ETHIOPIA - UNITED STATES COOPERATIVE PROGRAM
FOR THE STUDY OF WATER RESOURCES

In Collaboration With

United States
Department of State
Int'l. Cooperation Admin.

United States
Department of the Interior
Bureau of Reclamation

Imperial Ethiopian Government
Ministry of Public Works and Communications
Water Resources Department

1961 ANNUAL REPORT

OF THE

BUREAU OF RECLAMATION

ON THE

BLUE NILE RIVER BASIN INVESTIGATIONS

Washington, D. C.
December 31, 1961

RG Post

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
WASHINGTON 25, D. C.

IN REPLY
REFER TO: 220

December 31, 1961

Mr. Allen Loren, Director
USAID to Ethiopia
c/o American Embassy
Addis Ababa, Ethiopia

Dear Mr. Loren:

Under the terms of the Agreement, dated August 9, 1957, between the Department of the Interior and the Department of State, providing for Water Resources Investigations in the Blue Nile River Basin, Ethiopia, an annual report is required.

It is a pleasure to submit herewith the annual report for the calendar year 1961. This is the fourth such report, the project being in the fifth ot six years as now programed.

Sincerely yours,

Commissioner

- 10 -

Finchaa Falls

One of the more promising future developments is associated with the use of Chomen Swamp, above the falls, for storage, and the irrigation of land in the lower valley, coupled with a power installation below the falls.

1961 ANNUAL REPORT

BLUE NILE RIVER BASIN INVESTIGATIONS

C O N T E N T S

1961 ANNUAL REPORT

BLUE NILE RIVER BASIN INVESTIGATIONS

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(continued)

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BLUE NILE RIVER BASIN INVESTIGATIONS

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Location & Surveys and Agricultural Census Surveys	E	8.0-BN-1
Progress of General Geology Mapping	F	5.0-BN-6
Potential Power and Irrigation Sites	G	2.0-BN-26

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1961 ANNUAL REPORT

BLUE NILE RIVER BASIN INVESTIGATIONS

I. INTRODUCTION

The purposes of the project are to inventory and report on the economic development of the resources of the Blue Nile River Basin while at the same time assisting in establishing and training a Water Resources Department capable of carrying on the work when the project is terminated. A more complete explanation of the objectives as originally formulated will be found in the 1958 and 1959 annual reports.

In late 1960 it was recognized that time would not permit the fully comprehensive depth and scope originally planned. In late 1961, the requirement for dealing with groundwater resources was dropped, and the necessity for terminating the project in 1963 rather than in 1964, was acknowledged, thus further reducing the amount of detail to be treated in the final report.

During 1961, however, operations continued at maximum pace with available strength which reached approximately 90 per cent of that originally programed. The year's developments, together with other problems and projections for the future, are presented on the following papers.

