22 30.0	21.223 km
	40 05 58.448	105 30 00.0	31.857 km
Ward	40 05 58.448	105 30 00.0	31.857 km
	40 06 04.307	105 37 30.0	42.491 km
Monarch Lake	40 06 04.307	105 37 30.0	42.491 km
	40 06 09.682	105 45 00.0	53.124 km
Strawberry Lake	40 06 09.682	105 45 00.0	53.124 km
	40 06 14.574	105 52 30.0	63.757 km
Granby	40 06 14.574	105 52 30.0	63.757 km
	40 06 18.981	106 00 00.0	74.389 km
Hot Sulphur Springs	40 06 18.981	106 00 00.0	74.389 km
	40 06 19.8	106 01 29.5	76.504 km XMTR
<u>R1-120-T1 Buckingham</u>			
Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 05 38.812	105 07 30.0	0.054 km
Erie	40 50 38.812	105 07 30.0	0.054 km
	40 07 30.0	105 02 55.810	7.385 km
Longmont	40 07 30.0	105 02 55.810	7.385 km
	40 08 41.140	105 00 00.0	12.083 km
Gowanda	40 08 41.140	105 00 00.0	12.083 km
	40 11 42.725	104 52 30.0	24.094 km
Platteville	40 11 42.725	104 52 30.0	24.094 km
	40 14 43.552	104 45 00.0	36.087 km

<u>Quadrangle</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Distance</u>
Milton	40 14 43.552	104 45 00.0	36.087 km
Reservoir	40 15 00.0	104 44 18.973	37.180 km
LaSalle	40 15 00.0	104 44 18.973	37.180 km
	40 17 43.627	104 37 30.0	48.063 km
Valley View	40 17 43.627	104 37 30.0	48.063 km
School	40 20 42.952	104 30 00.0	60.021
Hardin	40 20 42.952	104 30 00.0	60.021 km
	40 22 30.0	104 25 30.473	67.175 km
Barneville	40 22 30.0	104 25 30.473	67.175 km
	40 23 41.529	104 22 30.0	71.961 km
Point of Rocks	40 23 41.529	104 22 30.0	71.961 km
	40 26 39.359	104 15 00.0	83.884 km
Greasewood	40 26 39.359	104 15 00.0	83.884 km
Lake	40 29 36.445	104 07 30.0	95.789 km
Sunken Lake	40 29 36.445	104 07 30.0	95.789 km
	40 30 00.0	104 06 30.0	97.375 km XMTR

R1-120-T2 Fort Morgan N12

Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 05 38.532	105 07 30.0	0.050 km
Erie	40 05 38.532	105 07 30.0	0.050 km
	40 07 30.0	105 00 29.528	10.563 km
Longmont	40 07 30.0	105 00 29.528	10.563 km
	40 07 37.808	105 00 00.0	11.301 km
Gowanda	40 07 37.808	105 00 00.0	11.301 km
	40 09 36.486	104 52 30.0	22.541 km
Platteville	40 09 36.486	104 52 30.0	22.541 km
	40 11 34.545	104 45 00.0	33.770 km

<u>Quadrangle</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Distance</u>
Milton	40 11 34.545	104 45 00.0	33.770 km
Reservoir	40 13 32.046	104 37 30.0	44.988 km
Klug Ranch	40 13 32.046	104 37 30.0	44.988 km
	40 15 00.0	104 31 51.595	53.417 km
Valley View	40 15 00.0	104 31 51.595	53.417 km
School	40 15 28.930	104 30 00.0	56.196 km
Hardin	40 15 28.930	104 30 00.0	56.196 km
	40 17 25.219	104 22 30.0	67.392 km
Dearfield	40 17 25.219	104 22 30.0	67.392 km
	40 19 20.913	104 15 00.0	78.579 km
Masters	40 19 20.913	104 15 00.0	78.579 km
	40 21 16.013	104 07 30.0	89.754 km
Orchard	40 21 16.013	104 07 30.0	89.754 km
	40 22 30.0	104 02 39.506	96.963 km
Sunken Lake	40 22 30.0	104 02 39.506	96.963 km
	40 23 10.520	104 00 00.0	100.919 km
Judson Hills	40 23 10.520	104 00 00.0	100.919 km
	40 25 04.435	103 52 30.0	112.073 km
Peace Valley	40 25 04.435	103 52 30.0	112.073 km
School	40 26 12.5	103 48 00.0	118.761 km XMTR

R1-129-T3 Deer Trail N1

Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 05 37.161	105 07 30.0	0.054 km
Erie	40 05 37.161	105 07 30.0	0.054 km
	40 02 28.082	105 00 00.0	12.189 km
Frederick	40 02 28.082	105 00 00.0	12.189 km
	40 00 00.0	104 54 08.855	21.671 km

