MID-EAST REGIONAL

TELECOMMUNICATIONS STUDY

Work Order No. 3
AID/otr-C-1619
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Teleconsult Inc.
Washington, D.C.

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Prepared by

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EXECUTIVE SUMMARY

OBJECTIVE

This report presents the results of an investigation to identify economically and technically feasible regional telecommunications investment possibilities for the Middle East which would promote economic, commercial and cultural linkages which would enhance the peaceful stabilization of the area.

FINDINGS

The countries and areas considered in the study include Egypt, Israel, Jordan, Lebanon, Sinai-Gaza-West Bank, Saudi Arabia and Syria.

Consideration was given to all types of communication services applicable to commercial use - satellite earth stations as well as other types of systems.

The method used in the investigation included the following four principal steps:

1) review and analysis of existing and planned telecommunications facilities in each country/area
2) forecast of overall demand for telecommunications in the region to 1990
3) preparation of a plan for development of intra-national telecommunications facilities throughout the region
4) identification and analysis of the new investment possibilities in order of sequence within the development program.

The investigation has identified seven specific projects which are judged to meet the principal criteria of the study, in that they are technically feasible and show high potential for promoting economic, commercial and cultural linkages among the nations involved. These seven projects are listed in Table I, which also shows the estimated costs of initial construction as well as the annual costs of maintenance and operation of each project.

TABLE I

SUMMARY OF ESTIMATED COSTS

SEQUENCE	ROUTES	INITIAL INVESTMENT	ANNUAL MAINTENANCE, OPERATION
I			
A	Ismailiya-Ber Sheba	$9.1M	$0.67M
B	Jerusalem-Amman	6.8	0.50
C	Aqaba Jct.Haql	3.1	0.23
	Subtotal	$19.0M	$1.40M
II	Haifa-Jct. on Amman-Beirut Route	$2.4M	$0.17M
III	Damascus-Jct.on Amman-Beirut Route	1.7	0.13
IV	Suez-Elat/Aqaba/Haql	8.3	0.61
V	Quraiyat-Suweida	7.4	0.54
	Total Cost	$38.8M	$2.85M

It can be seen that the initial investment of the plan is in the order of $40 million in 1980 dollars. At least one-half of this amount would be committed initially, with the remaining half to be provided over a 2-3 year period. The initial investment includes the cost of all equipment, installation, construction, and management and training for the complete program, to include coordination with the host administration. Initially, funds must also be provided as shown in Table I for the costs of maintenance and operation of the system; however, it can be anticipated that these costs would later be off-set by revenues generated by the system.

The proposed projects can almost certainly be expected to provide substantial benefits in terms of economic, commercial and cultural linkages among the residents of the region. Egypt, Israel, Syria and Saudi Arabia all face a large unsatisfied demand for domestic telephone and telex services, and each country has active plans to expand and improve their national networks. As local service is improved in each of these countries, the demand for international service can be expected to keep pace, creating a natural need for the proposed projects. Therefore, a program to facilitate and expedite the early construction of the proposed system will strongly encourage the use of each country's telephone/telex facilities to seek economic, commercial and cultural ties with its neighbors.

The study has identified four specific benefits which can be derived directly as a result of the proposed telecommunications program:

1) Stimulation of trade among the countries of the region - history has repeatedly demonstrated a cause and effect relationship between international telephone calls and international trade. In order to trade with each other, people need to talk to each other.
2) Development of the Sinai Peninsula - the Sinai appears to have considerable future potential in terms of petroleum, minerals and agriculture. The development of these activities and the necessary governmental structure will benefit directly from the proposed telecommunications links across the Sinai.

3) Extension of Mass-Media Television Services - the proposed facilities include the capabilities to provide television (and radio) program material, live, throughout the region. The requirement for such services is already known to exist in some portions of the region. Benefits are anticipated from the stimulation of tourism and cultural exchange, and possibly from the marketing of consumer goods.

4) Cooperation Among Governments - the planning, coordination, construction and operation of the proposed facilities will necessitate close cooperation among the appropriate authorities of the nations involved. Experience has shown that, when properly administered, such contacts can be made an additional powerful force towards the rationalization of relationships among peoples; such contacts can involve people at several levels of the society, including technocrat, businessman, worker, and local citizen.

RECOMMENDATIONS

It is recommended that serious consideration be given to the adoption of a comprehensive program incorporating all seven of the proposed projects. Such an approach would be technically sound, since it would provide for the orderly development of a complete network designed to meet appropriate technical performance criteria. Adoption of the comprehensive plan would also be economically sound, since it would facilitate the orderly step-by step development of a financially workable program, and would permit the continuity and dedication of planning and management effort which is required to insure the program's successful achievement of its objectives.

SECTION 1

INTRODUCTION

1.1 CONTRACT REFERENCE

This report is in fulfillment of the requirements of contract number AID/otr-C-1619, work order number 3, dated October 2, 1978. The contract was issued by Central Operations Division, Office of Contract Management, Agency for International Development, Washington, D.C., 20523.

1.2 OBJECTIVES OF STUDY

This study was initiated on the assumption that full-scale peace in the Mid-East is imminent and that good telecommunications can be a viable vehicle to promote peaceful pursuits among previously polarized factions. Thus the specific objectives of the study are to investigate and identify economically and technically feasible regional telecommunications investment possibilities for the Mid-East which would promote economic, commercial and cultural linkages which would in turn tend to enhance the peaceful stabilization of the area.

The area, for study purposes, would encompass the following countries and regions: Egypt, Israel, Jordan, Lebanon, Syria, Gaza, West Bank and other countries to the extent necessary. During the course of the study, it was felt that Saudi Arabia should be included in the region in view of its proximity with the region and its financial influence in the area of study.

1.3 KEY ASSUMPTIONS

The underlying premise of this study is that full-scale peace will come to the Mid-East with a gradual lessening of the present restrictions on the flow of people, goods and information across the intra-regional borders.

It was also assumed that agreements could be worked out among the participants in regard to network planning, project funding and scheduling, system operation and maintenance and tariffs. Another key ingredient to the success of a regional network is also the accountability of the participants in the above matters; it was assumed in this study that such accountability would exist.

1.4 ORGANIZATION OF REPORT

This report was organized to provide the reader with a logical presentation of the study data, study procedures and recommendations of the study. The report starts with an Executive Summary to give a brief concise overview of the objectives and findings of the study. The main body of the report is in seven sections as follows:

Section 1 -- Introduction

Section 2 -- Potential Benefits of Proposed Telecommunications Project

Section 3 -- Methodology Used in Study

Section 4 -- Present and Planned Telecommunications Networks

Section 5 -- Current Demand Forecasts

Section 6 -- Analysis of Alternate Plans and Approaches

Section 7 -- Recommendations

Included in this report are maps of the existing high-capacity communications network in each country and proposed linkages to establish a regional telecommunications system.

SECTION 2

POTENTIAL BENEFITS OF PROPOSED TELECOMMUNICATIONS PROJECT

2.1 GENERAL

The study objectives are to investigate and identify economically and technically feasible regional telecommunications investment possibilities which would promote economic, commercial and cultural linkages tending to enhance the peaceful stabilization of the area. This section discusses some of the benefits envisioned from such a telecommunications capability. There are surely many others and this section serves only to highlight a few of the possibilities which, alone, would appear to make such investments attractive.

2.2 COMMUNICATIONS AS A TRADE STIMULANT

Most of the countries involved in this mid-east regional study have active plans to augment and improve their national telecommunications systems. All of the countries are faced with a pent-up demand for telephone service which they are currently unable to meet. As service is rehabilitated and expanded in these countries, people will be able to better communicate with one another, rapidly, reliably and efficiently. As peace evolves throughout the area, a need will develop for people with common interests in adjacent nations to communicate with each other and this process could be greatly facilitated by the availability of modern telecommunication interconnections. Historically, there is a cause-effect relationship between overall economic growth and telecommunications development. Correlations between telephone density, national long-distance calls per capita and international traffic on the one hand and economic indices such as gross national product, per capita income, etc. on the other, have been amply demonstrated. For example, Figure 2-1 depicts a least-squares correlation between telephone density and gross national product for a group of nations and Figure 2-2

indicates the relationship between foreign trade volume and international telephone revenue minutes.

Past experience indicates that these forces are interdependent, i.e. trade revenue increases result in additional international calls, and conversely, good, rapid, economic international (intra-regional) communications stimulates greater trade revenues. Thus it is highly feasible that investments in intra-regional linkages, as covered herein, could result, not only in compensating telecommunications revenues, but also in stimulated trade revenues which in turn will increase telecommunications demands and further revenue opportunities. In the case of the mid-east, it is not expected that such benefits will occur immediately or overnight as there are many psychological road blocks that have developed over the past years and must be overcome. However, the process can be nourished and abetted by the early establishment of good paths of communication between people with common interests and needs.

2.3 DEVELOPMENT OF THE SINAI PENINSULA

There are a number of underdeveloped areas in the mid-east that hold considerable future potential. One of these is the Sinai Peninsula. One of the first tasks facing the Sinai provincial administration when it returns is to construct settlements for the returned exiles. Oil exploration and irrigation are also projects that are high on the agenda. These potential projects are generators of telephone demand which must be fulfilled to sustain success in any of these endeavors. One of the proposals of this regional telecommunications study is the construction of a microwave link (or links) across the Sinai as a linkage between Egypt and its neighbors to the east. The availability of a basic communications link across the Sinai would be extremely useful in providing economic service to localities en route and in the near vicinity. A radio relay link would provide the basic support for short-haul microwave and rural radio facilities that might not be economical otherwise. Such usage is a byproduct of the original intention of the route (intra-regional network linkage) but it could well be the key that allows development of the surrounding area and fulfillment of plans other than telecommunications.

2.4 MASS MEDIA SERVICES

The establishment of telecommunications linkages between mid-eastern countries will also make possible the extension of mass media services between the various countries on an economical basis. For example, the distance between Cairo and Tel Aviv is such that domestic television stations in one country are out of range of viewers in the other country. However, with a high-capacity microwave or coaxial cable route interconnecting the two countries, it would be economically feasible to provide both television and program facilities over the telecommunications route. Thus, programs originating in Egypt could be viewed throughout Israel and vice versa. While video exchange is presently possible utilizing satellite facilities, the space segment is shared by many users and may not always be available to fit programming schedules of the involved countries. In addition, such service is relatively costly for the short distances involved.

What is the impact of readily available economic video facilities between these two countries? The potential seems great--consider one possibility: Assume a professionally conducted and prepared tour of Egypt's pyramids were televised for viewing in Israel on a live basis. If properly staged, this could stimulate a desire in Israel (or in Jordan, Syria, Lebanon, etc.) to see these wonders firsthand, thereby greatly stimulating tourism between the involved countries. Tourism not only creates revenues, it also creates additional transportation needs, highway construction and service establishments. These by products in turn create revenues and, most importantly, create opportunities for socializing and understandings between countries as the grass roots level. Of course, the same could be true of programming originating in Israel on cultural events, travel, etc.

Another example: Consider a manufacturer in Israel who has a product that could meet a need in one or more of the regional countries. Why not advertise using video or program facilities from the new intra-regional telecommunications linkages? And offer fast service by calling an advertised telephone number. This could develop the need for WATS-type services in the mid-east region thereby further stimulating trade, communications, fellowship, understanding and, hopefully, lasting peace.

As demand increases, economics of scale come into effect, reducing circuit costs and further stimulating demand which, in turn, further reduces

cost. But a start must be made. Perhaps the intra-regional connections proposed herein will be the trigger that will start the synergetic process.

2.5 COOPERATION BETWEEN TELEPHONE ADMINISTRATIONS

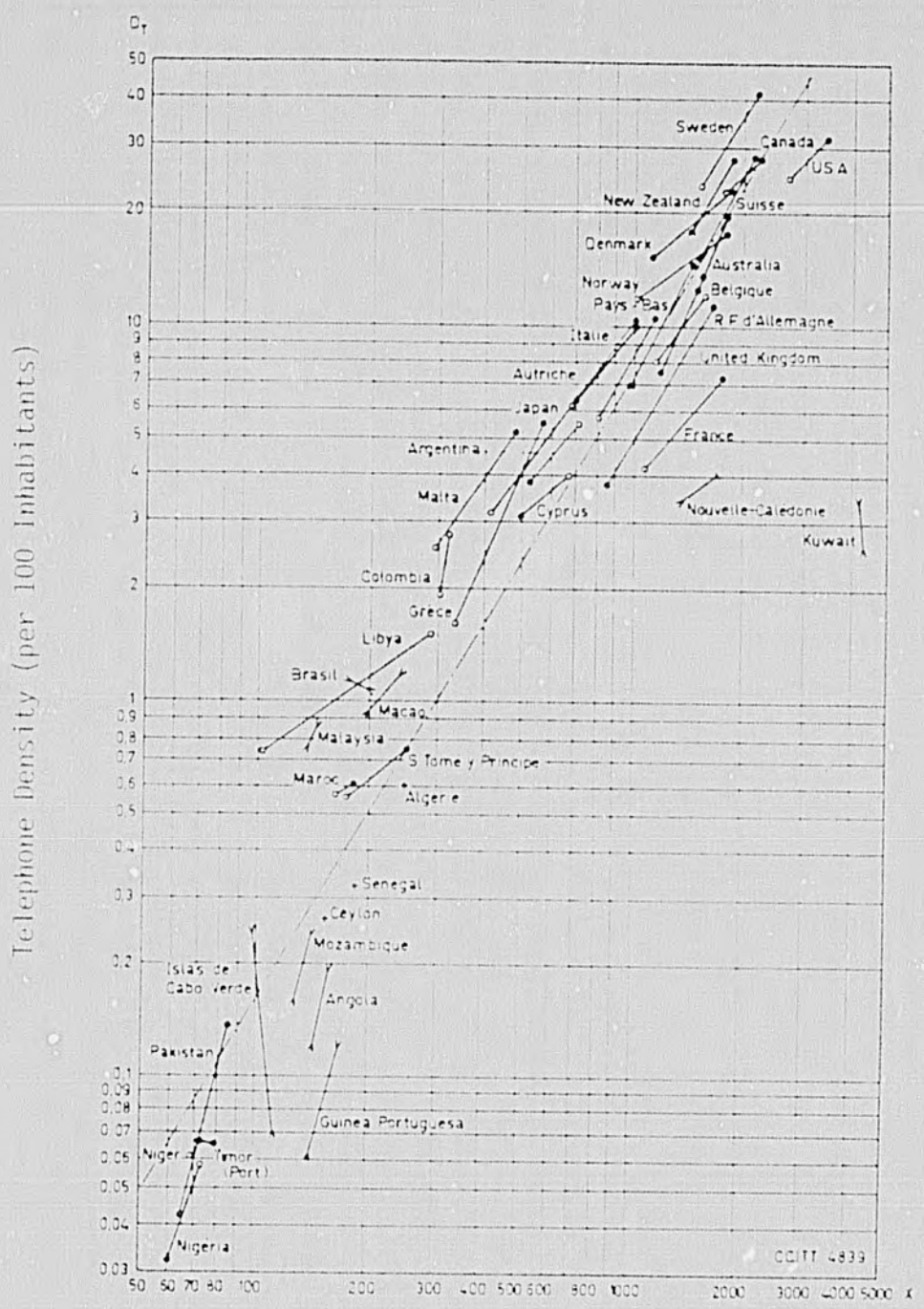
Intra-regional terrestrial facilities, as proposed herein, would better meet the study objectives than would similar facilities implemented by satellite. A case in point: consider a need exists for 12 circuits from Amman, Jordan to Cairo, Egypt and assume for the moment that costs of satellite vs terrestrial are a stand-off. (This could easily be the case when an existing broadband terrestrial route exists and it is only necessary to add multiplex equipment to obtain the 12 additional circuits.)

If the circuits were provided by satellite, Jordan and Egypt would get together and establish a need and coordinate the installation of equipment at each earth station (or international switching center). Only Jordan and Egypt would be involved in the transaction.

Now consider the procedure utilizing terrestrial facilities. Under this study recommendation, a combination of broadband radio relay and or coaxial cable route would be available from Amman to the West Bank, to Tel Aviv, to Bersheba and across the Sinai to Ismailiya and on to Cairo. To implement 12 circuits from Amman to Cairo would require the addition of a channel bank at Amman and at Cairo. It would also probably require a super-group or group connector at Tel Aviv and possibly at Ismailiya. It would required obtaining a frequency slot across the West Bank, through at least two routes in Israel and two or three routes in the Sinai and Egypt. This requires cooperation and working together among the "partners" of the project (Jordan, West Bank, Israel and Egypt).

Furthermore, how is each country going to be compensated for their capital outlays? They must divide the revenues. Thus, more cooperation and working together to set up "Division of Revenue" procedures and means and methods of administering the agreed-on procedures. Division of Revenue procedures require cooperation and trust, or accountability. Perhaps regional audit teams would be set up, thereby further exposing members of one nation to the workings

and ways and means of other regional nations. Friendship of people with common goals could be established as well as understanding of each other's ways of life. Thus implementation of a terrestrial facility would, of necessity, require co-operation and working together of the regional nations on the working level, planning level and executive level, thereby fostering opportunities for peaceful endeavors with common goals.



GDP Per Capita (U.S. Dollars in 1964)

- ● 1954 and 1968 respectively
- ○ Intermediate year

From Chapter 3, Analysis of the National Demand of Telephone Service, Economic Studies on a National Scale in the Area of Telecommunications (1964-1972), CCITT, ITU Geneva, 1972.

Figure 2-1

Telephone Density U.S. GDP PER CAPITA
1954-1968
(in U.S. Dollars)

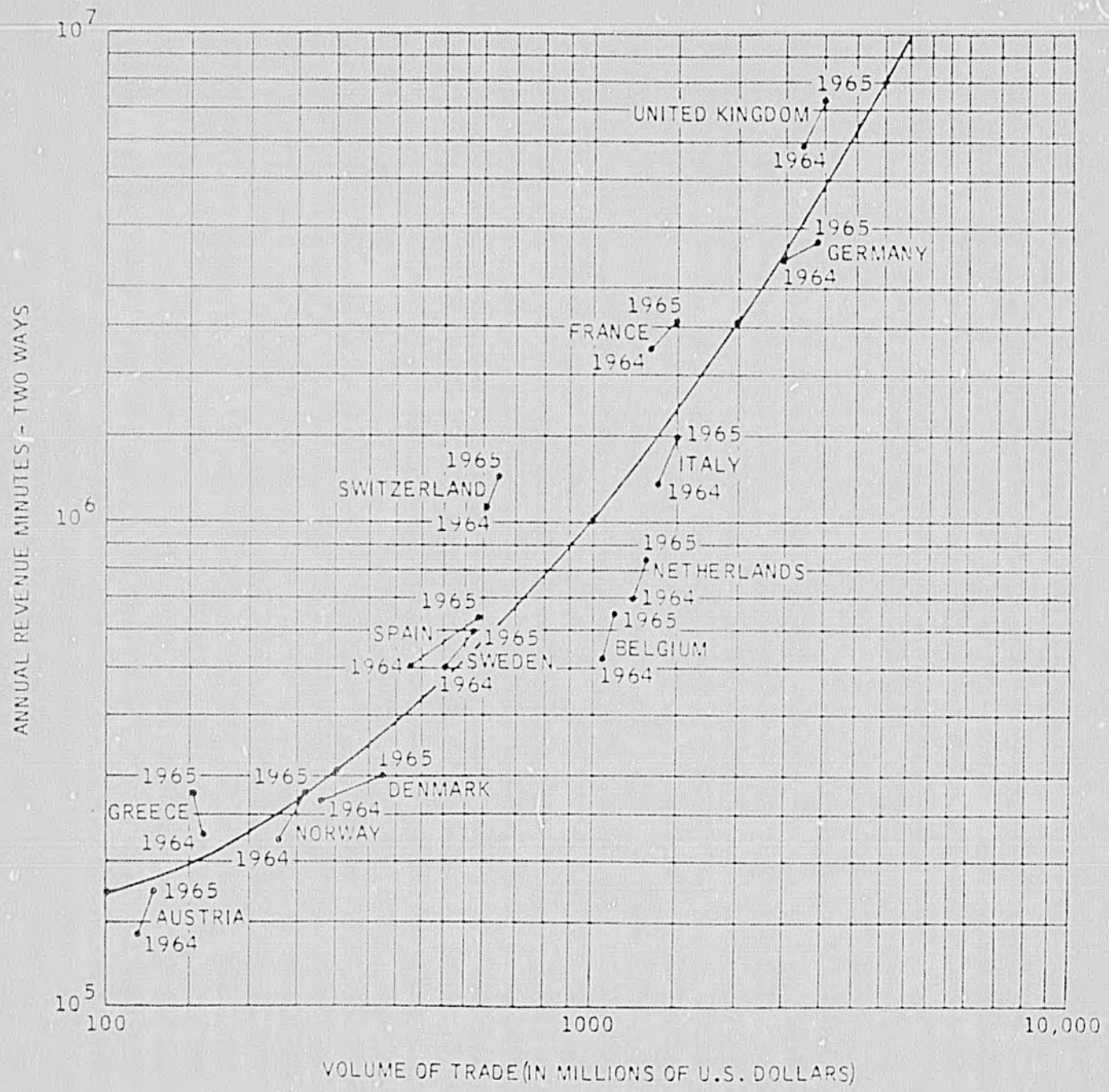


Figure 2-2

Correlation Between Annual Telephone Traffic
And Volume of Trade.

SECTION 3

METHODOLOGY USED IN STUDY

3.1 STUDY PROCEDURES

The methods normally used in telecommunication studies of this type consist of several distinct tasks, starting with the gathering of existing data. This data consists of number of calls made at specific times in the past, call holding times, busy hour-busy day data, etc., so that point-to-point calling rates can be utilized to provide past trends. This data is then projected into the future based on these past trends modified by such things as future economic forecasts, proposed changes in rates and type of operation, expected changes in calling habits, etc. These future calling rates are then converted into circuit requirements based on standard traffic engineering procedures for a particular assumed routing pattern. Once the traffic circuit requirements are determined, various plans are formulated to care for these requirements in future years and cost studies are made to compare the various alternatives to aid in selecting the optimal plan.

3.2 PROCEDURES USED IN THIS STUDY

The above study procedures require considerable data-gathering effort unless adequate data-gathering techniques have been established and have been in effect for a number of past years. In the Mid-East, such techniques have not been established and data is not readily available. In fact, certain expected future calling patterns were non-existent in the past due to the political situation in the region (e.g., calling rates between Cairo and Tel Aviv over the past ten years would be no indication of future requirements under full-scale peace conditions). Furthermore, time constraints of the study limit the effort that can be devoted to the collection and analyzation of existing traffic data.

With limited traffic data, future projections are unreliable and, therefore, other methods must be used to determine order-of-magnitude requirements. Such methods include correlation of telecommunications demand with economic factors such as Gross National Product (GNP), foreign trade revenues, etc. Again, such work is time consuming and in view of the time restraints of the study, only order-of-magnitude future requirements could be derived based on available regional data that could be obtained and on the experience of Teleconsult Inc. engineers and economists.

Another basic ingredient of a normal study procedure is the existing plant on which the future additions are planned. Detailed records are researched to determine what exists today and will exist at the time the planned growth facility is implemented. Type of equipment, ultimate capacity and implemented capacity, current and planned usage are all inputs to a normal study procedure. In the instant study, many of these study ingredients were obtained from previous studies, by telephone queries and by analyzing available reports. Field visits to verify existing equipment types, capacities and condition were not feasible due to time and budgetary constraints. The study conclusions and recommendations were based on the best information obtainable from many sources, both in this country and overseas (e.g., up-to-date material on the Israel telecommunications network was obtained in Tel Aviv by a Teleconsult Inc. engineer in the Mid-East on another project). The information obtained and utilized as the basis for this study is considered to be sound for the order-of-magnitude purposes of the study.

SECTION 4

PRESENT AND PLANNED TELECOMMUNICATIONS NETWORKS

4.1 GENERAL

This section documents the existing telecommunications network in each country and the planned additions that will be available in the 1980 time frame. Only high-capacity routes (microwave, coaxial and cable carrier) are documented as only these routes are considered as economic candidates for possible intra-region linkages. Sources of data were recent studies such as the Teleconsult Fundamental Plan for Jordan, the AID study of Egypt, World Bank Telecommunications Appraisal Reports (Syria and Egypt), ITU documentation and firsthand information from the involved Telephone Administration (Israel and Jordan).

The format for this section is a brief subparagraph on each country and an associated map of that country's telecommunications network. Where possible, route capacities and implemented capacities are shown. The section also discusses current plans for INTELSAT and ARABSAT satellite usage.

4.2 EGYPT

A map of the Arab Republic of Egypt showing existing and planned (1980) major telecommunications routes is shown in Figure 4-1. This information was obtained from the AID - Egypt study, the World Bank Project Appraisal and International Telecommunications Union [ITU] documents. The facilities germain to this study consist of a four-tube, 4 MHz coaxial cable system from Cairo to Suez having a 960-channel capacity, a similar coaxial cable system routing from Cairo to Ismailiya via Banha and a coaxial system to El Mansura via Tanta extended to Port Said via 2 GHz microwave radio. There is also a microwave and coaxial

system extending to Alexandria and west and a coaxial system from Cairo along the Nile River to Aswan. A paralleling two-tube coaxial also extends from Suez along the Red Sea to Safaga and Quseir. This system is equipped from 120 channels. In particular, the routes to Port Said, Ismailiya and Suez lend themselves to possible linkages to the east.

4.3 ISRAEL

A map of the state of Israel showing existing and planned (1980) major telecommunications routes is shown in Figure 4.2. This information was obtained from Israel Ministry of Communication personnel in Tel Aviv and by discussions with knowledgeable Israeli telecommunications experts in this country. The state of Israel has many coaxial cable and radio relay routes. Only those germain to this study are shown on the referenced map. A coaxial route and a radio relay route extend from Tel Aviv to Haifa in the north and to Jerusalem to the east. Both coaxial routes are 8-tube, 2700 channel per pair, cables. There are two pairs of radio channels to Haifa with 2700 channel capacity each and two pairs to Jerusalem with 960 channel capacity each. A third pair to Jerusalem is planned by 1980.

There is also an existing coaxial cable from Haifa to Tiberia and on to the Golan Heights. Both coaxial and radio relay routes are available from Tel Aviv to Elat on the Gulf of Aqaba via Ber Sheba and a 960 channel radio system extends from Ber Sheba to the Sinai. These are all relatively high capacity routes that are candidates for intra-regional interconnections.

4.4 JORDAN

A map of the Hashemite Kingdom of Jordan showing existing and planned (1980) major telecommunications routes is shown in Figure 4-3. This information was obtained from the Teleconsult Inc. Fundamental Plan for Jordan, updated by telephone consultation with Teleconsult Inc. personnel in Jordan. The country is spanned brom Irbid, in the north, via Amman, the location of the International Switching Center, to Aqaba in the south by a microwave radio relay system. The system is combined with the military and the telephone company capacity is, in general, 300 channels. Sidelegs extend to Ramtha, Zarka, Salt, Madaba, Karak

and the earth station at Baqa. Coaxial cable connections to Damascus, Syria (24 channels) and Baghdad, Iraq (12 channels) are also provided in a military cable which is in relatively poor condition. A radio relay route is currently under construction to Damascus for completion this year (1978) and when completed, will provide 960 channel capacity (180 channels initially) and two-way TV connections to Syria. At that time, the coaxial cable systems to Damascus will probably be abandoned by the telephone company as well as the circuits to Baghdad as soon as a microwave facility is available via Damascus. There is also a radio relay route from Amman to Beirut, Lebanon which is equipped for 120 channels. This route is not in service at present due to the hostilities in Lebanon. It can eventually, however, be restored to provide a linkage to Lebanon. The radio relay route from Amman to Salt and to Aqaba provides a potential linkage to the West Bank and to Saudi Arabia, respectively.

4.5 LEBANON

A map of Lebanon and the existing and planned (1980) major telecommunications routes is shown in Figure 4-4. This information was obtained from a 1976 ITU regional telecommunications study. A four-tube coaxial cable extends from Beirut, east to Zahle and on to Damascus. At Zahle, a microwave route extends northeast to Baalbek. There is also a four-tube coaxial route running north and south out of Beirut. The route to the south interconnects with microwave at Saida, which extends to Jordan via a junction at Jabal Safi. A microwave route from Jabal Safi connects to Tyr on the Mediterranean. The coaxial to the north extends to Jounie and Byblos.

Microwave routes out of Beirut go north to Tripoli and east to Damascus. There are also underseas cables out of Beirut to Alexandria, Egypt, Marseilles, France and Larnaca, Cyprus. The condition of these facilities at the present time is unknown due to the current political/military situation in Beirut. It is expected, however, that the present routes can be restored and utilized for intra-regional communications links during the time frame of this study.

4.6 SINAI-GAZA-WEST BANK

There appears to be no high-capacity route development in the Sinai or in the West Bank at the present time, other than the routes to Jerusalem shown in Figure 4-2. A high capacity radio relay route exists from Ber Sheba to either Gaza or to the northeastern corner of the Sinai. It was not possible to verify the actual location of this route, other than that a route out of Ber Sheba exists to the general vicinity of the Gaza Strip.

In the West Bank, Jerusalem serves as a secondary center with Hebron and Nablus functioning as primary centers homing on Jerusalem. Although it could not be verified, there must be telephone plant existing to interconnect these and other locations on the West Bank. It is considered in this study that a connection to Jerusalem would provide an outlet for the West Bank.

4.7 SAUDI ARABIA

A map of Saudi Arabia and the routes of the Intra-Kingdom Microwave Project are shown in Figure 4-5. The microwave construction is being implemented by Western Electric Rockwell-Collins and is expected to be in service in 1980. The routes of particular interest in this study are those bordering on Jordan at Haql, Syria, Halat Ammar and Quraiyat as these have the potential of being linkage points to Jordan, Syria and possibly the Sinai.

In addition, Saudi Arabia has established a domsat system. These stations provide national video service and an interim connection between switching centers of the national telephone network until the microwave link, discussed above, is completed. The system consists of one master and control center station, located at Riyad plus 14 other stations, including two mobil stations. Eleven of these use 11-meter diameter antennas and ten are designed to be unattended. These are shown in Figure 4-5. This system is interesting for its basis of inception, namely, in an administration where cost was <u>not</u> the overriding factor, a domsat system was implemented to provide immediate telecommunication service until terrestial facilities could be completed. Thereafter, the system will continue to provide video service and alternate routing for the national network, or they may be moved to sites remote from the new facilities.

4.8 SYRIA

A map of the Syrian Arab Republic showing existing and planned (1980) major telecommunications routes is shown in Figure 4-6. This information was obtained from a 1976 World Bank Project Appraisal and from information obtained from the ITU. In addition to the radio relay route from Damascus to Amman mentioned in paragraph 4.4, there is an extensive coaxial cable and radio relay network throughout Syria. The coaxial cable system extends from Damascus to a junction at Homs where it branches to Tartous and Latakia on the Mediterranean and to Aleppo in the north and Palmyra to the east. The cable to Palmyra will eventually be extended to Baghdad, Iraq. Radio relay interconnects Damascus with Homs, Latakia, Aleppo and Raqqa and Deir Es Zor on the Euphrates River. It also extends to the northeastern part of Syria and on into Iraq. A coaxial and a radio relay connection also extend from Damascus to Beirut, Lebanon which can eventually be utilized as a link in the intra-regional network.

4.9 REGIONAL

The existing terrestrial regional connections were discussed above in describing each country's telecommunications network. However, they will be reviewed here for clarity and are shown in Figure 4-7. It is obvious that there are currently no connections between Israel and the Arab countries. Also, connections between Arab regional countries are minimal as summarized below:

Egypt - Lebanon:	120 chs. underseas cable, status unknown
Jordan - Lebanon:	120 chs. radio relay, out of service
Jordan - Syria:	180 chs. radio relay, service 1978
Syria - Lebanon:	Coaxial cable and radio relay, status unknown

These facilities, however, are potential linkages to be considered in this mid-east study.

4.10 INTELSAT INTERNATIONAL

All of the countries in the study have earth stations associated with the INTELSAT Atlantic Ocean Region (AOR), the Indian Ocean Region (IOR), or in some cases, both regions (Figure 4-8). These earth stations are used for international connections which include some intra-regional circuits existing and forecast for 1980. These intra-regional circuits (Figure 4-9) are relatively expensive, however, on a cost/mile basis due to the relatively short distances involved. With the availability of intra-regional terrestrial facilities, it is expected that at least some circuits will be off-loaded for both route diversity purposes and so that the satellite capacity can be better utilized for long-haul international facilities.

4.11 ARABSAT REGIONAL

This project will provide regional satellite service to the Arabic speaking countries from West Africa to the eastern part of the Arabian Peninsula and from the Mediterranean Sea to the southern Sudan, thus covering an area significantly larger than, but including the entire area of this study. It is sponsored and is being paid for by many of those nations who share the Arabic language. ARABSAT'S purpose is to provide communication within the Arab world in order to provide business, cultural and scientific interests. Although it is envisioned that the system will eventually be self-supporting, its developers are not limited by the usual rules of fiscal viability, for example break-even distance.

The project is presently in the definition and design phase. This will be followed by specification preparation, proposal evaluation and contract negotiation for the ground and space segments. Network operation, including the launch of two satellites, has been variously estimated to be complete in the 1981-1983 period. An accelerated schedule, which might utilize a space segment provided by others, e.g. INTELSAT, on either a temporary or permanent basis could shorten this time.

The network, as originally envisioned, would provide service to some 19 to 21 main station antennas (see figure 4-10). In addition, television receive only (TVRO) stations would be located throughout the coverage area as needed by national administrations to satisfy domestic requirements. It can be ex-

pected that once the space segment becomes available, and the main stations become operative, that smaller antennas providing thin route service will appear. Traffic demand for telephone circuits in this region has been estimated[1] to be as follows:

1980	Permanently Assigned	638
	Demand Assigned	482
	TOTAL	1120
1990	Permanently Assigned	1992
	Demand Assigned	609
	TOTAL	2601

It may be expected that ARABSAT service will, like INTELSAT service, develop a now latent demand which in turn will cause an operational evolution which will bring smaller stations into the system to serve the more remote and thin traffic areas. Being designed as a regional system, the break-even distance for satellite vs radio-relay service may be expected to be reduced for narrow band communication service and wideband, e.g. video, service will certainly be viable in the region of interest. The availability of this system will, however, probably not occur until long after pacification of the area since delays in regional settlements will most likely be accompanied by some lack of agreement about the ARABSAT system from the Arab Telecommunication Union membership.

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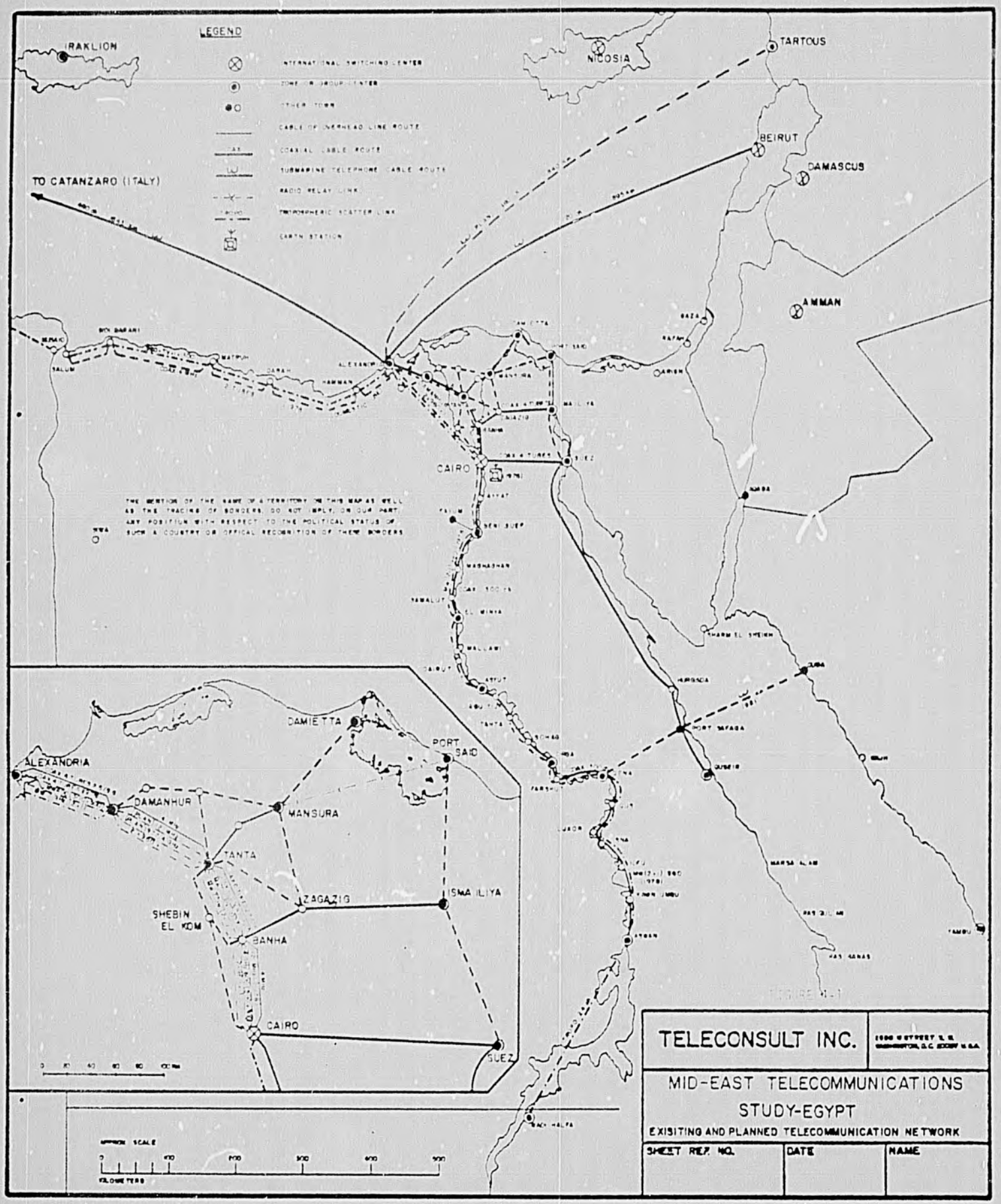
[1] Report on Arab Telecommunication Union Meeting, INTELSAT BG-18-68E W/11/75 dated 24 November 1975. (This document also provides information sourced to an ITU Report, Telecommunication Network in the Middle East and Mediterranean Area).