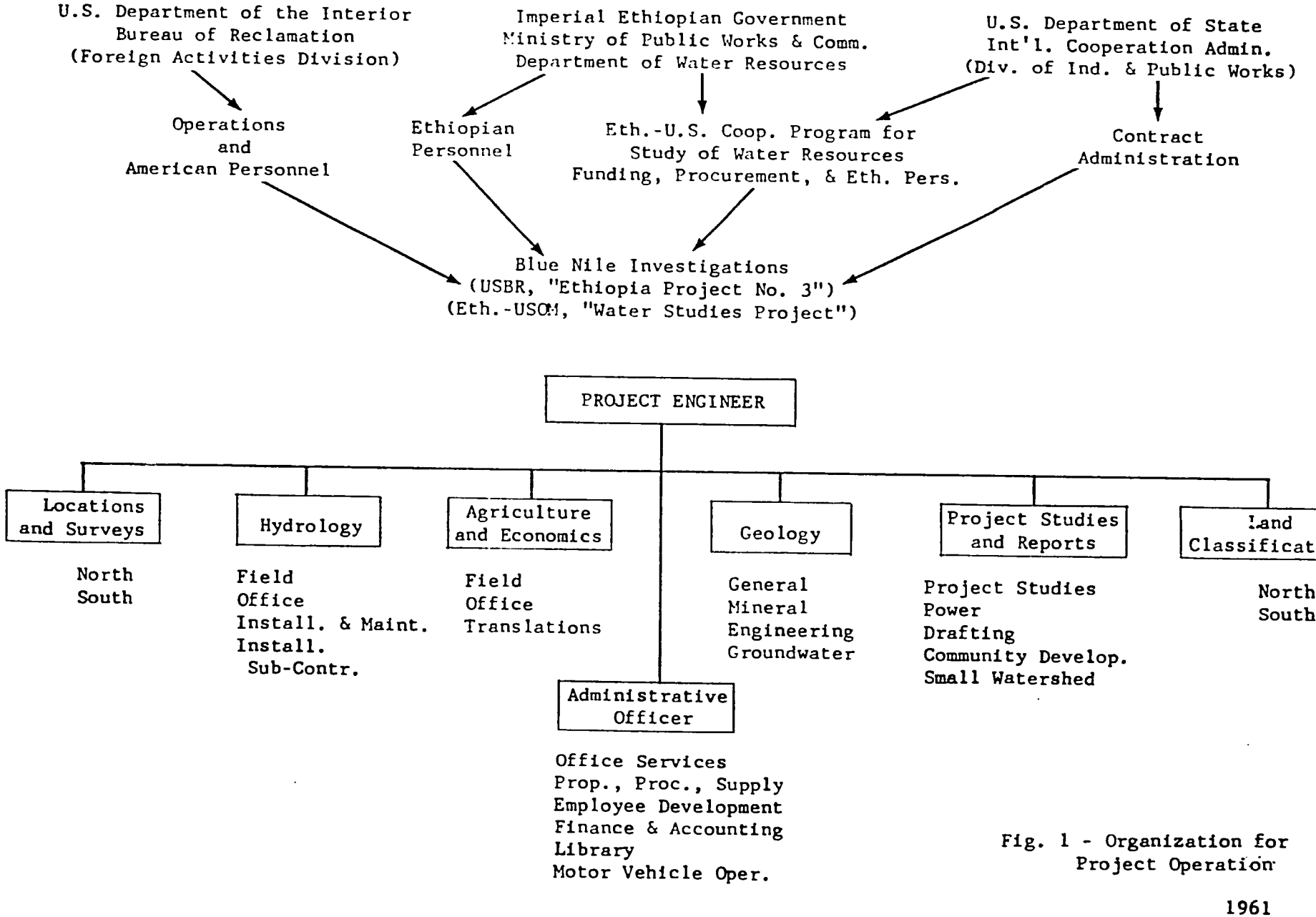


Fig. 1 - Organization for Project Operation

1961

II. CONDUCT OF OPERATIONS

Mobilization of the project staff was continued throughout the year and at the end of the 1961 calendar year there were employed on the project about 150 Ethiopian personnel and 28 Americans. This is an increase in personnel from 20 Americans and 115 Ethiopians, and is somewhat below the previously estimated ultimate requirement of approximately 35 Americans and 261 Ethiopians. However, at the close of the year, consideration was being given to holding the staffing pattern to approximately present levels.

As indicated in previous reports, difficulties of access to the sites of various field activities have been a limiting feature of project operations. The semipermanent camp facilities established at Debre Markos, Asosa, Nekemte, and Bahir Dar were fully effective during the year and were particularly helpful to hydrologic operations during the rainy season when they were used as bases of operation for all activities. Temporary buildings were erected at Bahir Dar and Debre Markos.

A helicopter crash on April 19 resulted in suspension of all helicopter operations until July 10. This necessitated complete reliance upon motor vehicle and pack train transportation during that period. Temporary camps were established at remote gaging stations and hydrographers were assigned to these stations for the duration of the heavy rains. Supplies and materials were transported to these sites by truck or donkey pack train prior to the heavy rains.

The arrangements sought, as reported last year, for construction of additional roads and bridges by the Imperial Highway Authority in conjunction with the program of its provincial road division failed to materialize. Trails were therefore broken out by project forces from the Asosa road to the Dabus station, 58, and to the Beles station, 60. Other trails will be required during the coming year.

Ato Kassa Haile, who in 1960 had been appointed by His Imperial Majesty as Deputy Project Chief, Field, was advanced to Acting Technical Director, Water Resources Directorate, and has been of great assistance to the project in that capacity. Other appointments made by His Imperial Majesty at the same time are still being adjusted to meet the changing aspects of the work. Ato Hailu Shawel, who had been named as counterpart Chief Hydrologist, left the service to enter private employment.

In February, the construction of stream gaging stations was shifted from a management contract to a force account operation. The former contractor, Mr. Carlo Branz, was appointed by the Co-Directors of the Joint Fund as General Construction Supervisor, and he and his men were

made employees of the Joint Fund, operating under the supervision of the Project Engineer. Some of the administrative problems were overcome by the new arrangement, and the work has proceeded with uninterrupted effectiveness.

Supervisory and consulting visits were made in connection with the project as follows:

a. In April by Mr. Earl Fogarty, Chief of the Economics and Soils Branch of the Office of the Assistant Commissioner and Chief Engineer. On April 19 Mr. Fogarty, Mr. Ferris, Project Soils Scientist, and the pilot of the helicopter in which they were flying were killed in the crash of the helicopter.

b. In April and May the Project Engineer, Mr. Donald P. Barnes, in conjunction with home leave visited the Commissioner's Office in Washington and the Office of the Assistant Commissioner and Chief Engineer in Denver, Colorado, for consultations.

III. THE YEAR'S DEVELOPMENT

During this year all elements of the investigation program were active. Substantial progress was made in the collection of data and in the prosecution of field work, in spite of the three months' outage of helicopter support and the continuing below-target strength in personnel. Progress of specific operations may be summarized in the following terms:

(A) Stream Flow Measuring Stations Installed:

Location	Item
Blue Nile River at Sudan border	Bubbler gage and cableway
Blue Nile River at Shogali	Cableway
Dabus River	Cableway
Dabana River	Recorder gage and cableway
Guder River at town of Guder	Bubbler gage and cableway
Giamma River near mouth	Cableway
Blue Nile River at bridge	Cableway
Andassa River	Cableway
Guder River near junction with Blue Nile	Bubbler gage and cableway
Beles River near Metekkel	Cableway and recorder gage (under construction)
Blue Nile near Guder Junction	Bubbler gage and cableway

(B) Other Construction. A corrugated aluminum building 24 feet by 42 feet in plan has been erected at Bahir Dar for use as field headquarters by hydrologists and others working in that vicinity. A temporary office building 13 feet by 33 feet, a kitchen and mess hall 13 feet by 33 feet, sleeping quarters 13 feet by 25 feet, and a well were constructed at Debre Markos as field headquarters for that area. Tent camps were used at all other field locations except at Asosa where buildings were previously constructed and at Nekemte where a rented building is occupied. A 10-foot by 80-foot temporary stores warehouse, and an 18-foot by 108-foot temporary motor maintenance shop were constructed at the Water Resources Directorate headquarters in Addis Ababa.

(C) Hydrology. During past years stream flow measurements were possible only during the periods of low discharge because of the lack of cableways. Heretofore, rating curves for the stations therefore reflected only the conditions at the low stage. This year, with many of the cableways available, measurements were made of the high flows at all stations. This permitted the further development of rating curves and the computation of stream flows from previous gage height records.

Samples of water were taken at representative stations and analyzed to determine the quality of water for irrigation purposes. Samples of suspended sediment were also taken to determine sediment concentration. Stream flow computations for the period of record were essentially complete at the end of the year. These records will now be extended by correlation with other stations of longer record in the Sudan.