<u>Quadrangle</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Distance</u>
East Lake	40 00 00.0	104 54 08.855	21.671 km
	39 59 18.226	104 52 30.0	24.343 km
Brighton	39 59 18.226	104 52 30.0	24.343 km
	39 56 07.593	104 45 00.0	36.516 km
Mile High Lakes	39 56 07.593	104 45 00.0	36.516 km
	39 52 56.181	104 37 30.0	48.707 km
Horse Creek	39 52 56.181	104 37 30.0	48.707 km
	39 52 30.0	104 36 28.593	50.372 km
Manila	39 52 30.0	104 36 28.593	50.372 km
	39 49 43.987	104 30 00.0	60.918 km
Bennett	39 49 43.987	104 30 00.0	60.918 km
	39 46 31.010	104 22 30.0	73.148 km
Roper School	39 46 31.010	104 22 30.0	73.148 km
	39 45 00.0	104 18 58.407	78.905 km
Strasburg	39 45 00.0	104 18 58.407	78.905 km
	39 43 17.249	104 15 00.0	85.396 km
Byers	39 43 17.249	104 15 00.0	85.396 km
	39 40 02.702	104 07 30.0	97.664 km
Peoria	39 40 02.702	104 07 30.0	97.664 km
	39 37 53.0	104 02 31.0	105.826 km XMTR

R1-120-T4 Fairplay NE5

Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 00 00.0	105 13 15.661	13.230 km
Louisville	40 00 00.0	105 13 15.661	13.230 km
	39 58 17.139	105 15 00.0	17.254 km
Eldorado Springs	39 58 17.139	105 15 00.0	17.254 km
	39 52 30.0	105 20 51.293	30.827 km

<u>Quadrangle</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Distance</u>
Ralston Buttes	39 52 30.0	105 20 51.293	30.827 km
	39 50 52.230	105 22 30.0	34.647 km
Black Hawk	39 50 52.230	105 22 30.0	34.647 km
	39 45 00.0	105 28 24.770	48.404 km
Squaw Pass	39 45 00.0	105 28 24.770	48.404 km
	39 43 25.229	105 30 00.0	52.104 km
Idaho Springs	39 43 25.229	105 30 00.0	52.104 km
	39 37 30.0	105 35 56.114	65.963 km
Harris Peak	39 37 30.0	105 35 56.114	65.963 km
	39 35 56.128	105 37 30.0	69.623 km
Mount Evans	39 35 56.128	105 37 30.0	69.623 km
	39 30 00.0	105 43 25.349	83.503 km
Mount Logan	39 30 00.0	105 43 25.349	83.503 km
	39 28 24.920	105 45 00.0	87.206 km
Jefferson	39 28 24.920	105 45 00.0	87.206 km
	39 22 30.0	105 50 52.496	101.024 km
Milligan Lakes	39 22 30.0	105 50 52.396	101.024 km
	39 20 51.596	105 52 30.0	104.853 km
Como	39 20 51.596	105 52 30.0	104.853 km
	39 15 56.0	105 57 22.3	116.349 km XMTR

R1-120-T5 Walden NE5

Niwot	40 05 38.0	105 07 32.0	0.000 km RCVR
	40 07 30.0	105 10 30.359	5.452 km
Hygiene	40 07 30.0	105 10 30.359	5.452 km
	40 10 18.981	105 15 00.0	13.684 km
Lyons	40 10 18.981	105 15 00.0	13.684 km
	40 15 00.0	105 22 29.862	27.394 km

<u>Quadrangle</u>	<u>Latitude</u>	<u>Longitude</u>	<u>Distance</u>
Rattlesnake	40 15 00.0	105 22 29.862	27.394 km
Reservoir	40 15 00.086	105 22 30.0	27.398 km
Panorama	40 15 00.086	105 22 30.0	27.398 km
Peak	40 19 40.060	105 30 00.0	41.080 km
Longs Peak	40 19 40.060	105 30 00.0	41.080 km
	40 22 30.0	105 34 34.030	49.397 km
Estes Park	40 22 30.0	105 34 34.030	49.397 km
	40 24 18.908	105 37 30.0	54.731 km
Trail Ridge	40 24 18.908	105 37 30.0	54.731 km
	40 28 56.632	105 45 00.0	68.351 km
Fall River	40 28 56.632	105 45 00.0	68.351 km
Pass	40 30 00.0	105 46 42.932	71.461 km
Chambers	40 30 00.0	105 46 42.932	71.461 km
Lake	40 33 33.235	105 52 30.0	81.939 km
Clark Peak	40 33 33.235	105 52 30.0	81.939 km
	40 37 30.0	105 58 56.640	93.589 km
Rahwah Lakes	40 37 30.0	105 58 56.640	93.589 km
	40 38 08.721	106 00 00.0	95.496 km
Johnny Moor	40 38 08.721	106 00 00.0	95.496 km
Mountain	40 42 43.093	106 07 30.0	109.022 km
Gould NW	40 42 43.093	106 07 30.0	109.022 km
	40 45 00.0	106 11 15.228	115.781 km
Eagle Hill	40 45 00.0	106 11 15.228	115.781 km
	40 46 19.0	106 13 25.4	119.683 km XMTR