LEGEND
IRAKLION
NICOSIA
TARTOUS
BEIRUT
DAMASCUS
AMMAN
TO CATANZARO (ITALY)
CAIRO
SUEZ
DAMIETTA
PORT SAID
ALEXANDRIA
DAMANHUR
MANSURA
TANTA
ZAGAZIG
ISMA ILIYA
SHEBIN EL KOM
BANHA
CAIRO
SUEZ
TELECONSULT INC.
MID-EAST TELECOMMUNICATIONS STUDY-EGYPT
EXISITING AND PLANNED TELECOMMUNICATION NETWORK
SHEET REF. NO.
DATE
NAME

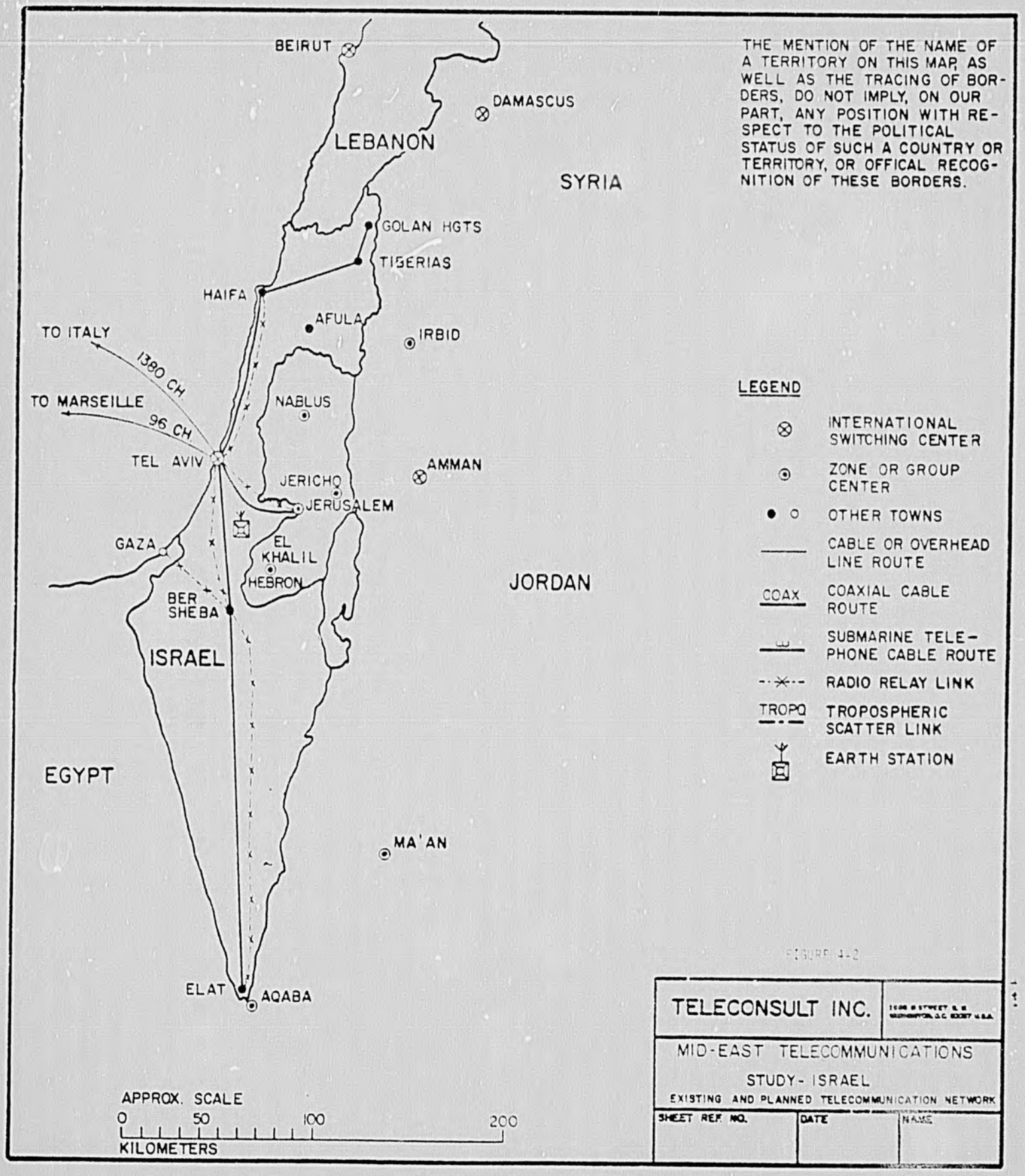
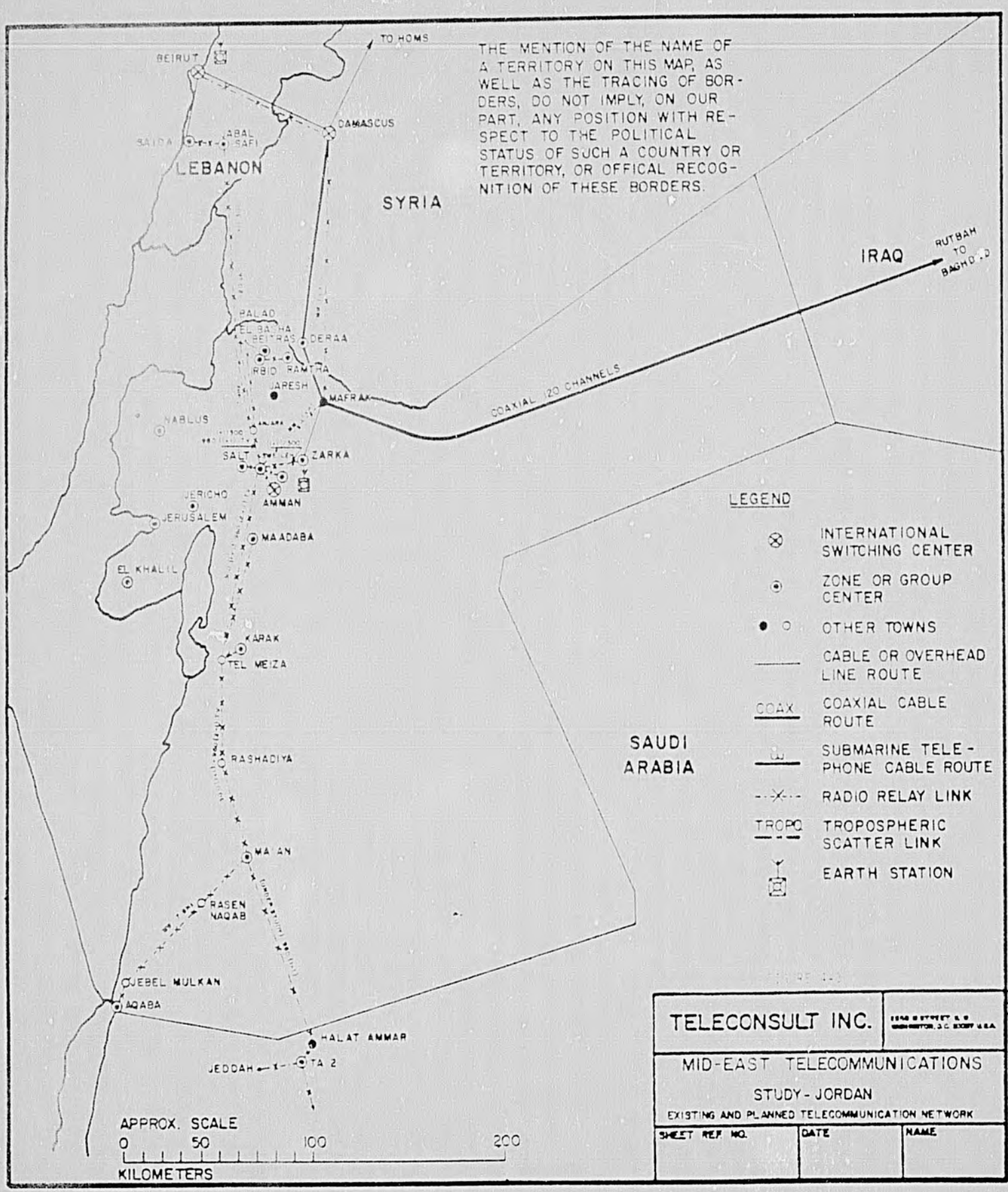
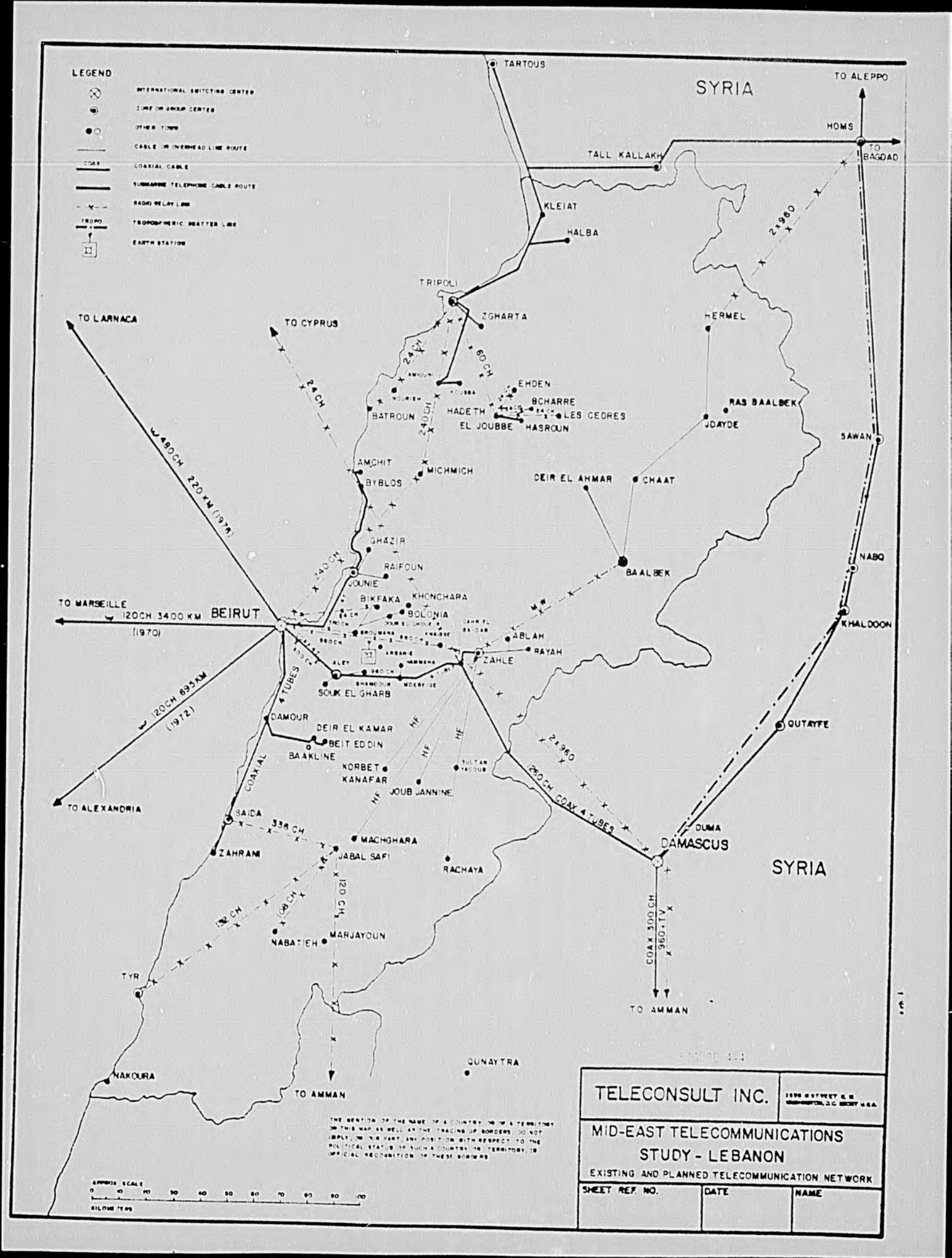

BEIRUT
DAMASCUS
LEBANON
SYRIA
GOLAN HGTS
TIBERIAS
HAIFA
AFULA
IRBID
TO ITALY
1380 CH
TO MARSEILLE
96 CH
NABLUS
TEL AVIV
AMMAN
JERICHO
JERUSALEM
GAZA
EL KHALIL
HEBRON
JORDAN
BER SHEBA
ISRAEL
EGYPT
MA'AN
ELAT
AQABA
APPROX. SCALE
0 50 100 200
KILOMETERS
THE MENTION OF THE NAME OF A TERRITORY ON THIS MAP, AS WELL AS THE TRACING OF BORDERS, DO NOT IMPLY, ON OUR PART, ANY POSITION WITH RESPECT TO THE POLITICAL STATUS OF SUCH A COUNTRY OR TERRITORY, OR OFFICAL RECOGNITION OF THESE BORDERS.
LEGEND
INTERNATIONAL SWITCHING CENTER
ZONE OR GROUP CENTER
OTHER TOWNS
CABLE OR OVERHEAD LINE ROUTE
COAX
COAXIAL CABLE ROUTE
SUBMARINE TELEPHONE CABLE ROUTE
RADIO RELAY LINK
TROPO
TROPOSPHERIC SCATTER LINK
EARTH STATION
TELECONSULT INC.
MID-EAST TELECOMMUNICATIONS
STUDY- ISRAEL
EXISTING AND PLANNED TELECOMMUNICATION NETWORK
SHEET REF. NO.
DATE
NAME

FIGURE 4-2


THE MENTION OF THE NAME OF A TERRITORY ON THIS MAP, AS WELL AS THE TRACING OF BORDERS, DO NOT IMPLY, ON OUR PART, ANY POSITION WITH RESPECT TO THE POLITICAL STATUS OF SUCH A COUNTRY OR TERRITORY, OR OFFICAL RECOGNITION OF THESE BORDERS.
TO HOMS
BEIRUT
DAMASCUS
SAIDA
ABAL SAFI
LEBANON
SYRIA
IRAQ
RUTBAH TO BAGHDAD
COAXIAL 120 CHANNELS
PALAD
EL BASHA
BEITRAS
DERAA
RBID
RAMTHA
JAPESH
MAFRAK
NABLUS
SALT
ZARKA
AMMAN
JERICHO
JERUSALEM
MAADABA
EL KHALIL
KARAK
TEL MEIZA
RASHADIYA
MA AN
RASEN NAQAB
JEBEL MULKAN
AQABA
HALAT AMMAR
JEDDAH
TA 2
SAUDI ARABIA
LEGEND
INTERNATIONAL SWITCHING CENTER
ZONE OR GROUP CENTER
OTHER TOWNS
CABLE OR OVERHEAD LINE ROUTE
COAX
COAXIAL CABLE ROUTE
SUBMARINE TELEPHONE CABLE ROUTE
RADIO RELAY LINK
TROPO
TROPOSPHERIC SCATTER LINK
EARTH STATION
APPROX. SCALE
0 50 100 200
KILOMETERS
TELECONSULT INC.
MID-EAST TELECOMMUNICATIONS
STUDY - JORDAN
EXISTING AND PLANNED TELECOMMUNICATION NETWORK
SHEET REF. NO.
DATE
NAME


LEGEND
INTERNATIONAL SWITCHING CENTER
ZONE OR GROUP CENTER
OTHER TOWN
CABLE OR OVERHEAD LINE ROUTE
COAXIAL CABLE
SUBMARINE TELEPHONE CABLE ROUTE
RADIO RELAY LINE
TROPOSPHERIC SCATTER LINE
EARTH STATION
SYRIA
TARTOUS
TO ALEPPO
HOMS
TO BAGDAD
TALL KALLAKH
KLEIAT
HALBA
TRIPOLI
ZGHARTA
TO LARNACA
TO CYPRUS
HERMEL
EHDEN
BCHARRE
HADETH
LES CEDRES
EL JOUBBE
HASROUN
BATROUN
RAS BAALBEK
JDAYDE
SAWAN
AMCHIT
MICHMICH
BYBLOS
DEIR EL AHMAR
CHAAT
GHAZIR
RAIFOUN
JOUNIE
BAALBEK
NABQ
TO MARSEILLE
120CH 3400 KM
(1970)
BEIRUT
BIKFAKA
KHONCHARA
BOLONIA
ABLAH
RAYAH
ZAHLE
KHALDOON
SOUK EL GHARB
DAMOUR
DEIR EL KAMAR
BEIT EDDIN
BAAKLINE
KORBET
KANAFAR
JOUB JANNINE
QUTAYFE
TO ALEXANDRIA
SAIDA
ZAHRANI
MACHGHARA
JABAL SAFI
RACHAYA
DUMA
DAMASCUS
SYRIA
NABATIEH
MARJAYOUN
TYR
TO AMMAN
QUNAYTRA
NAKOURA
TO AMMAN
TELECONSULT INC.
MID-EAST TELECOMMUNICATIONS
STUDY - LEBANON
EXISTING AND PLANNED TELECOMMUNICATION NETWORK
SHEET REF. NO.
DATE
NAME
APPROX. SCALE
KILOMETERS

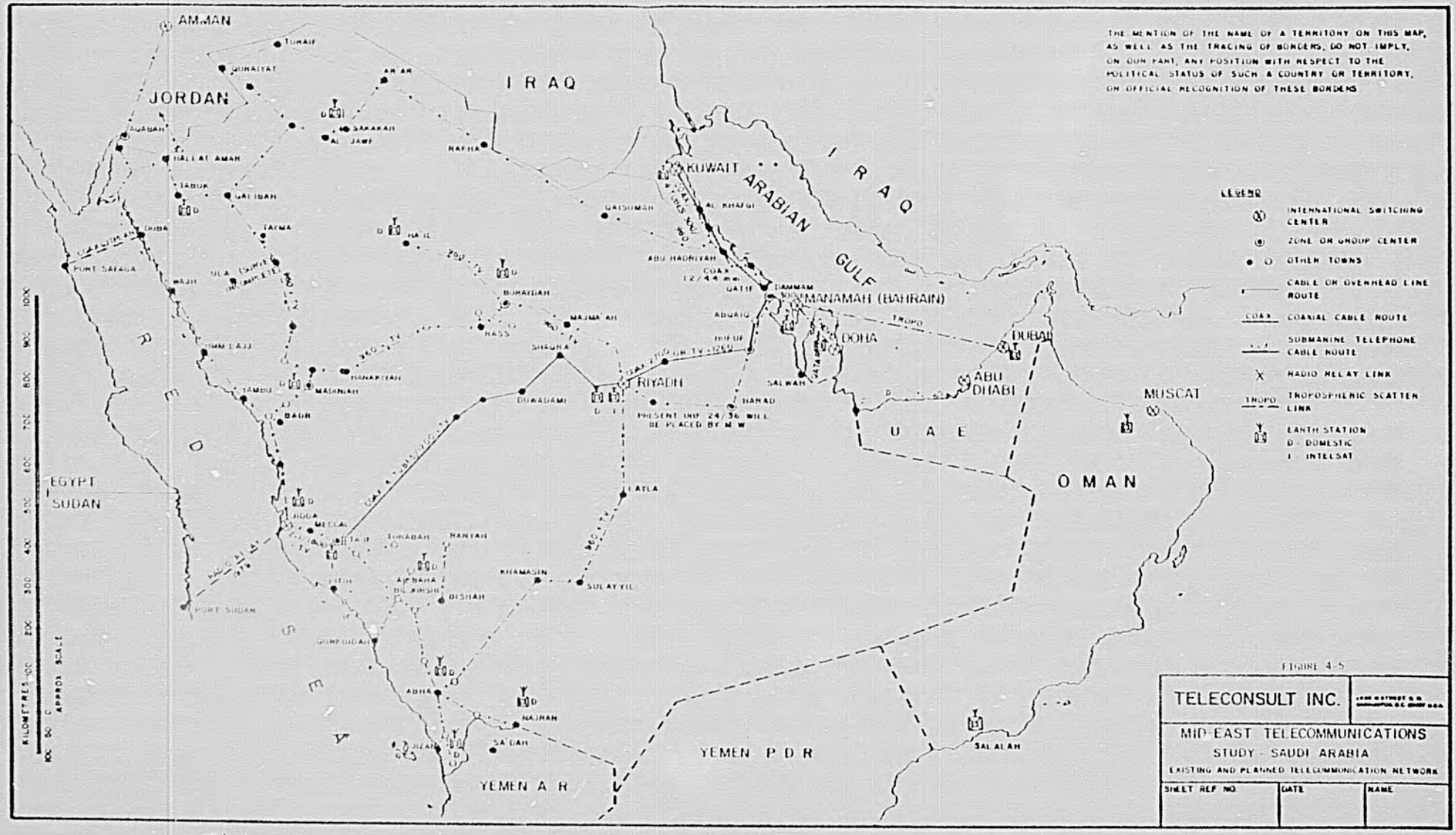


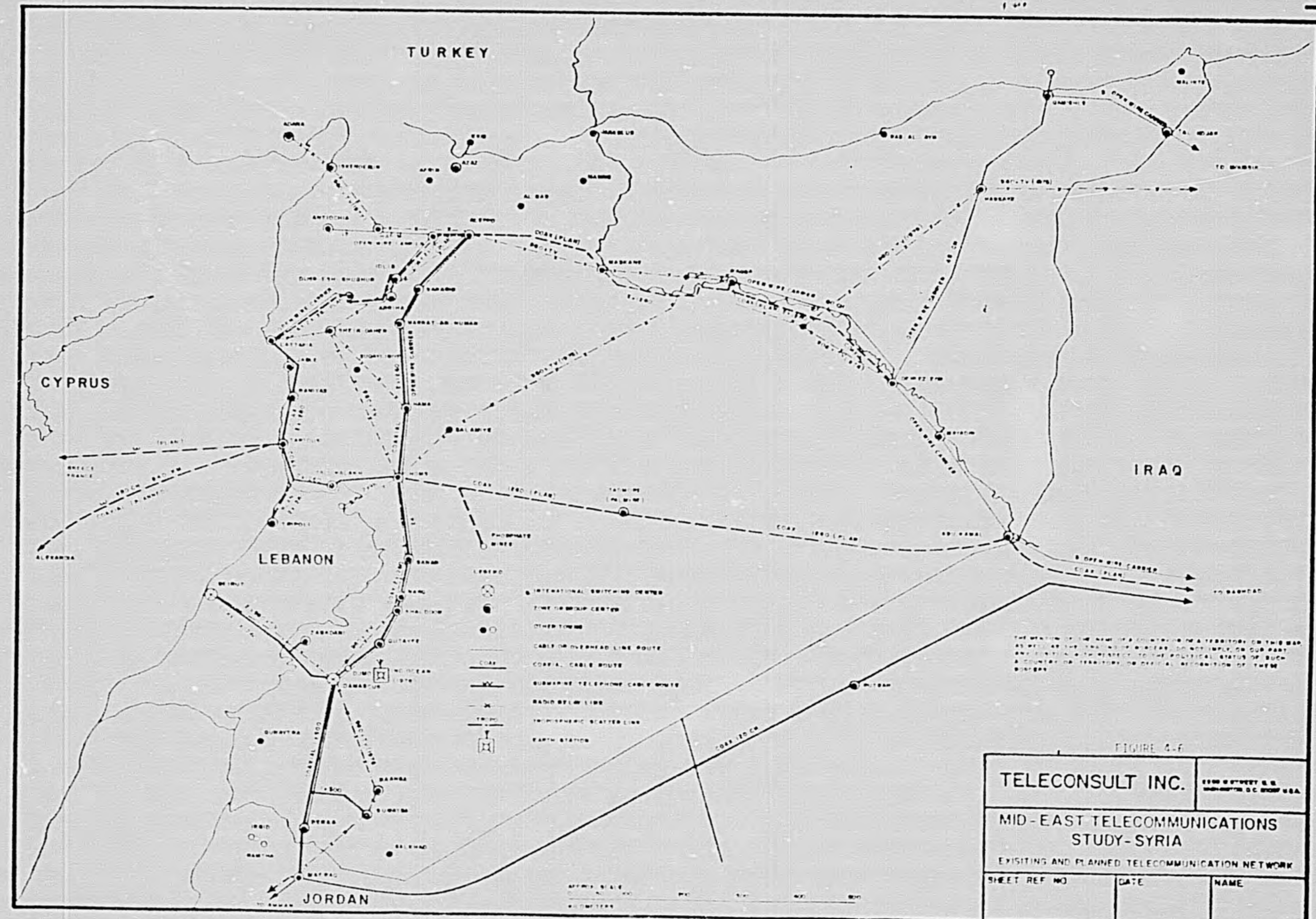
FIGURE 4-5

TELECONSULT INC.

MID-EAST TELECOMMUNICATIONS STUDY - SAUDI ARABIA

EXISTING AND PLANNED TELECOMMUNICATION NETWORK

SHEET REF NO.	DATE	NAME


TURKEY
CYPRUS
LEBANON
IRAQ
JORDAN
ANTIOCHIA
FIGURE 4-6
TELECONSULT INC.
MID-EAST TELECOMMUNICATIONS
STUDY-SYRIA
EXISITING AND PLANNED TELECOMMUNICATION NETWORK
SHEET REF. NO
DATE
NAME

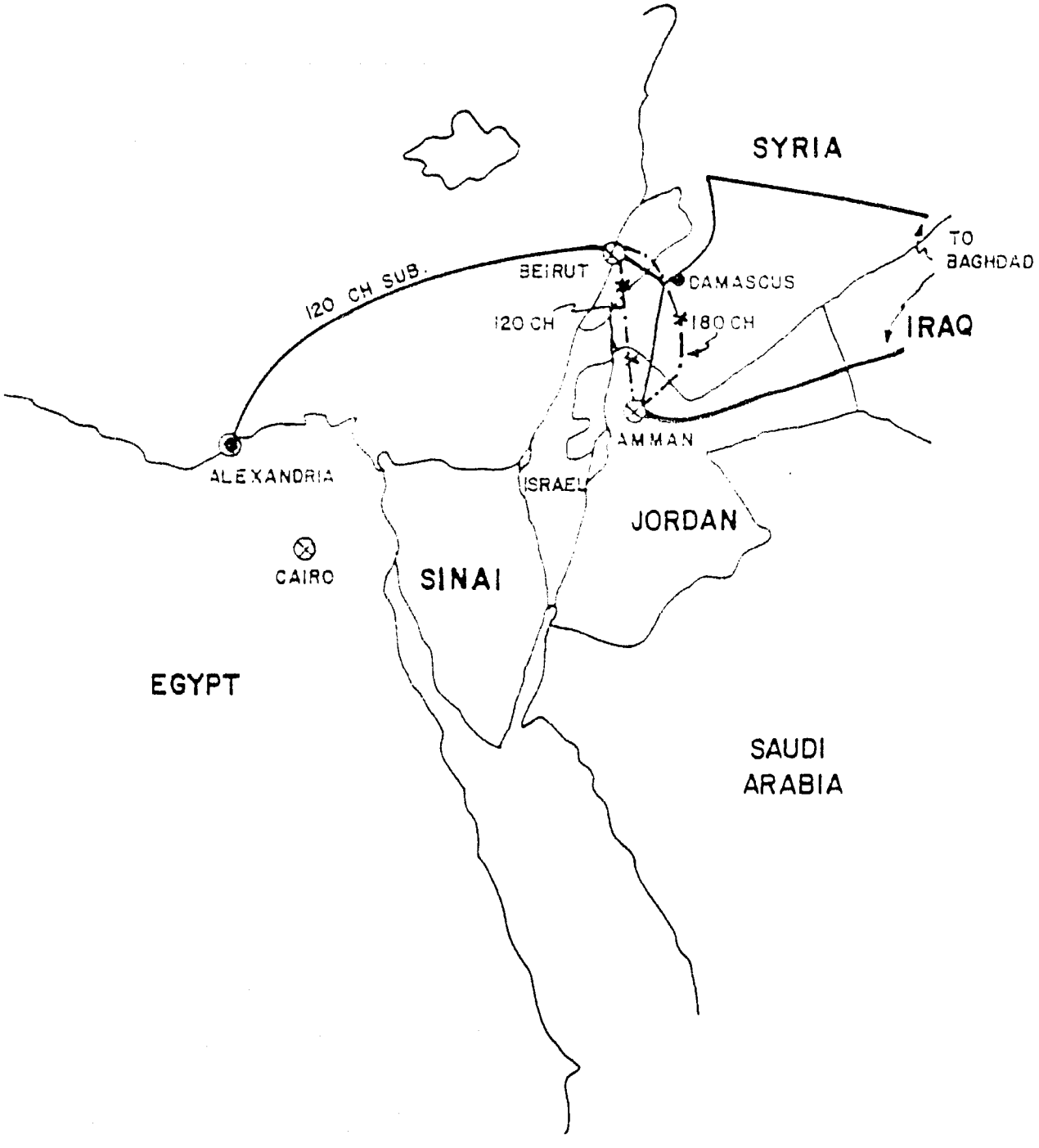


FIGURE 4-7

EXISTING INTRA-REGIONAL
TERRESTRIAL FACILITIES

Country	INTELSAT Configuration			Notes
	Station Name	Station Type	Satellite	
Egypt	Maadi	Standard A	AOR Primary	Several regional circuits via Italy (using the Italcable subcable from Egypt)
Israel	Emeq Ha'ela 1 Emeq Ha'ela 2	Standard A Standard A	AOR Primary —	 Planned
Jordan	Baqa 1 Baqa 2	Standard A Standard A	AOR Primary Construction	When Baqa 2 becomes operational in March 1979 it will take over AOR service. Baqa 1 will be modified and put into IOR service
Lebanon	Arbaniyeh 1 Arbaniyeh 2	Standard A Standard A	IOR Primary AOR Primary	 Planned
Saudi Arabia	Riyadh 1 Riyadh 4 Taif	Standard A Standard A Standard A	IOR Primary AOR Major Path AOR Primary	 Planned
	15 Antenna Network	Non-Standard	AOR Lease	Domestic Service Using INTELSAT Space Segment
Syria	Sedunaya	Standard A	IOR Primary AOR Atlantic Ocean Region IOR Indian Ocean Region	

Existing INTELSAT Space Segment Service in the Region

Figure 4-8

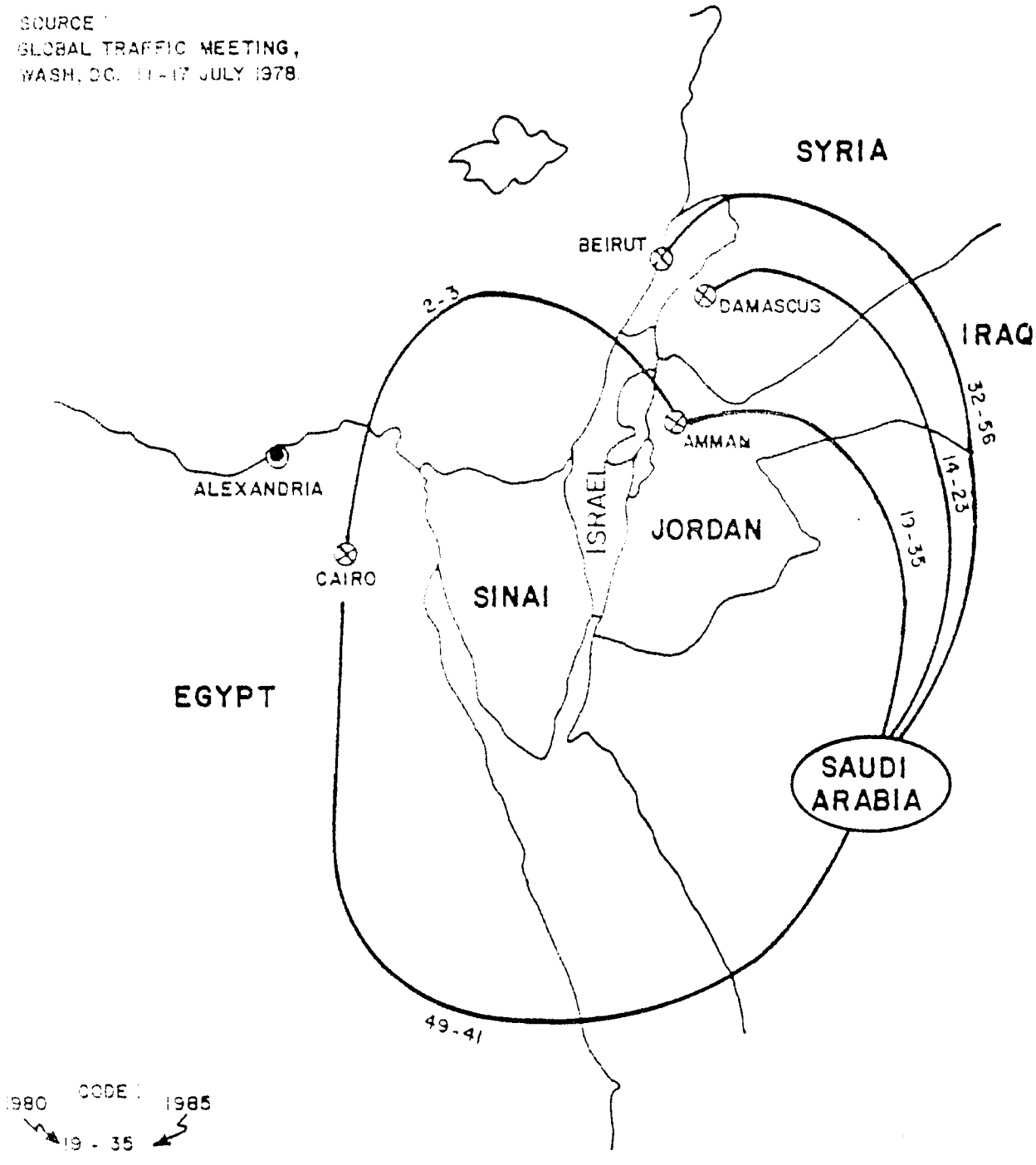


FIGURE 4-9

INTELSAT CIRCUIT FORECAST

1980-1985

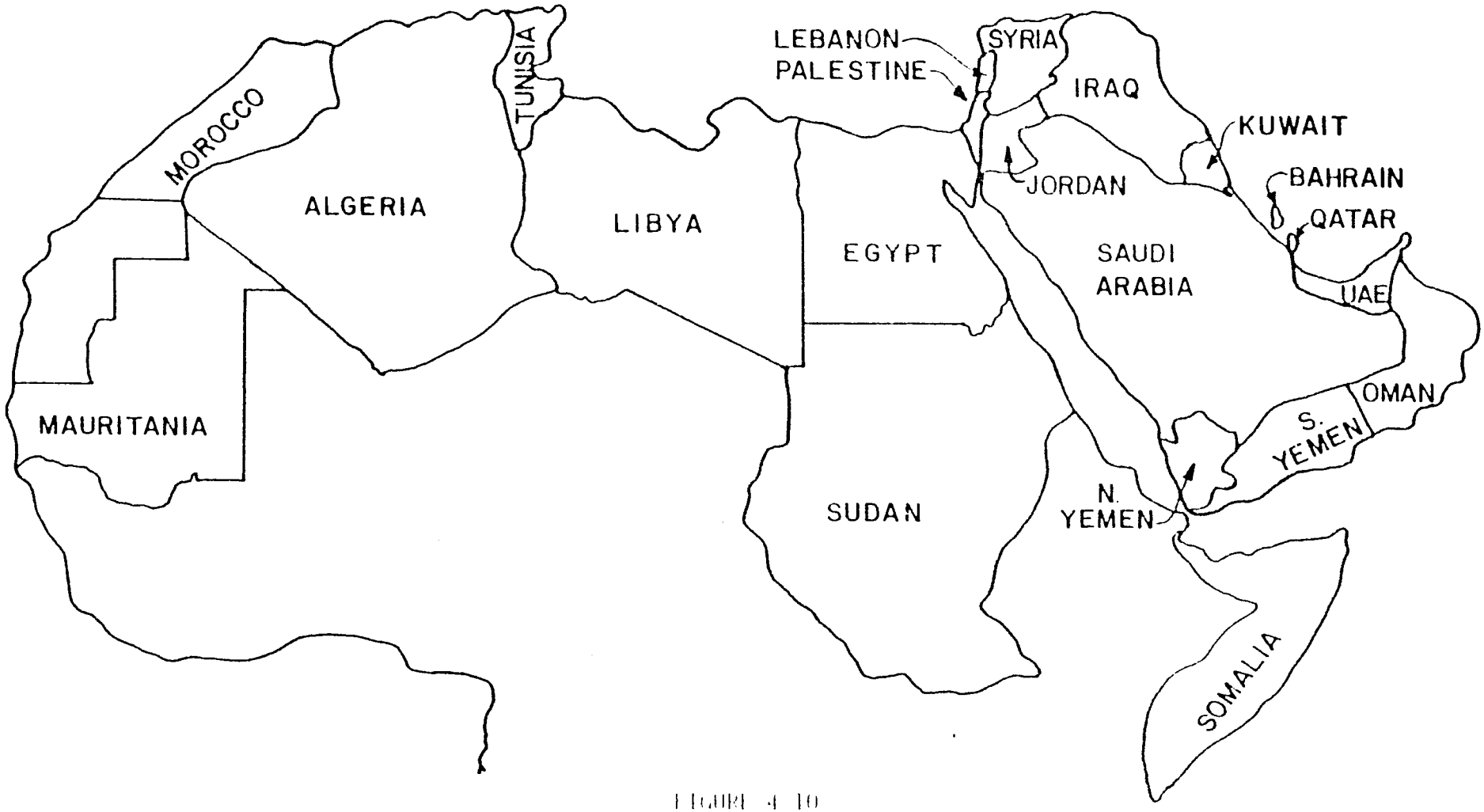


FIGURE 4-10

PROPOSED ARABSAT NETWORK
GENERAL COVERAGE AREA
AND
MEMBERSHIP

SECTION 5

CURRENT DEMAND FORECASTS

5.1 BACKGROUND

Considerable progress has been made during the past five years in the regional telecommunications planning in the Mid-East area. The joint effort culminated in the formulations of a master plan under the auspices of ITU/UNDP in 1976. The feasibility study and preinvestment survey for the Mid-East and Mediterranean telecommunications network compiled and analyzed considerable data supplied by 27 countries and paved the way to the recent development work on a regional satellite system for the Arab nations.

Since 1976/77, some nations within the scope of this study have instituted significant telecommunications expansion programs approaching the scale of quantum jump rather than the familiar evolution path of the facilitated nations in the past. On the other hand, the usual delay in project execution tends to diminish, in some cases, the optimistic forecast of the early seventies. The demand and facility forecast presented herein is based primarily on the ITU Study, with modifications based on more current surveys and analysis.

The methodology applied in the ITU study is generally sound and included some generally accepted techniques in correlating telecommunications demand with selected economic parameters. Needless to say, time limitations and budgetary constraints would not permit a thorough review and critique of the methodology applied therein; however, considerable judgement has been applied based on Teleconsult's experience in this region, in presenting a set of working assumptions based on the network which is contemplated.

By way of introduction, the historical development of the telecommunications sector in this region should be of considerable interest in the present context. Figures 5-1 to 5-6 depict some key statistics for Egypt, Israel, Jordan, Lebanon, Saudi Arabia and Syria in relating telecommunications development to such key economic parameters as gross domestic product (GDP), population growth, and international trade expansion patterns.

5.2 SUMMARY OF FORECASTS

5.2.1 National Forecasts

In the context of prescribed objectives of this investigation, the relevant data are the forecasts of direct exchange lines, Telex subscribers, as well as international outgoing telephone and Telex traffic. The data is summarized in Figures 5-7 and 5-8 for the six countries in question over the 1980-1990 period. On the whole, the information is derived from the ITU study, with some modifications based on more recent information derived from IBRD Surveys and published expansion plans of various administrations. Telecommunications demand/facilities and traffic forecasts, by their very nature, are not exact quantities unaffected by a host of variables and events prevalent in telecommunications planning and execution of activities. However, it is Teleconsult's judgement that these forecasts do provide the general order of magnitude which can reasonably be used for the present purpose.

5.2.2 Intra-Regional Traffic Forecasts

Intra-regional traffic or intra-country traffic forecasts from the following sources have been carefully examined:

a) The ITU Regional Master Plan, 1976
b) The Jordan TCC Fundamental Plan, 1977
c) The Arab Fund for regional projects, 1977
d) The Arab Telecommunications network, ITU paper, 1978
e) Traffic Data Base, INTELSAT, Document BG-34-10E, W/9/78

Considerable care has been exercised to explore the respective relevancy and critical assumptions of the above traffic forecasts. In particular, since there is a total void on data between Israel and the rest of the Arab nations in any of the forecasts hitherto published, considerable judgement has been applied to estimate the probable traffic volume and circuit requirement in the absence of any knowledge and field intelligence on possible community interest and historical trends. The end result of this effort is depicted in Figure 5-9 and 5-10 for an initial design capacity for 1980.

A. BASIC SECTOR DATA

	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
POPULATION ('000'S)	28659	29389	30139	30907	31693	32510	33329	34062	34812	35619
GROSS DOMESTIC PRODUCT (MIL. US$)	5089	5524	5703	5823	6199	6831	7231	7671	7906	8945
NO. OF D.E.L.'S	249646	270666	297126	307106	314299	330810	342350	346992	353326	471791
NO. OF TELEX SUBS.						83	110	122	170	152
GDP/CAP. (US$/CAP)	178	188	189	188	196	210	217	225	227	251
D.E.L./100 CAP	0.8711	0.9210	0.9859	0.9936	0.9917	1.0176	1.0272	1.0187	1.0150	1.3245
TELEX/10'000 CAP						0.0255	0.0336	0.0358	0.0488	0.0427

B. INTERNATIONAL TRADE

TOTAL IMPORT (MIL. US$)	953	933	1070	792	665	637	786	920	898	906
TOTAL EXPORT (MIL. US$)	538	605	566	557	619	744	761	789	824	1117
TOTAL IMP + EXP (MIL. US$)	1491	1538	1636	1349	1285	1382	1547	1709	1723	2023
IMP+EXP/CAP. (US$/CAP) (MIL. US$)	52	52	54	44	41	43	46	50	49	57

C. INTERNATIONAL OUTGOING TRAFFIC

TELEPHONE (MIN/DAY)	1026	1026	1073	997	916	914	1033	1074	1826	3091
TELEX (MIN/DAY)						334	530	676	958	1567
TELEGRAPH (WORDS/DAY)	76703	75087	74027	81137	77070	78103	83620	88697	89343	

Figure 5-1
Egypt - Key Statistics Relative to Telecommunications Development

A. BASIC SECTOR DATA

	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
POPULATION ('000'S)	2480	2560	2630	2680	2740	2810	2890	2980	3080	3210
GROSS DOMESTIC PRODUCT (MIL. US$)	2864	3429	3775	3891	3970	4590	5372	6270	7139	9233
NO. OF D.E.L.'S		139950	171690	209430	244540	290700	332900	369380	418100	461400
NO. OF TELEX SUBS.	610	670	780	900	1030	1200	1350	1475	1730	1930
GDP/CAP. (US$/CAP)	1155	1339	1435	1452	1449	1633	1859	2104	2318	2876
D.E.L./100 CAP		5.42	6.49	7.63	8.66	10.0	11.1	12.0	13.1	14.0
TELEX/10'000 CAP	2.40	2.52	2.92	3.23	3.61	4.08	4.47	4.70	5.32	5.75

B. INTERNATIONAL TRADE

TOTAL IMPORT (MIL. US$)	839	838	833	774	1370	1666	2086	2388	2477	4240
TOTAL EXPORT (MIL. US$)	372	430	503	555	639	729	779	958	1147	1459
TOTAL IMP + EXP (MIL. US$)	1211	1268	1336	1329	2009	2395	2865	3346	3624	5699
IMP+EXP/CAP. (US$/CAP) (MIL. US$)	484	495	508	496	733	852	991	1123	1177	1775

C. INTERNATIONAL OUTGOING TRAFFIC

TELEPHONE (MIN/DAY)	532	630	816	1041	2076	5312	6762	9151	11397	14932
TELEX (MIN/DAY)	605	636	671	1266	1490	1770	2310	2879	3647	5293
TELEGRAPH (WORDS/DAY)		36932	34712	48630	44932	45945	45699	48466	49096	49342

Figure 5-2
Israel - Key Statistics Relative to Telecommunications Development

A. BASIC SECTOR DATA

	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
POPULATION ('000'S)	1880	1950	2010	2080	2150	2230	2299	2375	2453	2537
GROSS DOMESTIC PRODUCT (MIL. US$)	417	469	478	545	524	615	588	626	671	813
NO. OF D.E.L.'S		19838	21443	23962	16600	17185	17785	20012	20964	21461
NO. OF TELEX SUBS.						27	37	43	51	
GDP/CAP. (US$/CAP)	222	241	238	262	244	276	256	264	274	320
D.E.L./100 CAP		1.0173	1.0668	1.1520	0.7721	0.7706	0.7736	0.8426	0.8546	0.8459
TELEX/10'000 CAP						0.1211	0.1609	0.1811	0.2079	

B. INTERNATIONAL TRADE

TOTAL IMPORT (MIL. US$)	149	156	190	154	160	189	184	214	266	335
TOTAL EXPORT (MIL. US$)	19	21	24	31	40	41	34	32	48	59
TOTAL IMP + EXP (MIL. US$)	169	178	215	185	200	230	218	246	314	394
IMP+EXP/CAP. (US$/CAP) (MIL. US$)	90	92	107	89	93	103	95	104	128	155

C. INTERNATIONAL OUTGOING TRAFFIC

TELEPHONE (MIN/DAY)							1451	1751	1884	1902
TELEX (MIN/DAY)						17	130	193	309	486
TELEGRAPH (WORDS/DAY)					6864	7728	8592	9456	10321	13771

Figure 5-3
Jordan - Key Statistics Relative to Telecommunications Development

A. BASIC SECTOR DATA

	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
POPULATION ('000'S)	2340	2410	2470	2550	2620	2700	2787	2873	2962	3055
GROSS DOMESTIC PRODUCT (MIL. US$)	1042	1148	1231	1194	1352	1400	1488	1842	2009	2569
NO. OF D.E.L.'S	73000	80500	89000	97000	104000	125000	142000	156562	191600	226700
NO. OF TELEX SUBS.	111	116	162	208	255	350	428	635	800	
GDP/CAP. (US$/CAP)	445	476	498	468	516	519	534	641	678	841
D.E.L./100 CAP	3.1197	3.3402	3.6032	3.8039	3.9695	4.6296	5.0951	5.4494	6.4686	7.4206
TELEX/10'000 CAP	0.4744	0.4813	0.6559	0.8157	0.9733	1.2963	1.5357	2.2102	2.7009	

B. INTERNATIONAL TRADE

TOTAL IMPORT (MIL. US$)	545	581	636	471	521	531	567	677	849	1186
TOTAL EXPORT (MIL. US$)	98	105	119	119	146	170	197	256	350	503
TOTAL IMP + EXP (MIL. US$)	643	687	755	590	667	702	765	933	1199	1689
IMP+EXP/CAP (US$/CAP) (MIL. US$)	275	285	306	231	255	260	275	325	405	553

C. INTERNATIONAL OUTGOING TRAFFIC

TELEPHONE (MIN/DAY)	901	1100	1347	1685	1962	1892	3470	5434	13399	
TELEX (MIN/DAY)	410	593	735	1068	1315	1591	1771	2658	4828	
TELEGRAPH (WORDS/DAY)						26070	25792	29145		34549

Figure 5-4
Lebanon - Key Statistics Relative to Telecommunications Development

A. BASIC SECTOR DATA

	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
POPULATION ('000'S)	6592	6772	6958	7148	7344	7545	7740	7965	8195	8443
GROSS DOMESTIC PRODUCT (MIL. US$)	2087	2325	2669	2964	3277	3550	3937	4855	5819	9369
NO. OF D.E.L.'S	28000	28500	28500	28500	28500	28500	29407	34748	55789	62574
NO. OF TELEX SUBS.										65
GDP/CAP. (US$/CAP)	317	343	384	415	446	471	509	610	710	1110
D.E.L./100 CAP	0.4248	0.4209	0.4096	0.3987	0.3881	0.3777	0.3799	0.4363	0.6808	0.7411
TELEX/10'000 CAP										0.0770

B. INTERNATIONAL TRADE

TOTAL IMPORT (MIL. US$)	301	376	457	507	563	747	692	806	1127	1893
TOTAL EXPORT (MIL. US$)	1181	1329	1519	1799	2026	2001	2423	3845	5490	7616
TOTAL IMP + EXP (MIL. US$)	1483	1706	1976	2306	2589	2748	3115	4651	6617	9509
IMP+EXP/CAP (US$/CAP) (MIL. US$)	225	252	284	323	353	364	402	584	807	1126

C. INTERNATIONAL OUTGOING TRAFFIC

TELEPHONE (MIN/DAY)									1328	3224
TELEX (MIN/DAY)									190	365
TELEGRAPH (WORDS/DAY)								111706	116767	146936

Figure 5-5
Saudi Arabia - Key Statistics Relative to Telecommunications Development

A. BASIC SECTOR DATA

	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973
POPULATION ('000'S)	5150	5320	5490	5670	5860	6050	6258	6464	6679	6890
GROSS DOMESTIC PRODUCT (MIL. US$)	1203	1208	1230	1423	1443	1570	1684	1950	2327	2462
NO. OF D.E.L.'S		56884	62456	66118	69820	74660	79792	87987	98731	108947
NO. OF TELEX SUBS.							13	27	32	56
GDP/CAP. (US$/CAP)	234	227	224	251	246	260	269	302	348	357
D.E.L./100 CAP		1.0692	1.1376	1.1661	1.1915	1.2340	1.2750	1.3612	1.4782	1.5812
TELEX/10'000 CAP							0.0208	0.0418	0.0479	0.0813

B. INTERNATIONAL TRADE

TOTAL IMPORT (MIL. US$)	235	212	288	264	303	367	357	438	477	595
TOTAL EXPORT (MIL. US$)	176	168	173	152	172	206	202	207	254	339
TOTAL IMP + EXP (MIL. US$)	411	381	461	416	475	574	559	645	731	934
IMP+EXP/CAP (US$/CAP) (MIL. US$)	80	72	84	73	81	95	89	100	109	136

C. INTERNATIONAL OUTGOING TRAFFIC

TELEPHONE (MIN/DAY)						8013	7858	8486	8974	10530
TELEX (MIN/DAY)							8	73	109	282
TELEGRAPH (WORDS/DAY)	7473	7710	9700	13686	15536	15686	15883	17040	19023	21913

Figure 5-6
Syria - Key Statistics Relative to Telecommunications Development

FIGURE 5-7

FORECAST OF DIRECT EXCHANGE LINES
AND TELEX SUBSCRIBERS

A. DEL (in thousands)

	1978	1980	1985	1990
1. Egypt	392	472	1700	3100
2. Israel	687	786	1077	1441
3. Jordan	55	75	155	320
4. Lebanon	400	513	885	1600
5. Saudi Arabia	440	600	1100	2200
6. Syria	240	330	690	1400

B. Telex Subscribers

	1978	1980	1985	1990
1. Egypt	7500	11000	22000	40000
2. Israel	2566	3000	3820	4650
3. Jordan	550	800	2100	5000
4. Lebanon	5000	7000	15000	25000
5. Saudi Arabia	7000	15000	18000	30000
6. Syria	3500	5000	10000	17000

FIGURE 5-8

FORECAST OF INTERNATIONAL TRAFFIC

A. Telephone Outgoing Traffic (Thousand minutes/day)

	1978	1980	1985	1990
1. Egypt	31	52	177	675
2. Israel	31	77	155	312
3. Jordan	18	25	56	125
4. Lebanon	80	109	239	526
5. Saudi Arabia	30	48	140	608
6. Syria	36	51	120	303

B. Telex Outgoing Traffic (Thousand minutes/day)

	1978	1980	1985	1990
1. Egypt	65	90	170	280
2. Israel	3	10	18	32
3. Jordan	5	7	17	38
4. Lebanon	40	55	110	175
5. Saudi Arabia	55	65	125	200
6. Syria	28	40	75	125

Figure 5-9

Intra-Regional Circuit Traffic Matrix

Initial Design Capacity
for 1980

	EGYPT	ISRAEL	JORDAN	LEBANON	SAUDI ARABIA	SYRIA
EGYPT		120	60	12	12	12
ISRAEL	120		180	48	12	48
JORDAN	60	180		48	24	108
LEBANON	12	48	48		12	120
SAUDI ARABIA	12	12	24	12		12
SYRIA	12	48	96	120	12	
TOTAL	216	408	405	240	72	300

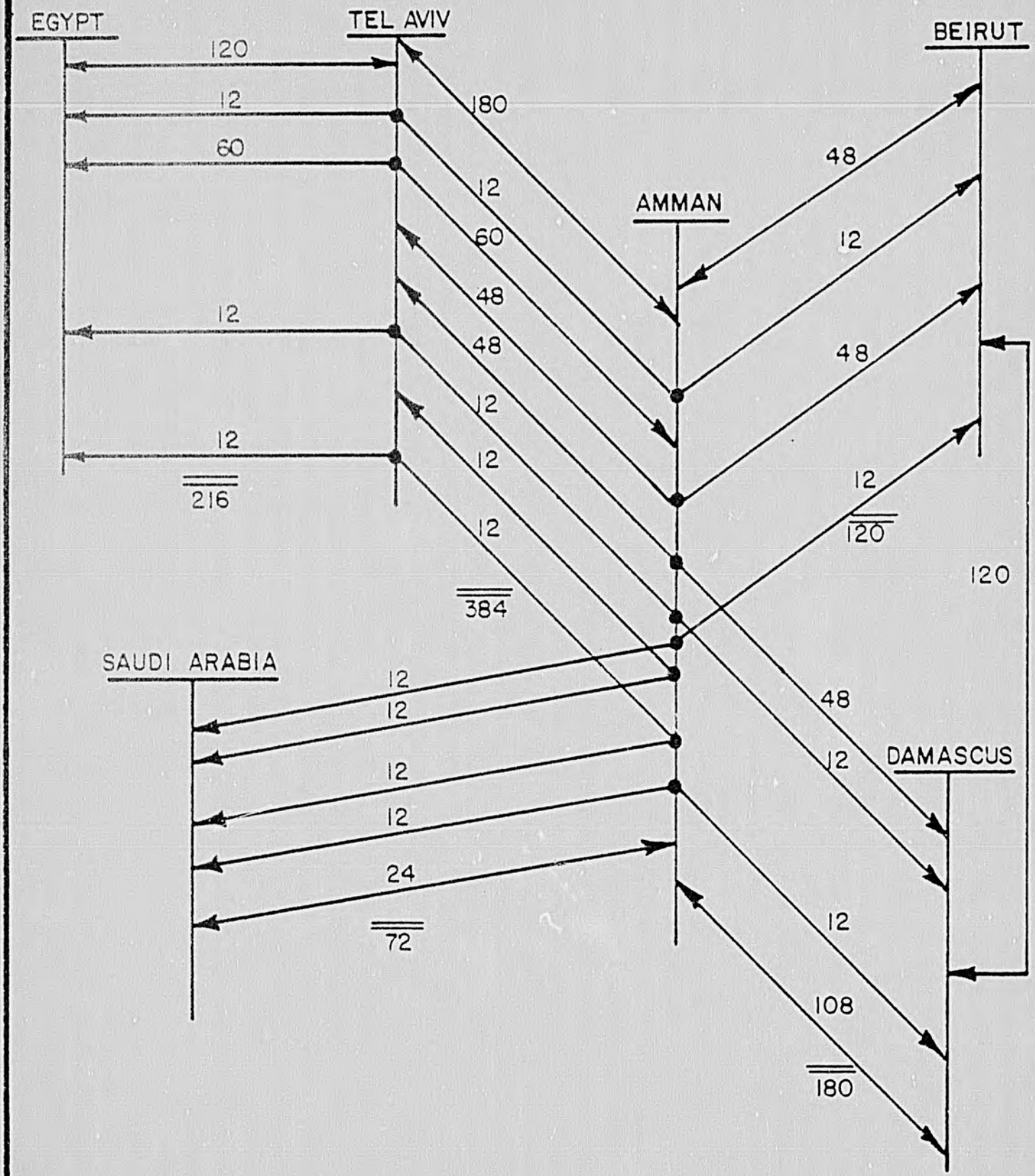


FIGURE 5-10

INTRA-REGIONAL TRAFFIC CIRCUIT ROUTINGS
AND CROSS SECTIONS
INITIAL DESIGN CAPACITY FOR 1980

SECTION 6

ANALYSIS OF ALTERNATIVE PLANS AND APPROACHES

6.1 TECHNICAL/ECONOMICAL FEASIBILITY

There are a number of instrumentalities that could be used to provide intra-regional service in the study area. Satellites, submarine cable, coaxial cable, radio relay, tropo-scatter and short-haul cable carrier are some of the types of systems which could be utilized. This section will briefly discuss the various alternatives and their advantages and disadvantages for this particular application.