The first annual hydrologic summary, for the year 1960, was compiled early in the year, and is now duplicated and ready for distribution. This contains a substantially complete record of hydrologic and climatologic data available for the year, and is designed as a prototype publication for possible continuance by the Directorate with eventual application to the whole of Ethiopia.

(D) Geology. Field work on the general geologic reconnaissance of the Blue Nile Basin has been completed, except for a small portion of the Beshilo sub-basin in the northeast. A general geologic map of the basin, scale 1 to 500,000, has been drafted.

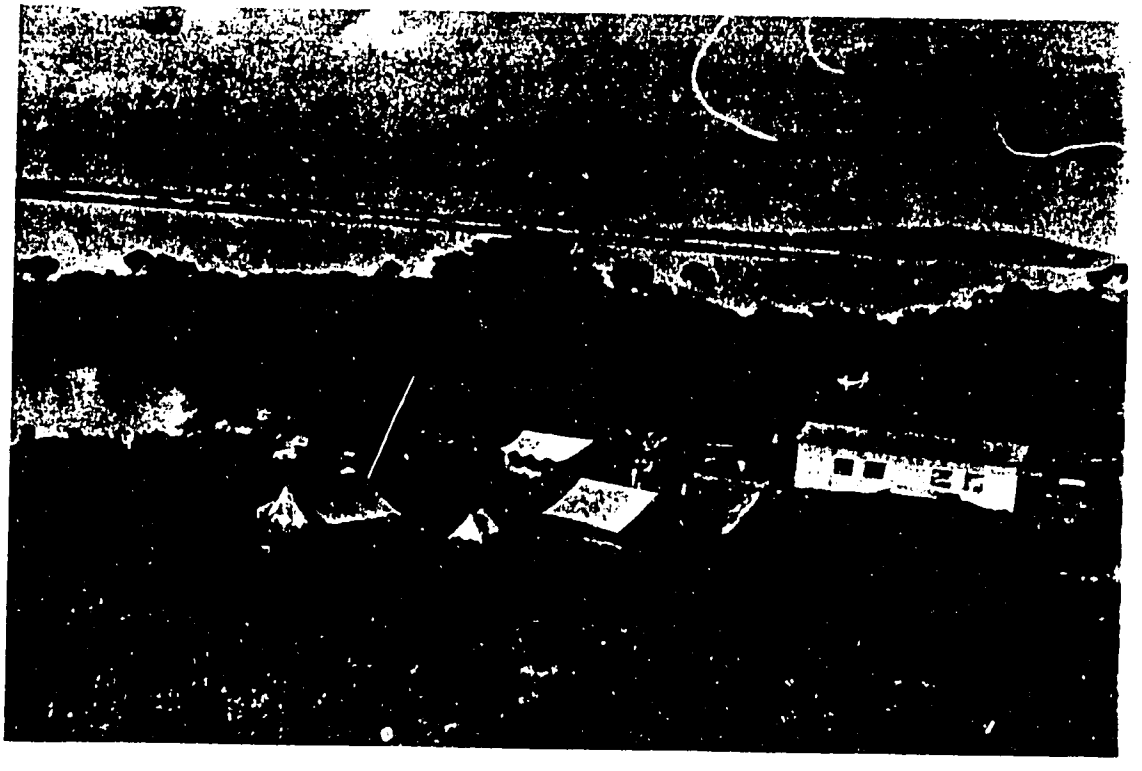
A geologic evaluation of the dam sites and construction materials has been made for about 20 dam sites. Samples of construction materials were obtained at several dam sites and were tested by the Imperial Highway Authority.

Drafts of project geologic reports for several projects are under way.

Mr. Jepsen, Project Geologist, departed for the United States on December 3 where he will complete work on some of the basin geologic maps and reports.

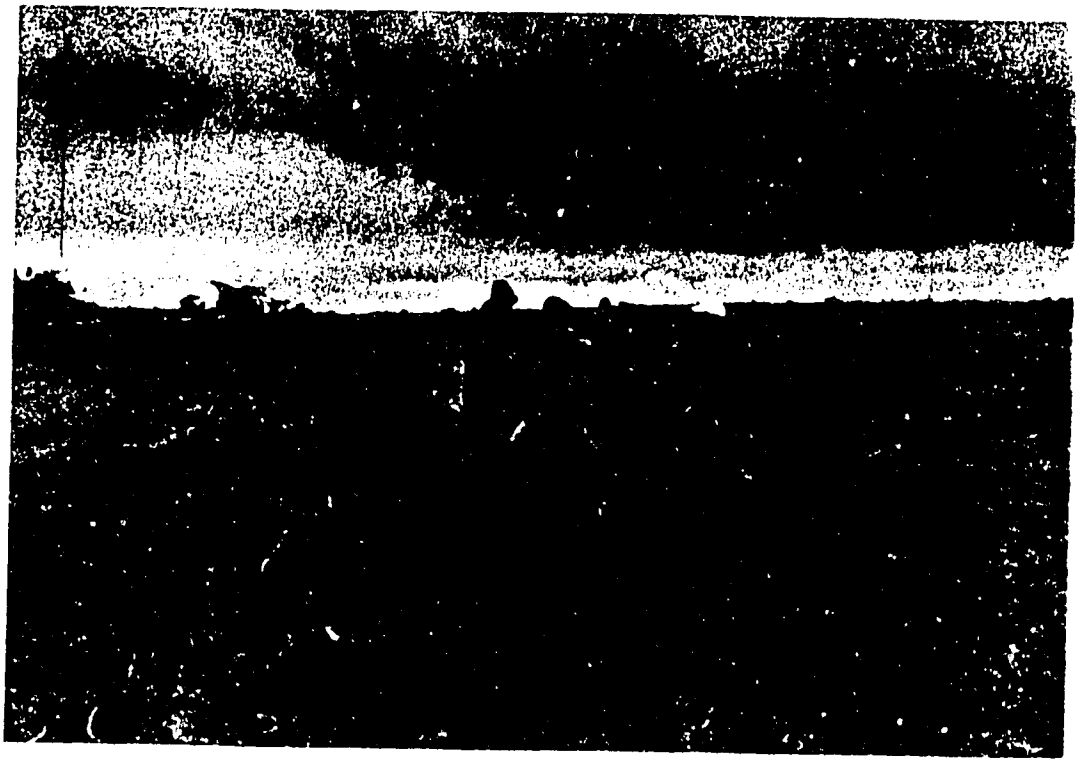
(E) Field Surveys. A topographic survey of the Jiga Springs Project area of about 6,000 acres with contours at one meter intervals was completed. Surveys started on the Guder Project last year were completed. Fifteen dam sites and reservoir areas on the Birr River Project, two dam sites and reservoir areas on the Finchaa Project, one dam and reservoir area on the Upper Giamma, one dam site on the Muger River, one dam site reservoir area, and canal fly line on the Megech, a survey of the outlet of Lake Tana, and a dam and reservoir site on the Ribb were completed during the year.