6.1.1 Satellites

Since satellite costs are independent of distance, their basic field of use, for voice communications, is for long-haul circuits in the order of 1,000 miles or more. The average circuit length in the instant study is in the order of 2/300 miles, or well below the economic range of satellites. This is particularly true where a basic high-capacity terrestrial route already exists for most of the distance. Figure 6-1 shows a cost comparison between satellite and terrestrial facilities for a typical circuit that would be utilized in this intra-regional network. It can be seen that the annual cost per circuit for a satellite system is seven times the per circuit cost for microwave radio relay. Because of this cost penalty and since the region is fairly compact, a regional satellite system appears to have limited applicability for the purposes of this study (ARABSAT, of course is such a system; however it is not scheduled to be available until about 1983; ARABSAT and INTELSAT are discussed further in Sections 4.10 and 4.11 of this report.)

There could, however, be conditions which would make the use of satellite service attractive in meeting the needs of the area. Perhaps the most significant advantage in using satellites is the short implementation time which could be exploited if time intervals are such that terrestial link

implementation would not meet the imposed time schedules. Satellite service could be achieved either of two ways, namely, flying in portable or small stations which could provide a bearer to carry the traffic, or to reconfigure existing satellite service via INTELSAT. Both of these alternatives are discussed below.

6.1.1.1 Establishment of Additional Satellite Facilities

New portable or small stations have a finite procurement time, however, there are now many manufacturers of such equipment, of which some may have prototype and or demonstration units, and there are several satellite system operators or carriers, who may have portable or emergency service units which could be placed into service very quickly. Such entities might readily seize the opportunity to have their facilities involved in the pacification process, for any of several reasons from humanitarian desires, for the advertising value of such service or for the opportunity of future business. The details of possible sourcing for this ground segment of a satellite link, including response time and cost, would require further study.

Implementation of a new satellite link also requires the availability of a space segment. Possibilities for such service are by an INTELSAT lease or possibly another satellite such as the Franco-German Symphony.

Finally, interfacing with the existing national network is required. This involves such technical and administrative details as earth station to national network interconnect, channel signalling, switching and service billing. Determination of the complexity of each of these matters requires a site survey.

6.1.1.2 Utilization of Existing Satellite Facilities

As shown in Section 4, INTELSAT earth stations are available in each of the study countries and are used primarily for longer haul international connections, although they can be and are utilized for some regional traffic. This network, with its established ground and space segments could be temporarily expanded to provide almost immediate new paths. Existing paths in the study area exclude Israel, see Figure 4-9. New paths via the AOR Primary Path satellite could be established between Israel and Egypt, Jordan or Saudi Arabia. The near proximity of Israel administered and Jordanian population centers, with their social affinity and potentially large traffic demands, points toward utilization of other methods as being better for establishing new West-East

Bank paths, but the Egypt and Saudi Arabia paths appear to be logical choices to use satellite service.

It is usual that INTELSAT network stations have unused (expansion) channels available, in fact it would be unusual if the respective administrations had not already internally addressed the possibility of establishing INTELSAT paths immediately upon signature of agreement, if not before. Determination of the number of circuits which could be immediately established would require a survey of the existing facilities. Such a survey would also be required in order to determine the quantity and type of new equipments which would be required to establish new circuits in quantity, either by adding to the existing frequency division multiplex (FDM) service or using Single Channel Per Carrier (SCPC) techniques.

6.1.2 Underseas Cable

There are existing and proposed underseas cables within the region under study and, where available, these cables will be utilized as links in this regional study. It is not proposed, however, to construct any additional underseas cables as a part of this study (from Alexandria to Tel Aviv, for example) due to the sizeable cost penalties as compared with other terrestrial facilities (Figure 6-2).

6.1.3 Coaxial Cable

Most of the countries in the study area have existing and planned coaxial cable facilities in their national networks. These cables will be utilized, where economically attractive, in providing the intra-regional communications links in this study. The initial costs for coaxial construction are generally higher than for radio relay since the majority of the total plant must be installed initially (i.e., the only coaxial investment that can be deferred is the equipping of additional coaxial pairs with repeaters as requirements increase). On the other hand, the initial investment for radio relay construction is less, percentagewise, since growth radio channels do not have to be added until needed. Exceptions to this generality are in fast-growing, high capacity routes where the interval between the initial service and full route capacity is relatively short. In this case, the deferral of capital expenditures for

growth makes the two facilities about equal from a capital expenditure standpoint and the lower annual charges of the coaxial system will "prove-in" the cable over radio relay.

Another exception is the use of the smaller size coaxial cable where ultimate requirements will permit its use. The small size coaxial competes favorably with radio relay on an annual charge basis (Figure 6-3) and the first costs are not appreciably higher than radio relay. Thus, the small size coaxial cable has a field of use in this study.

6.1.4 Radio Relay

Based on the estimated circuit quantities and growth rates in the study region, radio relay construction would appear to be the most economical facility for the intra-regional linkages. It is desirable, however, to have a diversified type of facility where economically feasible. For this reason, both coaxial cable (small size coaxials) and radio relays are utilized in this study.

6.1.5 Tropo-Scatter

The use of tropospheric scatter radio should be considered only where there is a combination of low circuit demand (up to 120 circuits for high power or up to 24 circuits for low power) and a need far beyond the horizon hop lengths, 300 to 450 km for high power or 250 to 300 km for low power. Because of the higher ultimate circuit requirements anticipated in this region, tropo-scatter was ruled out in favor of radio relay or coaxial cable. Further, as covered elsewhere in this report, the necessary cooperation and working together necessitated by a more physical link (such as coaxial or radio relay) would appear to better meet the aims of this study project.

6.1.6 Cable Carrier (non-coaxial)

The utilization of short-haul carrier systems on voice-frequency cables (both digital and analog) has a definite field of use in the region under study. It is visualized that there will be many cross-border situations where there is a large community of interest that requires good, economical telecommunications. Small additions of connecting-link cable and short-haul carrier will provide an economical solution to these cross-border situations. Due primarily to time

restraints and lack of valid information on much of the local cable plant in the involved countries, no attempt was made in this study to include these more local, intra-regional community-of-interest telecommunications opportunities. Perhaps this aspect of the intra-regional telecommunications project can be covered in future studies as there appears to be a fertile field in this area in meeting many of the study objectives on a more local scale.

6.2 DESCRIPTION OF POTENTIAL PROJECTS

This section will discuss the projects that have potential application as links in establishing an intra-regional telecommunications system.

6.2.1 Israel-Egypt

As can be seen from the facility maps for Egypt and Israel (Figure 4-1 and 4-2), high-capacity radio relay and coaxial routes exist in both countries, however, there is a void of facilities across the Sinai Peninsula. Two basic routes are considered in this study for construction to fill this void and to provide basic routes for communications between Egypt and Israel and other regional partners to the east and north. The first route would extend from Ismailiya, Egypt to Ber Sheba, Israel and the second route would link Suez, Egypt to the northern end of the Gulf of Aqaba (Figure 6-4). Such a route, if constructed, could interconnect Egypt with Saudi Arabia (at Haql), Jordan (at Aqaba) and Israel (at Elat).

The first route could be effected with either an estimated 6-hop radio relay or small tube coaxial cable. The cable would consist of four tubes equipped for 6 MHz operation which would provide an ultimate capacity of 2520 channels or 1260 voice channels and one TV channel in each direction. If necessary, it could be converted at a later date for 12 MHz operation which could provide as many as 5400 voice channels or 3900 voice channels and one TV channel in each direction. Both the radio relay and more so, the cable, would, in general, follow the highway route from Ismailiya, across the Sinai, to Ber Sheba, a distance of approximately 270 km. Dropping and blocking multiplex equipment and appropriate connectors would be necessary at both ends of the route whether coax or radio relay, in order to carry circuits from Cairo and Alexandria to Tel Aviv, Jerusalem, Haifa, Amman, Damascus and other appropriate circuit destinations. Whether this route should be coaxial cable or radio relay should be decided following a field survey of the area and the more accurate determination of those considerations discussed below.

The second route, because of the terrain traversed (the Sinai and the Gulf of Aqaba), would more likely be limited to the use of radio relay and would require construction of an estimated 5 intermediate relay stations. It would thus also provide a good alternate route to Saudi Arabia, Israel and Jordan. In addition to its through communications value, its construction would help further the development of the Sinai Peninsula and would be of particular value should the proposed road tunnel under the Suez Canal become a reality. A good highway connection would result in increased commercial and tourist traffic with their inherent telecommunications demand.

Other parameters which need to be weighed in routing and equipping decisions include fiscal, cultural and developmental considerations. Concerning cost, it is estimated that radio relay, for the first (northerly) route discussed above, could be emplaced at a savings in first cost of approximately $1 M. The annual charges are comparable for the two types of systems, but on the other hand coaxial cable for this route would provide transmission diversity since the proposed second (southerly) route will almost certainly be radio relay. One of the advantages of radio relay is the convenience of dropping and inserting channels along the route, which cannot be done so economically as with coaxial cable. The capability thus exists to serve rural and industrial communities along the route. A low capacity radio relay network might one day criss-cross the strategic (in terms of economic, oil production and social values) localities as a spin-off from a cross Sinai route. This network's flexibility could be enhanced if both the northern and southern routes were radio relay, thus better accommodating those developments discussed in paragraph 2.2.

6.2.2 Jordan - Saudi Arabia

A radio relay connection from Ma'an, Jordan to Halat Ammer, Saudi Arabia is proposed for service in 1980 by a CCITT Committee (Plan Committee for Asia and Oceania). If such a route develops, it would serve as a good interconnection route from Saudi Arabia to all of the other regional partners included in the instant study. At Ma'an, radio relay facilities are existing in Amman and its interconnecting points. Halat Ammer interconnects with the Saudi Arabia Intra-Kingdom microwave network (see Figure 4-3).

If this route is not developed, an alternative route is included in this study. The alternative is a radio relay connection from Aqaba (or Jebel Mulkan) to Haql in Saudi Arabia (Figure 6-4). Haql is also on the Intra-Kingdom microwave network and Aqaba connects to Ma'an and Amman by existing microwave. Either route would serve the purpose of this study, but a full investigation would be required to determine the most economical route.

6.2.3 Israel - Jordan

Construction of a direct microwave link between the existing Salt junction station (Sweileh) in Jordan and the existing microwave terminal at Jerusalem (Figure 6-5) would provide an economical, high-capacity link between Jordan and Israel. Such a linkage would also enable traffic from Egypt and Israel to transit Jordan to access Syria (Damascus) and Lebanon (Beirut). High capacity radio routes could be augmented to provide circuits to Israel and Egypt. The addition of channel banks at Jerusalem would provide the means of interconnecting the rest of the region with locations in the West Bank.

6.2.4 Israel - Lebanon/Syria

To link Israel with Lebanon and Syria directly (rather than transiting Jordan, a radio relay connection is proposed from Haifa, Israel to a junction station on the existing radio relay route between Amman, Jordan and Saida, Lebanon (Figure 6-5). Such a connection would only require 1 intermediate station and would provide circuit access from Israel to Lebanon as well as providing an economical backup facility from Israel to Jordan. At Haifa, circuits from Lebanon could be extended on existing routes to Tel Aviv, Jerusalem and to Jordan and Egypt over linkages proposed above.

The further extension of the proposed route from Haifa, Israel (discussed above) on to Damascus, Syria may be effected with the addition of a maximum of one intermediate station, based on a study of available maps. This should be verified by field survey. This added connection would provide Israel with an economical direct connection to Syria and would provide an additional route for circuits from Egypt to Syria.

6.2.5 Saudi Arabia - Syria

The construction of a radio relay link from Quraiyat, on the Saudi Arabia Intra-Kingdom microwave route, to Suweida, a junction station on the existing Amman-Damascus radio relay route, would provide an economical link from points in Saudi Arabia to Syria, Lebanon and Jordan and would provide a diversified routeing for this intra-regional traffic. Four new intermediate repeater stations are estimated to be required as well as antenna and radio additions at Quraiyat and Suweida. The approximate routing of the proposed interconnection is shown in Figure 6-5.

6.3 ECONOMIC/COST ANALYSIS

Cost data utilized in this study was obtained primarily from a 1976 study (base on 1975 prices) made of the Mid-East and Mediterranean Area by the ITU under the auspices of the United Nations Development Program. These costs appeared to be the most accurate available for the area involved. The applicable cost data is summarized in Appendix 1. These prices have, for the purpose of this study, been increased by 61% to an expected 1980 cost, using a 10% annum inflation rate, compounded.*

The costing procedure for each route consisted of, first, determining the new investment required to establish a link. This cost, independent of the transmission method chosen, is made up of two components, namely, the cost of the bearer itself, e.g., radio relay, coaxial cable etc.,plus the interfacing costs. These interfacing costs include a pro rata share of the channel banks, connectors and other necessary multiplex equipment, on an average basis, which would have to be installed in order to connect the circuits into existing facilities. This overall initial investment is designated in the text and tables herein as the total "out-of-pocket" cost. The second step in the costing procedure is to determine the amount of investment in the existing facility which is used in the process of interconnecting the new link (complete with interfacing equipment) via the existing plant into the switching centers of the respective national networks. This cost has been based on the average cost per circuit per kilometer for the transmision means presently existing and into which the new link would connect. The sum of these,

---

*The prices shown are not adusted by the difficulty factor, risk factor or an overall program management factor which are discussed in paragraph 7.1.2.

namely the out-of-pocket cost for the new link and the amount of investment used constitutes the total investment of the new route.

It is noted that the total investment calculation assumes that baseband capacity is available on the existing routes without construction of additional radio or coaxial bearers. Undoubtedly there will be some existing sections that will have to be reinforced and additional dollars will have to be spent. However, for the purposes of this study, it is assumed that these capital dollars would have to be spent at some time anyway for normal growth and that the addition of the intra-regional circuits merely advanced these expenditures. Thus, the penalty to this study would be the carrying charges on the capital dollars for the period of the advancement which is considered to be small in relation to the total expenditures.

Each of the routes discussed in paragraph 6.2 above was investigated for feasibility utilizing a topographical map for route inspection. The only readily available maps were 1:1,000,000 and 1:250,000 scale and were not finegrain enough to run accurate profiles. Assumptions on intermediate and terminal station altitude had to be made which could differ from actual locations and tower heights should the proposed routes be constructed. It is anticipated, however, that such changes would have only a moderate affect on the total cost.

A summary of costs for each proposed route is shown in Figures 6-6 through 6-9. Circuit quantities were used as developed in Section 5. A cost of $8.50/cct/km was used from Appendix 1 to obtain the investment in existing routes for assumed average circuited lengths. No fill-factor was applied since the $ 8.50 represents the higher end of the cost scale and its equivalence to a cost/circuit/km of $11.25 at 75 fill. Terminal costs of $1000.00 per circuit were used to cover the cost of channel banks, group and supergroup and a pro-rata share of other terminal equipment. As explained above it is assumed that these costs would be out-of-pocket, i.e. would require new investment, whereas the investment per circuit per kilometer is considered as an existing investment.

FIGURE 6-1

TYPICAL CIRCUIT COSTS

REGIONAL SATELLITE VS. RADIO RELAY

Comparison of First Costs and Annual Charges for an Average Length Circuit (650 km) in Mid-East Region Under Study.

Regional Satellite

Assume 500 channels/transponder and 2 transponders/earth station.

- First Costs - Earth Station only:

$1.6M per earth station x 2 stations	$ 3.2M
Inflated cost, 61%	1.95M
Projected 1980 cost	$ 5.15M
Cost/cct = 5.15/1000 channels	$5150/cct

- Annual Charges:

Basic cost/cct x 23.5 1/	$ 1,210
Space segment at $5000 2/ per half cct	10,000/cct
Total	$11,210/cct

Radio Relay

- First Costs:

$8.5/cct/km = 8.5 x 650 km	$ 5,525/cct
Inflated cost, 61%	3,370
Projected 1980 cost	$ 8,895/cct

- Annual Charges:

$8,895/cct x 20.7% 1/	$ 1,841/cct

Summary:

Annual Charge per 650 km cct	Satellite	Radio Relay
	$11,210	$1,841

1/ Annual Cost Factors, ITU Reference, P4.8

2/ Expected Intelsat half-circuit charge, per annum, 1980

FIGURE 6-2

TYPICAL CIRCUIT COSTS, SUBMARINE CABLE VS. RADIO RELAY

Comparison of First Costs and Annual Charges for a Submarine Cable from Alexandria to Tel Aviv vs. Radio Relay Construction Across Sinai and Use of Existing Routes to Cairo and Tel Aviv.

Submarine Cable (1380 channel capacity)

- Fixed Costs

1,380 channel capacity, basic fixed cost	$ 3.0M 1/
Distance cost, 500 km x $1.4 1/ (per 100 km)	7.0M
Total cost, 1975 prices	$10.0M
Inflated cost, 61	6.1M
Projected 1980 cost	$16.1M

	500 ccts	1000 ccts
First costs per cct	$32,000	$16,100
Annual Charge at 15 2/	$ 4,830	$ 2,415

Radio Relay (6 new stations plus 1/2 station at each end to connect to the existing facilities)

- First Costs

6 stations at $350,000/station	$ 2.1M
2 existing stations equipped to connect to new link at 150,000 each	.3M
Total new equipment cost, 1975 prices	$ 2.4M
Inflated cost, 61	$ 1.5M
Projected 1980 cost	$ 3.9M

	500ccts	1000 ccts
First costs per cct	$7,800	$3,900
Existing facilities path upgrade, 375km x $8.5 per cct/km	3,190	3,190
Inflated cost, 61	1,940	1,940
Projected 1980 cost	5,130	5,130
Total first cost/cct	$12,930	$9,030
Annual charges 20.7 2/	$ 2,677	$1,869

Summary

	Fixed Costs/cct		Annual Charge/cct	
	500 ccts	1000 ccts	500 ccts	1000 ccts
Submarine Cable	32,200	16,100	4,830	2,415
Radio Relay	12,930	9,030	2,677	1,869

1/ ITU Study ₽ 4.2.2
2/ ITU Study ₽ 4.3

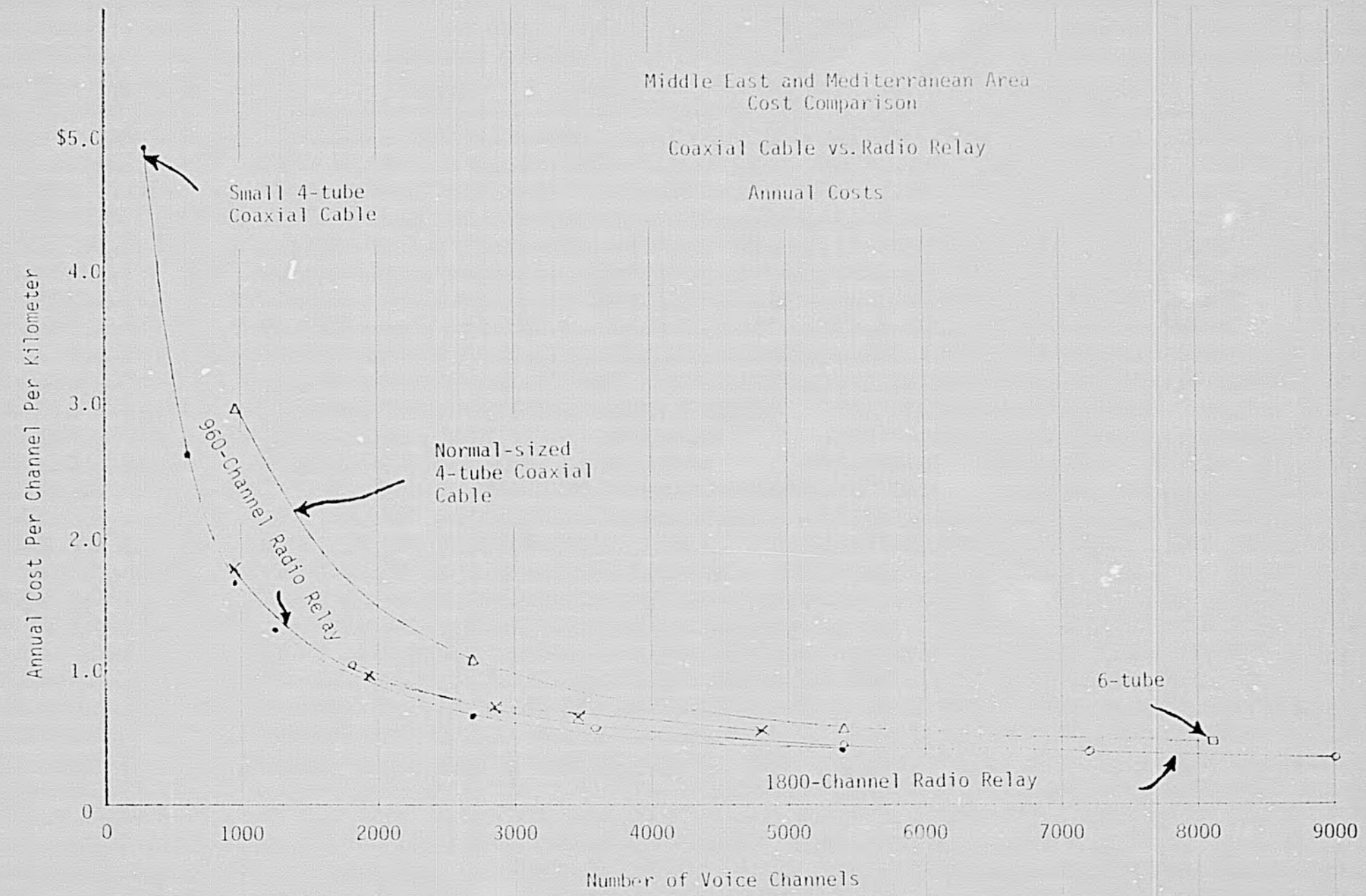

Middle East and Mediterranean Area
Cost Comparison
Coaxial Cable vs. Radio Relay
Annual Costs
Small 4-tube
Coaxial Cable
Normal-sized
4-tube Coaxial
Cable
960-Channel Radio Relay
6-tube
1800-Channel Radio Relay
Annual Cost Per Channel Per Kilometer
$5.0
4.0
3.0
2.0
1.0
0
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Number of Voice Channels

Figure 6-3

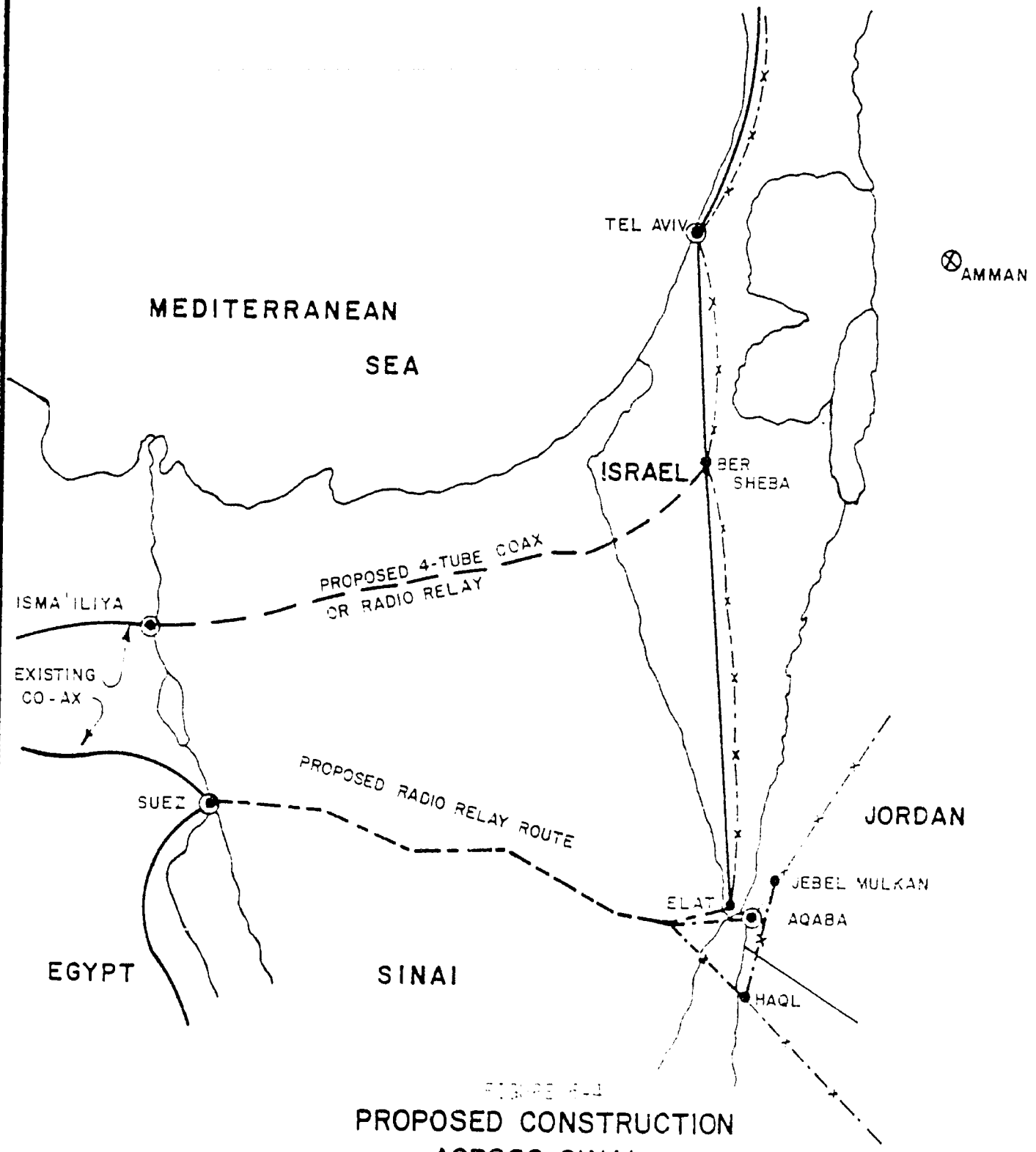


FIGURE A-1

PROPOSED CONSTRUCTION
ACROSS SINAI
SAUDI ARABIA-JORDAN

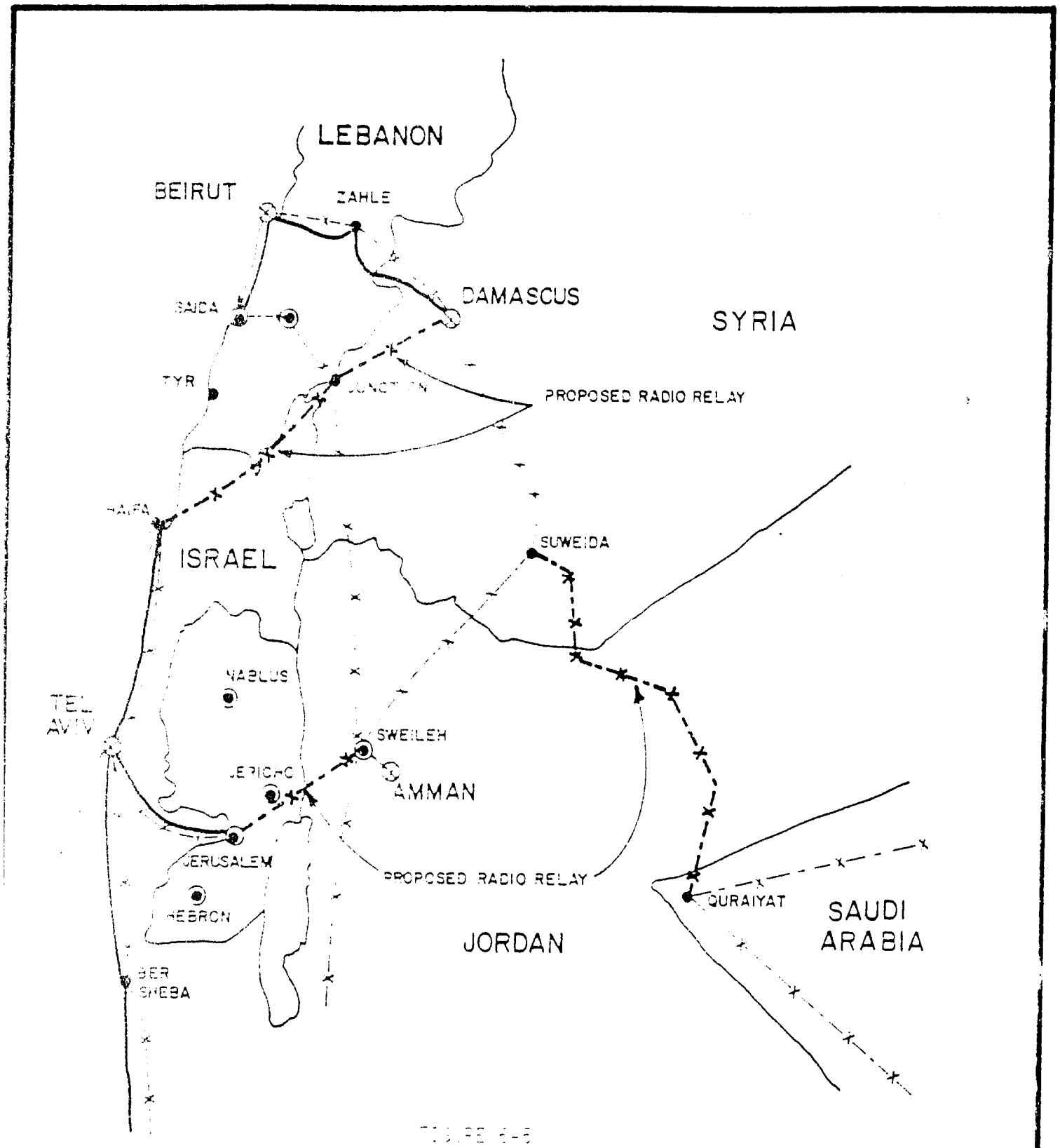


FIGURE 6-5

PROPOSED CONSTRUCTION
ISRAEL - JORDAN
ISRAEL - SYRIA
SAUDI ARABIA - SYRIA

FIGURE 6-6

COST DATA--SINAI PENINSULA

Ismailiya-Ber Sheba Coaxial Route (270 km)

Proposed 4-tube, small-size, 6 MHz system one pair equipped - 1260 channel capacity: First cost - $10,700/km[1] x 270 km	$ 2.9 M
Inflated cost, 61%	1.8 M
Projected 1980 cost	$ 4.7 M
Additional plant to add to existing routes to extend service to Cairo, to Tel-Aviv, Beirut, Damascus, etc.; Assume 200 ccts with an average length of 650 km.	
1) 650 (average length) - 270 (new coax) = 390 km 380 x $8.5 per cct/km x 200 ccts =	$ 0.65M
Inflated cost, 61%	0.40M
Projected 1980 cost	$ 1.05M
2) 200 ccts x $1000/terminal x 2 terminals (one at each end) =	$ 0.40M
Inflated cost, 61%	0.24M
Projected 1980 cost	0.64M
• Total out-of-pocket costs (4.7 + 0.64)	5.34M
• Total investment (4.7 + 0.64 + 1.05)	6.39M

Ismailiya-Ber Sheba Radio Relay Route (270 km)

Proposed 6 intermediate station route Projected cost 1980 (See Figure 6-2)	$ 3.90M
Additional plant to add to existing routes to extend service from Cairo to Tel Aviv, Amman, Beirut, Damascus, etc. Assume 200 ccts with an average length of 650 km	
1) Average circuit costs, same as co-ax (above)	
Projected 1980 cost	$ 1.05M
2) Terminal costs, same as co-ax (above)	
Projected 1980 cost	$ 0.64M
• Total out-of-pocket costs (3.9 + 0.64)	$ 4.54M
• Total investment (3.9 + 0.64 + 1.05)	$ 5.60M

1/ ITU Report, Table 4.5.7.

Figure 6-6 (continued)

Figure 6-6 (continued)

SUMMARY COMPARISON

	Coaxial Cable	Radio Relay
• Total out-of-pocket cost	$ 5.34 M	$ 4.54 M
• Total investment	6.39 M	5.60 M

Suez-Elat/Aqaba/Haql Radio Relay Route

Assume 5 new stations at $ .35 M	=	$ 1.75M
Equipping 3 existing stations at $ .15 M	=	.45M
New terminal station at Suez $ .3 M	=	.3 M
Dropping & blocking equip at Jct. stn	=	.1 M
TOTAL	=	$ 2.6 M
Inflated cost, 61		1.59M
Projected 1980 cost		$ 4.19M
Assume 100 growth ccts, average length 700 km		
1) 700 (average length) -150 (new route) = 450 km 450 x $8.5 per cct/km x 100 ccts =		$ 0.383M
Inflated cost, 61		0.233M
Projected 1980 cost		$ 0.616M
2) 100 ccts x 1000/terminal x 2 terminals (one at each end)		$ 0.20 M
Inflated cost, 61		0.12 M
Projected 1980 cost		$ 0.32 M
• Total out-of-pocket costs (4.19 + 0.32)		$ 4.51 M
• Total investment (4.19 + 0.32 + 0.616)		$ 5.126M

FIGURE 6-7

COST DATA--JORDAN-ISRAEL/SAUDI ARABIA

Salt Junction (Sweileh) - Jerusalem Radio Relay Route

Assume direct hop Sweileh - Jerusalem	
Equipment at adjacent stations at $0.15M	$ 0.3 M
Inflated cost, 61	0.18M
Projected 1980 cost	$ 0.48M
Assume 400 ccts with an average length of 500 km	
1) 500 (average length) -60 (new path) = 440 km	
440 x $8.5 per cct km x 400 ccts	$ 1.5 M
Inflated cost, 61	0.92M
Projected 1980 cost	$ 2.42M
2) 400 ccts x $1000 terminal x 2 terminals (one at each end)	$ 0.80M
Inflated cost, 61	0.49M
Projected 1980 cost	$ 1.29M
• Total out-of-pocket costs (0.48 + 1.29)	$ 1.77M
• Total investment (0.48 + 1.29 + 2.42)	$ 4.19M

Aqaba-Haql Radio Relay Route

Equipment at adjacent stations at $0.15M	$ 0.30M
Inflated cost, 61	0.18M
Projected 1980 cost	$ 0.48M
Assume 75 ccts with an average length of 1200 km:	
1) 1200-50 (new route) = 1150 km	
1150 x $8.5 per cct km x 75 ccts	$ 0.733M
Inflated cost, 61	0.447M
Projected 1980 cost	1.18 M
2) 75 ccts x $1000 terminal x 2 terminals (one at each end)	$ 0.150M
Inflated cost, 61	0.092M
Projected 1980 cost	$ 0.242M
• Total out-of-pocket cost (0.48 + 0.242)	$ 0.722M
• Total investment (0.48 + 0.242 + 1.18)	$ 1.90 M

FIGURE 6-8

COST DATA--ISRAEL-LEBANON/SYRIA

Haifa-Junction on Amman-Saida Radio Relay Route

Assume one new intermediate station	$ 0.35M
Equipment at adjacent stations at $0.15M	0.30M
Convert Junction station to main station	0.25M
Total	$ 0.9 M
Inflation cost, 61	.55M
Projected 1980 cost	$ 1.45M
Assume circuits on this route were previously routed via Amman - no additional cost	
Total Investment/out-of-pocket cost	$ 1.45M

Damascus-Junction on Amman-Saida (Beirut) Radio Relay Route

Assume one new intermediate station	$ 0.35M
Equipment at adjacent stations at $0.15M	0.30M
Total	$ 0.65M
Inflation cost, 61	0.40M
Projected 1980 cost	$ 1.05M
Assume circuits on this route were previously routed via Amman or Lebanon - no additional cost.	
Total Investment/out-of-pocket cost	$ 1.05M

FIGURE 6-9

COST DATA--SAUDI ARABIA-SYRIA

Quraiyat-Suweida Radio Relay Route

Assume four new intermediates at $0.35M	$ 1.4 M
Equipment at adjacent stations at $0.15M	.3 M
Dropping and blocking equip. at Suweida	.1 M
TOTAL	$ 1.8 M
Inflation Cost, 61	1.1 M
Projected 1980 Cost	$ 2.9 M
Assume 100 cct growth, average length 1200 km	
1) 1200-150 km (new route) = 1050 km 1050 x $8.5 per cct km x 100 cct =	$ 0.893M
Inflation cost, 61	0.544M
Projected 1980 cost	$ 1.437M
2) 100 ccts x $1000/terminal x 2 terminals (one at each end)	$ 0.02 M
• Total out-of-pocket cost (2.9 + 0.2)	$ 3.1 M
• Total investment (2.9 + 0.2 + 1.437)	$ 4.54 M

SECTION 7

RECOMMENDATIONS

7.1 PRIORITY LISTING OF FEASIBLE PLANS

7.1.1 General

As covered in Section 6, there are a number of interconnecting links that are technically and economically feasible to provide an integrated mid-eastern regional network as covered in the study objective. Certain of these links are considered as primary links to provide maximum interconnectability and other links are considered as secondary or back-up links that will provide alternate routings and more direct interconnections. Thus it is possible to prioritize the proposed construction on the basis of what should be done first to obtain maximum benefits per dollar expenditure, and what construction is desirable but can be deferred until adequate funding is available.

The proposed construction falls into five priority groupings as described below. A connectability chart is also shown for each priority to indicate those countries that can be interconnected directly and those that are interconnected via an intermediate country. The charts also indicate whether back-up or alternate routes are available and as successive priorities are implemented, the availability of alternate routes increases until finally, with the completion of priority 4, complete back-up is available for all routes.

As proposed, the indicated priorities should be implemented consecutively, i.e., priority 2 construction is dependent on priority 1 and should be implemented either at the same time as priority 1 or subsequent to priority 1 completion.

7.1.2 Actual Cost of Priority Construction

The previous section tabulated costs for the different communication plans based on 1975 prices, extrapolated to 1980 cost at an annual inflation rate of 10% compounded annually. In actuality, cost may be further escalated by several factors. In order to determine a more accurate cost estimate, field surveys are required. Until such time as surveys could be completed, the estimate of actual implementation costs can, by experienced engineering judgement, be adjusted by an overall increase due to three factors. Two of these, namely a difficulty factor and a risk factor, each add an estimated 15% to the hardware cost. The cost estimates contained in this study are based on information found in the document entitled Telecommunication Network, Middle East and Mediterranean Area (see Appendix 4). Chapter 4 of this reference, entitled Cost Factors, addresses this matter in paragraph 4.1,

> "The cost figures developed ... represent averages for Mediterranean and Middle East nations. Therefore, in all individual cases, local factors such as climatic conditions, terrain topography, transport costs, installation crew allowances, local wages, agents' fees, risk factors and the current supply and demand situation have to be considered. Prices are also higher in countries where travel, shipping and internal transportation costs are high."

The third factor concerns overall program management. This factor is estimated to be equal to 25% of the adjusted hardware cost.

7.1.2.1 Difficulty Factor

This factor is based on the increased costs which bidders can be expected to program into their proposals in order to meet those unusual costs which can be expected because of what is known about the region. Although certain portions of the region are highly developed, several of those areas of priority construction are undeveloped. Difficulties in obtaining materials for construction from local markets required hauling in from long distance or possibly importation of materials. National boundaries in the region must be crossed with construction material which requires satisfaction of formalities. Local heavy equipment rental and or skilled help may be difficult to obtain. Consumables required for personnel and operations support may be lacking, and an evironment which provides minimal subsistence needs requires higher than usual expenditures for either the importation of special material and consumables and the payment of an incentive or a completion bonus in order to procure and retain skilled personnel.

7.1.2.2 Risk Factor

This factor is based on the increased costs because of fear about what is not known about the region, things which are not identifiable per se, but which form an inventory of potential problems among which a certain number can be expected to appear. The experienced, and therefore more probably reliable bidder will, because of his previous work, program his prices by a best estimate method to allow for such unknowns. These unknown conditions are compounded by the well know regional record of political instability. Reliable bidders tend to construct their prices in such a way as to offset the risk of losing the work half way through the job, as well as the prospect of several years in arbitration and litigation in an effort to collect claimed compensation.

7.1.2.3 Overall Program Management

The administration of this regional program can be expected to have greater than usual administrative costs due to the vastness of area and the multinational nature of the coordination which must be effected between administrations of naitons which have in the past experienced either varying degrees of political affinity or, in some cases, hostility. Other relevant program management considerations are discussed in paragraph 7.3.2 below.

7.1.3 Priority 1 Construction

Priority one construction consists of three links as discussed in Section 6 and shown in Figure 7-1:

a) Ismailiya - Ber Sheba coaxial cable or radio relay
b) Jerusalem - Salt Jct. radio relay
c) Aqaba - Haql radio relay

These three links will provide complete terrestrial connectivity of all of the countries included in the study. The Ismailiya-Ber Sheba link across the Sinai (either coaxial cable or radio relay) will interconnect Egypt and Israel and with the addition of (b), Jerusalem-Salt Jct., Egypt and Israel can be interconnected with all regional partners except Saudi Arabia. Construction of (c), Aqaba-Haql, will close this missing link. Prior to the construction of (c), however, plans current at that time should be reviewed as there is a possibility that a connection from Jordan to Saudi Arabia via Ma'an and Halat Ammar may be planned as it is currently proposed by another study (see paragraph 6.2.2). The Ma'an-Halat Ammar route will also provide connectability between Saudi Arabia and the other regional partners.

7.1.4 Priority 2 Construction

As shown on Figure 7-2, with the completion of priority one construction, many of the interconnection routes to Syria and Lebanon must transit Jordan. Priority 2 construction (Figure 7-3) provides a direct route from Israel to Lebanon and provides an alternate route for circuits to Jordan and Syria. Proposed Priority 2 construction is radio relay from Haifa to a junction station on the existing radio route between Amman and Beirut and will result in increased connectability as shown in Figure 7-4.

7.1.5 Priority 3 Construction

The extension of the priority 2 link to Damascus will provide further direct interconnections and additional alternate routing possibilities as shown in Figure 7-5. This radio relay construction from the Junction on the Amman-Beirut route to Damascus is proposed as priority 3. It will be noted in priority 2 and 3 cost development, that no circuit costs are included as it is assumed that no additional circuits will be provided, i.e. the existing circuits in priority 1 will be rerouted to these new links. In actuality, it may be that these priority routes will be considered at a time when growth capacity is required and can be utilized as growth routes.

7.1.6 Priority 4 Construction

With the exception of those circuits routed via the submarine cable from Alexandria to Beirut, all circuits from Egypt to Jordan, Syria, Lebanon and Saudi Arabia must transit Israel as no high-capacity alternate route is available. Priority 4 recommends construction of a second route across the Sinai from Suez to the northern end of the Gulf of Aqaba (Figure 7-6). It is envisioned that this route would interconnect with existing routes at Elat (Israel), Aqaba (Jordan) and Haql (Saudi Arabia), thereby providing a direct linkage to Jordan and Saudi Arabia and an alternate route to Israel. Such construction could very well be considered as growth construction at a later date when additional facilities are required from Egypt to the other regional partners. Connectability after the addition of this route is shown on Figure 7-7.

On the other hand, regional preferences for direct circuits from Egypt to Jordan and Saudi Arabia may require the implementation of this microwave radio relay route as an earlier priority. The inherent channel drop/insert capability along the route is also an attraction characteristic of the development of the Sinai subregion.

7.1.7 Priority 5 Construction

As will be noted from Figure 7-7, Saudi Arabia has direct connections (after completion of priority 4 construction) to all partners except Lebanon and Syria. Priority 5 construction, which should be considered in connection with growth requirements, will provide a direct connection to Syria and a more direct connection to Lebanon via Damascus. The proposed priority 5 construction is a radio relay route from Quaraiyat, on the Intra-Kingdom microwave route to Suweida, a junction station on the existing Amman-Damascus radio relay route (Figure 7-8). Such construction will also provide a more direct route from Riyadh and Damman, in Saudi Arabia, to Amman, Jordan.

The final resulting connectability after completion of all five priorities is shown in Figure 7-9 and the total construction proposed in this study (priority 1 through 5) is summarized in Figure 7-10.

With this construction, the total for the five priorities proposed will be $17.6M out-of-pocket with a total investment in the order of $24.4M (1975 costs). The projected order of magnitude 1980 costs and these 1980 costs with an added contingency are shown in Figure 7-11. These are order of magnitude costs only, as study constraints precluded an in-depth examination of the proposed routes.

7.1.8 The Relationship Between System Capacity and System Cost

The costs developed in this study were based on circuit requirements as estimated in Section 5. Since basic data for circuit projections is not available, the estimated circuit requirements do not have the same degree of validity as would forecast made from good past-trend data. Therefore, a sensitivity check of the costs appeared desirable, based on variations in circuit requirements. Costs were re-calculated based on a 50% reduction in circuit requirements and on a 100% increase, or a doubling, of the circuit requirements. The results of the sensitivity check are shown in Figure 7-12 for the out-of-pocket (additional investment) costs and in Figure 7-13 for the total investment. As can be seen from Figure 7-12, a large swing in circuit requirements (from 1/2 to twice the circuit requirements used in the study) has only a minimal effect on the total out-of-pocket costs (-6.9 to +22%). The effect of the total investment (Figure 7-13) is somewhat greater (-19 to +40%) for a 50% reduction or a 100% increase in circuit requirements. Thus, the sensitivity check indicates that the accuracy of the circuit forecast does not have a major effect on the additional investment required to implement the study findings.

7.1.9 Maintenance and Operating Costs

Based on the cost data summarized in Appendix 1, annual costs for maintenance and operating the facilities proposed in this study will average about 6% of the investment for coaxial cable and 12% of the investment for radio relay. These percentages have been purposely doubled from more usual values, the rationale being that the new routes would likely be initially staffed by expatriates who owe allegiance to none of the area countries and who may be thus provided by the contracting agency. These people could also train indigenous personnel thus providing more national skill at a time when regional pacification and international priorities will heavily load existing skilled manpower reserves in the area's development. Thus, the annual maintenance and operating costs for the priority 1 construction will run about $1.2M based on 1980 estimated investment. As shown in Figure 7-14, the total maintenance and operating costs for all five priorities is estimated at $2.6M annually.

7.2 SCOPE OF WORK FOR POSSIBLE FIELD INVESTIGATIONS AND FURTHER STUDIES

7.2.1 General

As discussed in paragraph 1.3 - "Key Assumptions," and paragraph 3.2 - "Procedures Used in this Study," this mid-east regional interconnection study was based on information available to Teleconsult Inc. in Washington, D.C., and obtained from existing reports, telephone contacts and discussion with people knowledgeable of existing telecommunications systems in the countries of interest where such contacts could be made. Proposed construction was based on map investigations using the best maps available. Fine-grain topographical maps of the area of interest were not available. Furthermore, assumptions had to be made regarding capacities of existing routes, tower heights and space availability at multiplex and junction points. The details required in order to refine these assumptions would therefore represent one aspect of further investigation and study.

Since the time of World War II, the region of study has undergone significant political and technological change. The establishment of independent states has allowed some differentiation of communication plants based on national needs, goals and suppliers. Each state's communication need was generally great during a period of rapid technological advancement. It is therefore typical to find a large mix of communication equipment in such an environment. The inter-

facing problems associated with adding new plant to such mix are often compounded. It is therefore most cost effective to investigate the actual environment and to evaluate the characteristics of the communication plant in such regions so that further studies and resulting projects can be based on more specific details of reality.

7.2.2 Possible Field Investigations and In-Country Tasks

That work which is recommended in order to complete the planning and to prepare for implementation is listed below.

a) Determination of national communication administrations' existing plants, routes and facilities and their planned expansion to determine if any new route construction or interconnection has been planned or implemented that was not included in this study. An example of such construction or plan might be a submarine, troposcatter or microwave link across the Red Sea between Egypt and Saudi Arabia. Such a link is under study but its status is sufficiently vague at this time as to preclude it from this study.

   Investigate by an actual field survey for each country and each route, existing capacities and facilities. Field surveys should also be made and profiles run for planning and engineering any of the proposed links, to determine terrain traversed, construction and maintenance access and actual site location. It is recommended that this work be done in cooperation with the Telephone Administration involved in the various countries to help foster cooperation and understanding between the involved countries.

   Determination of the amount of new plant, if any, which would be required to implement the planned intra-regional circuit quantities, focusing on feasibility and costs. Recommend alternates if necessary.

b) Preparation of a revised system concept based on a review of regional priority communication needs (referenced to such investigation as applicable and item a) above) showing the alternate network configuration as required to provide for actual conditions at

the time of implementation.

c) Development of estimated program costs, including equipment and all action necessary to implement the program.

d) Provision of estimates of the economic benefit of each major alternative program approach. Study the projected economic growth in the various sectors which will require increased telecommunications services. Isolate those economic activities which will result in increased regional telecommunications needs and calculate these increases. Estimate to what degree these economic sectors might be accelarated in their growth in the presence of adequate regional telecommunications services.

e) Recommendation and preparation of a detailed implementaion and construction program.

f) Assistance in the formation of a Regional Planning Council to include representations of the host country governments and other appropriate agencies. (See also Paragraph 7.3.3).

7.2.3 Program Studies and Implementation Plans

Studies to be made would focus on the feasibility of establishing a new communication network based on political, social, fiscal, topographical and technical factors and the interrelationships therof. The details gathered from investigations, such as noted above, would provide a reliable source for final planning inputs. Examples of such studies are listed as follows:

a) The review or the development of the communications fundamental plan for each county in the region taking into consideration national communication needs based on political, social and economic factors and traffic, both actual and latent traffic, including projections. This might conclude with a tabular comparison of the plans and a list of recommendations which would lead toward the harmonious satisfaction of the intent of all administrations on a regional level.

b) Development of Telecommunication tariffs and an organization for administration of same.

c) Development of individual communications implementation plans some of which may be particularly troublesome, for example,

i) Interfacing various transmission methods and standards

ii) Switching network plan to complement the transmission routing plan.

iii) Interfacing various manufacturers' equipment and various equipment generations (analog, digital, MSI, LSI).

iv) Examination of alternative methods to meet specific requirements.

v) Planning and scheduling considerations in order to obtain international coordination for proposed projects.

vi) Planning for network control and maintenance.

vii) Provision of adequate building space to house equipment and operating personnel.

viii) Recommendations for developing primary and emergency power generation capability, water and sanitary facilities and other related needs.

d) Preparation of specifications and bid documents for new facilities and plant with sufficient detail so that competetive bids can be solicited. This could include,

i) Contract terms and conditions, procedures for presentation, instructions for submission, schedules, plans and procedures for acceptance tests, delivery schedule, penalties, etc.

ii) General environmental requirements and specifications of materials, components, procedure, and finishing.

iii) Site plans, civil and communication.

iv) Technical objectives and system performance, functional and schematic diagrams, technical characteristics and specifications of all systems and subsystems.

v) Testing, test plans, procedures, etc.

vi) Considerations regarding availability of qualified maintenance, operations and engineering personnel and operations procedures, etc.

vii) Training, instruction manuals, specification and spares.

e) Program Implementation tasks in the areas discussed above. This includes:

i) Overall Program Planning
ii) Program Management
iii) Construction Program Coordination
iv) Commercial Management
v) System Engineering
vi) Service Cut-Over Program
vii) Operation and Maintenance Program
viii) Training Program

7.3 ORGANIZATION OF A REGIONAL COMMUNICATIONS PROGRAM

The preceeding analysis has shown that there are a number of potential telecommunications projects which can be developed for the improvement of regional communications in the Mid-East. However, experience has shown that great care must be taken in the planning, design, implementation, coordination, and administration of such projects, in order to ensure that the end objective of the program - to use the telecommunications facilities to obtain the desired benefits - is actually achieved. This section addresses this issue.

7.3.1 Background

Several regional telecommunications programs have been conducted in recent times, notably:

(a) CENTO - as part of the overall Central Treaty Organization, a system was developed to interconnect major cities in Iran, Turkey and Pakistan.

(b) SEATO - as part of the overall Southeast Asia Treaty Organization, a system was developed to interconnect key cities in this region.

(c) ITN - the Inter-American Telecommunications Network, made up of individual sections, owned and controlled by administrations in the countries of Latin America, designed to operate as an integrated network.

Each of the above programs has been successful in some aspects, while unsuccessful in other aspects. It is not appropriate to present a critical analysis of these programs in this report; however, it would be wise to consider

the various problems which were faced, and to include provisions for the successful solution of such problems in the Mid-East program.

The CENTO and SEATO programs were similar in size and scope; and although the total ITN program was many times as large, the truly regional portion of the ITN was of the same order of magnitude as CENTO and SEATO. Thus, all three programs are applicable to the case at hand. A primary purpose of all three programs was the same - to improve regional communications.

7.3.2 Program Planning

At this stage, the single most important aspect of the Mid-East Telecommunications Program is the preparation of a comprehensive plan. This plan must provide a description of each part of the complete program, as well as a timetable and budgetary cost estimate for every step.

For example, the practical use of the proposed interconnection between Ber Sheba and Ismailiya is dependent on the development of a method for interconnecting actual telephone (or telex) users in Tel Aviv and Cairo onto the system. There is every reason to believe that this can be accomplished. However, care must be taken to plan an efficient technical approach, and then to support and coordinate the efforts by the two telecommunications authorities (Egypt and Israel) to insure that the many technical, commercial, and institutional, problems are solved effectively (and in a reasonable period of time), so that users can actually use the system and thereby further the overall aims of this program. This is only one simple example -- many, many others can be anticipated.

7.3.3 Organization and Management

The types of problems to be anticipated in the implementation of this program are clearly implied in the two preceding subsections (7.2.2 and 7.2.3). These progress from field surveys and economic analyses during the early stages, through system design and installation, continuing through to system "cut-over" (putting the facilities into actual service) in the later stages. Actually, since there are many individual segments of the system, these phases will overlap, so that the various segments of the overall system will each be in different stages of development at any particular time. The entire development process, of course, is relatively involved and complex.

The worlds' telecommunications community had developed a sophisticated

process for coordinating the evolutionary development of system complexes such as this. An element of this process is the International Telecommunications Union (ITU), which coordinates the preparation of standards and procedures, and acts as focal point and forum for the telecommunications authorities of its member countries. Coordination with ITU plans is necessary; however, a separate organization will be required to assure the flexibility and responsiveness required in this program.

We recommend that the U.S. initiate formal steps to develop the required organization at the earliest possible time. It is our understanding that a Mid-East Regional Projects Office has already been formed. A second immediate step should be the selection of a government/consultant team to support the regional telecommunications project and to provide the planning and coordinating activities indicated in this report. Immediately following these steps, a third logical step will be the formation of a Regional Telecommunications Planning Council, probably chaired by a U.S. representative, and including representatives of the host country telecommunications authorities. By this means, we foresee the effective beginning of the implementation process, with excellent chances for meeting the objectives of the program in a timely and efficient manner.

Route	a 1	a 2	b	c
Out-of-Pocket	5.34M	4.54M	1.77M	0.72M
Total Investment	6.39M	5.60M	4.19M	1.90M
Total Hardware Cost (Investment + 30% due to difficulty & risk)	8.31M	7.28M	5.45M	2.47M
Overall Program Management, 25%	2.08M	1.82M	1.36M	0.62M
TOTAL	10.38M	9.10M	6.81M	3.09M

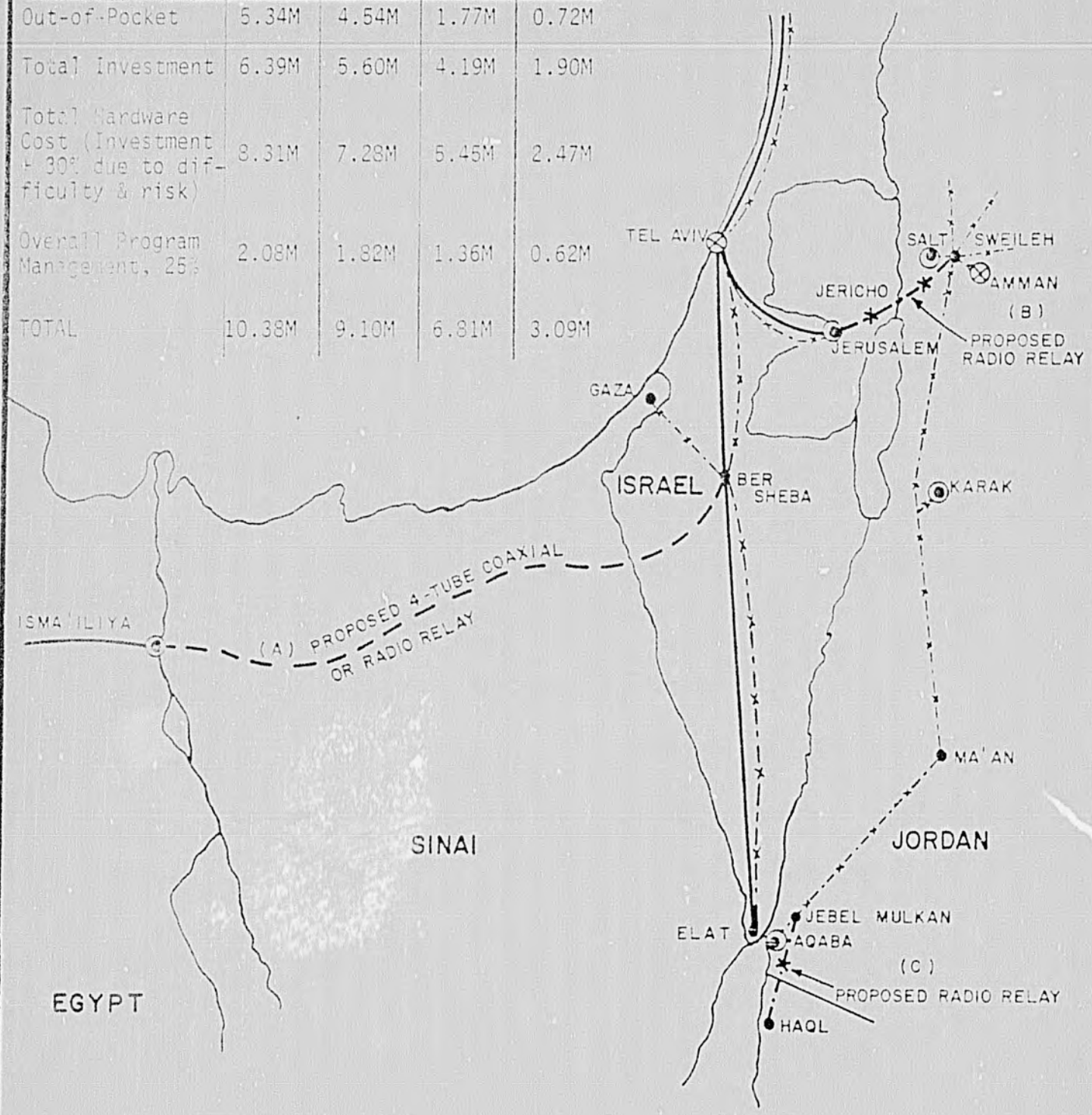


FIGURE 7-1
PROPOSED PRIORITY I
CONSTRUCTION

FIGURE 7-2

PRIORITY NO. 1 CONNECTABILITY

	Egypt	Israel	Jordan	Lebanon	Saudi Arabia	Syria
Egypt		D	via Israel	D	via Israel, Jordan	via Israel Jordan
Israel	D		D	via Jordan	via Jordan	via Jordan
Jordan	via Israel	D		D	D	D
Lebanon	D	via Jordan	D		via Jordan	D
Saudi Arabia	via Israel Jordan	via Jordan	D	via Jordan		via Jordan
Syria	via Israel Jordan	via Jordan	D	D	via Jordan	

Construction:

a) Ismailiya - Ber Sheba Coaxial Cable or Radio Relay

b) Jerusalem - Sweileh Radio Relay

c) Aqaba - Haql Radio Relay

Code

D = Direct Routing

◯ = Alternate Route Available

(D) = Both Direct & Alternate Available

Route	d	e
Out-of Pocket	1.45M	1.05M
Total Investment	1.45M	1.05M
Total Hardware Cost (Investment + 30 due to difficulty & risk)	1.89M	1.37M
Overall Program Management (25)	0.47M	0.34M
TOTAL	2.36M	1.71M

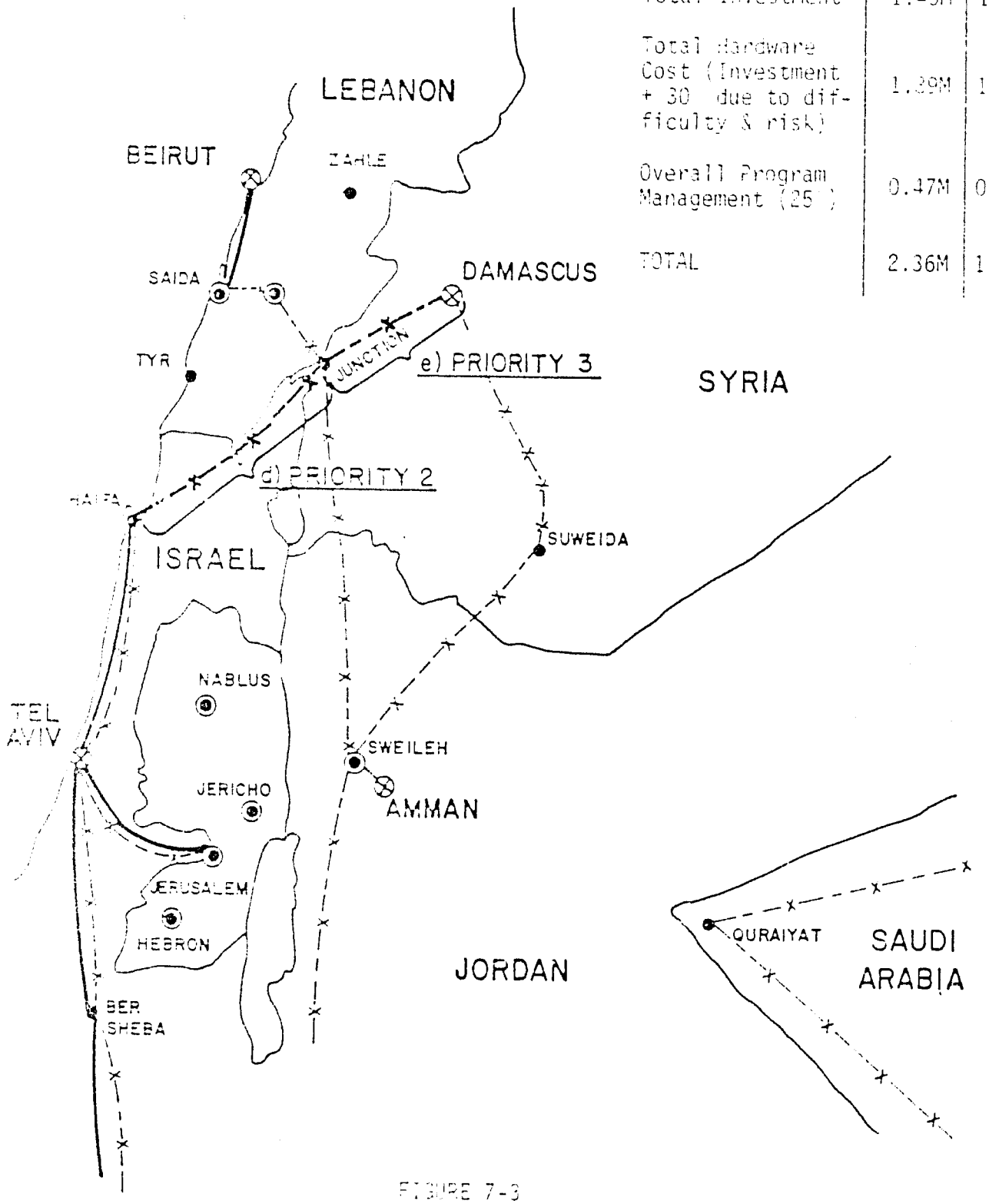


FIGURE 7-3
PROPOSED PRIORITY 2 & 3
RADIO RELAY CONSTRUCTION

FIGURE 7-4

PRIORITY NO. 2 CONNECTABILITY

	Egypt	Israel	Jordan	Lebanon	Saudi Arabia	Syria
Egypt		D	via Israel	D	via Israel, Jordan	via Israel, Jordan
Israel	D		D	D	via Jordan	via Lebanon
Jordan	via Israel	D		D	D	D
Lebanon	D	D	D		via Jordan	D
Saudi Arabia	via Israel, Jordan	via Jordan	D	via Jordan		via Jordan
Syria	via Israel, Jordan	via Lebanon	D	D	via Jordan	

Construction:

a) }
b) } Same as priority 1.
c) }

d) Haifa-Jct. on Amman-Saida route

Code

D = Direct Routing

( ) = Alternate Route Available

(D) = Both Direct & Alternate Available

FIGURE 7-5

PRIORITY NO. 3 CONNECTABILITY

	Egypt	Israel	Jordan	Lebanon	Saudi Arabia	Syria
Egypt		D	via Israel	D	via Israel, Jordan	via Israel
Israel	D		D	D	via Jordan	D
Jordan	via Israel	D		D	D	D
Lebanon	D	D	D		via Jordan	D
Saudi Arabia	via Israel, Jordan	via Jordan	D	via Jordan		via Jordan
Syria	via Israel	D	D	D	via Jordan	

Construction:

a) }
b) } Same as priority 1.
c) }

d) Same as priority 2.

e) Damascus-Jct. on Amman Saida route

Code

D = Direct Routing

◯ = Alternate Route Available

D = Both Direct & Alternate Available

Route	f
Out-of-Pocket	4.5 M
Total Investment	5.1 M
Total Hardware Cost (Investment + 30% due to difficulty & risk)	6.63M
Overall Program Management (25%)	1.66M
TOTAL	8.39M

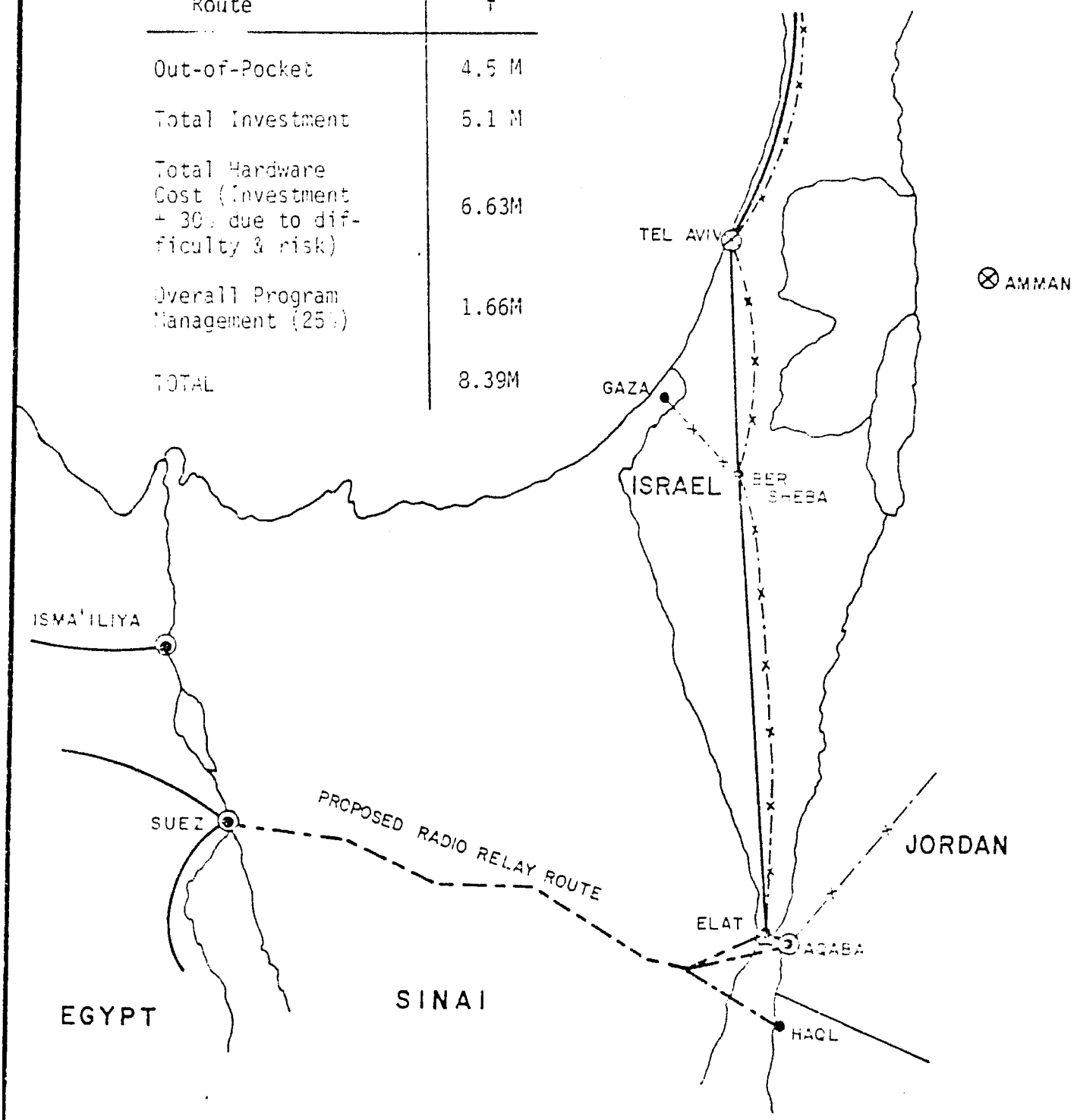


FIGURE 7-6
PROPOSED PRIORITY 4
CONSTRUCTION

FIGURE 7-7

PRIORITY NO. 4 CONNECTABILITY

	Egypt	Israel	Jordan	Lebanon	Saudi Arabia	Syria
Egypt		D	D	D	D	via Israel
Israel	D		D	D	D	D
Jordan	D	D		D	D	D
Lebanon	D	D	D		via Jordan	D
Saudi Arabia	D	D	D	via Jordan		via Jordan
Syria	via Israel	D	D	D	via Jordan	

Construction:

a) }
b) } Same as priority 1.
c) }

d) Same as priority 2.

e) Same as priority 3.

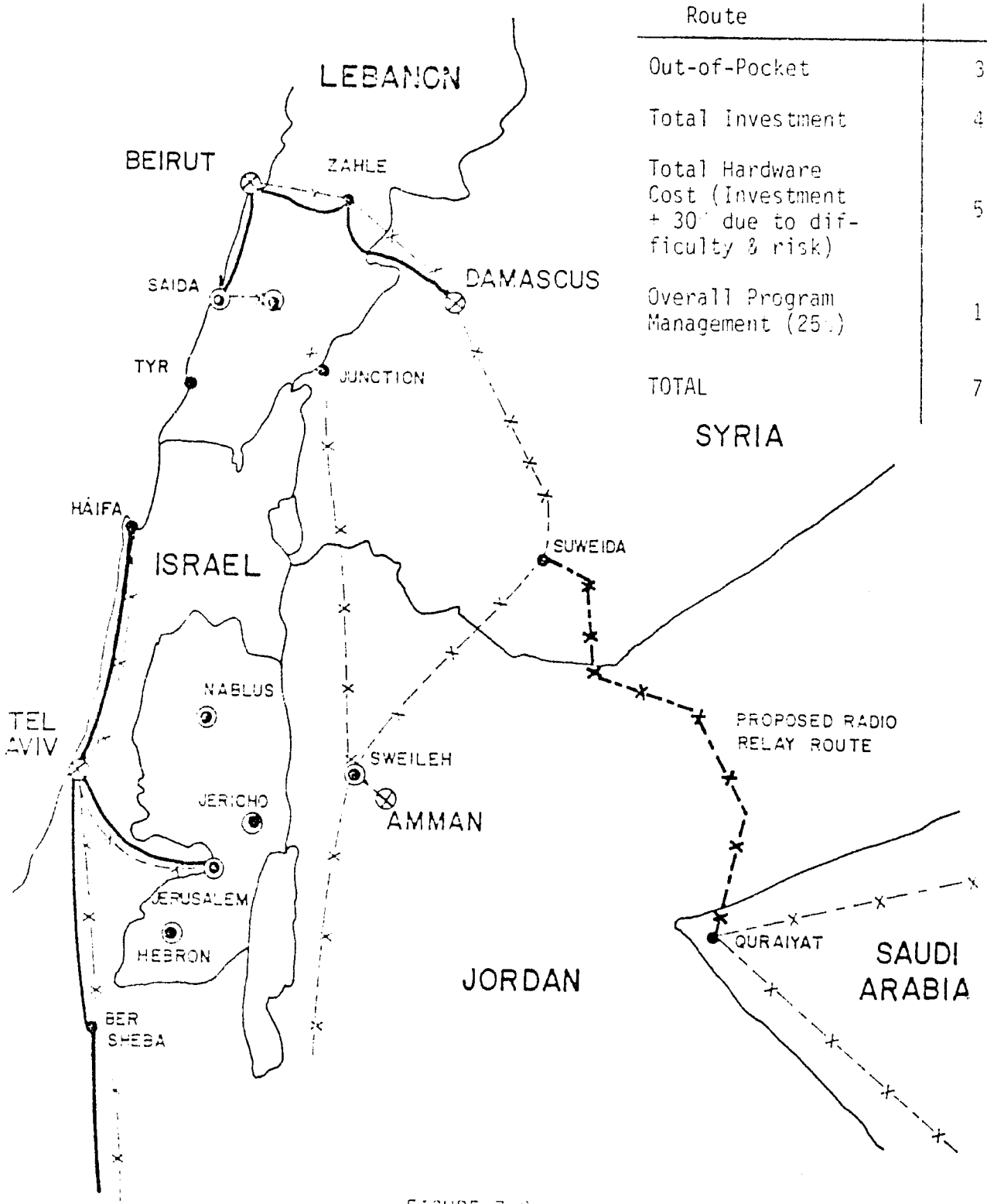
f) Suez-Elat/Aqaba/Haql route

Code

D = Direct Routing

◯ = Alternate Route Available

(D) = Both Direct & Alternate Available



Route	$
Out-of-Pocket	3.10M
Total Investment	4.54M
Total Hardware Cost (Investment + 30% due to difficulty & risk)	5.90M
Overall Program Management (25%)	1.48M
TOTAL	7.38M

FIGURE 7-8
PROPOSED PRIORITY 5 CONSTRUCTION

FIGURE 7-9

PRIORITY NO. 5 CONNECTABILITY

	Egypt	Israel	Jordan	Lebanon	Saudi Arabia	Syria
Egypt		D	D	D	D	via Israel
Israel	D		D	D	D	D
Jordan	D	D		D	D	D
Lebanon	D	D	D		via Syria	D
Saudi Arabia	D	D	D	via Syria		D
Syria	via Israel	D	D		D	

Construction:

a) }
b) } Same as priority 1.
c) }

d) Same as priority 2.

e) Same as priority 3.

f) Same as priority 4.

g) Quaraiyait - Suweida route.

Code

D = Direct Routing

◯ = Alternate Route Available

(D) = Both Direct & Alternate Available

MISSING

PAGE

7-22

COSTS (in millions of dollars) / ROUTE	A 1 Ismailiya-Ber Sheba coaxial cable	A 2 Ismailiya-Ber Sheba radio relay	B Jerusalem-Amman radio relay	C Agaba Junction-Haql radio relay	D Haifa-Junction on existing radio relay	E Damascus-Junction on existing radio relay	F Suez-Elat/Agaba Haql radio relay	G Qurayat-Suwaiq radio relay	Option: al or ae	TOTAL
Out-of Pocket (1980 $'s)	5.34	4.54	1.77	0.72	1.45	1.05	4.50	3.10	1 2	17.13 17.93
Total Investment (1980 $'s)	6.39	5.60	4.19	1.90	1.45	1.05	5.10	4.54	1 2	23.83 24.62
Total Hardware Cost (Investment + 30% due to difficulty and risk)	8.31	7.28	5.45	2.47	1.89	1.37	6.63	5.90	1 2	30.99 32.02
Overall Program Management (25%)	2.08	1.82	1.36	0.62	0.47	0.34	1.66	1.48	1 2	7.75 8.01
TOTAL	10.38	9.10	6.81	3.09	2.36	1.71	8.29	7.38	1 2	38.74 40.02

Figure 7-11

Summary of Costs (Order-of-Magnitude)
In Millions of U.S. Dollars

Priority 1 through 5

FIGURE 7-12

OUT OF POCKET COSTS
SENSITIVITY CHECK
SUMMARY OF COSTS PRIORITY 1-5

Priority	Route	Circuit Estimate		
		50% reduction	Study Est.	100% incr.
1	a) Ismailiya-Ber Sheba			
	1) Coaxial cable or	5.0 M	5.3 M	6.0 M
	2) Radio relay	4.2 M	4.5 M	5.2 M
	b) Jerusalem-Amman radio relay route	1.1 M	1.8 M	3.1 M
	c) Aqaba-Haql radio relay route	.64M	0.72M	1.0 M
	Sub-total for Priority 1	$5.9-6.7M	$7.0-7.8M	$10.1-10.9M
2	d) Haifa-Jct. on Amman Beirut radio relay route	1.45M	1.45M	1.45M
3	e) Damascus-Jct. on Amman Beirut radio relay route	1.05M	1.05M	1.05M
4	f) Suez-Elat Aqaba Haql radio relay route	4.4 M	4.6 M	4.8 M
5	g) Quraiyat-Suweida radio relay route	3.1 M	3.1 M	3.5 M
	TOTAL 1980 COSTS	$16.3 M	$17.5 M	$21.3 M
		-6.9	--	+22

NOTE: These costs do not include any added cost for difficulty, risk or overall program management factors.

FIGURE 7-13

TOTAL INVESTMENT

SENSITIVITY CHECK

SUMMARY OF COSTS PRIORITY 1 to 5

ity	Route	Circuit Estimate		
		50% reduction	Study Est.	100% incr.
	a) Ismailiya-Ber Sheba			
	1) coaxial cable or	5.5 M	6.4 M	8.0 M
	2) radio relay	4.7 M	5.6 M	7.3 M
	b) Jerusalem-Amman radio relay route	2.3 M	4.2 M	7.9 M
	c) Aqaba-Haql radio relay route	1.2 M	1.9 M	3.4 M
	Sub-total for Priority 1	8.2-9.0M	11.7-12.5M	18.6-18.95M
	d) Haifa-Jct. on Amman-Beirut radio relay route	1.45M	1.45M	1.45M
3	e) Damascus-Jct. on Amman Beirut radio relay route	1.05M	1.05M	1.05M
4	f) Suez-Elat/Aqaba/Haql radio relay route	4.7 M	5.1 M	6.1 M
5	g) Quraiyat-Suweida radio relay route	3.8 M	4.5 M	6.4 M
	TOTAL 1980 COSTS	$19.6 M	$ 24.2 M	$ 33.8 M
		-19	--	+40

NOTE: These costs do not include any added cost for difficulty, risk or overall program management factors.

FIGURE 7-14

ANNUAL MAINTENANCE AND OPERATING COSTS

(1980 equivalent $'s)

Priority	Route	Annual Costs
1	a) Ismailiya-Ber Sheba	
	1) coaxial cable at 6%	$ 385,000
	2) radio relay at 12%	670,000
	b) Jerusalem-Amman radio relay route at 12%	500,000
	c) Aqaba-Haql radio relay route at 12%	230,000
	Sub-Total for Priority 1	$1.1M--1.4M
2	d) Haifa-Jct. on Amman-Beirut radio relay route at 12%	174,000
3	e) Damascus-Jct. on Amman Beirut radio relay route at 12%	126,000
4	f) Suez-Elat/Aqaba/Haql radio relay route at 12%	612,000
5	g) Quraiyat-Suweida radio relay route at 12%	540,000
	TOTAL	$ 2.6 M

TELECOMMUNICATION NETWORKS FOR MIDDLE EAST AND MEDITERRANEAN AREA

COST FACTORS*

GENERAL

The optimization of a telecommunication network involves the determination and proper application of the pertinent cost factors.

The costs suitable for the present use are averages for Mediterranean and Middle East nations based on 1975 dollars. In all individual cases, their derivation gives consideration to numerous local factors.

The six types of transmission systems considered in the report are:

- Submarine cable
- Tropospheric scatter
- Microwave radio relay
- Buried coaxial cable
- Intelsat satellite system
- Regional satellite system

Of principal interest in this regional study are microwave radio relay, buried coaxial cable and regional satellite systems. There is a secondary interest in tropospheric scatter and submarine cable only to ensure that other means are economically preferable for the applications at hand.

MICROWAVE RADIO RELAY

Initial consideration is given to an all-transistorized system, with capacity for 960 voice circuits or one TV signal per radio channel. Capability of expansion to a 6-1 channel arrangement is assumed. Also assumed is a standard switching section consisting of two terminal stations, four intermediate repeaters and hop lengths of only 40 kilometers reflecting transmission conditions in the Gulf area.

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* From January 1976 Study (Chapter 4) prepared by ITU for UNDP

	Radio Channel Arrangement				
	1+1	2+1	3+1	4+1	5+1
Maximum system capacity, VC	960	1,920	2,880	3,840	4,800
System cost, $/km	8,100	9,000	10,000	11,800	12,700
Cost per circuit per km, $	8.50	4.70	3.50	3.10	2.70

Another way to present these system costs is to consider that the cost of a typical 1+1 or 2+1 relay station is approximately $325,000 to $360,000. (Note that, costwise, the standard switching section consists of ½ + 4 + ½ = 5 relay stations, the cost of the 200 km section at $8,100 to $9,000 per kilometer being $1,620,000 = 5 x 324,000 to $1,800,000 = 5 x 360,000.)

Also considered is a higher capacity system with TWT equipment providing for 1,800 voice circuits or one TV signal per radio channel and capable of expansion to a 5+1 channel arrangement.

	Radio Channel Arrangement				
	1+1	2+1	3+1	4+1	5+1
Maximum system capacity, VC	1,800	3,600	5,400	7,200	9,000
System cost, $/km	8,900	10,200	11,500	13,800	15,100
Cost per circuit per km, $	5.0	2.8	2.1	1.9	1.7

The initial cost of a radio relay station is divided among various component subsystems broadly as follows:

	Range		
	Lower	Upper	Average
Electronic equipment, including antennas and waveguides	30%	40%	35.0%
Installed antenna tower	10	15	12.5
Primary power (generating equipment only)	10	15	12.5
Buildings, shelters, containers and civil works	15	30	22.5
Installation, training, test equipment, etc.	15	20	17.5
			100.0%

BURIED COAXIAL CABLE

Consideration is given to coaxial cable systems with maximum frequencies 3 and 12 MHz. The coaxial tube sizes considered are small (1.2/4.4 mm or 0.047/0.173 inch), normal (2.6/9.5 mm or 0.10/0.375 inch) and monocoaxial (9.7 mm or 0.10/0.38 inch).

The type of cable for the small tube size can be two-tube or four-tube. For the normal tube size, the present consideration is limited to the four-tube type and the six-tube type. The monocoaxial cable may be installed singly, or there may be some economy in installing two in the same trench.

The choice of cable type for a particular application depends upon factors such as initial demand, prospect of up-grading and a need for distance between power feed stations.