Control surveys for photo mapping were made for the Finchaa River Project, the Birr River area, and the Blue Nile



Semi-Permanent Quarters near Bahir Dar on Lake Tana

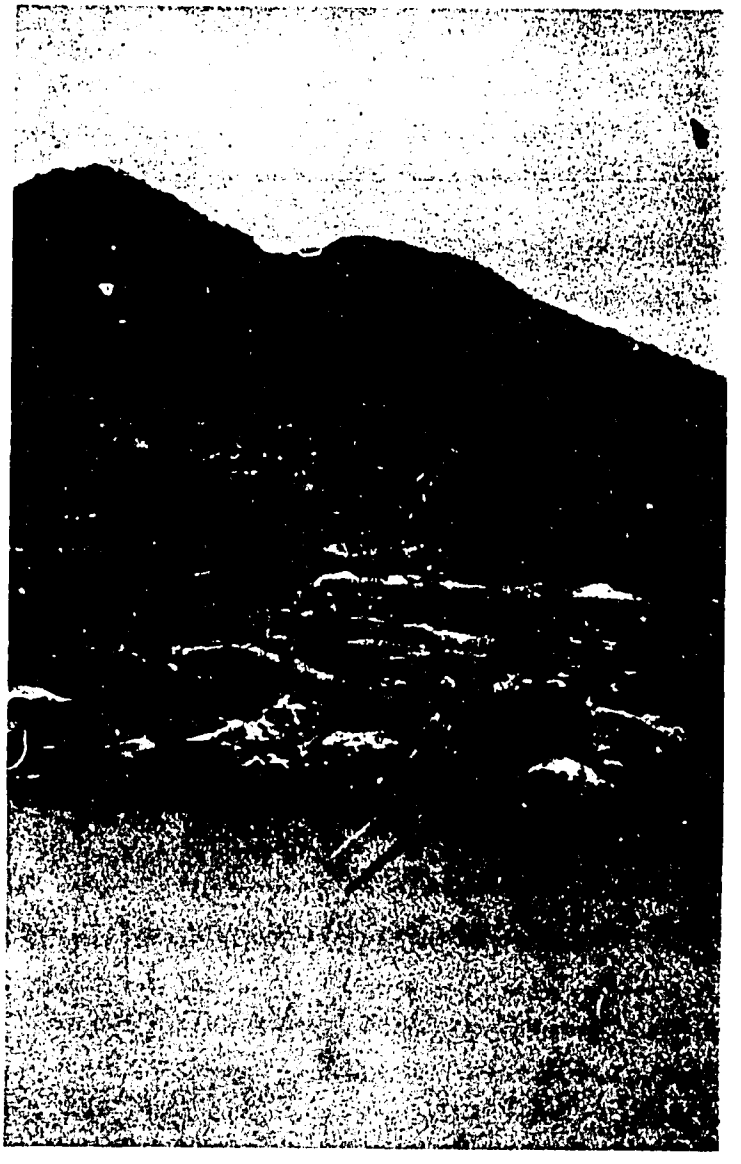
The corrugated aluminum building was made available by His Imperial Majesty. Hydrographers operating from this camp service nine recording stations in the Lake Tana area. The camp also serves as a supply point for various field parties operating in the vicinity.



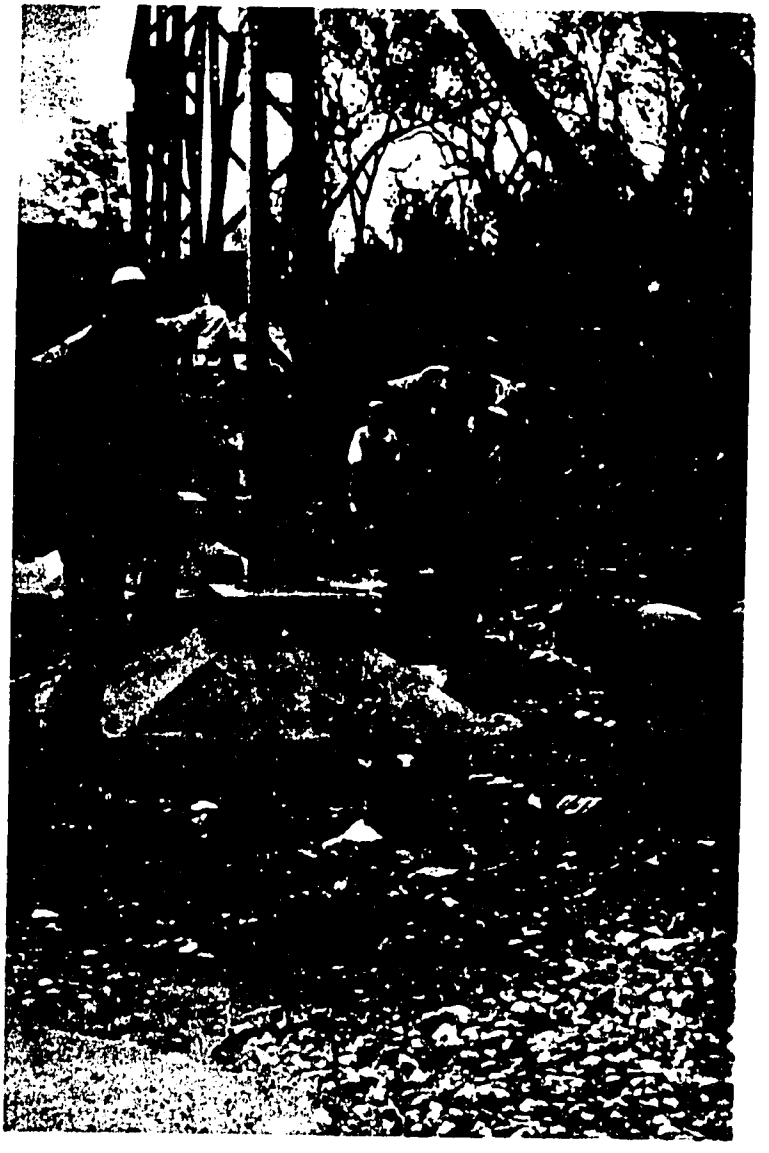
The Trek to Guder Gage

Breaking Camp before Descending the Escarpment

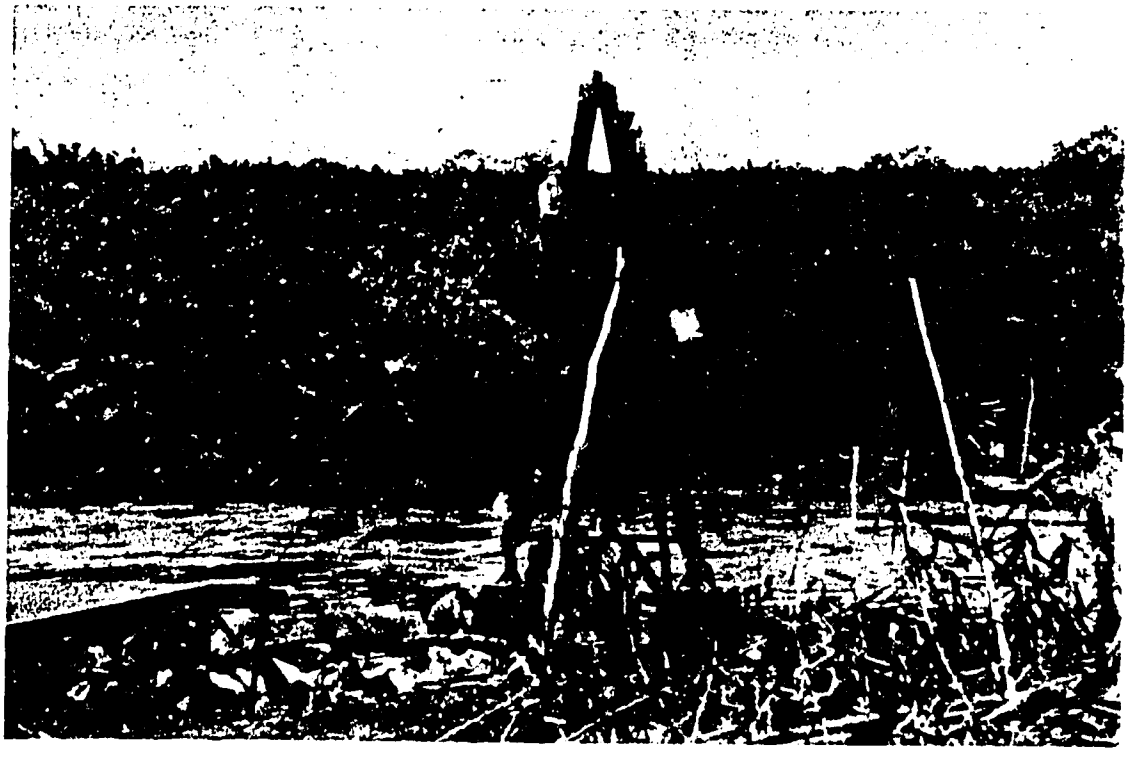
Burros and mules were used to pack into the "remote" stations during the high water season. Grounding of the helicopters after the fatal crash of April 19 necessitated adoption of anumal transport a year or two sooner than planned.



Sudan Border Cableway--View of Left Bank Tower from Right Bank.



Sudan Border Cableway--Cutting Cable Preparatory to Rigging--Left Bank.