Buried Coaxial Cables

Cable Type	Maximum Freq. MHz	Voice Chan. Capacity	Total Cost Per km	Total Cost Per Voice Ch. Fully Loaded
Small Size Tube				
Two-tube	0.55	120	7,800	$ 65.00
	1.3	300	8,200	27.30
Four-tube	1.3	300	9,600	32.00
	1.3	2 x 300	10,200	17.00
	4.0	960	10,500	10.90
	4.0	2 x 960	11,600	6.04
	6.0	1260	10,700	8.50
	6.0	2 x 1260	12,200	4.84
	12.0	2700	11,800	4.37
	12.0	2 x 2700	13,900	2.57
Normal Size Tube				
Four-tube	4.0	960	18,400	19.20
	12.0	2700	19,000	7.04
	12.0	2 x 2700	20,000	3.71
Six-tube	12.0	3 x 2700	24,800	3.06
Monocoaxial Cable				
Single	0.55	48	5,200	108.30
	3.6	360	5,500	15.30
Two cables	3.6	2 x 360	8,800	12.20

REGIONAL SATELLITE SYSTEMS

A regional satellite system may utilize space segment capacity leased from Intelsat, or it may have its own separately launched and operated satellite. In either case, the region will need to supply its own earth stations.

Leasing From Intelsat

The leasing from Intelsat may be by the half-circuit (a charge applicable to each earth station terminating the satellite link), or by the whole or part of a transponder. The cost for leasing a full transponder is at present 360 times the unit charge for a half-circuit. However, leasing other than by the half-circuit is not considered in the present analysis.

The 1978 Intelsat annual charge per half-circuit is $6,840. It is expected to be $5,000 in 1980 and $3,000 in 1985 and thereafter. This charge is applicable to each earth station terminating the satellite link.

These "standard" charges are for earth stations with G/T ratio of 40.7 dB/K. Here the antenna size is 30 meters. Where the earth station is of smaller size, say with a 12 meter antenna and a G/T of 31.7 dB/K, the half-circuit charge is increased by a factor of 2.5 when FDM/FM is used and 1.5 with SCPC. A further reduction in G/T by 6 dB, to the value 25.7 dB/K, would cause the charge factor for FDM/FM to increase to 10. The 12 meter antenna is economical in a limited number of cases, but the penalty for dropping the G/T to 25.7 dB/K is too great except for an interim solution.

Dedicated Regional Satellite

A decision to commit the region to its own satellite would hinge upon the total circuit requirement for the Middle East and Mediterranean area. It is now estimated that the total requirement up to 1990 for telephone and TV transmission can be handled by 12 standard 36 MHz transponders plus one or two higher powered transponders for TV operation. Such a load can be accommodated on a single spacecraft backed up by an orbiting spare. Here two fully operative satellites are launched into orbit, with a third satellite in reserve in case of launch failure or complete loss of one of the orbiting spacecraft.

With the satellite lifetime assumed to be seven years, a cost of $[illegible] million per satellite and $11 million per launch should apply. The estimated cost of the necessary control station is $11 million, the cost of maintenance and operation being about 12 percent of capital cost.

The estimated total cost of the space segment, in the case of dedicated regional satellites including launch insurance, range operations and satellite control station is shown as follows:

3 satellites	$ 36 million
2 launchers	22
Insurance and range operations	5
Control station system	11
	$ 74 million

Satellite System Ground Segment

Whereas the standard earth station of G/T = 40.7 dB/K and a 30 meter antenna has a cost of around $5.8 million, in a specially designed regional system adequate service can be provided through an earth station of G/T = 31.7 dB/K and a 12 meter antenna. The cost of such a station would be upward from $1.6 million.

In particular, with growth and the addition of simplified SPADE-type equipment the costs of the earth station segment would be about as follows:

	Millions of Dollars		
		Annual	
	Capital Cost	Cost Factor	Annual Cost
Station with 12 meter antenna	$ 1.6	23.5%	$0.380
Additional antenna and equipment	0.8	23.5	0.190
Demand Assigned Multiple Access equipment (DAMA)	0.2	23.5	0.050
	$ 2.6		$ 0.620

Annual Cost Factors

The applicable annual cost factors for microwave, buried coaxial cable and regional satellite systems are as follows:

	Assumed Life, yrs.	Cap. Recov. Factor at 12% Int.	Allowance for Maintenance & Operating	Annual Cost Factor
MW radio relay	15	14.7%	6.0%	20.7%
Buried coaxial cable	25-40	12.4	3.0	15.4
Satellite space segment	7	21.9		21.9
Satellite earth stations	12.5	15.8	7.7	23.5
Satellite control center	12.5	15.8	12.0	27.8

TROPOSPHERIC SCATTER

Tropospheric scatter is a useful transmission means over difficult terrain where the distance to be covered is 250 to 500 km. There can be multiple hops of such length, if required.

A representative large size installation will use quadruple diversity with 10 kW transmitters and square antennas 15 to 25 meters on the side. Such a link may provide 60 to 120 voice circuits over a 300 to 450 km distance. The cost per terminal for this size is approximately $2 million.

A representative smaller installation, providing 12 to 24 voice circuits over 250 to 300 kilometers distance, may have only dual diversity and may need only 1 kW transmitter power. Here the cost is approximately $0.5 million per terminal.

Cost Optimization

Where there are multiple hops of troposcatter transmission, the system cost is least for the lowest station cost per unit distance. This lowest cost is achieved where all repeater stations are essentially alike, when the station costs are distributed ¼ to the portion of the transmitter cost that is variable with transmitter power, ¼ to the antenna costs, and the remaining ½ to other station costs. Where there is a single hop of fixed length, this may reduce to simply matching the variable transmitter costs with the antenna costs.

In troposcatter the same antenna is used for both transmitting and receiving. The power required to be radiated from the transmitting antenna, or more accurately the ratio of radiated power to the required receiver power at the distant point, is quite sensitive to the length of the hop. This path-loss ratio varies as the eighth power of the interstation distance.

For a reduced number of voice channels in troposcatter, the required minimum signal power at the receiver is lower. Over the range of voice channels from n = 20 or 30 up to n = 120, the value of this required minimum power is nearly proportional to $n^{1.15}$. For example, the effect of halving the number of channels from 120 to 60 changes the required minimum signal power by $(0.5)^{1.15} = 0.46$. The end result, since $(0.46)^{1/8} = 0.905$, is to increase the maximum hop length for a given transmitter power and antenna gain by a factor of $1/0.905 = 1.105$, or 10½ percent. This change does not modify the optimum proportioning of station component costs, which remains at ⅓, ⅓, ⅓.

SUBMARINE CABLE

The estimated system costs of submarine cable are costs per 100 km of cable length, and vary with cable capacity in terms of the number of voice circuits. Although some submarine cable costing is in terms of 3-kHz circuits, the costs discussed herein are for circuits of 4-kHz pass band.

Number of 4 kHz Voice Circuits	Fixed Cost ($Millions)*	Cost per 100 km ($Millions)
120	2.0	0.8
480	2.6	1.1
1,380	3.0	1.4
2,580	3.5	2.1
3,600 4,140**	3.6	2.5

To these costs must be added the costs of multiplex equipment. Where the requirement is for 60 channels or more, these costs per channel per terminal are $1,000 for 4 kHz multiplex and $2,200 for 3 kHz multiplex.

For application to the longer systems, consideration may be given to the use of TASI to roughly double the talker capacity. The added total cost for doubling the capacity of a 480 circuit cable system would be of the order of $5 million.

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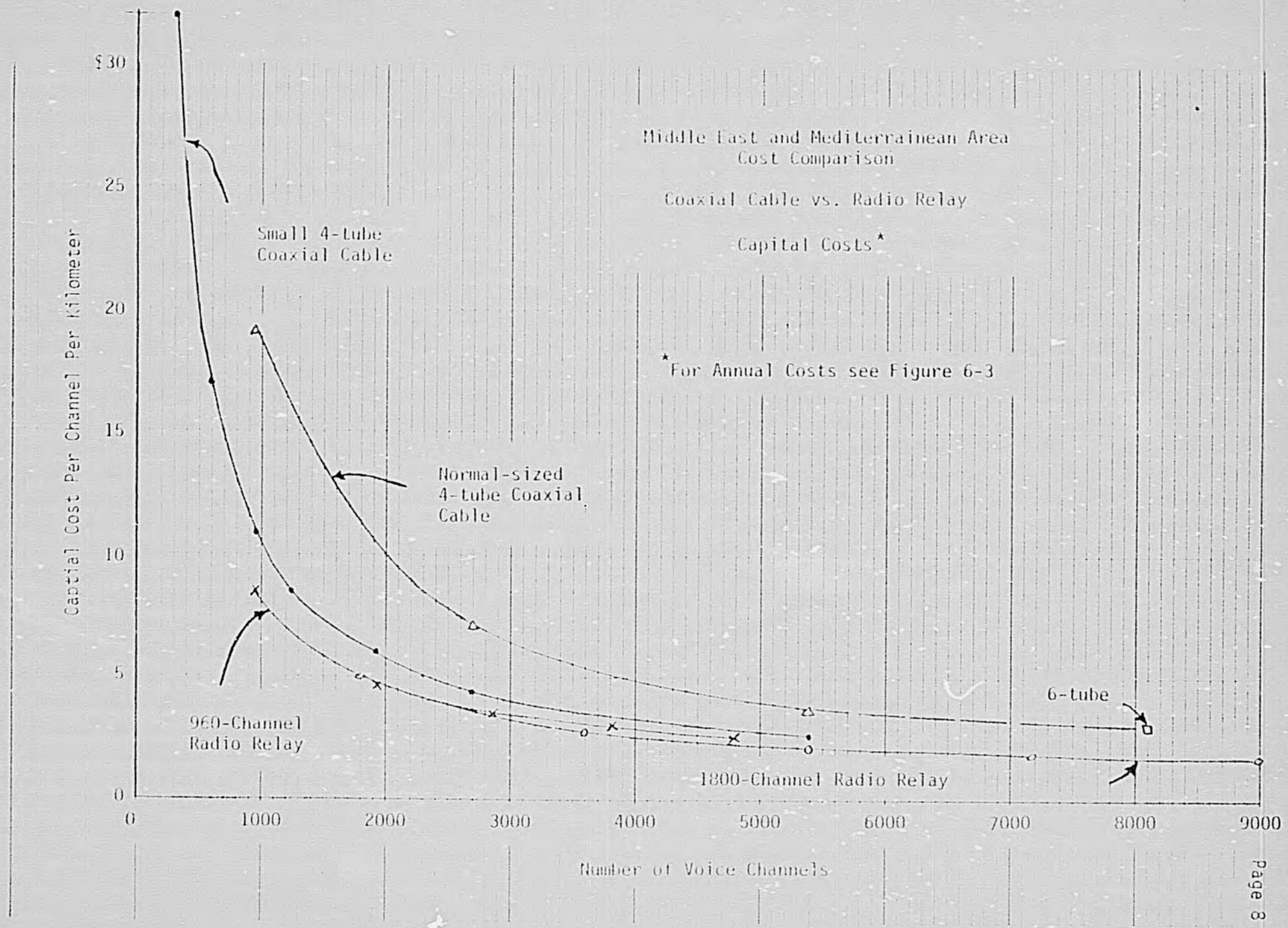
*These costs omit shore-end protection (undersea).

**Depending upon repeater spacing.


Middle East and Mediterrainean Area
Cost Comparison
Coaxial Cable vs. Radio Relay
Capital Costs*
*For Annual Costs see Figure 6-3
Small 4-tube
Coaxial Cable
Normal-sized
4-tube Coaxial
Cable
960-Channel
Radio Relay
6-tube
1800-Channel Radio Relay
Capital Cost Per Channel Per Kilometer
$30
25
20
15
10
5
0
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Number of Voice Channels

COST DATA FOR SENSITIVITY CHECK

a) Ismailiya - Ber Sheba

Coaxial Cable	100 ccts	400 ccts
Route investment	$ 2.9M	$ 2.9M
Avg. cct cost	.325M	1.3M
Terminal costs	.2M	.8M
• Total Investment	$ 3.4M	$ 5.0M
1980 equivalent (61% incr.)	$ 5.47M	$ 8.0M
• Total out-of-pocket cost	$ 3.1M	$ 3.7M
1980 equivalent (61% incr.)	$ 5.0M	$ 6.0M
Radio Relay		
Route investment	$ 2.4M	$ 2.4M
Avg. cct cost	.325M	1.3M
Terminal costs	.2M	.8M
• Total Investment	$ 2.9M	$ 4.5M
1980 equivalent (61% incr.)	$ 4.7M	$ 7.3M
• Total out-of-pocket cost	$ 2.6M	$ 3.2M
1980 equivalent (61% incr.)	$ 4.2M	$ 5.2M

b) Salt (Sweilen) - Jerusalem Radio Relay Route

	200 ccts	800 ccts
Route investment	$ .30M	$ .3M
Avg. cct cost	.75M	3.0M
Terminal costs	.40M	1.6M
• Total Investment	$ 1.45M	$ 4.9M
1980 equivalent (61% incr.)	$ 2.3M	$ 7.9M
• Total out-of-pocket cost	$ .7M	$ 1.9M
1980 equivalent (61% incr.)	$ 1.1M	$ 3.1M

c) Aqaba-Haql Radio Relay Route

	40 ccts	150 ccts
Route investment	$ .3 M	$ .3 M
Avg. cct cost	.37M	1.47M
Terminal costs	.08M	.3 M
• Total Investment	$ .75M	$ 2.1 M
1980 equivalent (61% incr.)	$ 1.2 M	$ 3.4 M
• Total out-of-pocket cost	$ .38M	$ .6 M
1980 equivalent (61% incr.)	$ .64M	$ 1.0 M

d) Haifa-Jct. on Amman--Saida Radio Relay Route

No change --- circuits previously routed.

e) Damascus--Jct. on Amman--Saida Radio Relay Route

No change --- circuits previously routed.

f) Suez-Elat/Aqaba/Haql Radio Relay Route

	50 ccts	200 ccts
Route investment	$ 2.6 M	$ 2.6 M
Avg. cct cost	.19M	.77M
Terminal costs	.1 M	.4 M
• Total Investment	$ 2.9 M	$ 3.8 M
1980 equivalent (61% incr.)	$ 4.7 M	$ 6.1 M
• Total out-of-pocket cost	$ 2.7 M	$ 3.0 M
1980 equivalent (61% incr.)	$ 4.4 M	$ 4.8 M

g) Quraiyat - Suweida Radio Relay Route

	50 ccts	200 ccts
Route investment	$ 1.8 M	$ 1.8 M
Avg. cct cost	.45M	1.8 M
Terminal costs	.1 M	.4 M
• Total Investment	$ 2.35M	$ 4.0 M
1980 equivalent (61% incr.)	$ 3.8 M	$ 6.4 M
• Total out-of-pocket cost	$ 1.9 M	$ 2.2 M
1980 equivalent (61% incr.)	$ 3.1 M	$ 3.5 M

RADIO RELAY PATH DATA

Radio relay has been shown to be a valid alternative for meeting the needs for some communication routes in the region. These are:

Priority 1a	Ismailiya, Egypt to Bersheba, Israel
Priority 1b	Jerusalem to Sweilen, Jordan
Priority 1c	Jebel Mulkan, Jordan to Haql, Saudia Arabia
Priority 2	Haifa, Israel to a junction station on the existing radio relay route between Amman and Beirut
Priority 3	From this same (above) junction to Damascus
Priority 4	Suez, Egypt to Elat, Israel, Aqaba, Jordan and Haql, Saudi Arabia

The topography over which these routes would pass has been examined in order to determine feasibility of such paths. Since the maps used all had a 1:250,000 or greater scale, only an approximation has been made. Exact routing will require planning using 1:50,000 and 1:25,000 scale maps followed by an area survey.

The path profiles which resulted from the topographical examination are included herein for reference. They are numbered according to the priority of the route and by site. Each potential site is named for a nearby settlement or a prominent topographical feature. Radio path clearance above the terrain is shown for two models, namely, where K (the effective earth radius divided by the true earth radius) is equal to infinity (flat earth) and K=0.5, where earth bulge between adjacent sites is assumed to occur for a small percentage of time. These values for K represent practical boundary limits for these route approximations. It is noted that due to the contour interval on the available maps the path height is only approximate. Where the terrain altitude is not discernable both the worst case (solid line) and probable case (broken line) are shown. The required Fresnel zone clearance (for the more conservative frequency of 2GHz) is shown on those few profiles where path height may be minimal (worst case).

The routes, sites and profiles may be cross referenced to each other using the table below.

Priority	Profile Number	Site Name
1A	1A-1	Ismailia
	1A-2	Mitman
	1A-3	Gedeira
	1A-4	El Mahash
	1A-5	Gebel Libni
	1A-6	Gebel Dalfa
	1A-7	Har Boger
		Beer-Sheva
1B	1B	Jerusalem
		Suweileh
2	2-1	Haifa
	2-2	Hare Meron
		Hadar
3	3A	Hadar to Damascus (Tower)
	3B	Hadar to Damascus (City)
4	4-1	Suez
	4-2	Ras El-Gifa
	4-3	Ras Abu Kanadu
	4-4	Ghariya
	4-5	Arqub
		Deneib el Eir
	4-6A	" " " To Elat
	4-6B	" " " To Aqaba
	4-6C	" " " To Haal

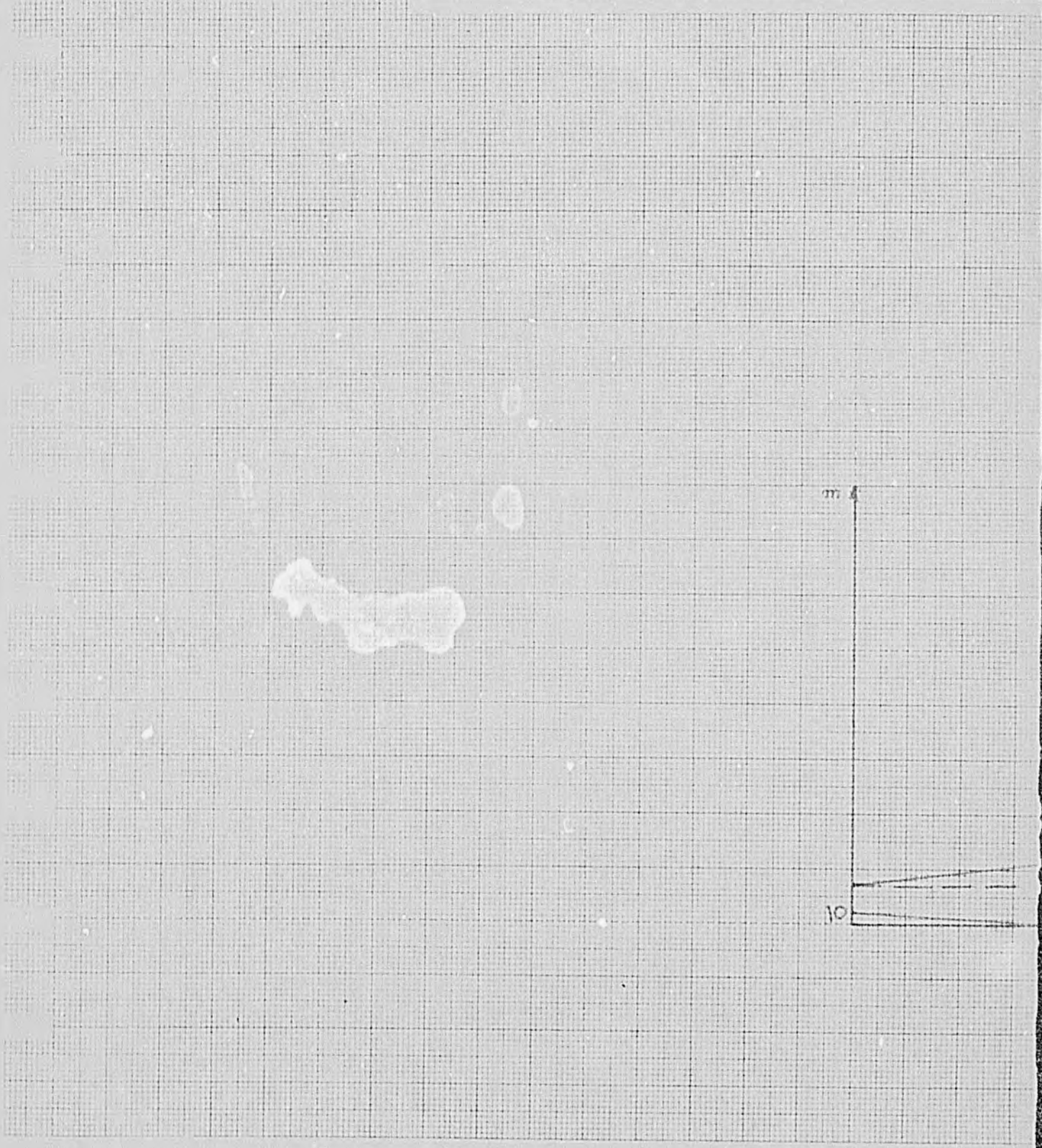
Priority	Profile Number	Site Name
	5-1	As Suwayda
	5-2	Tall Abu Qulayb
	5-3	Al Mugnayr
	5-4	Manattat ad Hafin
	5-5	Qanafi
	5-6	Ouraiyat

VERT. SCALE	1 cm = 50 m.
HORIZ. SCALE	4 cm = 5 Km.

LEGEND

- TREES ON PATH
- ON PATH OBSTRUCTION
- OFF PATH OBSTRUCTION
- WATER
- MARSH
- △ = 0.1 FIRST FRESNEL ZONE R
- △ = 0.6 FIRST FRESNEL ZONE R
- ▲ = FRESNEL ZONE RADIUS
- REFLECTION POINTS (VAR

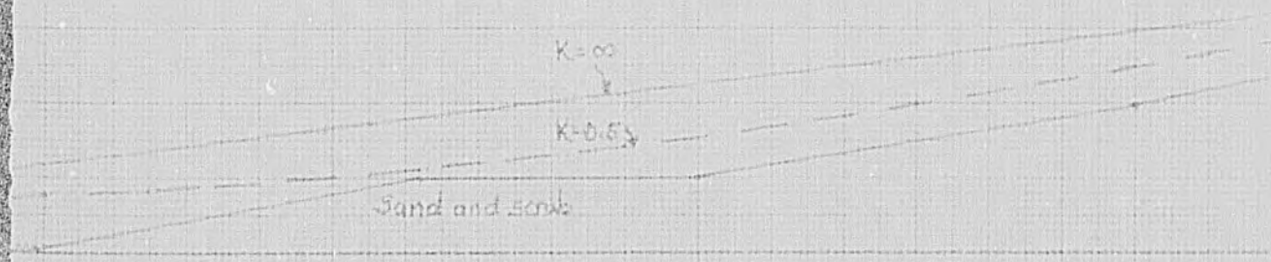
ELEVATION



SITE NAME

TOWER HEIGHT

SITE	Isoiola	MITMAN
LATITUDE	N: 30° 36' 24"	N 30° 37' 26"
LONGITUDE	E 34° 15' 30"	E 34° 14' 31"
SITE ELEVATION	≈ 16 m	164 m
TRUE AZIMUTH		
PATH LENGTH	30.6 Km	



DISTANCE

Teleconsult PATH PROFILE PLOTTING CHART

VERT. SC

HORIZ. SC

CUSTOMER USAID

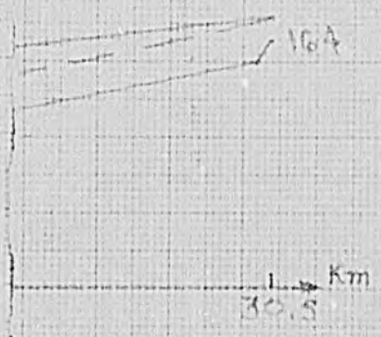
SITES ISMAILIA - MITMAN

ENGINEER [illegible] DATE [illegible] FREQ — GHz

PROJECT NO [illegible] PROFILE NO. [illegible] ISSUE 1

MAP NAME SOURCE SCALE CONTOUR INTERVAL

ELEVATION



SITE NAME

TOWER HEIGHT

[redacted]

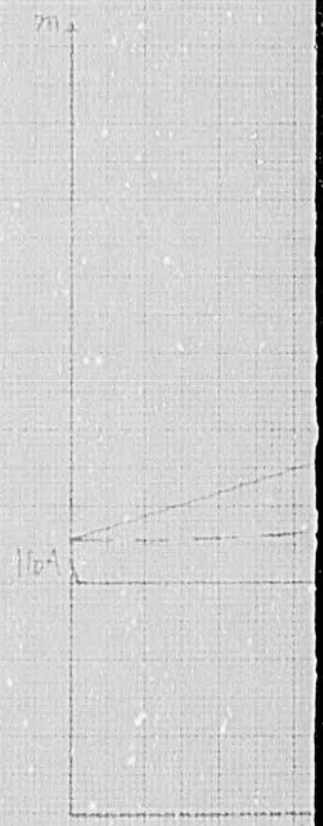
VERT. SCALE	
HORIZ. SCALE	

LEGEND

WATER

MARSH

ELEVATION



SITE NAME

TOWER HEIGHT

SITE	
LATITUDE	
LONGITUDE	
SITE ELEVATION	
TRUE AZIMUTH	
PATH LENGTH	

Teleconsult

PATH PROFILE PLOTTING CHART

VERT.
HORIZ.

CUSTOMER

SITE

ENGINEER DATE FREQ. GHz

PROJECT NO. PROFILE NO. ISSUE

MAP NAME SOURCE SCALE CONTOUR INTERVAL

ELEVATION

Km

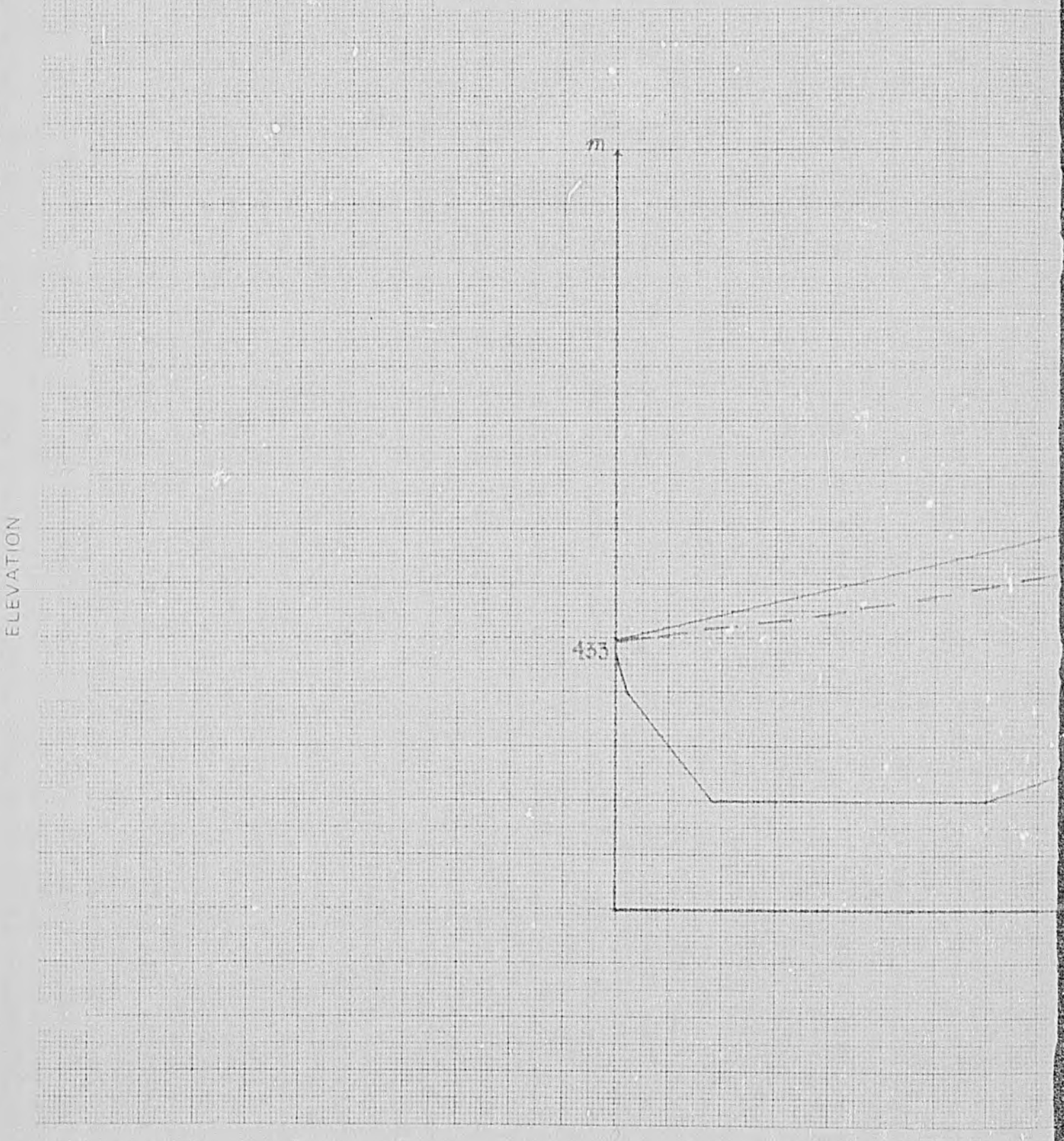
SITE NAME

TOWER HEIGHT

VERT. SCALE	1 cm
HORIZ. SCALE	1 cm = [illegible]

LEGEND

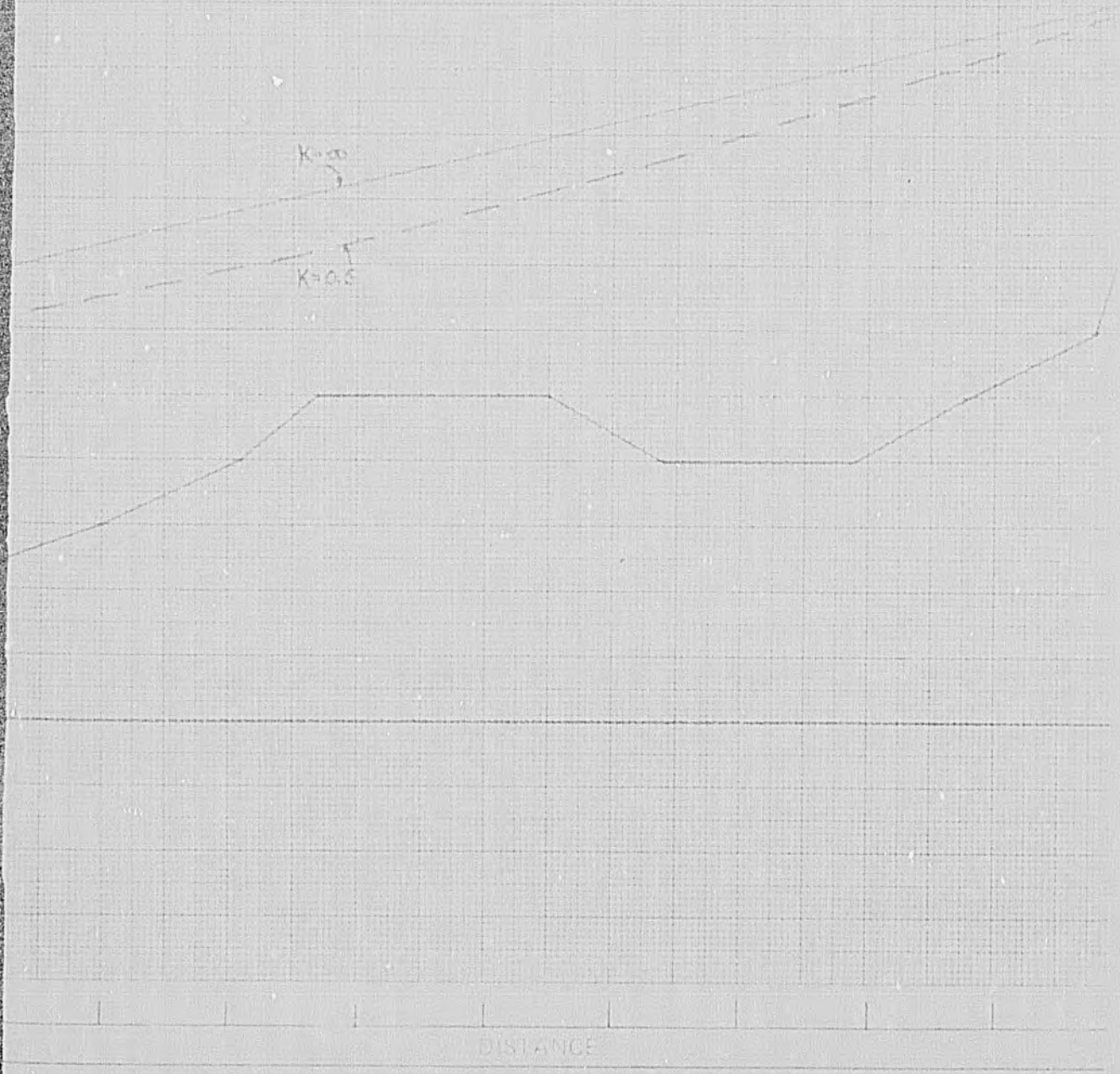
- TREES ON PATH
- ON PATH OBSTRUCTION
- OFF PATH OBSTRUCTION
- WATER
- MARSH
- [illegible] FIRST FRESNEL ZONE
- [illegible] 6 FIRST FRESNEL ZONE
- [illegible] FRESNEL ZONE RADIUS
- REFLECTION POINTS (VAR)



SITE NAME _____

TOWER HEIGHT _____

SITE	
LATITUDE	
LONGITUDE	
SITE ELEVATION	
TRUE AZIMUTH	
PATH LENGTH	



Teleconsult

PATH PROFILE PLOTTING CHART

VERT. SC

HORIZ. SC

CUSTOMER USAID

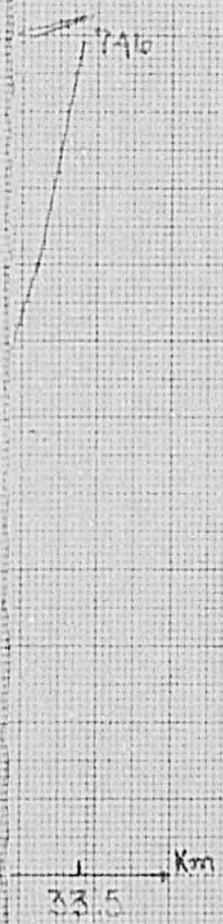
SITES [illegible] El Molino

ENGINEER [illegible] DATE [illegible] FREQ — GHz

PROJECT NO [illegible] PROFILE NO. [illegible] ISSUE 1

MAP NAME [illegible] SOURCE SCALE CONTOUR INTERVAL

ELEVATION



SITE NAME [illegible]

TOWER HEIGHT [illegible]

[redacted]

VERT. SCALE	1" = [illegible]
HORIZ. SCALE	1" = [illegible]

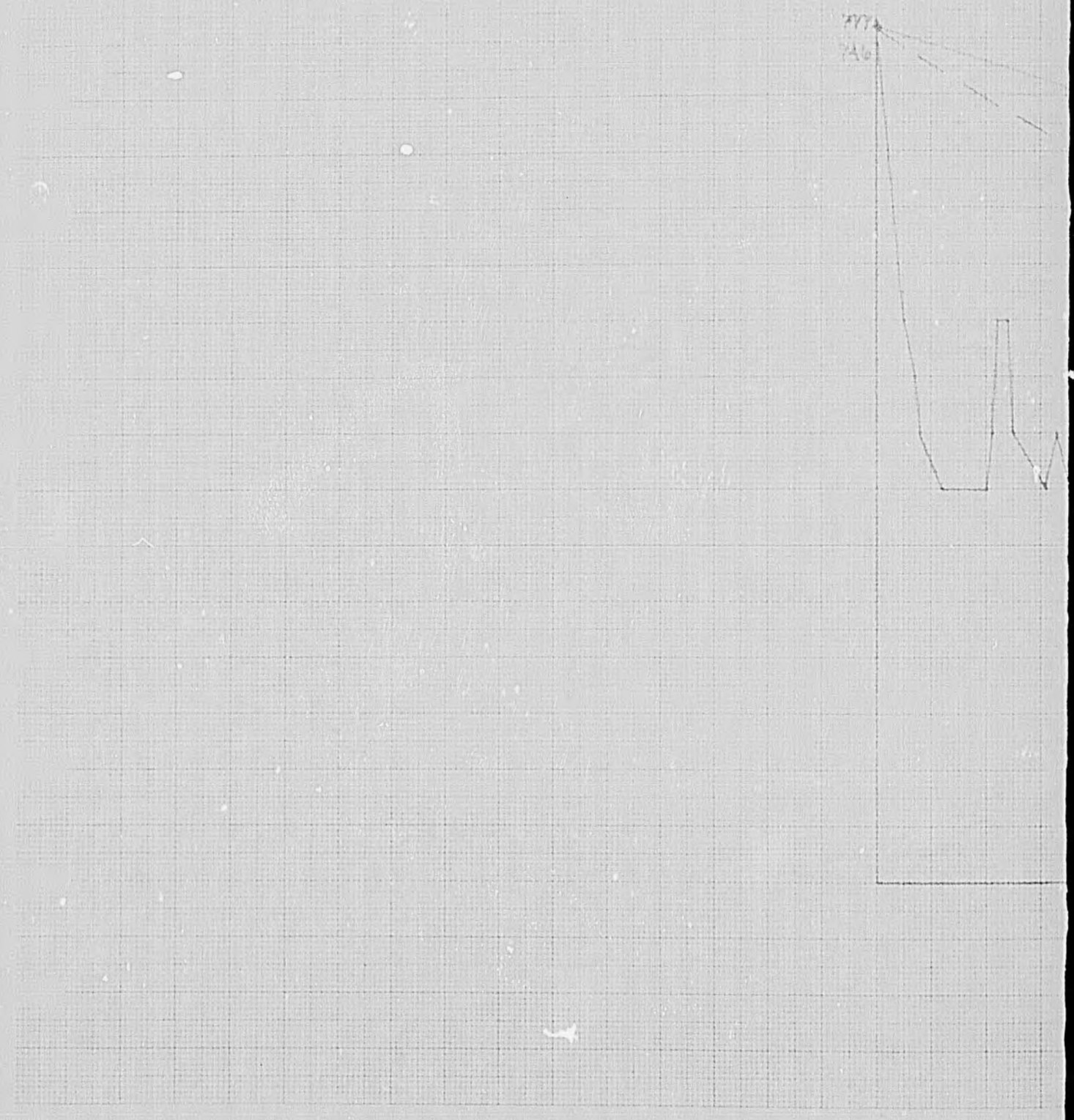
LEGEND

TREES ON ROAD

WIDTH OF ROAD OBSTRUCTION

WATER

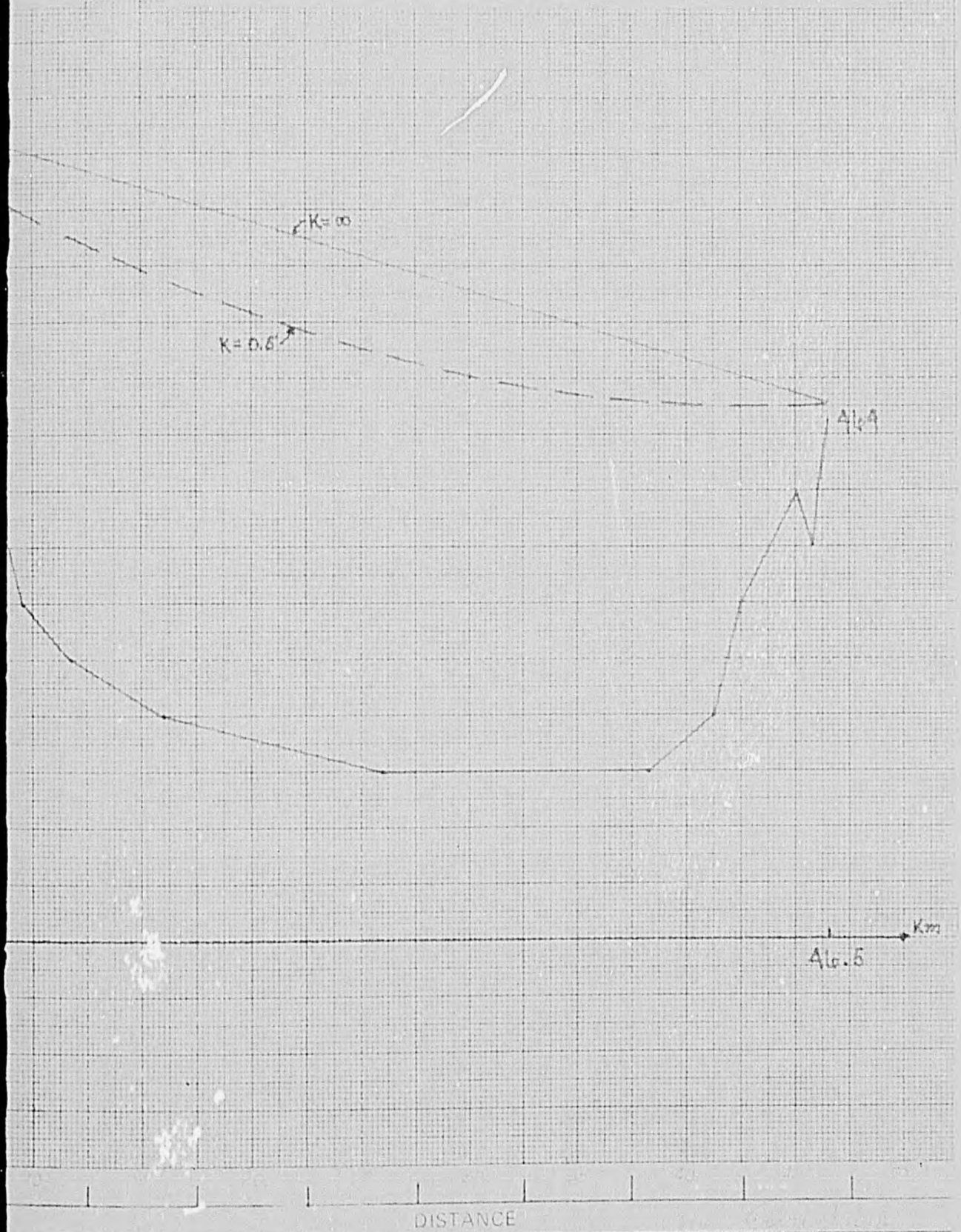
MARSH



SITE NAME _____

TOWER HEIGHT _____

SITE	
LATITUDE	
LONGITUDE	
SITE ELEVATION	
TRUE AZIMUTH	
PATH LENGTH	



Teleconsult

PATH PROFILE PLOTTING CHART

VERT SC

HORIZ SC

CUSTOMER

ENGINEER

DATE

FREQ GHz

PROJECT NO

PROFILE NO

ISSUE

MAP NAME

SOURCE

SCALE

CONTOUR INTERVAL

ELEVATION

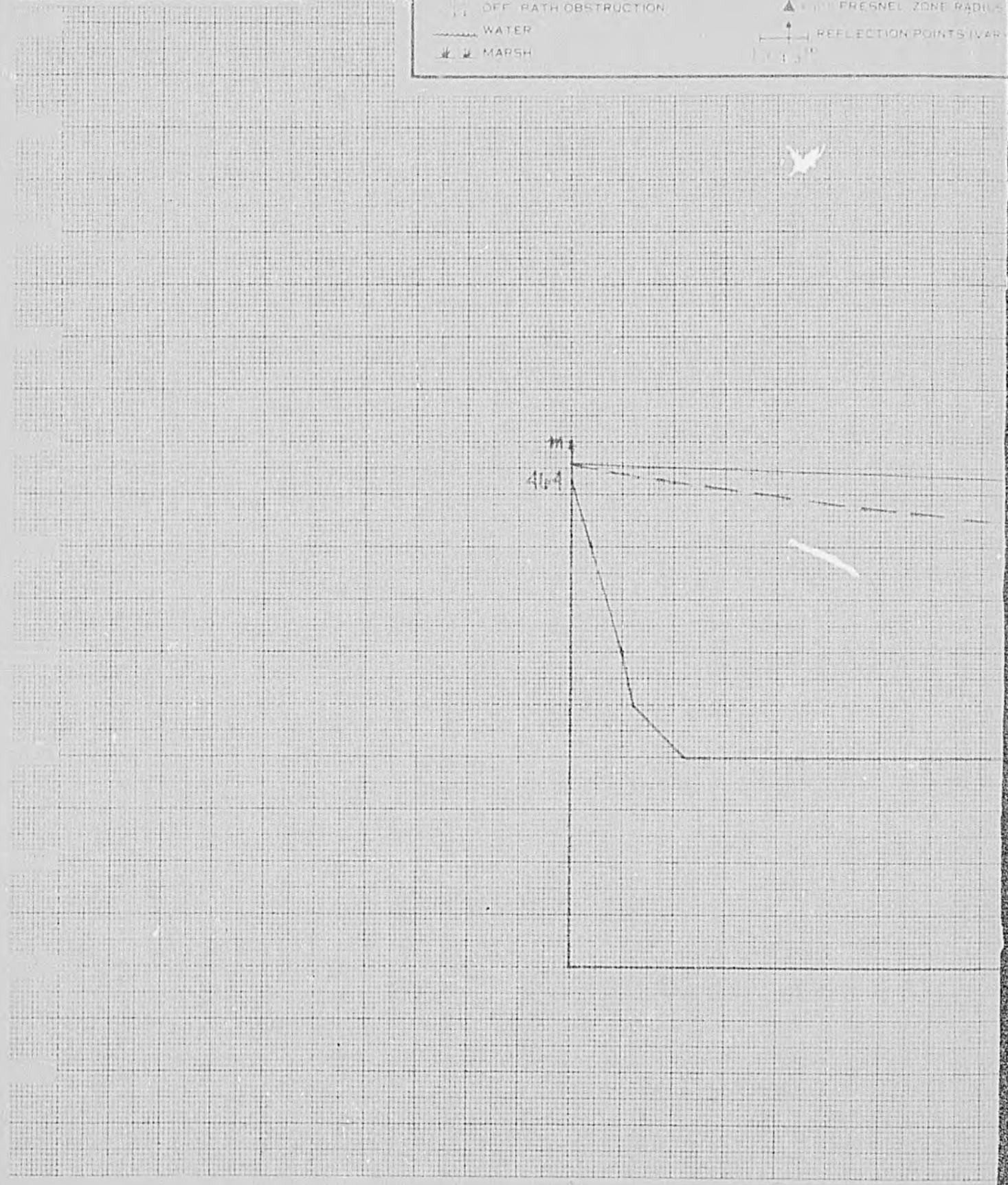
SITE NAME

TOWER HEIGHT

VERT. SCALE	1 cm
HORIZ. SCALE	4 cm =

LEGEND

- TREES ON PATH
- ON PATH OBSTRUCTION
- OFF PATH OBSTRUCTION
- WATER
- MARSH
- FIRST FRESNEL ZONE
- 0.6 FIRST FRESNEL ZONE
- FRESNEL ZONE RADIUS
- REFLECTION POINTS (VAR