Dabus Cableway--Connecting Cable to Right Tower

Dabus Cableway--Test Loading with Sand Bags

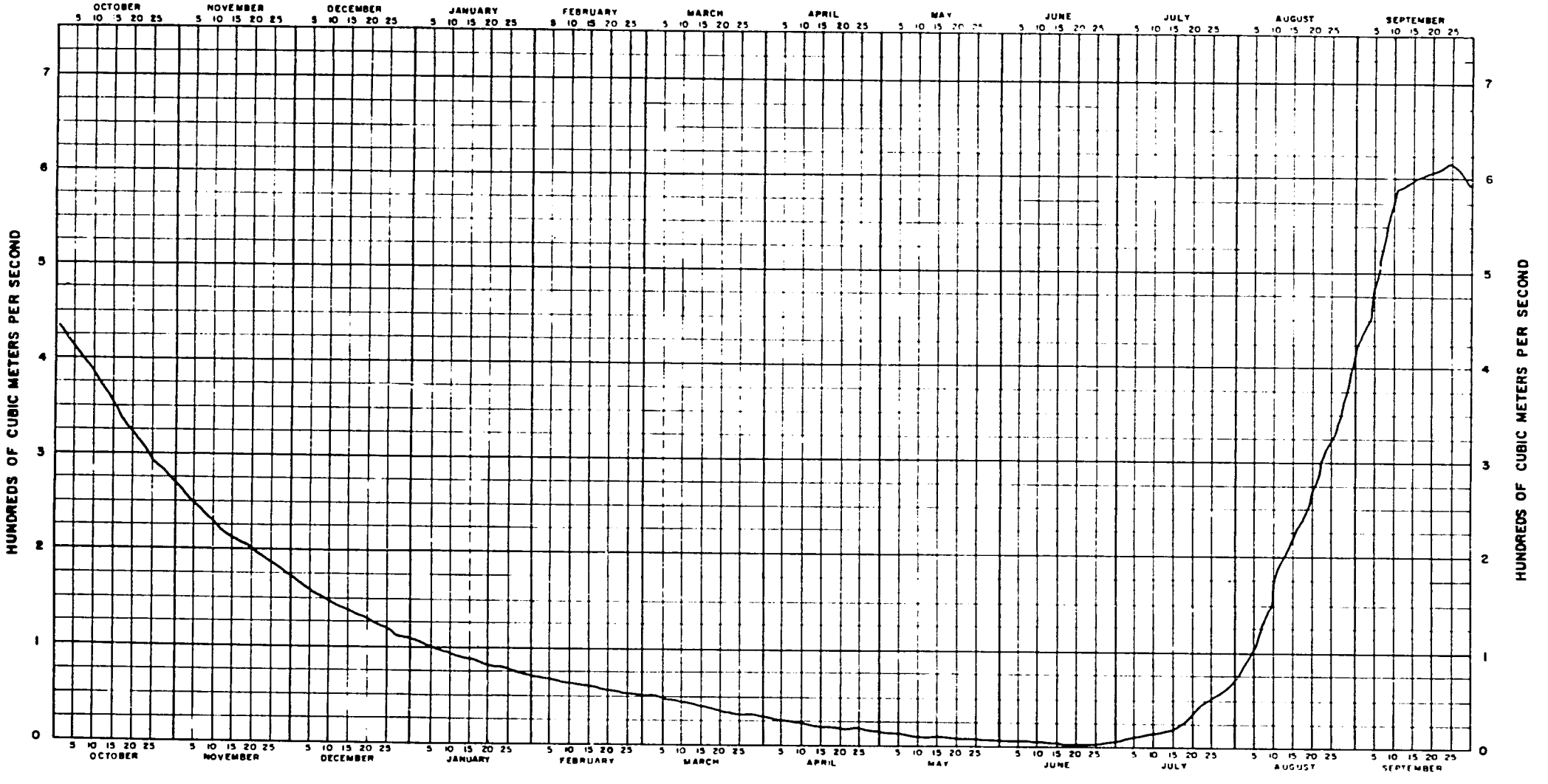
Four recording gage installations and ten cableways were placed in operation during the year.

FIGURE 2

Hydrograph for the Abbay River below Lake Tana

Flow for all streams of record
will be summarized in this form.

HYDROGRAPH FOR BLUE NILE (ABBAY) RIVER BELOW LAKE TANA
YEAR ENDING SEPT. 30, 1961.



DEC 29, 1961

6-0-BN-19

Figu

FIGURE 3

Fato Storage Dam

This dam would provide storage for about 49,000,000 cubic meters on the Upper Guder.

Limestone Formation in the Guder River Sub-Basin

This ledge north of Agere Hiywet (Ambo) may be more accessible than deposits in the Muger-Main Stream canyons.

canyon area from a point below the Guder-Nile confluence to a point near the Cheye-Nile confluence including approximately 20 miles of the Lower Giamma River.

(F) Land Classification. Lands in the following Project areas were classified to determine their suitability for irrigation.

a. Dabus River
b. Upper Diddessa
c. Arjo
d. Wama
e. Dabana
f. Azena-Fettam
g. Birr
h. Finchaa
i. Nekemte

In addition to the classification of lands for irrigation purposes, a general reconnaissance classification on the following dry land areas was made to determine the suitability of the land for various dry land agriculture developments.

a. Diddessa River Sub-basin
b. Dabus River Sub-basin
c. Debre Markos Sub-basin
d. Finchaa Sub-basin

Personnel of the land classification section have spent the balance of the year preparing reports and maps, and completing detailed infiltration studies for supplementing classification of areas completed in prior years. Tables I and II, respectively, show the Land Use Categories and Land Classification Criteria tentatively adopted for the basin studies.

Table I. Land Use Categories*

Mapping Symbol	General Description
X	Settlements and associated non-agricultural land
H	Horticulture - truck and garden crops (not tree crops)
T	Tree and other perennial crops, including orchards and eucalyptus
C	Cropland--includes areas of exclusive cropland and cropland intermixed with small areas of grass and pasture
C1	Predominantly cultivated (more than 60%)

Giamma Dam Site

Field Survey data were being obtained at this site in November and December to determine whether storage characteristics would be as favorable as indicated by inspection.

Burnt-over Lands in the Diddessa

Characteristic of the bush and high grass lands, these potentially Class I areas are burned annually to reduce infestation and to facilitate grazing and movement.

Mapping Symbol (continued)		General Description
	C2	Partially cultivated (less than 60%)
	C3	Irrigated
PP		Permanent pasture, improved
G		Grazing land, unimproved
	G1	Savanna and wooded grazing land
	G2	Meadow-like open pasture
F		Forest or woodland
	F1	Closed forest (tops of trees touch)
	F2	Open forest (tops of trees do not touch)
	F3	Bamboo forest
	F4	Scrub forest (found in dry areas, plants up to three meters high)
	F5	Riverine forest
S		Swamps and Marshes
	S1	Papyrus swamp
UL		Unproductive land
GU		Grassland

*These categories are adapted from the World Land Use Classification proposed by the International Geographical Union

Table II. Condensed Land Classification Criteria for Blue Nile Investigations*

Class 1 - Arable:	Highly suited to irrigation, capable of sustained yield, free draining, and water holding, favorable topography.
Class 2 - Arable:	Moderately suited to irrigation, generally less favorable characteristics than Class 1. Drainage may be required.
Class 3 - Arable:	Restricted suitability to irrigation. May require drainage, levelling, intensive soil improvement practices; may have restricted crop adaptability, higher operating costs.
Class 4 - Limited Arable:	Suited to irrigation only under specific conditions or crops. Marginal economic feasibility.

Class 6 - Non-Arable: Not suited irrigation. Rough terrain, rocky soil, marsh, lava, or above gravity supply limitations.

*Salts and alkali have been insignificant in Blue Nile Basin lands classified to date.

On April 19 a helicopter crash occurred in which Mr. Howard Ferris, Chief of the Project Land Classification Section and Earl Fogarty, Chief of the Land and Economics Division of the Bureau of Reclamation were killed while reviewing field work. No replacement for Mr. Ferris has been assigned to the Project.

(G) Project Planning and Reports. Although four additional American personnel were assigned to this group during the year, the grounding of helicopters and the press of other field assignments has necessitated detailing all of them to other duties for varying periods totaling about 35 per cent of their time. The stationing of personnel in remote areas for high priority measurements together with the lack of air transportation increased the demands on field supervisory time. This took the form of assistance to hydrology in supervision of construction, repairs to bubbler gages and Stevens recorders, and other allied problems during the entire rainy season, and of assistance to surveys in the reduction of computations during the remainder of the year. About three-man-months were devoted to the construction of the temporary warehouse and motor shop. Ato Wondwoosen, Civil Engineer, was loaned to the Zula project for four months and to the Webi Shibeli project for a month.

Nevertheless, considerable groundwork has been laid for the rapid processing of the data that are being accumulated from the year's field work. Typical designs have been adapted from Bureau of Reclamation examples, standards and curves developed, and unit prices assembled.

A preliminary inventory of potential hydroelectric power sites, as reflected in Power Working Paper No. 6, was completed. The Electrical Engineer also prepared the base for power load analysis, designs and estimates for a typical small power plant, established fixed cost criteria for electric power facilities as refected in Power Working Paper No. 5, and abstracted useful information from twelve previous investigations.

The Guder River Project has been laid out, complete with preliminary reconnaissance designs and estimates. Final presentation of this scheme awaits further land classification and hydrologic data.