SITE NAME _____

TOWER HEIGHT _____

SITE	
LATITUDE	
LONGITUDE	
SITE ELEVATION	
TO AZIMUTH	
PATH LENGTH	

Teleconsult

PATH PROFILE PLOTTING CHART

VERT. SCA

HORIZ. SCA

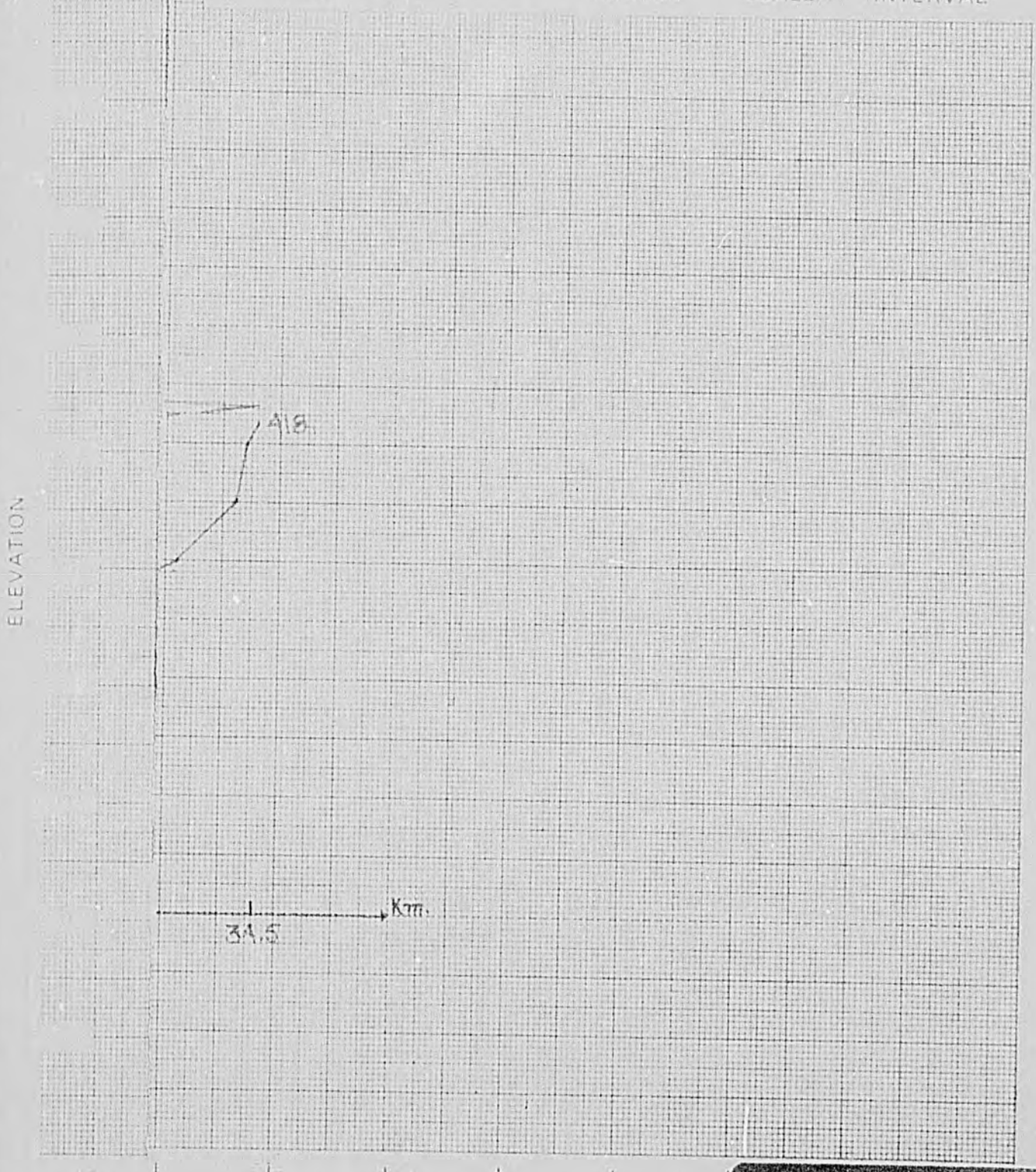
CUSTOMER

SITES

ENGINEER DATE FREQ GHz

PROJECT NO PROFILE NO ISSUE 1

MAP NAME SOURCE SCALE CONTOUR INTERVAL



SITE NAME

TOWER HEIGHT

[redacted]

VERT. SCALE	1 cm
HORIZ. SCALE	1 cm

LEGEND

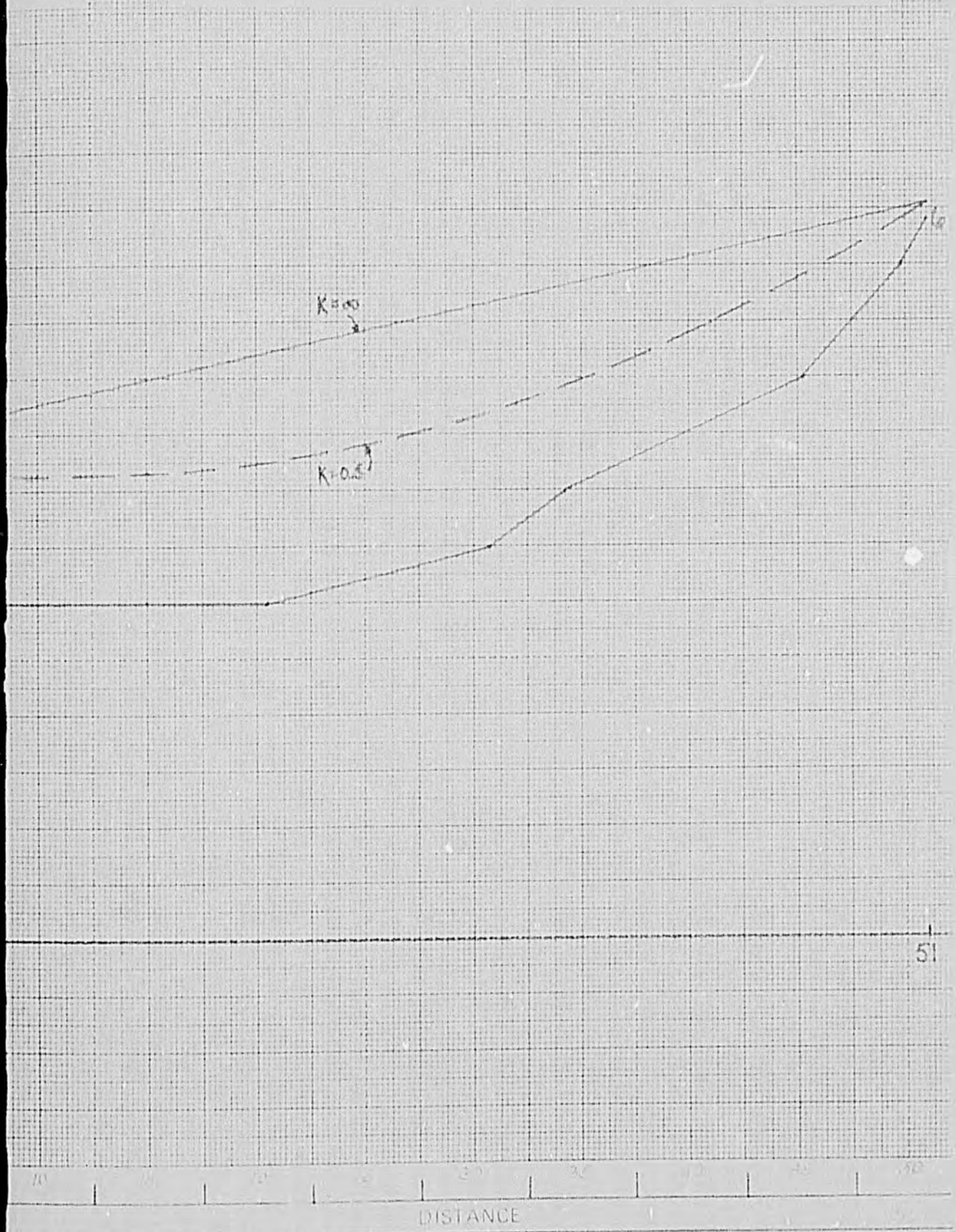
- TREES ON PATH
- ON PATH OBSTRUCTION
- OFF PATH OBSTRUCTION
- WATER
- MARSH
- FIRST FRESNEL ZONE
- SECOND FRESNEL ZONE
- FRESNEL ZONE RADIUS
- REFLECTION POINTS (VAR)

ELEVATION

SITE NAME

TOWER HEIGHT

SITE	[illegible]
LATITUDE	N [illegible]
LONGITUDE	E [illegible]
SITE ELEVATION,	[illegible]
TRUE AZIMUTH	
PATH LENGTH,	



Teleconsult

PATH PROFILE PLOTTING CHART

VERT SC

HORIZ SC

CUSTOMER

SITES

ENGINEER DATE FREQ GHz

PROJECT NO PROFILE NO ISSUE

MAP NAME SOURCE SCALE CONTOUR INTERVAL

ELEVATION

Km

SITE NAME

TOWER HEIGHT

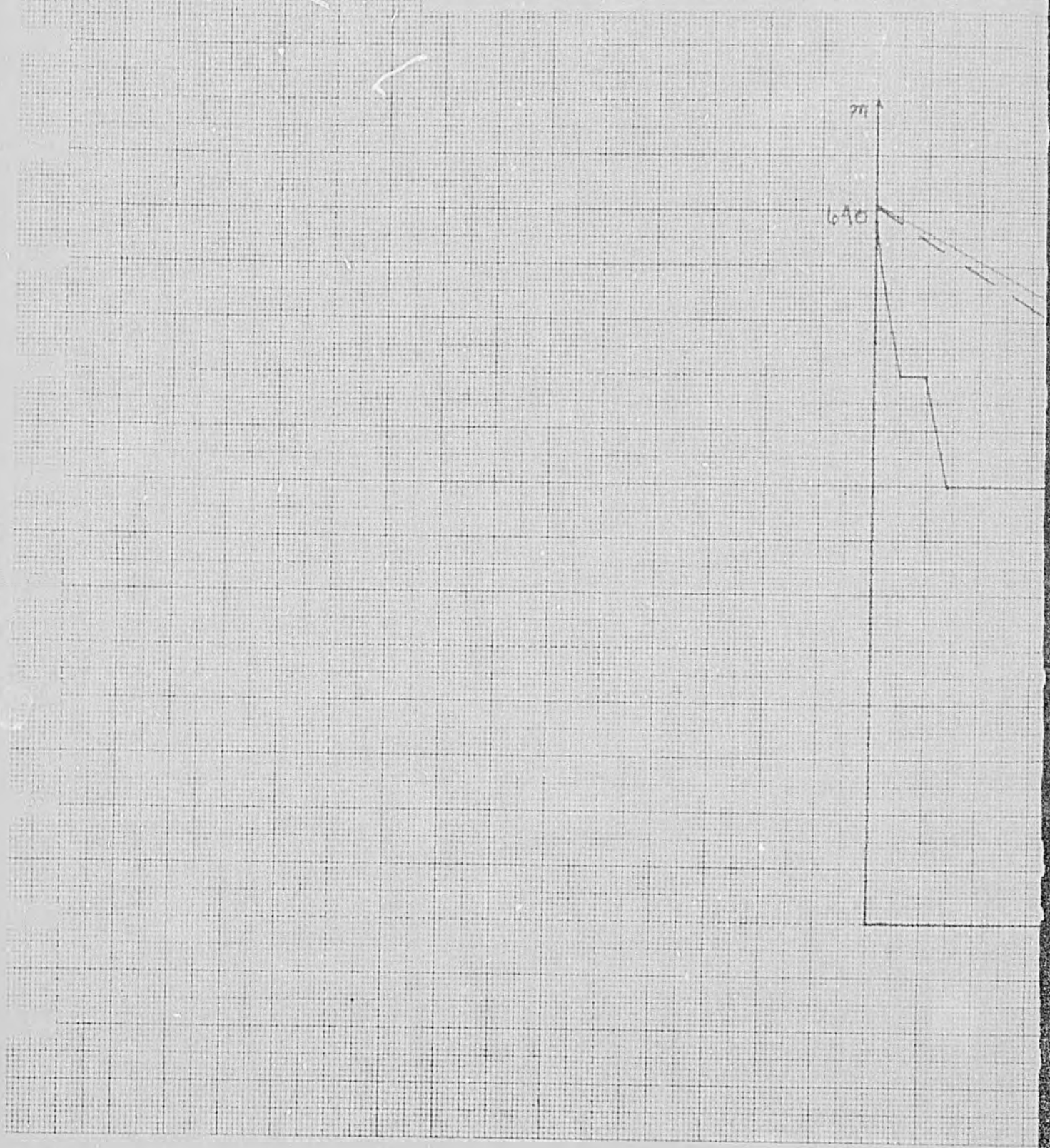
[redacted]

VERT. SCALE	1 cm =
HORIZ. SCALE	1 cm =

LEGEND

- TREES ON PATH
- ON PATH OBSTRUCTION
- OFF PATH OBSTRUCTION
- WATER
- MARSH
- FIRST FRESNEL ZONE
- FIRST FRESNEL ZONE
- FRESNEL ZONE RADI
- REFLECTION POINTS (VA

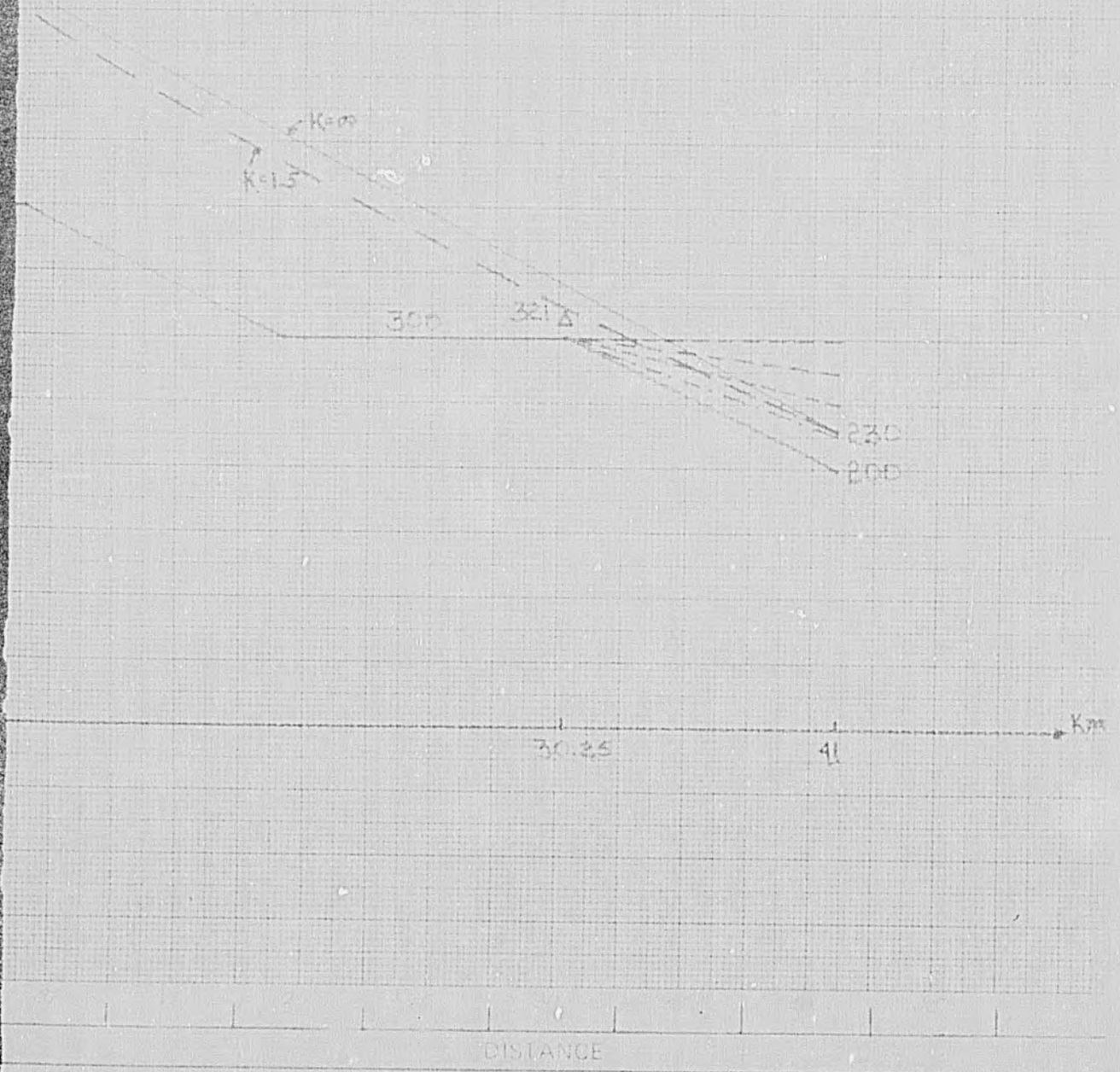
ELEVATION



SITE NAME

TOWER HEIGHT

SITE	
LATITUDE	
LONGITUDE	
SITE ELEVATION	
TRUE AZIMUTH	
PATH LENGTH	



Teleconsult

PATH PROFILE PLOTTING CHART

VERT. S

HORIZ. S

CUSTOMER [illegible]

SITES [illegible]

ENGINEER [illegible] DATE [illegible] FREQ [illegible] GHz

PROJECT NO. [illegible] PROFILE NO. [illegible] ISSUE 1

MAP NAME SOURCE SCALE CONTOUR INTERVAL

ELEVATION

Solid line-expected worst case.
Broken line-expected best case.

Based on contour interval of the best available maps.

SITE NAME

TOWER HEIGHT

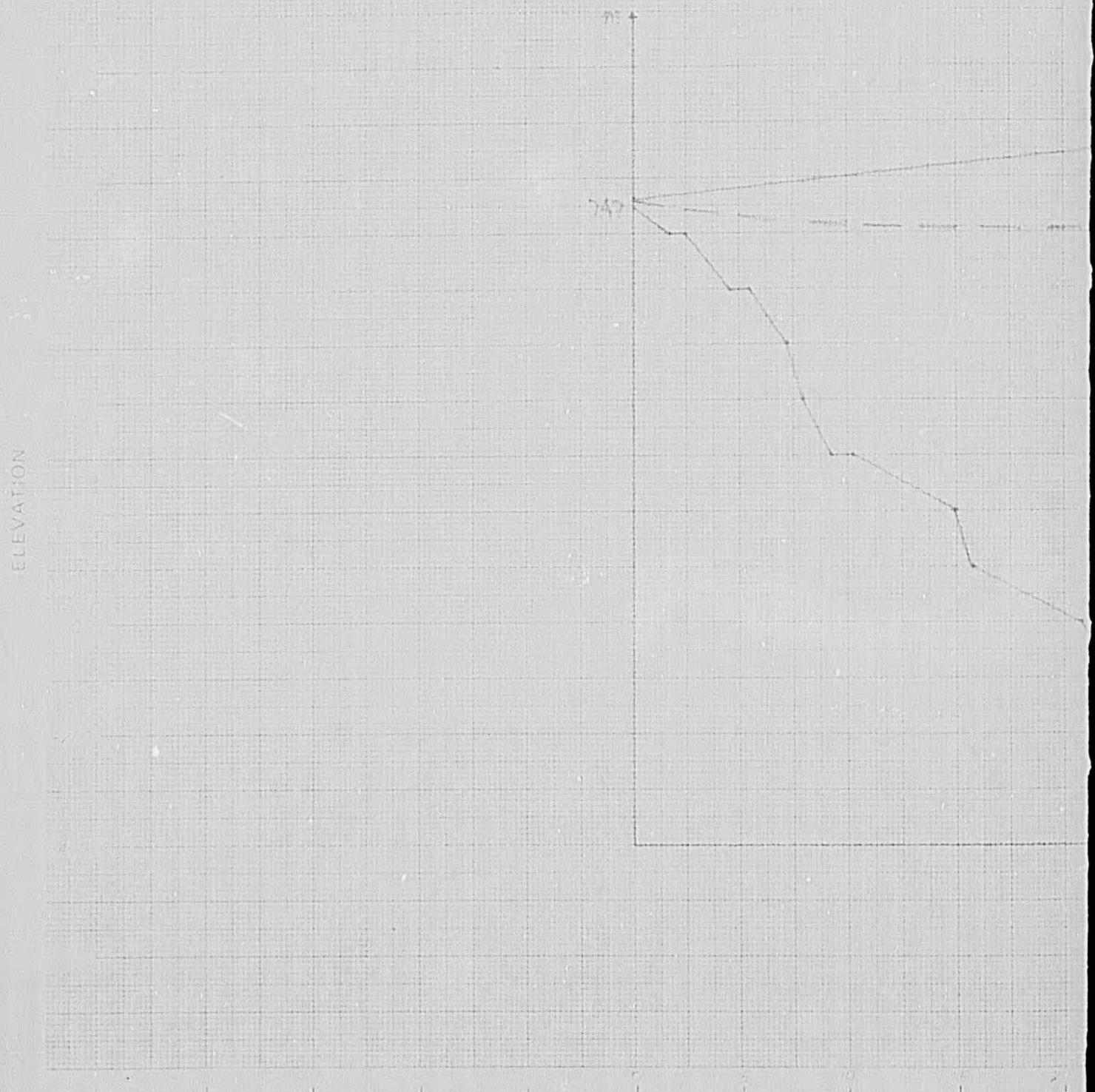
[redacted]

VERT. SCALE	1 cm
HORIZ. SCALE	1 cm

LEGEND

TREES IN PATH
ON PATH (BUTTE RIDGE)
OF PATH (BUTTE RIDGE)
WATER
MARSH

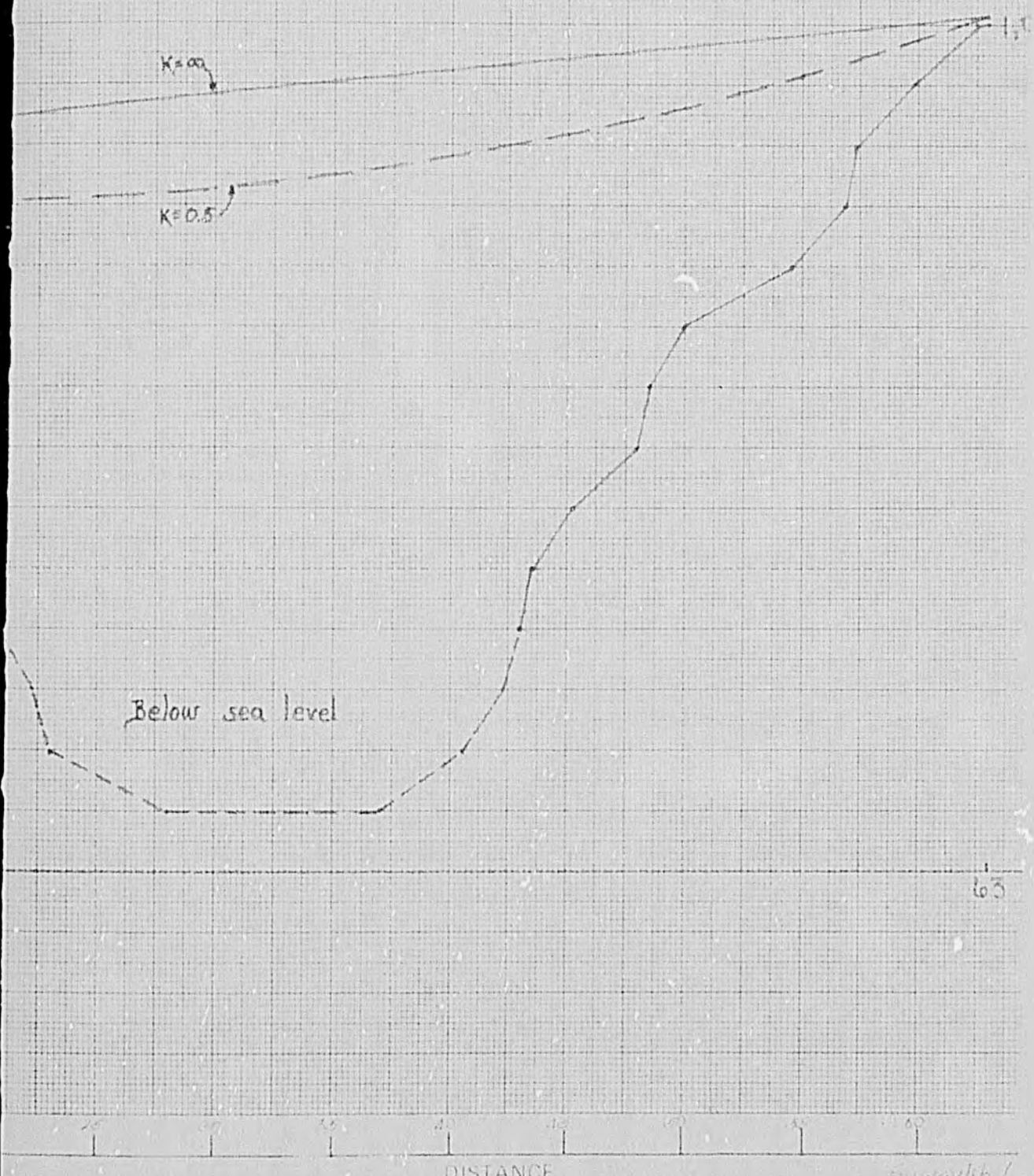
FIRST FRESNEL ZONE
SECOND FRESNEL ZONE
FRESNEL ZONE RADIUS
PROFILE STATION POINTS



SITE NAME: Sandstone

TOWER HEIGHT: (to tip Antenna)

SITE	[illegible]	[illegible]
LATITUDE	N [illegible]	N [illegible]
LONGITUDE	E [illegible]	E [illegible]
SITE ELEVATION	[illegible]	[illegible]
TRUE AZIMUTH		
PATH LENGTH		



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PATH PROFILE PLOTTING CHART

VERT. SCA

HORIZ. SC

CUSTOMER

SITES

ENGINEER DATE FREQ. GHz

PROJECT NO. PROFILE NO. ISSUE

MAP NAME SOURCE SCALE CONTOUR INTERVAL

ELEVATION

Solid line-expected worst case.
Broken line-expected best case.

Based on contour interval of the best available maps.

Km

SITE NAME

TOWER HEIGHT

[redacted]

VERT. SCALE	1 cm = [illegible]
HORIZ. SCALE	1 cm = [illegible]

LEGEND

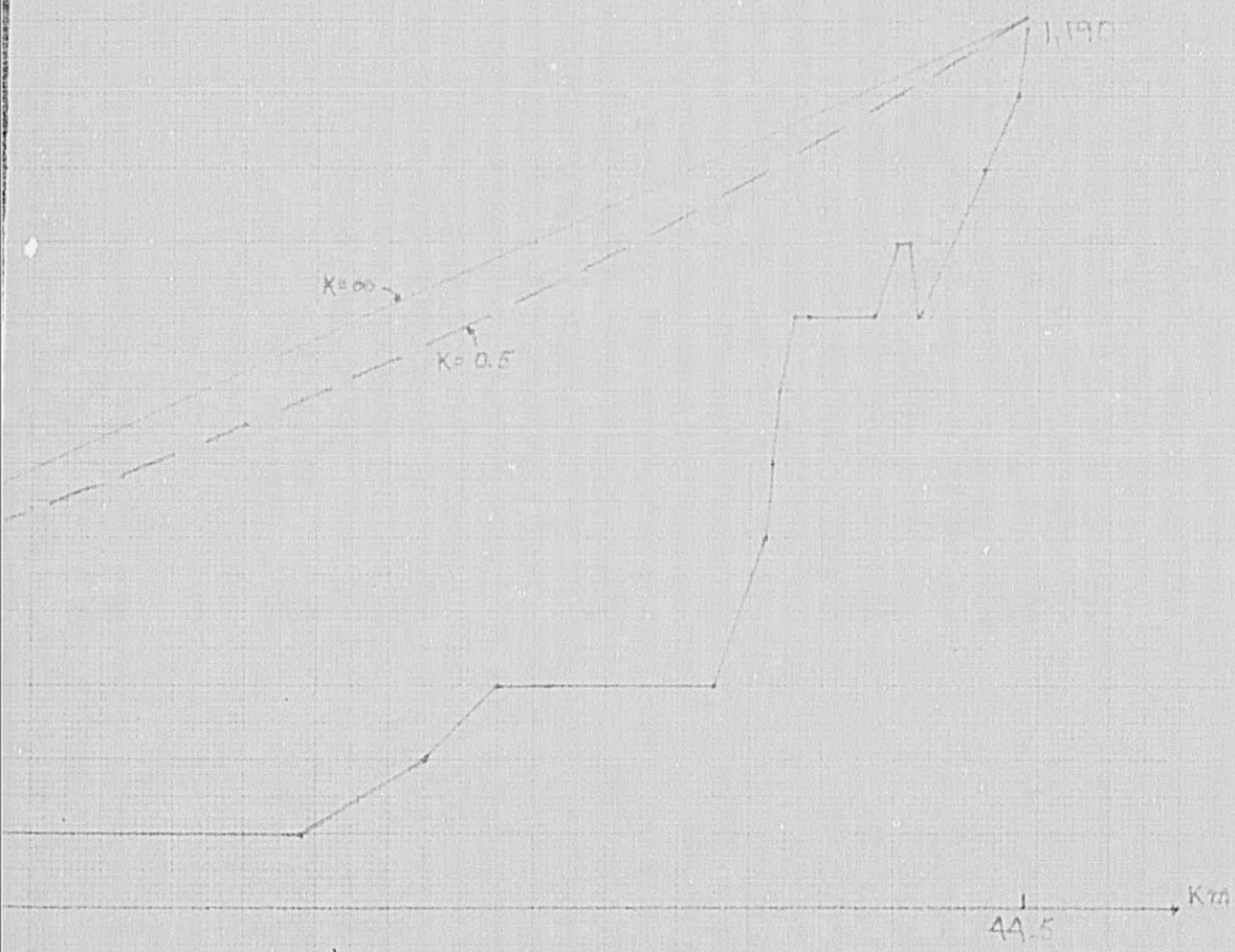
- TREES ON PATH
- ON PATH OBSTRUCTION
- OFF PATH OBSTRUCTION
- WATER
- MARSH
- FIRST FRESNEL ZONE R[illegible]
- 0.6 FIRST FRESNEL ZONE R[illegible]
- FRESNEL ZONE RADIUS
- REFLECTION POINTS (VARY[illegible])

ELEVATION

SITE NAME: Haifa

TOWER HEIGHT: (15 m Antenna)

SITE	
LATITUDE	
LONGITUDE	
SITE ELEVATION	
TRUE AZIMUTH	
PATH LENGTH	



DISTANCE

16 m Mast
(Incl. Antenna)

Teleconsult PATH PROFILE PLOTTING CHART

VERT. SCAL

HORIZ. SCAL

CUSTOMER USAID

SITES [illegible]

ENGINEER [illegible] DATE [illegible] FREQ. — GHz

PROJECT NO. [illegible] PROFILE NO. 21 ISSUE 1

MAP NAME [illegible] SOURCE SCALE CONTOUR INTERVAL

ELEVATION

SITE NAME —

TOWER HEIGHT —

[redacted]

VERT. SCALE	
HORIZ. SCALE	

LEGEND

WATER

MARSH

ELEVATION

1,100

SITE NAME

TOWER HEIGHT

SITE	
LATITUDE	
LONGITUDE	
SITE ELEVATION	
TRUE AZIMUTH	
PATH LENGTH	51.2

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PATH PROFILE PLOTTING CHART

VERT. SC

HORIZ. SC

CUSTOMER

SITE

ENGINEER

PROJECT NO.

PROFILE NO.

MAP NAME

SOURCE

221

ELEVATION

Km

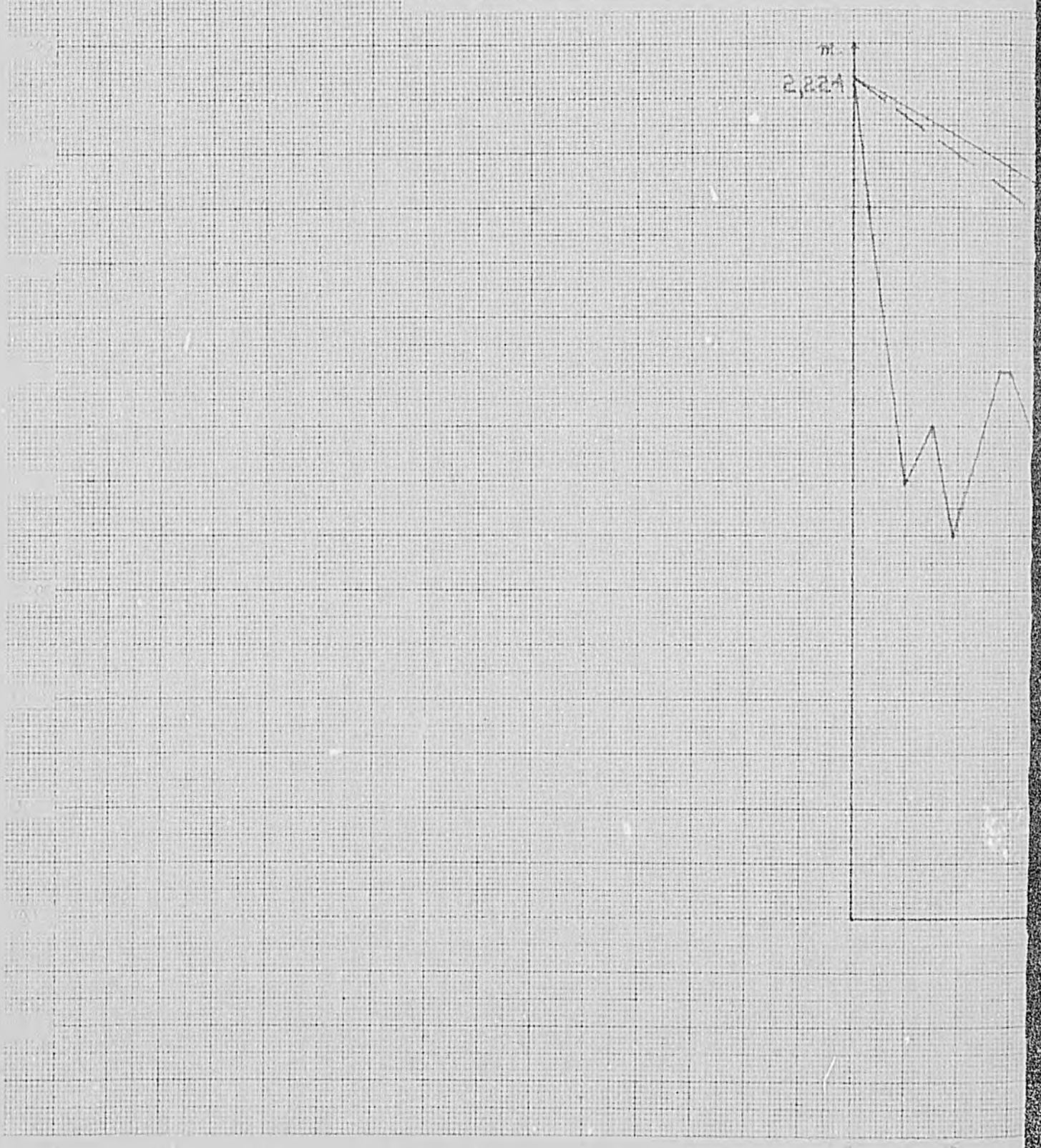
SITE NAME

TOWER HEIGHT

VERT. SCALE	1 cm =
HORIZ. SCALE	1 cm.

LEGEND

- TREES ON PATH
- ON PATH OBSTRUCTION
- OFF PATH OBSTRUCTION
- WATER
- MARSH
- 1 FIRST FRESNEL ZONE R
- 6 FIRST FRESNEL ZONE R
- FRESNEL ZONE RADIUS
- REFLECTION POINTS (LAR

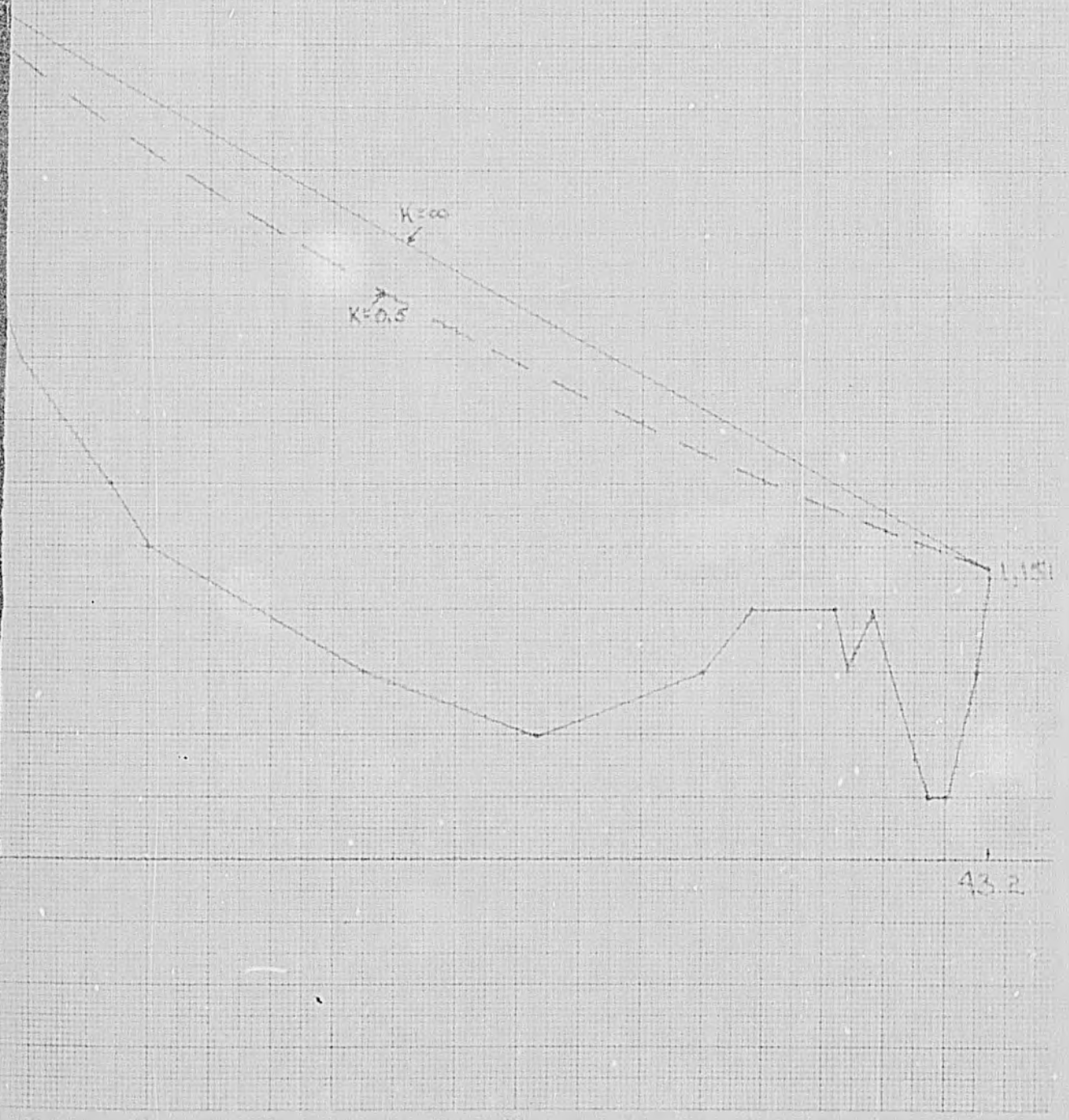


ELEVATION

SITE NAME

TOWER HEIGHT

SITE	
LATITUDE	
LONGITUDE	
SITE ELEVATION	
TRUE AZIMUTH	
PATH LENGTH	



Teleconsult PATH PROFILE PLOTTING CHART

VERT. SC

HORIZ. SC

CUSTOMER

SITES

ENGINEER DATE FREQ GHz

PROJECT NO. PROFILE NO. ISSUE

MAP NAME SOURCE SCALE CONTOUR INTERVAL

ELEVATION

Km

SITE NAME

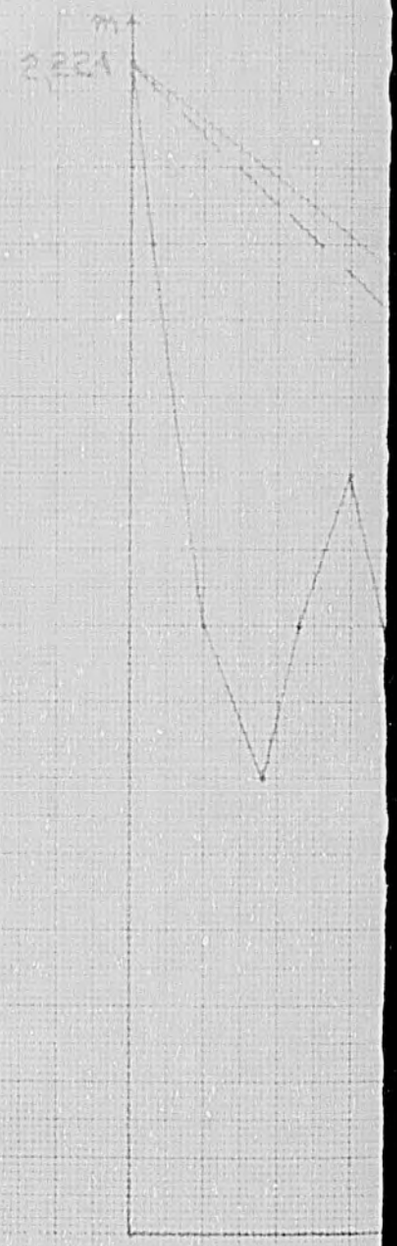
TOWER HEIGHT

VERT. SCALE	
HORIZ. SCALE	

LEGEND

WATER

MARSH

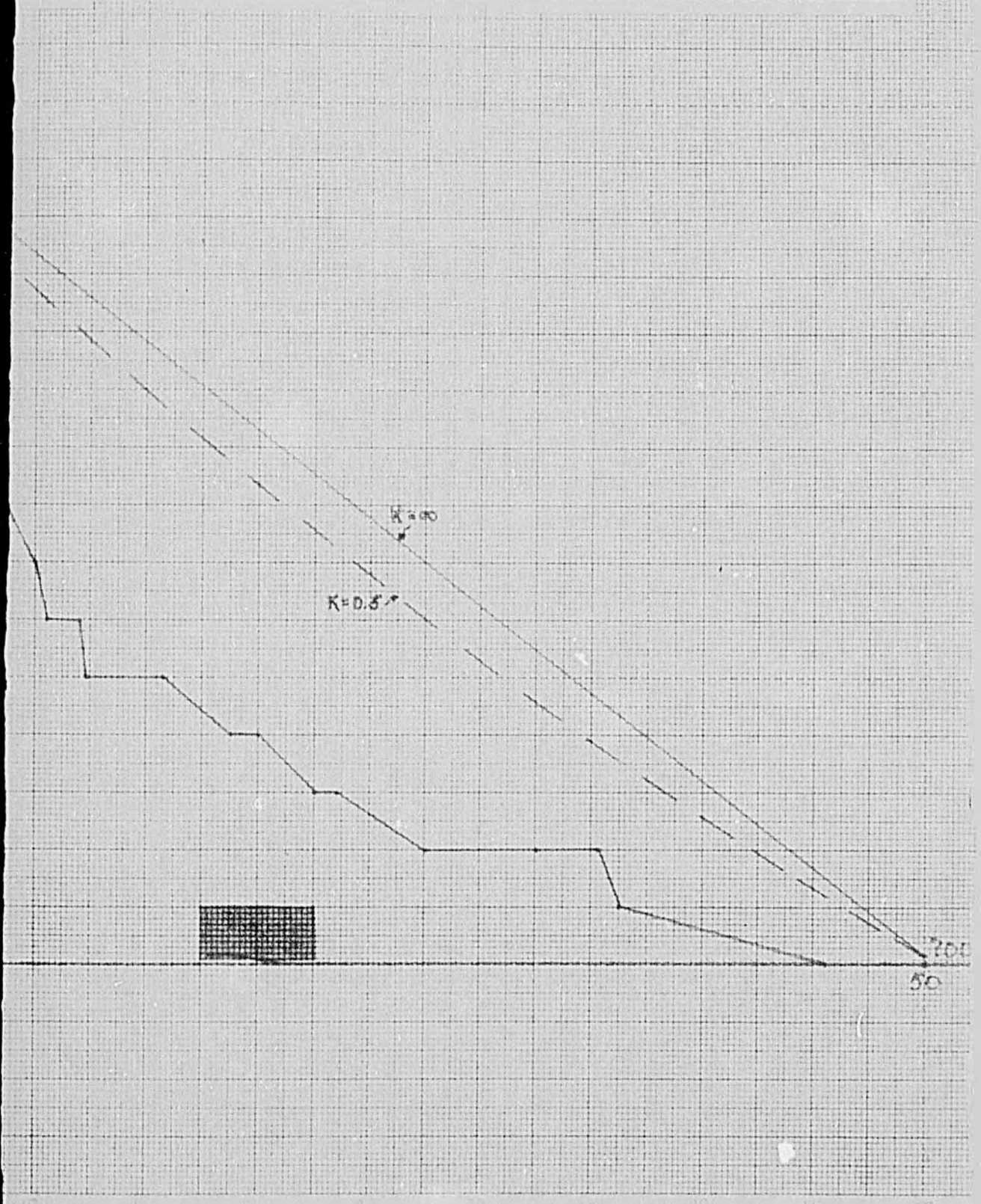


ELEVATION

SITE NAME

TOWER HEIGHT

SITE	
LATITUDE	
LONGITUDE	
SITE ELEVATION	
TRUE AZIMUTH	
PATH LENGTH	



Teleconsult

PATH PROFILE PLOTTING CHART

VERT. SCA

HORIZ. SCA

CUSTOMER

SITES

ENGINEER DATE FREQ GHz

PROJECT NO. PROFILE NO. ISSUE

MAP NAME SOURCE SCALE CONTOUR INTERVAL

ELEVATION

Km

SITE NAME

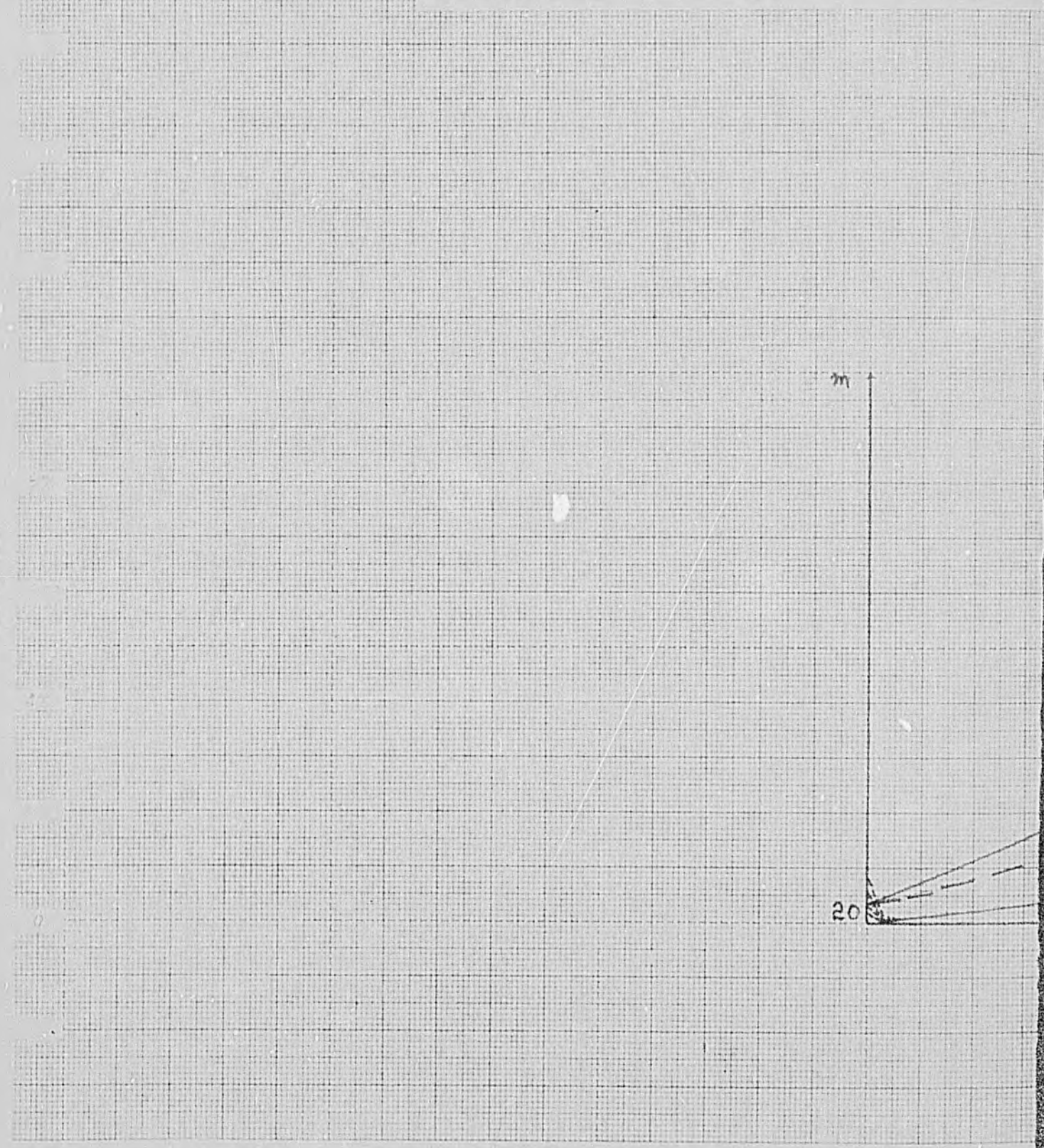
TOWER HEIGHT

VERT. SCALE	1 cm =
HORIZ. SCALE	1 cm =

LEGEND

- TREES ON PATH
- ON PATH OBSTRUCTION
- OFF PATH OBSTRUCTION
- WATER
- MARSH
- FIRST FRESNEL ZONE
- 0.6 FIRST FRESNEL ZONE
- FRESNEL ZONE RADIUS
- REFLECTION POINTS (VAR

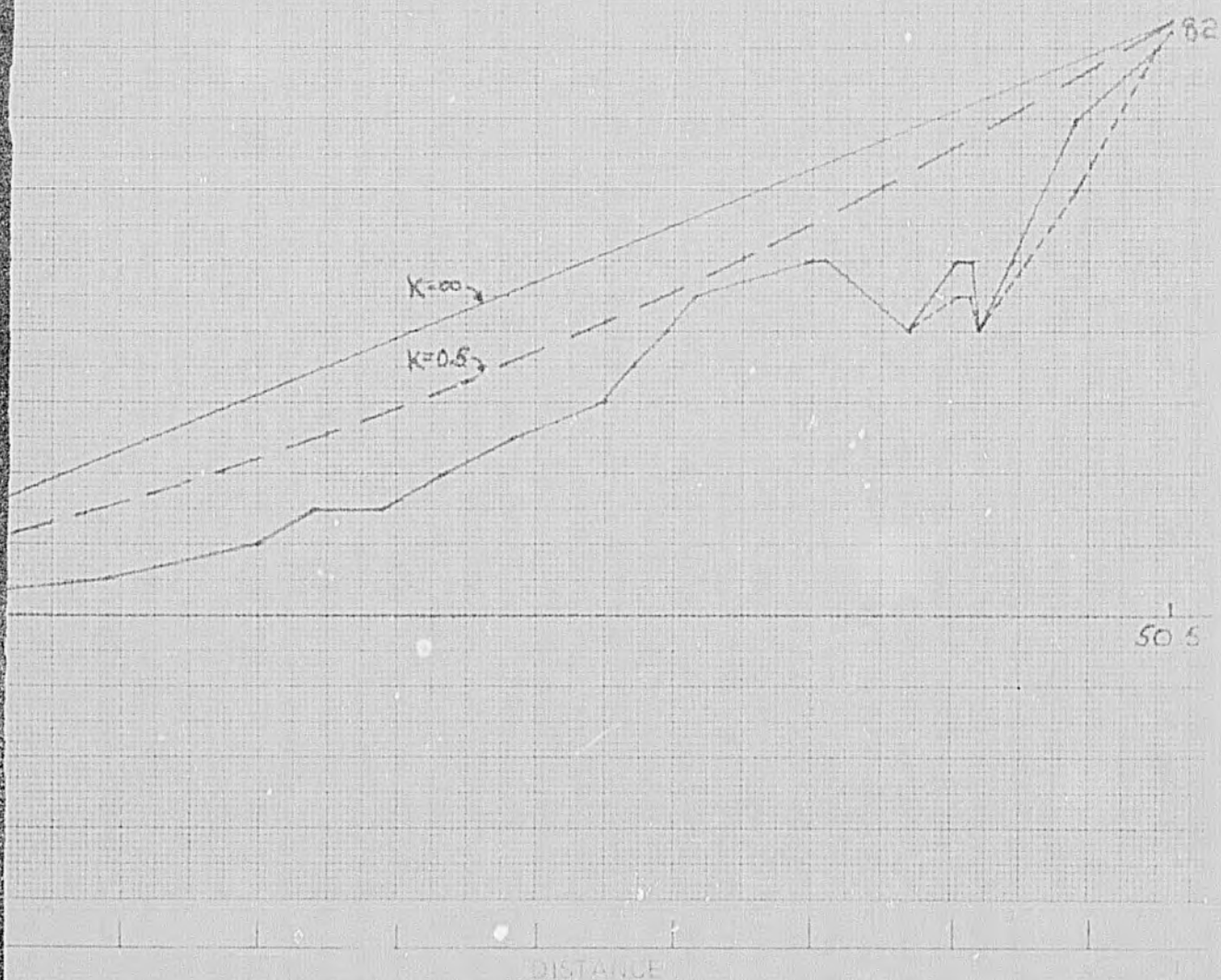
ELEVATION



SITE NAME

TOWER HEIGHT

SITE	
LATITUDE	
LONGITUDE	
SITE ELEVATION	
TRUE AZIMUTH	
PATH LENGTH	



Teleconsult

PATH PROFILE PLOTTING CHART

VERT. SC

HORIZ. SC

CUSTOMER USATC

SITES [illegible]

ENGINEER [illegible] DATE [illegible] FREQ — GHz

PROJECT NO [illegible] PROFILE NO. [illegible] ISSUE 1

MAP NAME [illegible] SOURCE SCALE CONTOUR INTERVAL

ELEVATION

2

Solid line-expected worst case.
Broken line-expected best case.

Based on contour interval of the best available maps.

0 Km

SITE NAME [illegible]

TOWER HEIGHT [illegible]

[redacted]

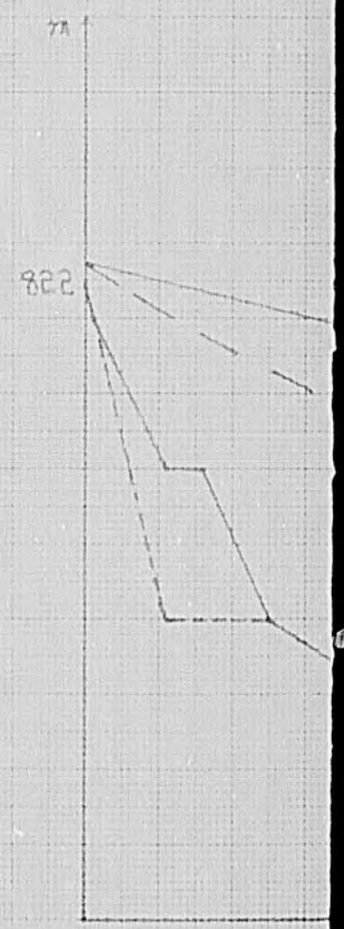
VERT SCALE	[illegible]
HORIZ SCALE	1 cm

LEGEND

TREES OR BUSH
ON PATH OBSTRUCTION
OFF PATH OBSTRUCTION
WATER
MARSH

FIRST FRESNEL ZONE
FRESNEL ZONE RADIUS
REFLECTION POINTS (VAR

ELEVATION

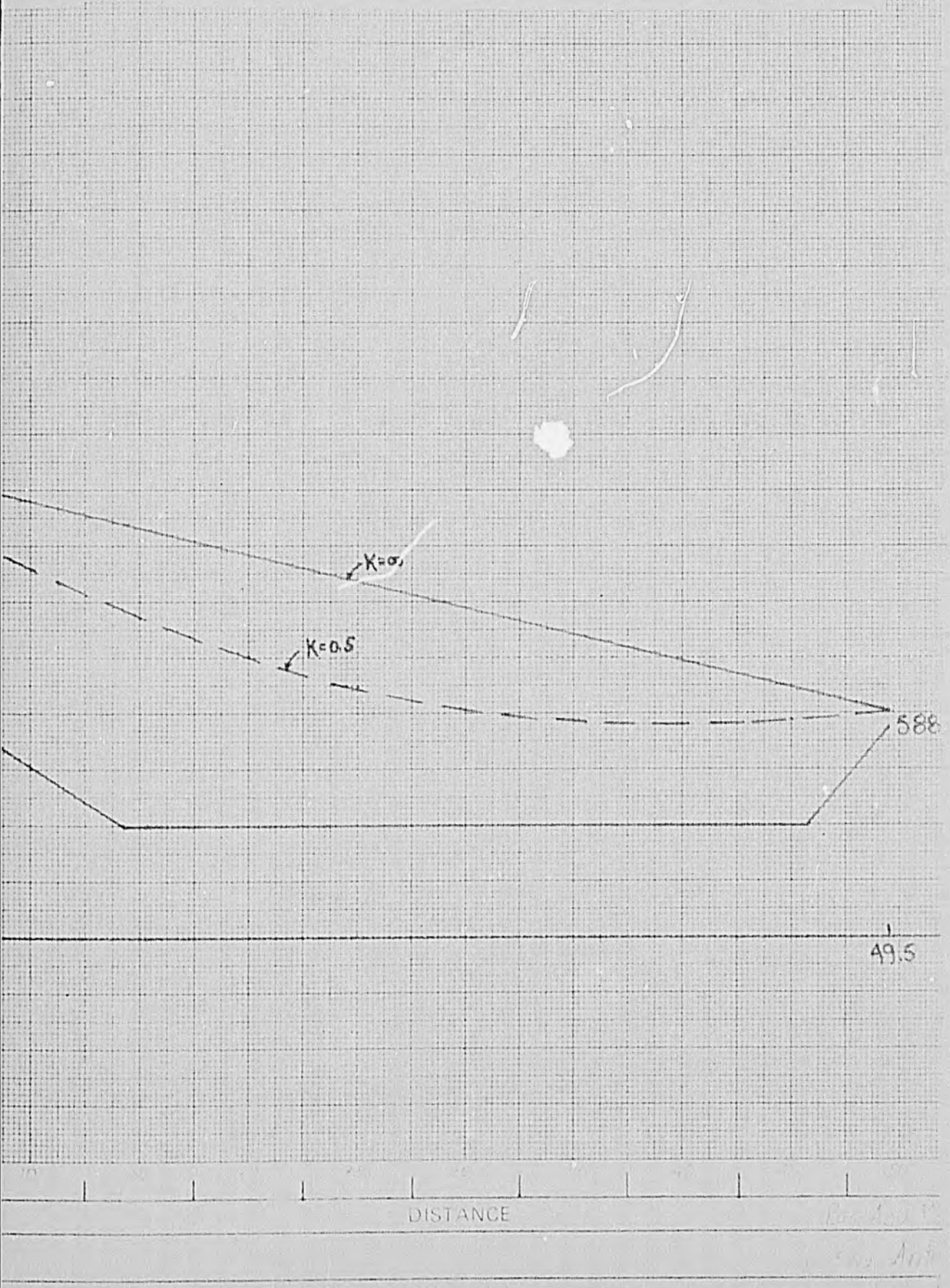


SITE NAME

TOWER HEIGHT

ADIUS
ADIUS
ING K)

SITE	
LATITUDE	
LONGITUDE	
SITE ELEVATION,	
TRUE AZIMUTH	
PATH LENGTH,	



Teleconsult

PATH PROFILE PLOTTING CHART

VERT. SC

HORIZ. SC

CUSTOMER

SITES

ENGINEER DATE FREQ GHz

PROJECT NO PROFILE NO ISSUE

MAP NAME SOURCE SCALE CONTOUR INTERVAL

ELEVATION

Solid line-expected worst case.
Broken line-expected best case.

Based on contour interval of the best available maps.

Km

SITE NAME

TOWER HEIGHT

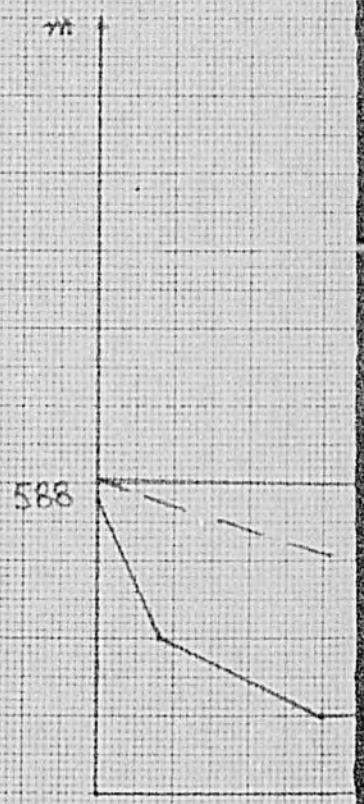
[redacted]

VERT. SCALE	1 cm
HORIZ. SCALE	1 cm

LEGEND

- TREES ON PATH
- ON PATH OBSTRUCTION
- OFF PATH OBSTRUCTION
- WATER
- MARSH
- 0.3 FIRST FRESNEL ZONE
- 0.6 FIRST FRESNEL ZONE
- FRESNEL ZONE RADIUS
- REFLECTION POINTS (VAR

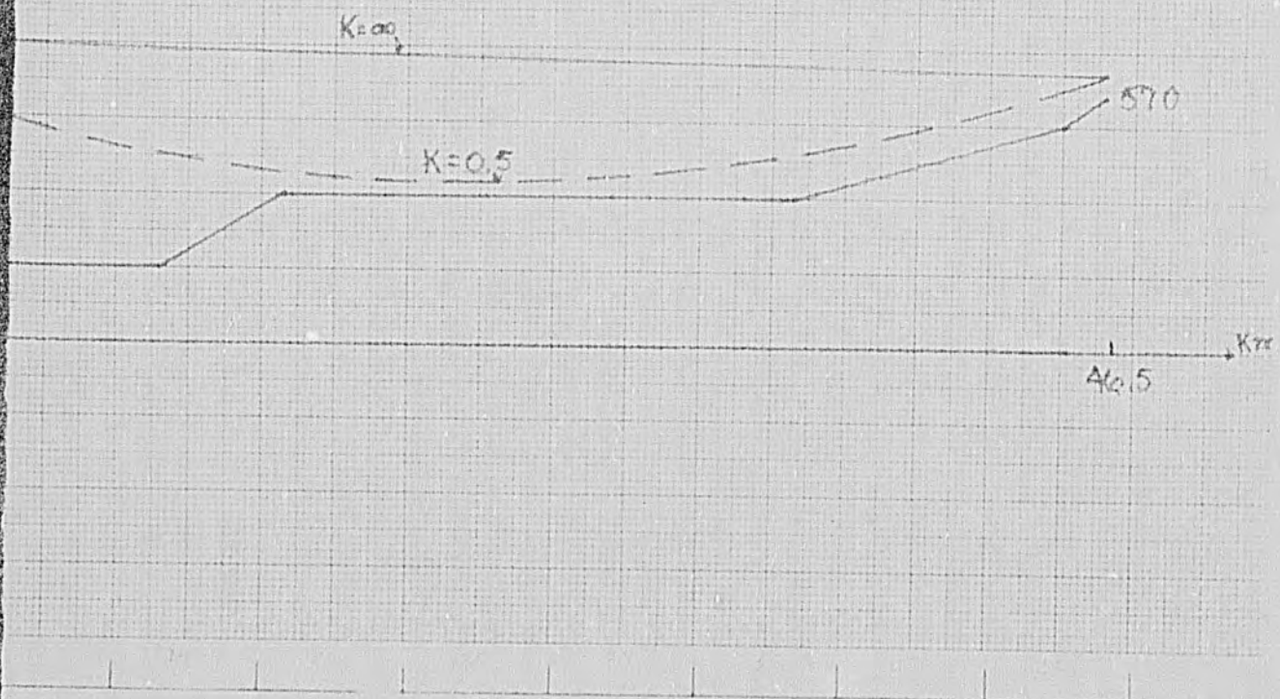
ELEVATION



SITE NAME — Ka. Ah. Kanan

TOWER HEIGHT — (see Attached)

SITE	
LATITUDE	
LONGITUDE	
SITE ELEVATION	
TRUE AZIMUTH	
PATH LENGTH	



Teleconsult PATH PROFILE PLOTTING CHART

VERT. SC

HORIZ. SC

CUSTOMER USAID

SITES [illegible]

ENGINEER [illegible] DATE [illegible] FREQ — GHz

PROJECT NO. [illegible] PROFILE NO. [illegible] ISSUE 1

MAP NAME SOURCE SCALE CONTOUR INTERVAL

ELEVATION

SITE NAME

TOWER HEIGHT

[redacted]

VERT. SCALE	1 cm =
HORIZ. SCALE	1 cm =

LEGEND

TREES ON PATH
ON PATH OBSTRUCTION
OFF PATH OBSTRUCTION
WATER
MARSH

FIRST FRESNEL ZONE
FIRST FRESNEL ZONE
TRANSMISSION RADIUS
REFLECTION POINTS (VAR

ELEVATION

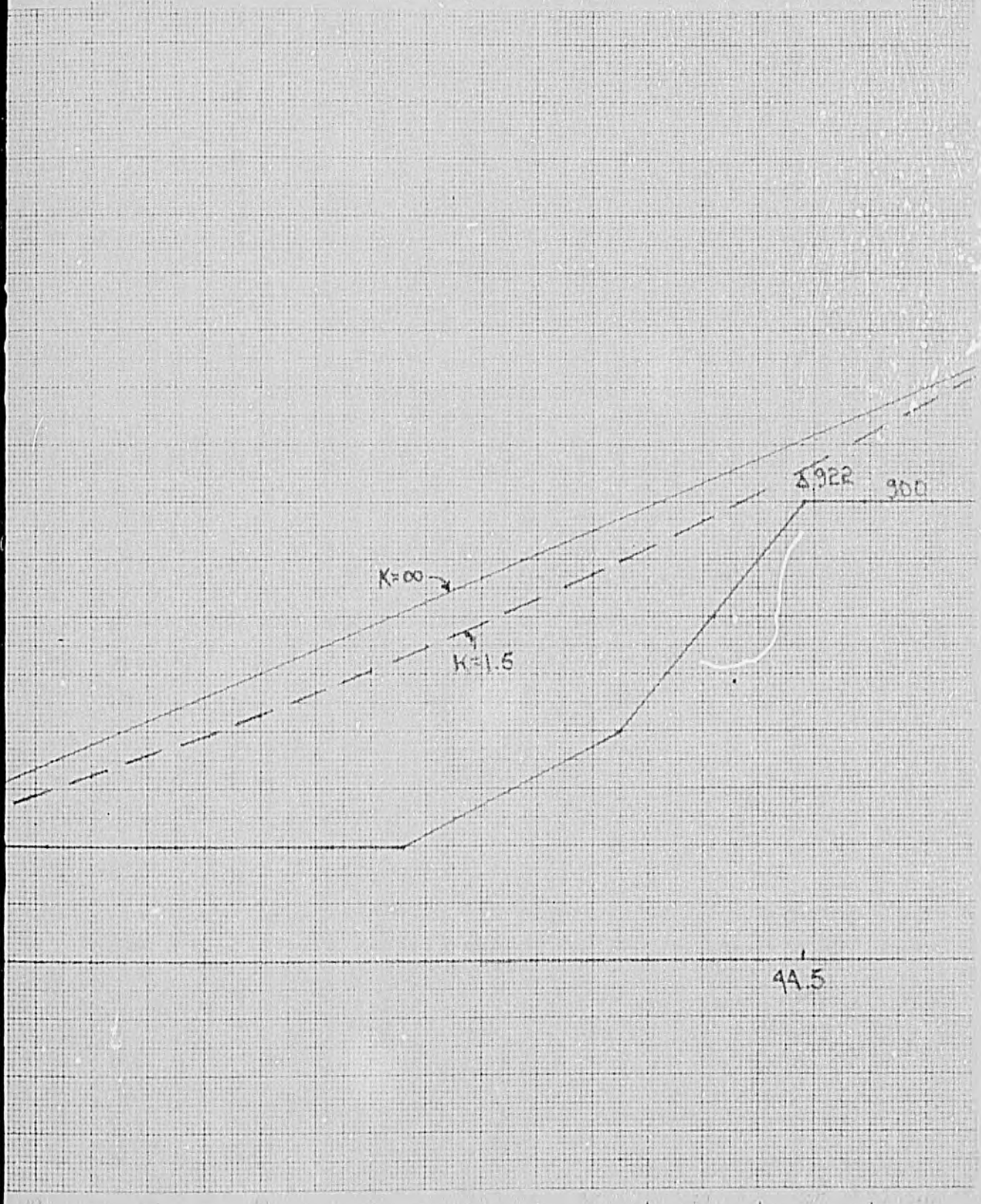
m

570

SITE NAME

TOWER HEIGHT

SITE	
LATITUDE	
LONGITUDE	
SITE ELEVATION	
TRUE AZIMUTH	
PATH LENGTH	



Teleconsult

PATH PROFILE PLOTTING CHART

VERT SC

HORIZ SC

CUSTOMER

SITES

ENGINEER DATE FREQ GHz

PROJECT NO PROFILE NO ISSUE

MAP NAME SOURCE SCALE CONTOUR INTERVAL

1,029

ELEVATION

Km

55.5

SITE NAME

TOWER HEIGHT

[redacted]

VERT. SCALE	1 cm =
HORIZ. SCALE	1 cm =

LEGEND

- TREES ON PATH
- ON PATH OBSTRUCTION
- OFF PATH OBSTRUCTION
- WATER
- MARSH
- 0.3 FIRST FRESNEL ZONE
- 0.6 FIRST FRESNEL ZONE
- FRESNEL ZONE RADIUS
- REFLECTION POINTS (VAR

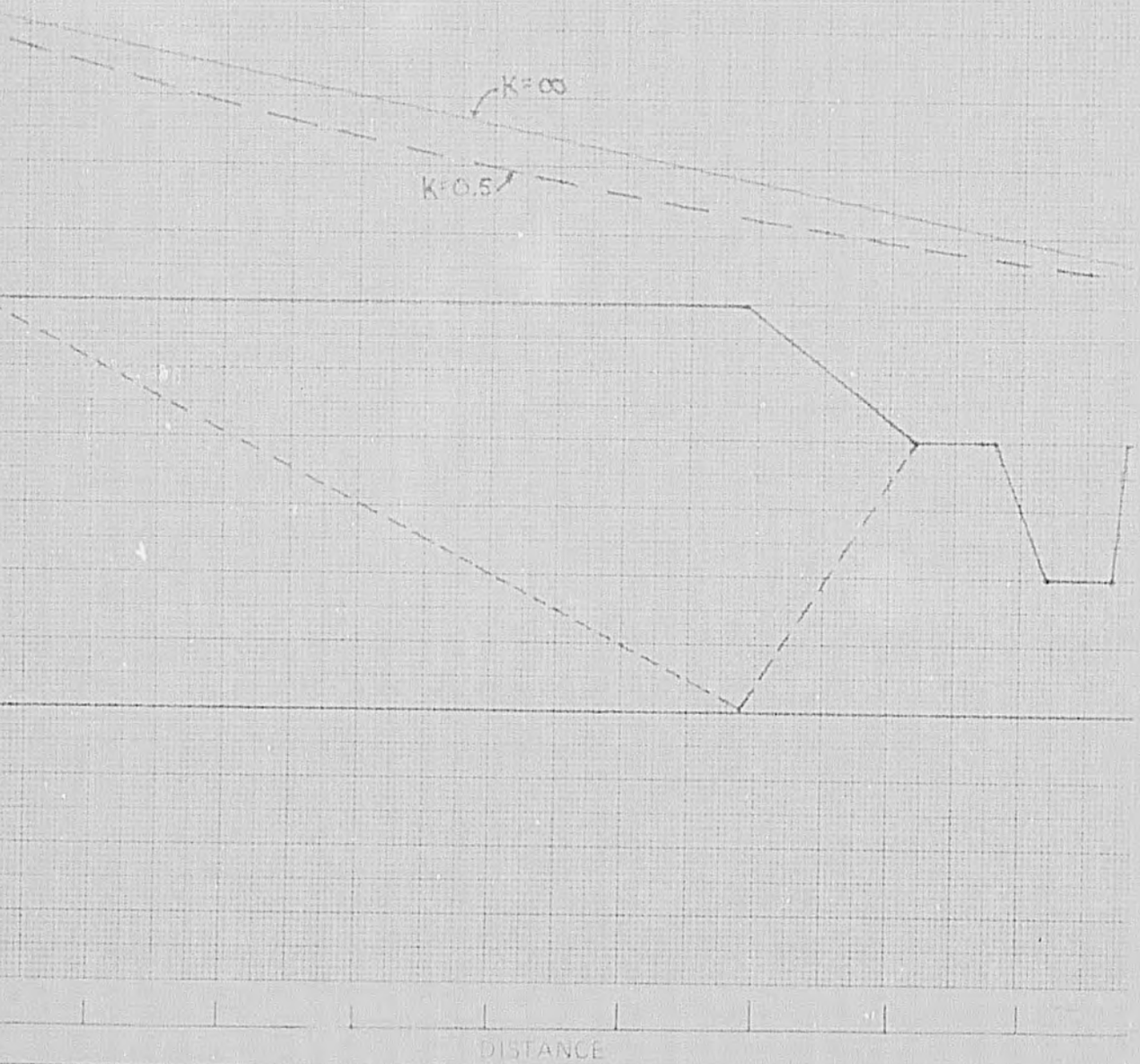
ELEVATION

SITE NAME

TOWER HEIGHT

(15 m Antenna)

SITE	
LATITUDE	
LONGITUDE	
SITE ELEVATION	
TRUE AZIMUTH	
PATH LENGTH	



Teleconsult PATH PROFILE PLOTTING CHART

VERT. SCA

HORIZ. SCA

CUSTOMER USAID

SITES [illegible]

ENGINEER [illegible] DATE [illegible] FREQ ____ GHz

PROJECT NO [illegible] PROFILE NO. [illegible] ISSUE 1

MAP NAME [illegible] SOURCE SCALE [illegible] CONTOUR INTERVAL

ELEVATION

797

Solid line-expected worst case.
Broken line-expected best case.

Based on contour interval of the best available maps.

28 Km

SITE NAME [illegible]

TOWER HEIGHT [illegible]

[redacted]

VERT. SCALE	1 cm
HORIZ. SCALE	½ cm

LEGEND

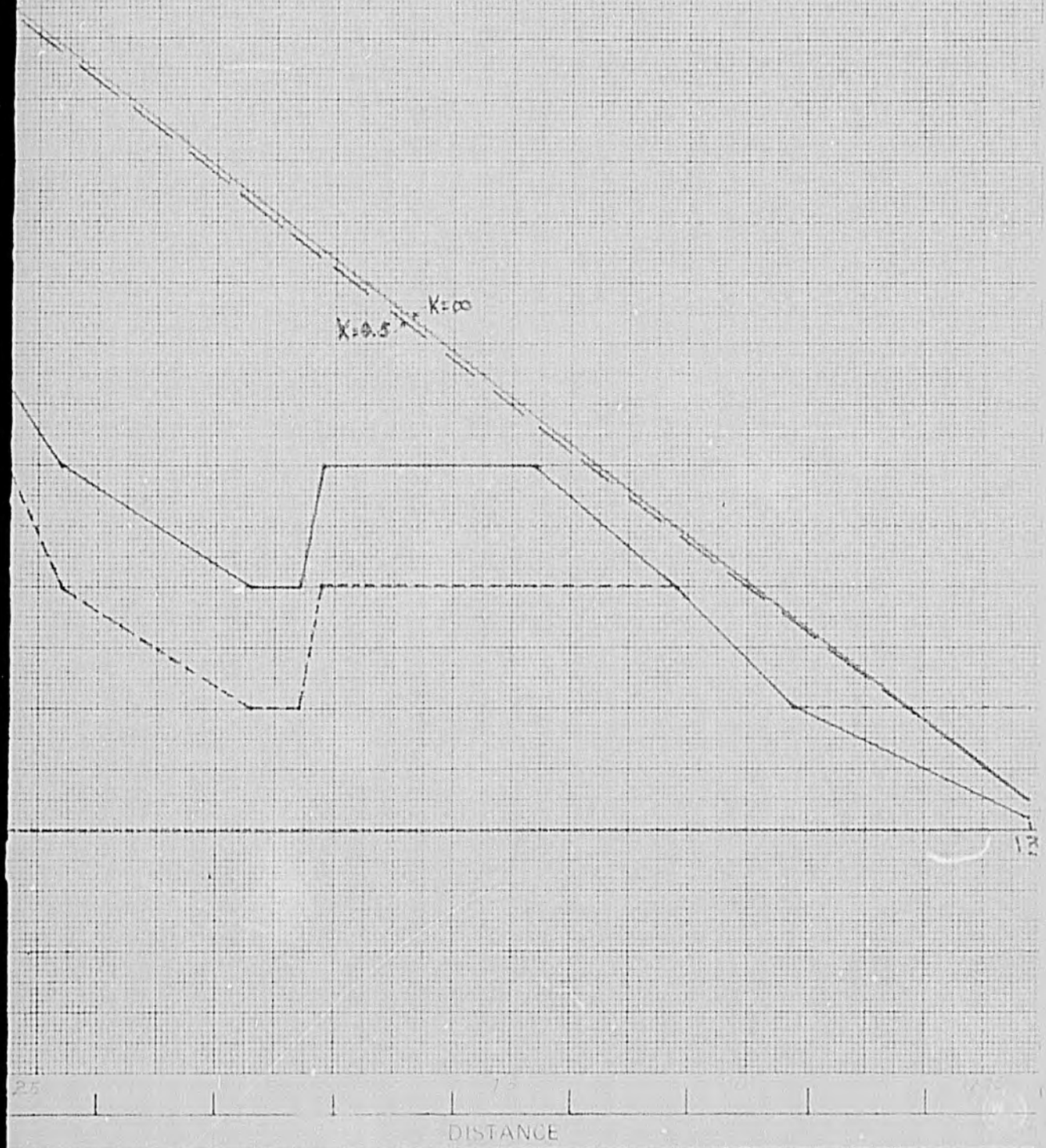
- TREES ON PATH
- ON PATH OBSTRUCTION
- OFF PATH OBSTRUCTION
- WATER
- MARSH
- TIP OF FRESNEL ZONE
- 60% FIRST FRESNEL ZONE
- FRESNEL ZONE RATIO
- REFLECTION POINTS (MAP)

ELEVATION

SITE NAME

TOWER HEIGHT

SITE	
LATITUDE	N 29° 24' 00" N 29° 24' 00"
LONGITUDE	E 34° 18' 00" E 34° 57' 45"
SITE ELEVATION,	
TRUE AZIMUTH	
PATH LENGTH,	



Teleconsult PATH PROFILE PLOTTING CHART

VERT. SC

HORIZ. SC

CUSTOMER

SITES

ENGINEER DATE FREQ GHz

PROJECT NO PROFILE NO ISSUE

MAP NAME SOURCE SCALE CONTOUR INTERVAL

ELEVATION

Solid line-expected worst case.
Broken line-expected best case.

Based on contour interval of the best available maps.

10 Km

SITE NAME

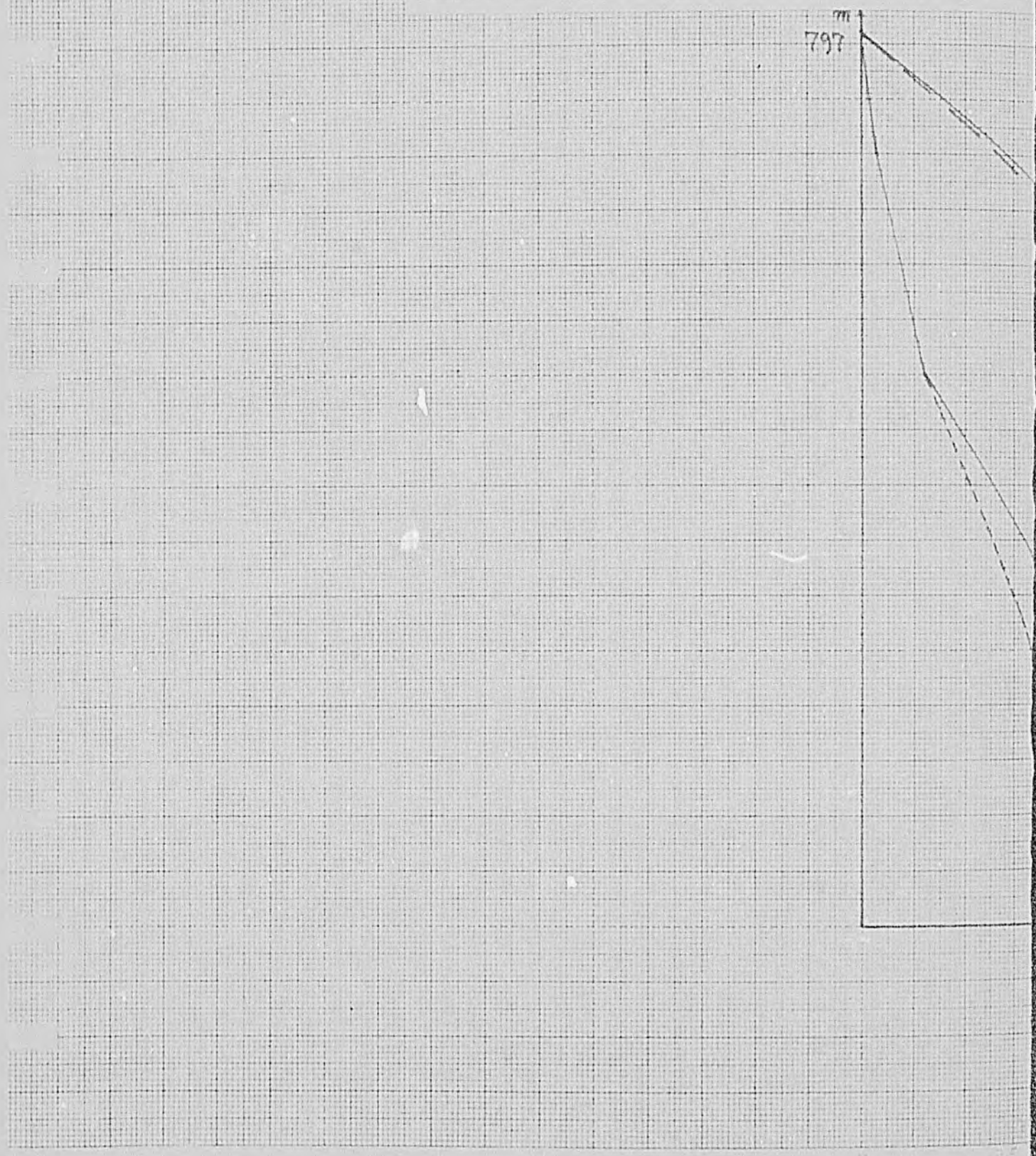
TOWER HEIGHT

[redacted]

VERT. SCALE	1 cm =
HORIZ. SCALE	3 cm =

LEGEND

- TREES ON PATH
- ON PATH OBSTRUCTION
- OFF PATH OBSTRUCTION
- WATER
- MARSH
- FIRST FRESNEL ZONE
- 0.6 FIRST FRESNEL ZONE
- FRESNEL ZONE RADIUS
- REFLECTION POINTS (VAR

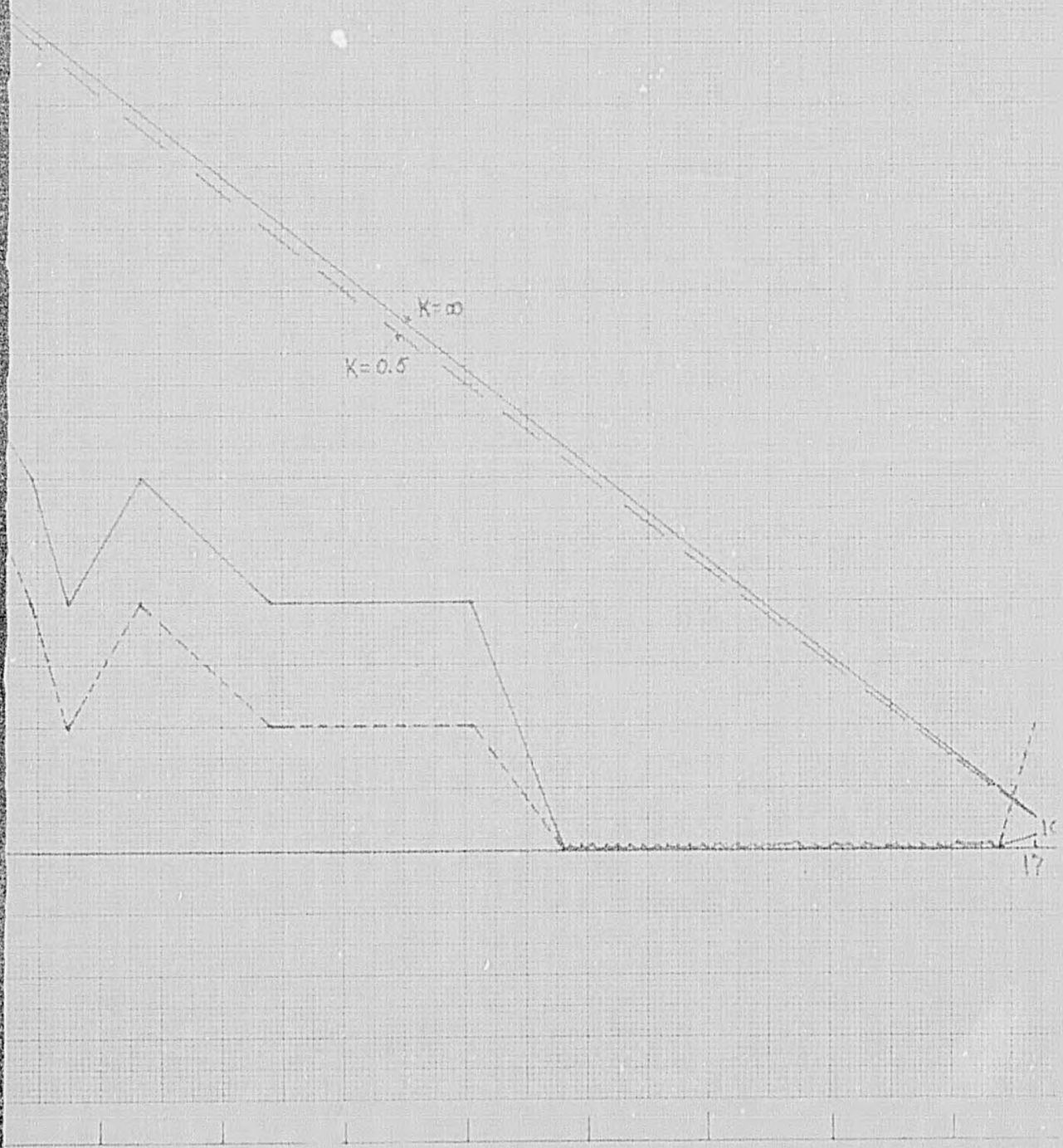


ELEVATION

SITE NAME

TOWER HEIGHT

SITES	
LATITUDE	
LONGITUDE	
SITE ELEVATION	
TRUE AZIMUTH	
PATH LENGTH	



Teleconsult

PATH PROFILE PLOTTING CHART

VERT. SCA

HORIZ. SCA

CUSTOMER USAID

SITES [illegible] Agola

ENGINEER [illegible] DATE [illegible] FREQ — GHz

PROJECT NO. [illegible] PROFILE NO. [illegible] ISSUE 1

MAP NAME [illegible] SOURCE SCALE CONTOUR INTERVAL

ELEVATION

Solid line-expected worst case.
Broken line-expected best case.

Based on contour interval of the best available maps.

0 Km

SITE NAME

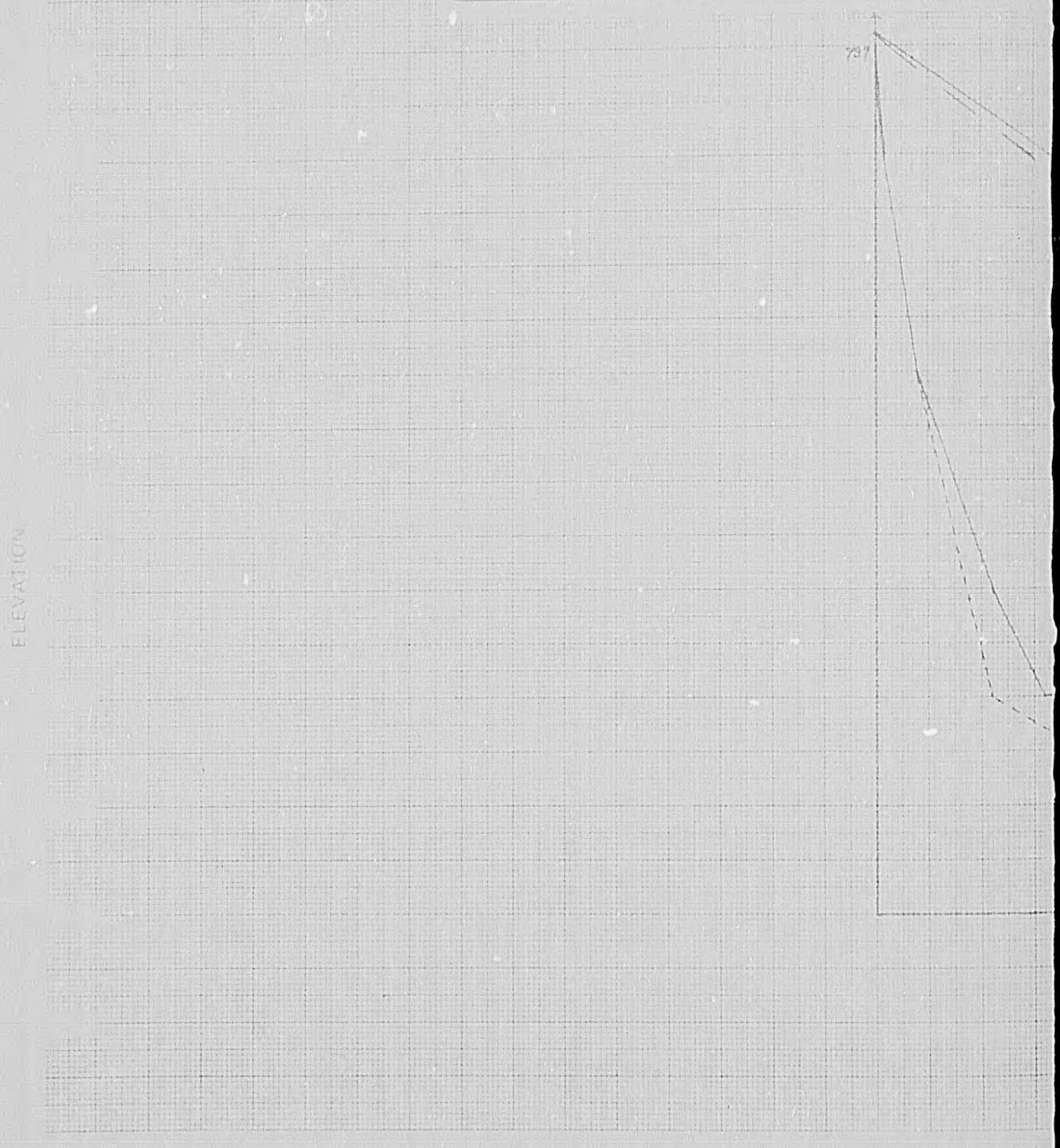
TOWER HEIGHT

[redacted]

VERT. SCALE	[illegible]
HORIZ. SCALE	1" = [illegible]

LEGEND

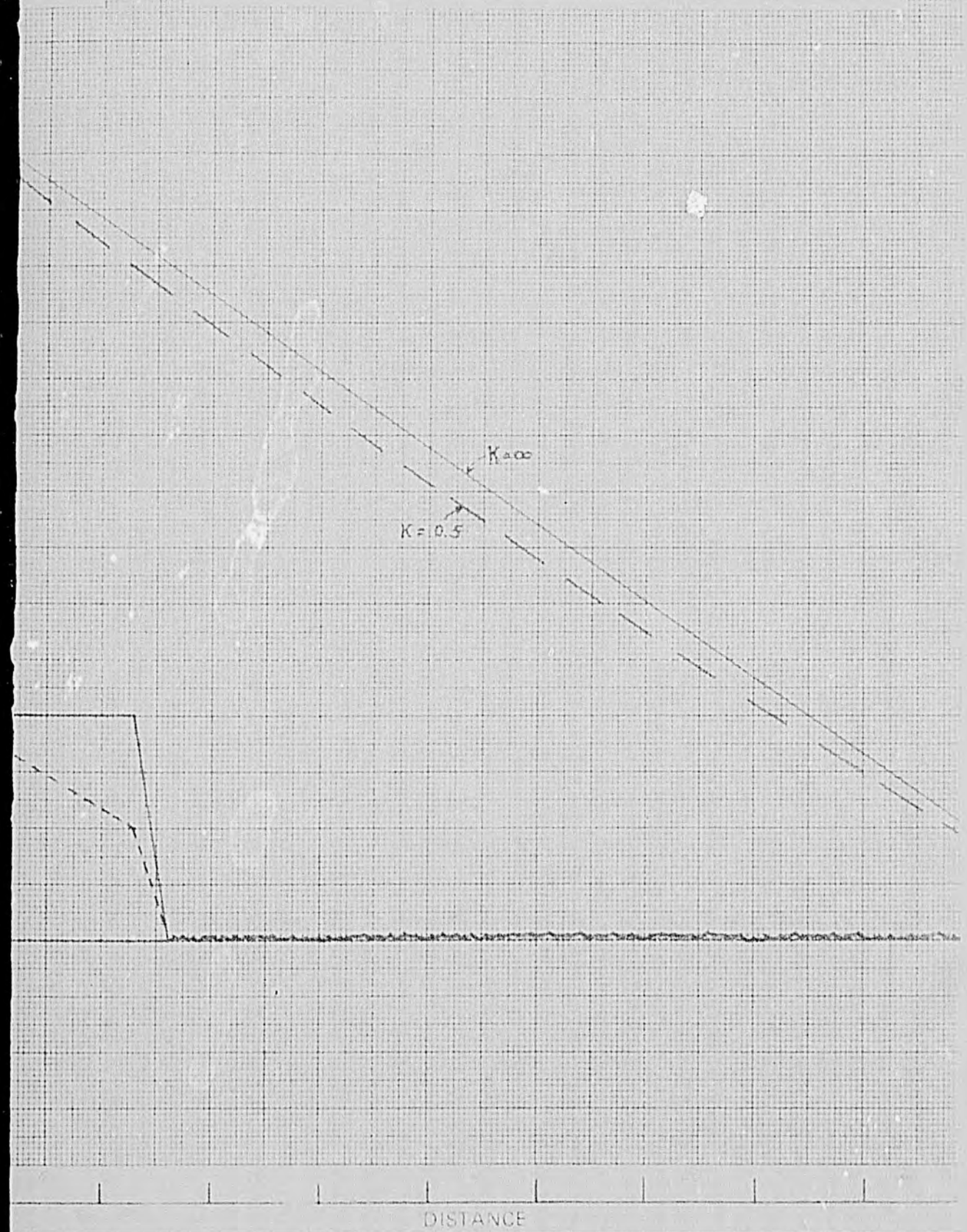
TREES ON PATH
ON PATH OBSTRUCTION
OFF PATH OBSTRUCTION
WATER
MARSH
FIRST FRESNEL ZONE
[illegible] FRESNEL ZONE
GROUND WAVE RADIUS
REFLECTION INTENSITY



SITE NAME _____

TOWER HEIGHT _____

SITE	
LATITUDE	[illegible]
LONGITUDE	[illegible]
SITE ELEVATION,	
TRUE AZIMUTH	
PATH LENGTH,	[illegible]



Teleconsult

PATH PROFILE PLOTTING CHART

VERT. SC

HORIZ. SC

CUSTOMER USAID

SITES [illegible]

ENGINEER [illegible] DATE [illegible] FREQ — GHz

PROJECT NO. [illegible] PROFILE NO. [illegible] ISSUE 1

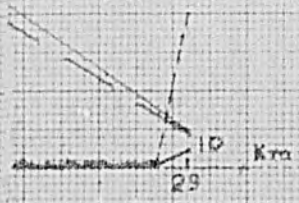
MAP NAME [illegible] SOURCE SCALE [illegible] CONTOUR INTERVAL

7

Solid line-expected worst case.
Broken line-expected best case.

Based on contour interval of the best available maps.

ELEVATION



SITE NAME [illegible]

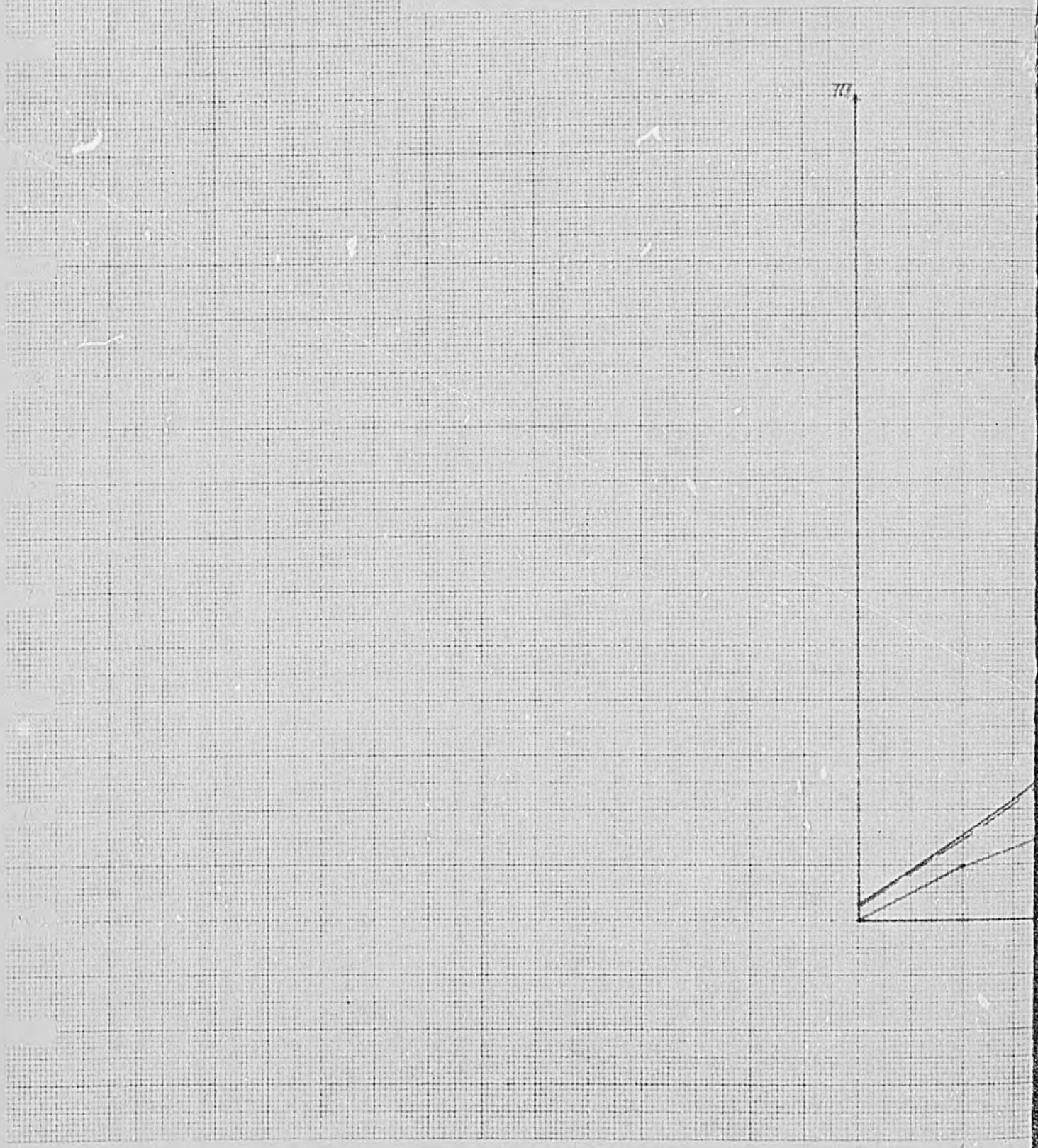
TOWER HEIGHT (see [illegible])

[redacted]

VERT. SCALE	1 cm =
HORIZ. SCALE	1 cm =

LEGEND

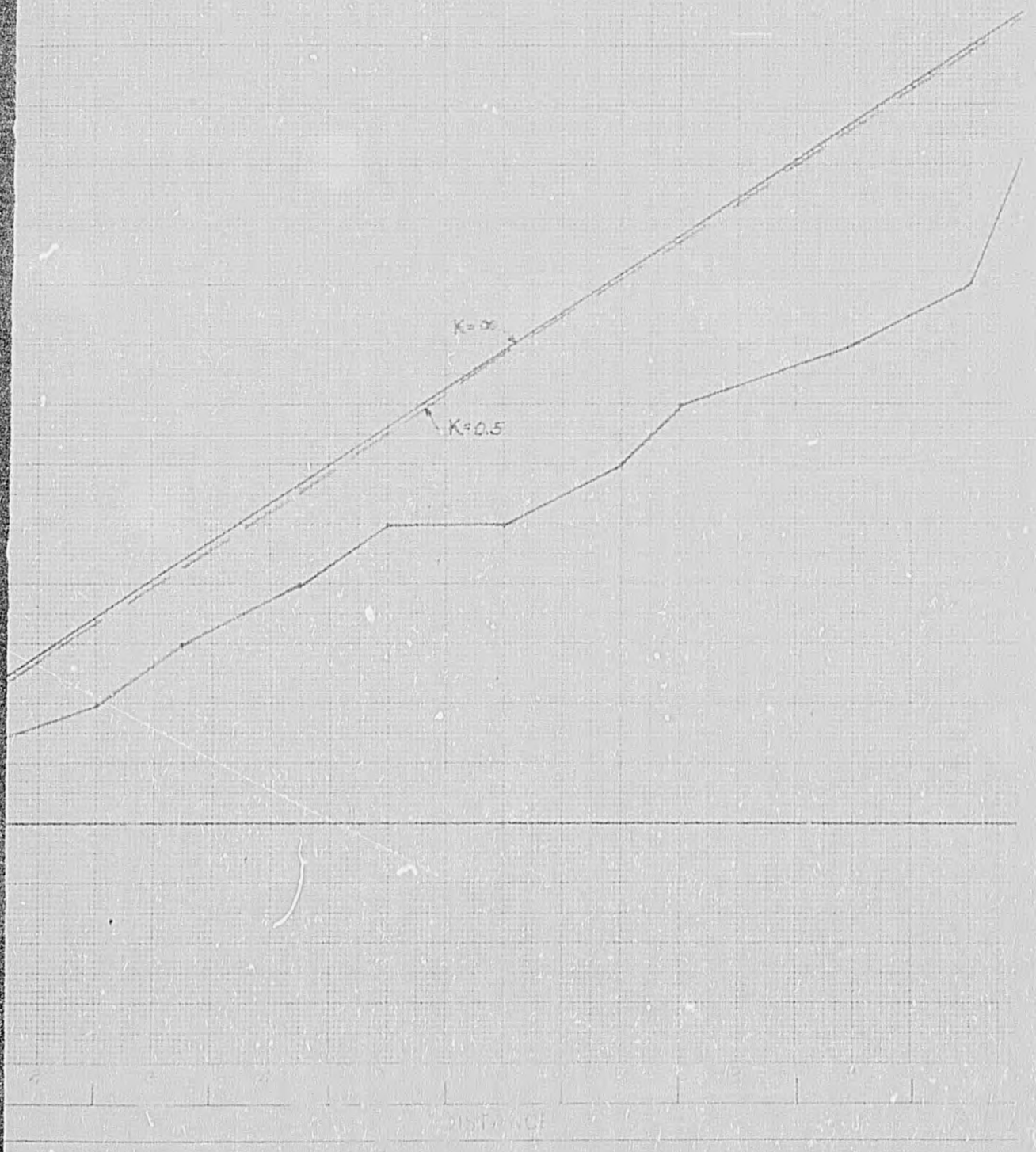
- TREES ON PATH
- ON PATH OBSTRUCTION
- OFF PATH OBSTRUCTION
- WATER
- MARSH
- FIRST FRESNEL ZONE
- FIRST FRESNEL ZONE
- FRESNEL ZONE RADIUS
- REFLECTION POINTS (VAR



SITE NAME _____

TOWER HEIGHT _____

SITE	
LATITUDE	
LONGITUDE	
SITE ELEVATION	
TRUE AZIMUTH	
PATH LENGTH	



Teleconsult PATH PROFILE PLOTTING CHART

VERT. SCAL

HORIZ. SCA

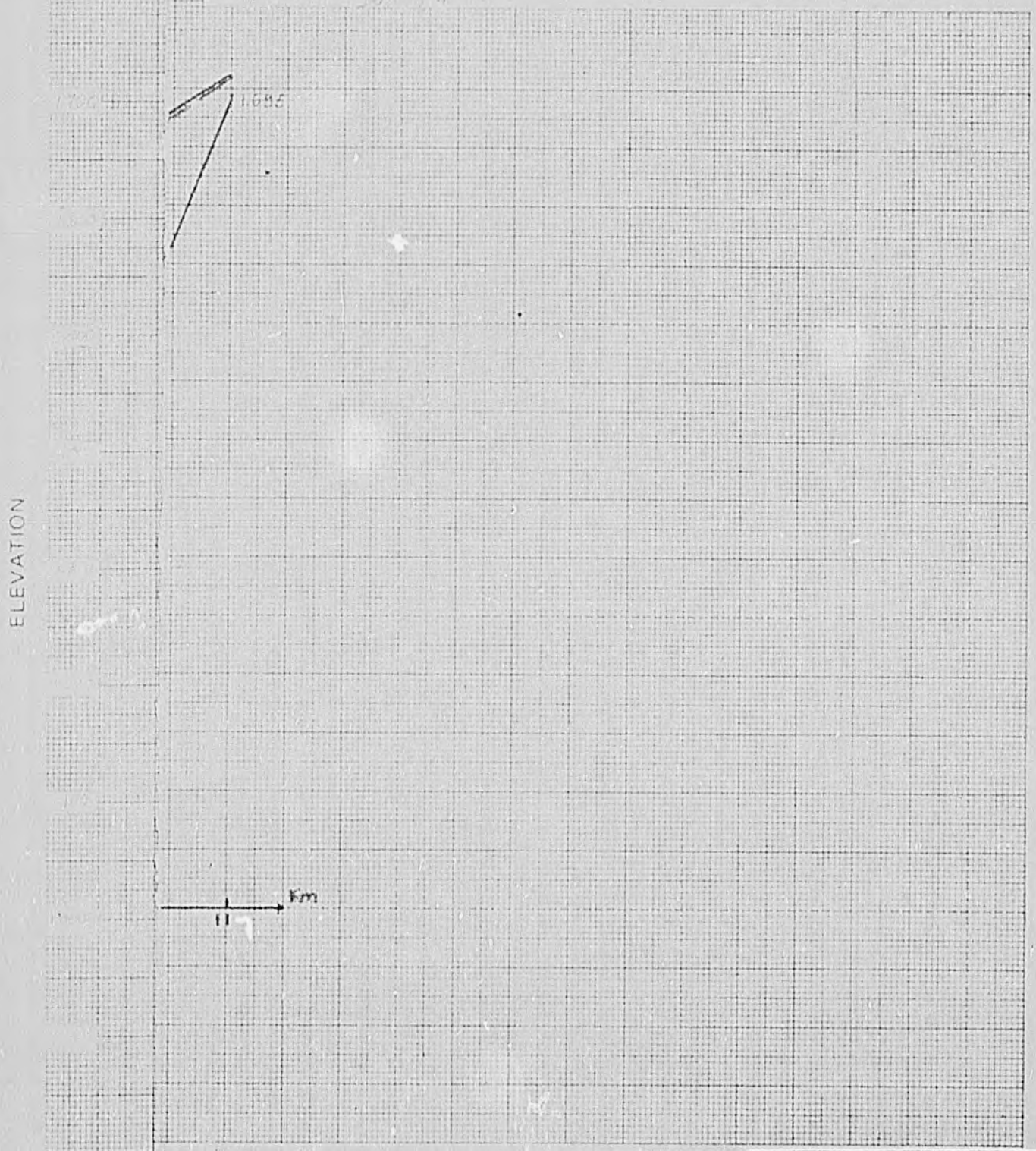
CUSTOMER USAID

SITES As Samawah - Tall Abu Gulayn

ENGINEER M. Gustin Sanchez DATE [illegible] FREQ. — GHz

PROJECT NO. AID-3 PROFILE NO. [illegible] ISSUE 1

MAP NAME [illegible] SOURCE SCALE CONTOUR INTERVAL



SITE NAME Tall Abu Gulayn

TOWER HEIGHT Antenna [illegible]

[redacted]

VERT. SCALE	[illegible]
HORIZ. SCALE	4 [illegible]

LEGEND

TREES ON FAR
ON RADIO OBSTRUCTION
NEAR FAR OBSTRUCTION
WATER
MARSH

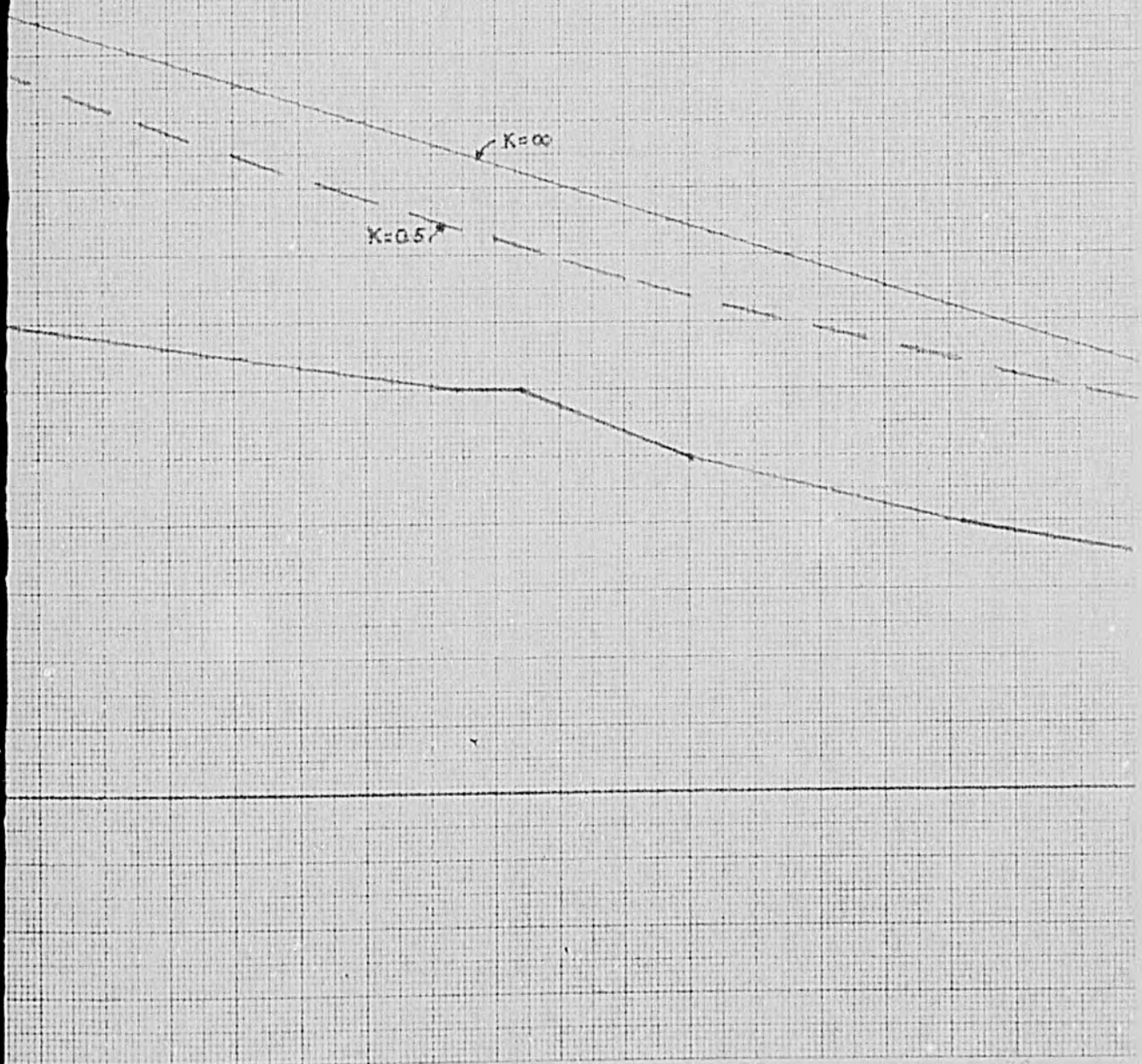
FIRST FRESNEL ZONE R
INTERFERENCE FRESNEL ZONE R
FRESNEL ZONE RADIUS
REFLECTION POINT (VAN

ELEVATION

SITE NAME [illegible]

TOWER HEIGHT [illegible]

SITE	[illegible]	[illegible]
LATITUDE	N 32° 33' 45"	N 32° 13' 11"
LONGITUDE	E [illegible]	E [illegible] 45' 05"
SITE ELEVATION,	[illegible]	[illegible]
TRUE AZIMUTH		
PATH LENGTH		



Teleconsult

PATH PROFILE PLOTTING CHART

VERT. SCAL

HORIZ. SCA

CUSTOMER

SITES

ENGINEER

DATE

FREQ GHz

PROJECT NO.

PROFILE NO.

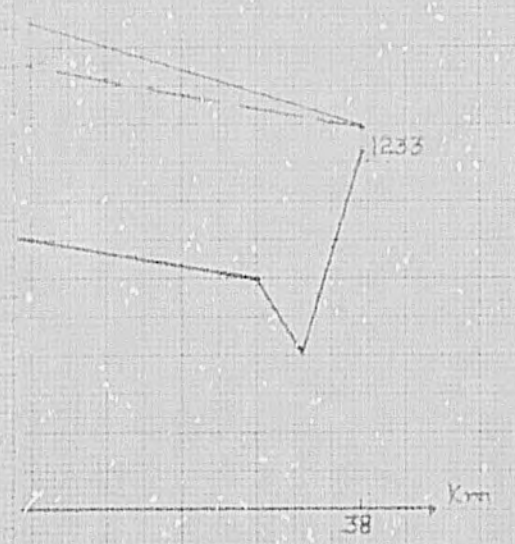
ISSUE

MAP NAME

SOURCE

SCALE

CONTOUR INTERVAL



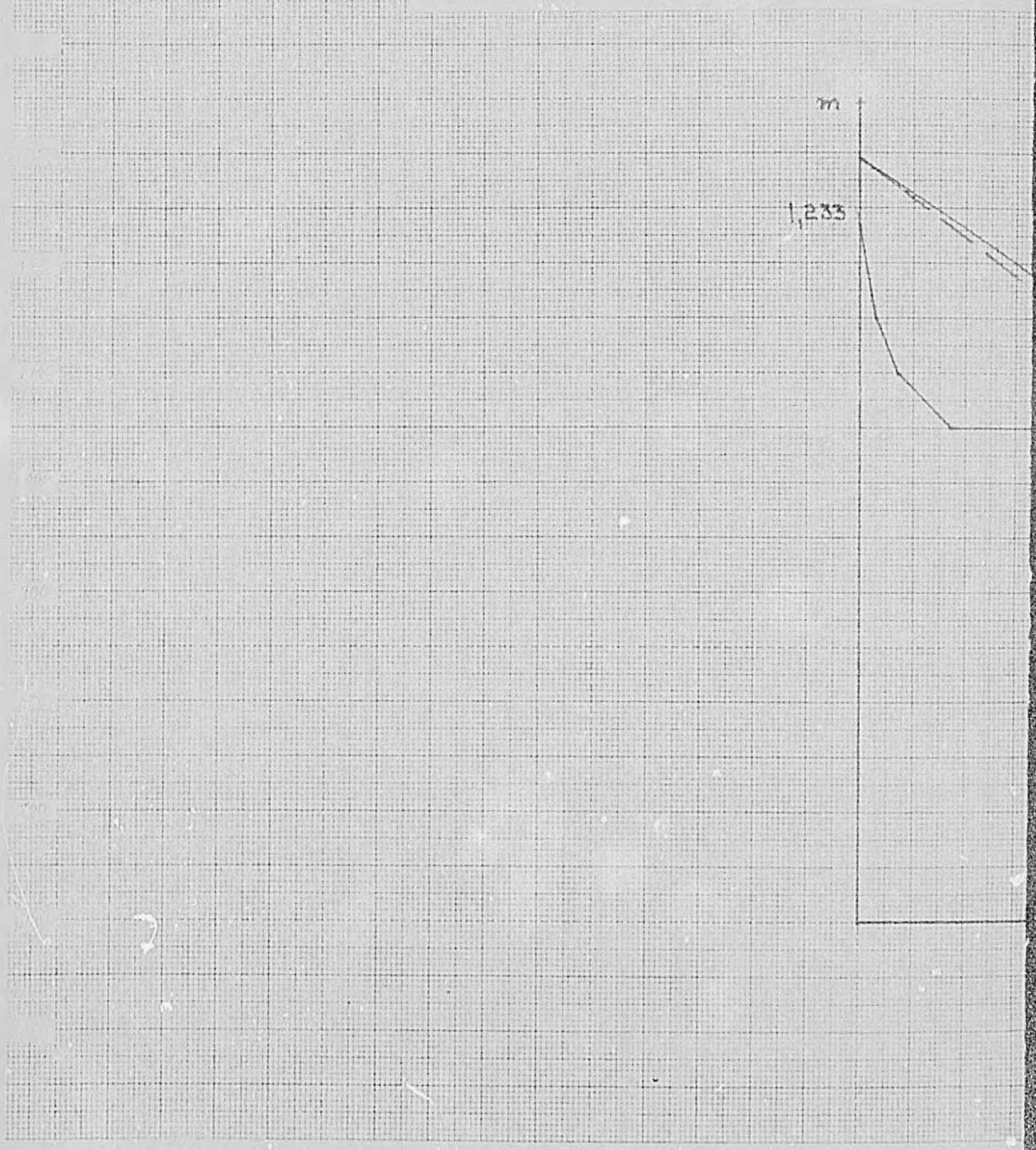
SITE NAME

TOWER HEIGHT

VERT. SCALE	1 cm = [illegible]
HORIZ. SCALE	1 cm = [illegible]

LEGEND

- TREES ON PATH
- ON PATH OBSTRUCTION
- OFF PATH OBSTRUCTION
- WATER
- MARSH
- △ = 0.3 FIRST FRESNEL ZONE
- △ = 0.6 FIRST FRESNEL ZONE
- ▲ = [illegible] FRESNEL ZONE RADIU[illegible]
- REFLECTION POINTS (VA[illegible]



ELEVATION

SITE NAME

TOWER HEIGHT

SITE	
LATITUDE	
LONGITUDE	
SITE ELEVATION	
TRUE AZIMUTH	
PATH LENGTH	

DISTANCE

Teleconsult

PATH PROFILE PLOTTING CHART

VERT. S

HORIZ. S

CUSTOMER

SITES

ENGINEER DATE FREQ GHz

PROJECT NO. PROFILE NO. ISSUE

MAP NAME SOURCE SCALE CONTOUR INTERVAL

ELEVATION

SITE NAME

TOWER HEIGHT

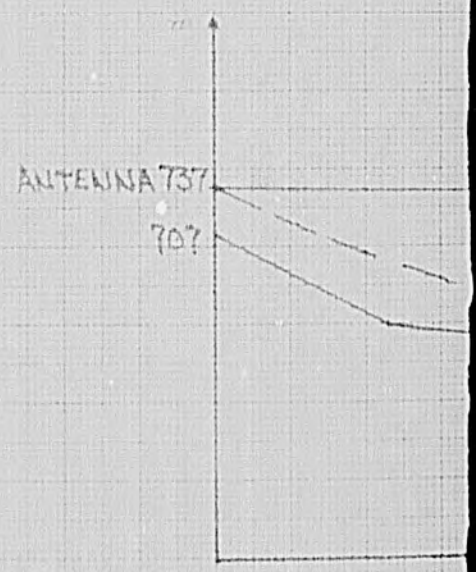
[redacted]

VERT. SCALE	1 cm
HORIZ. SCALE	1 cm

LEGEND

- TREES ON PATH
- ON PATH OBSTRUCTION
- OFF PATH OBSTRUCTION
- WATER
- MARSH
- 0.6 FIRST FRESNEL ZONE
- 1.0 FIRST FRESNEL ZONE
- FRESNEL ZONE RADIUS
- REFLECTION POINT (VAR)

ELEVATION

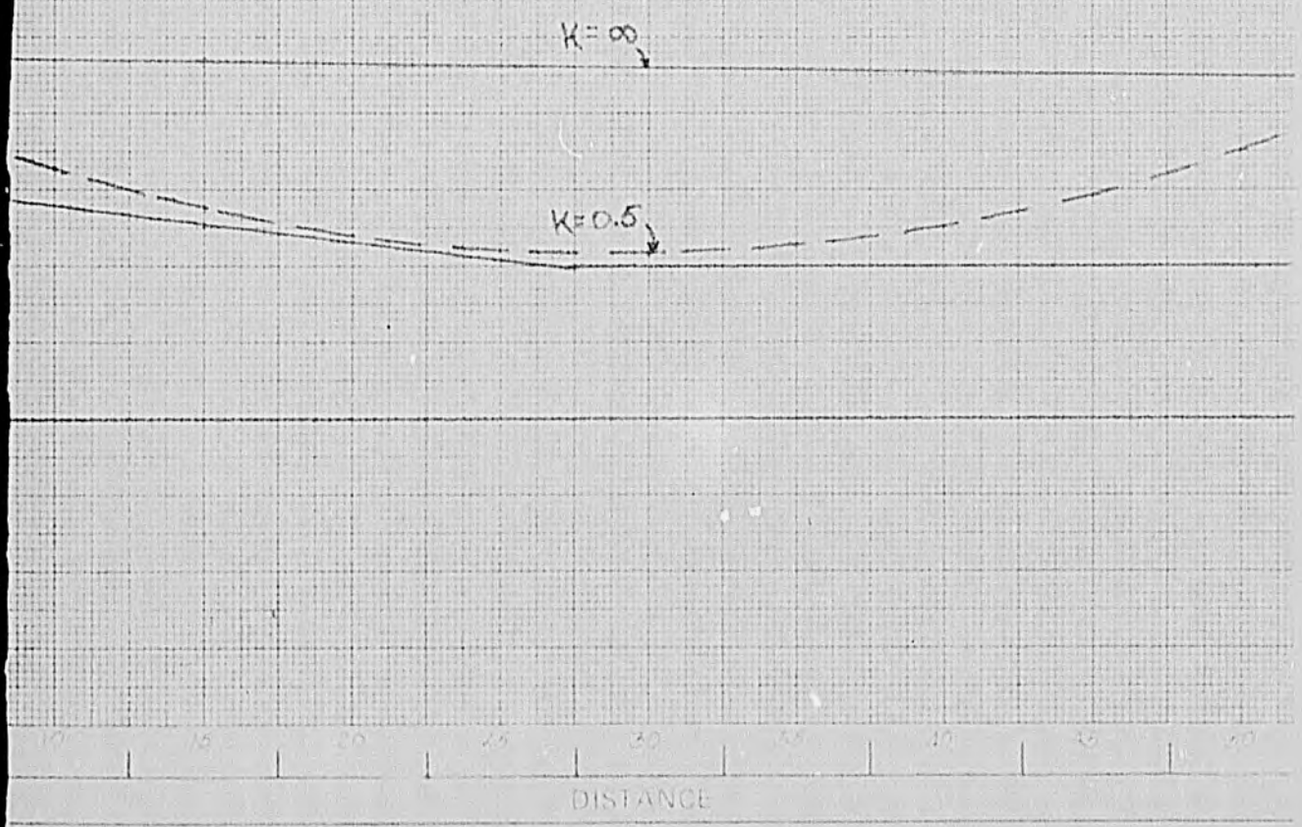


SITE NAME

TOWER HEIGHT

ADIUS
ADIUS
ING K)

SITE	Mahallat al Kafy	Sidi Ali
LATITUDE	N 32° 11' 21"	N 31° 46' 37"
LONGITUDE	E 37° 08' 18"	E 37° 23' 03"
SITE ELEVATION,	767 m	713 m
TRUE AZIMUTH		
PATH LENGTH,	56.25 km	



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PATH PROFILE PLOTTING CHART

VERT. SCA

HORIZ. SC

CUSTOMER

SITES

ENGINEER DATE FREQ GHz

PROJECT NO PROFILE NO ISSUE

MAP NAME SOURCE SCALE CONTOUR INTERVAL

ELEVATION

713

Km.

56.25

SITE NAME

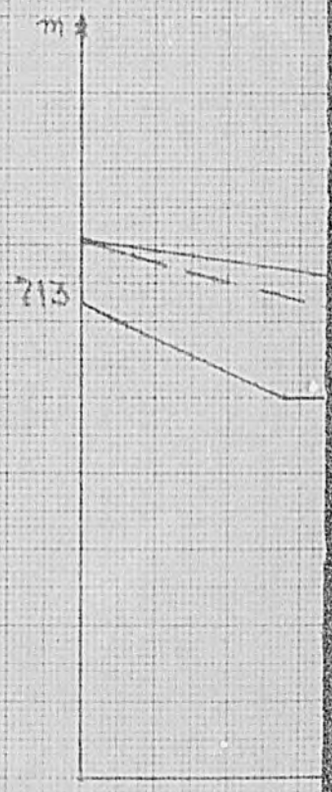
TOWER HEIGHT

VERT. SCALE	1 cm
HORIZ. SCALE	1 cm =

LEGEND

- TREES ON PATH
- ON PATH OBSTRUCTION
- OFF PATH OBSTRUCTION
- WATER
- MARSH
- FIRST FRESNEL ZONE
- FIRST FRESNEL ZONE
- FRESNEL ZONE RADIUS
- REFLECTION POINTS (VAR

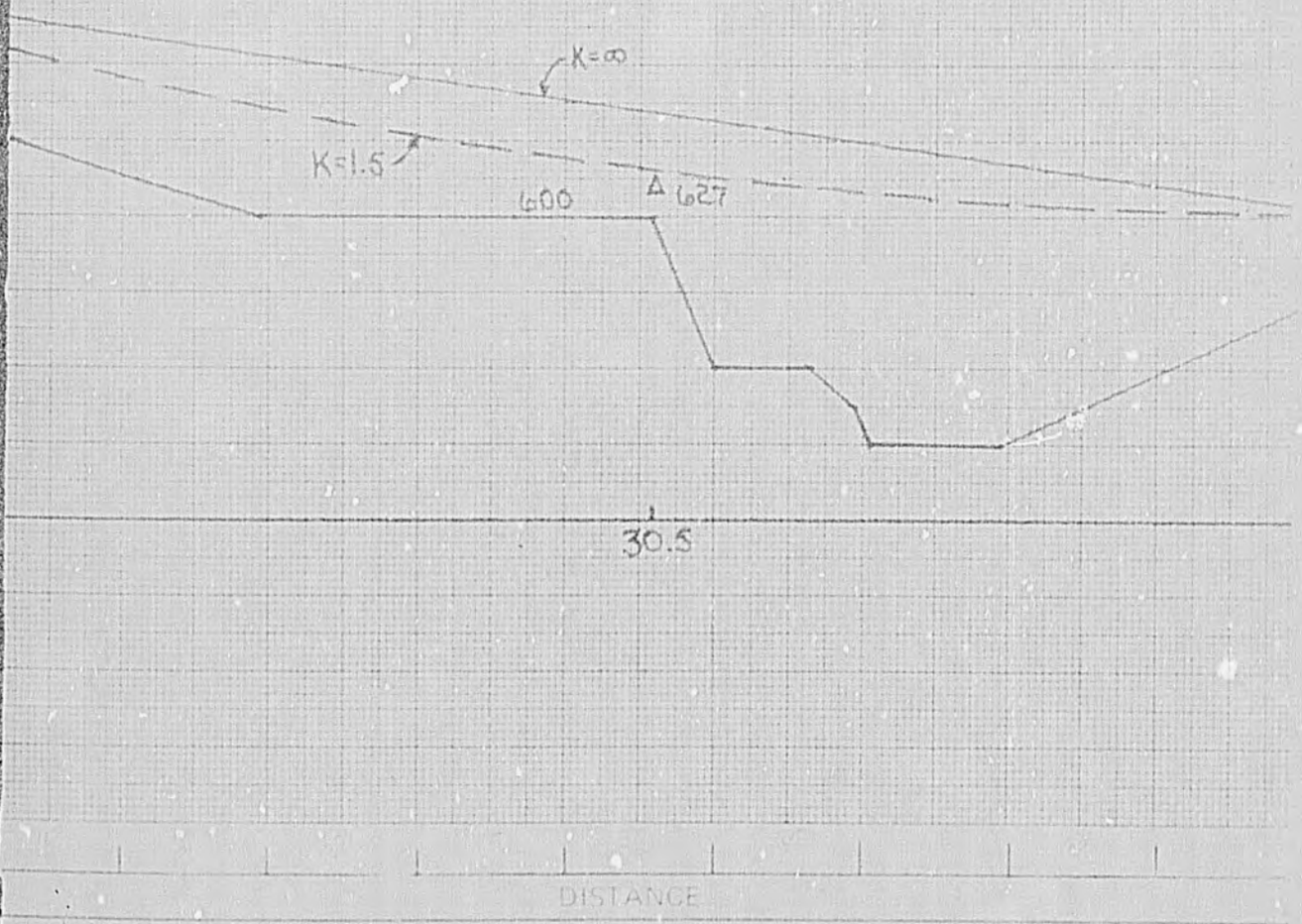
ELEVATION



SITE NAME

TOWER HEIGHT

SITE	
LATITUDE	
LONGITUDE	
SITE ELEVATION	
TRUE AZIMUTH	
PATH LENGTH	



Teleconsult

PATH PROFILE PLOTTING CHART

VERT. SC

HORIZ. SC

CUSTOMER US AID

SITES [illegible]

ENGINEER [illegible] DATE [illegible] FREQ [illegible] GHz

PROJECT NO [illegible] PROFILE NO [illegible] ISSUE [illegible]

MAP NAME [illegible] SOURCE SCALE CONTOUR INTERVAL

ELEVATION

540

54.5 Km

SITE NAME [illegible]

TOWER HEIGHT [illegible]

[redacted]

SOURCE MATERIAL

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