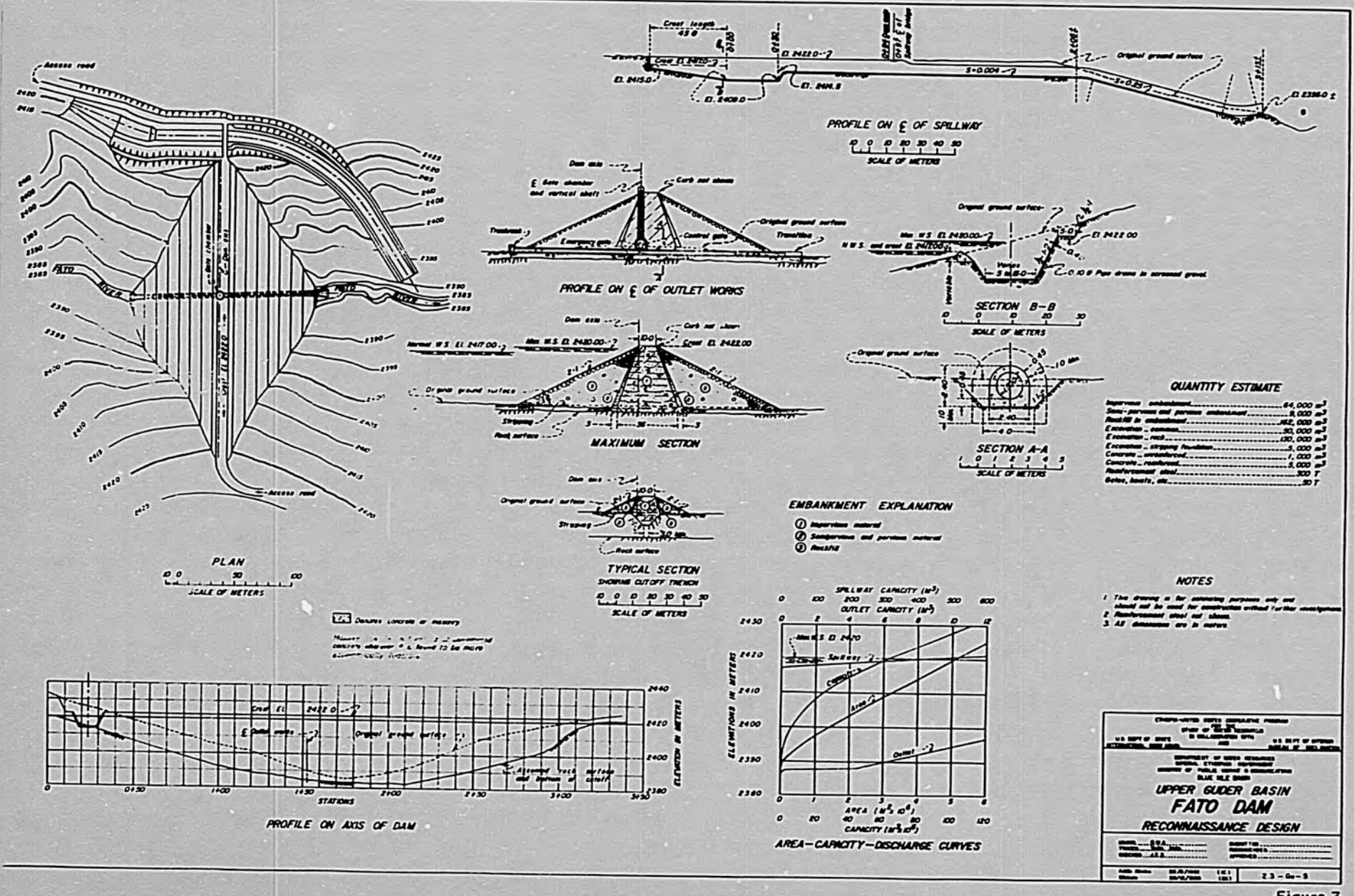
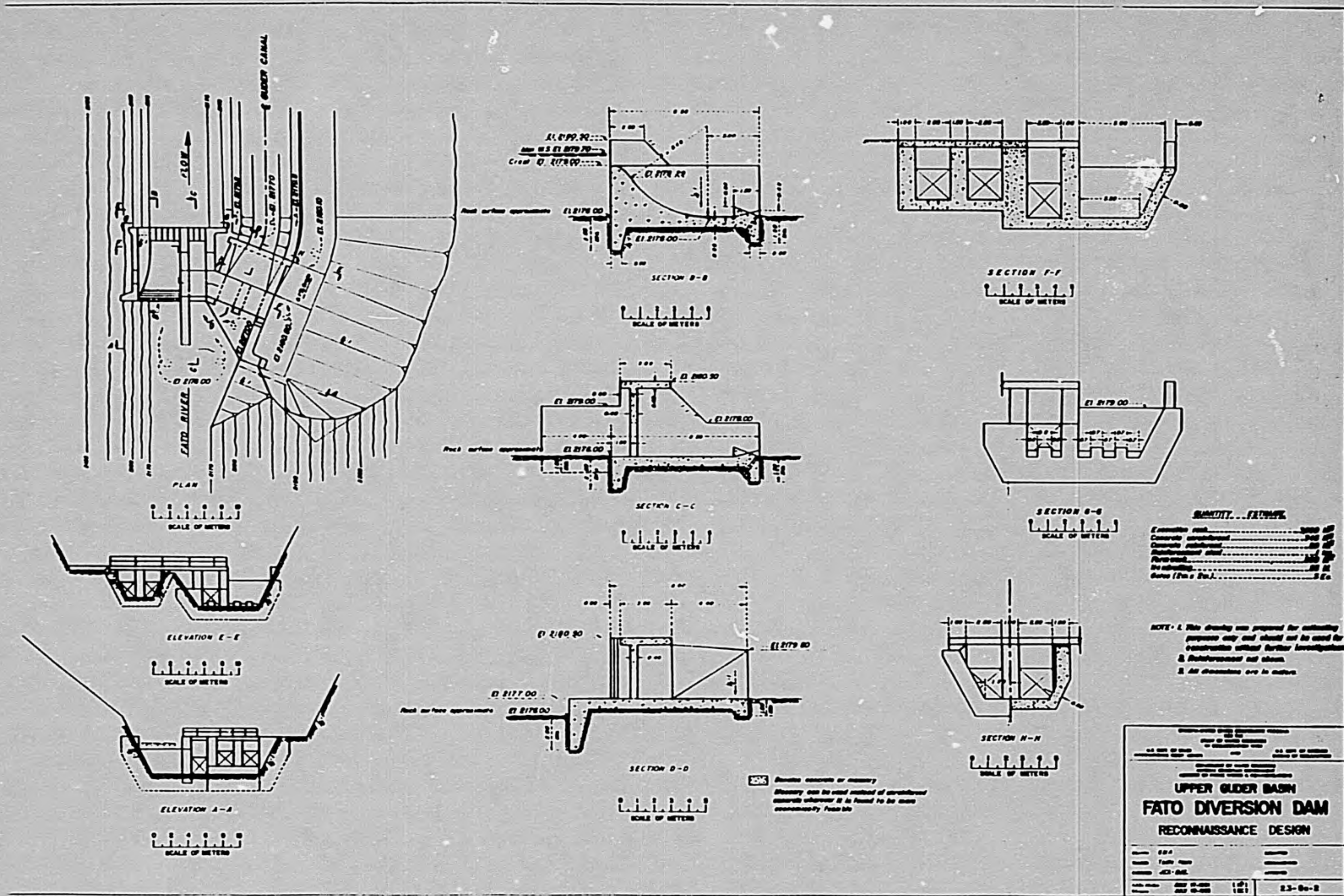

PROFILE ON ℄ OF SPILLWAY
PROFILE ON ℄ OF OUTLET WORKS
SECTION B-B
SECTION A-A
MAXIMUM SECTION
TYPICAL SECTION
SHOWING CUTOFF TRENCH
PLAN
SCALE OF METERS
EMBANKMENT EXPLANATION
1 Impervious material
2 Semipervious and pervious material
3 Rockfill
QUANTITY ESTIMATE
NOTES
1 This drawing is for estimating purposes only and should not be used for construction without further investigations.
2 Reinforcement steel not shown.
3 All dimensions are in meters.
PROFILE ON AXIS OF DAM
AREA-CAPACITY-DISCHARGE CURVES
U.S. DEPT. OF STATE
U.S. DEPT. OF INTERIOR
BUREAU OF RECLAMATION
BLUE NILE BASIN
UPPER GUDER BASIN
FATO DAM
RECONNAISSANCE DESIGN
23-Gu-5

Figure 3

FIGURE 4

Fato Diversion Dam

The water supply for the initial section of the Upper Guder Project, about five cubic meters per second, would be taken from the stream at this structure.



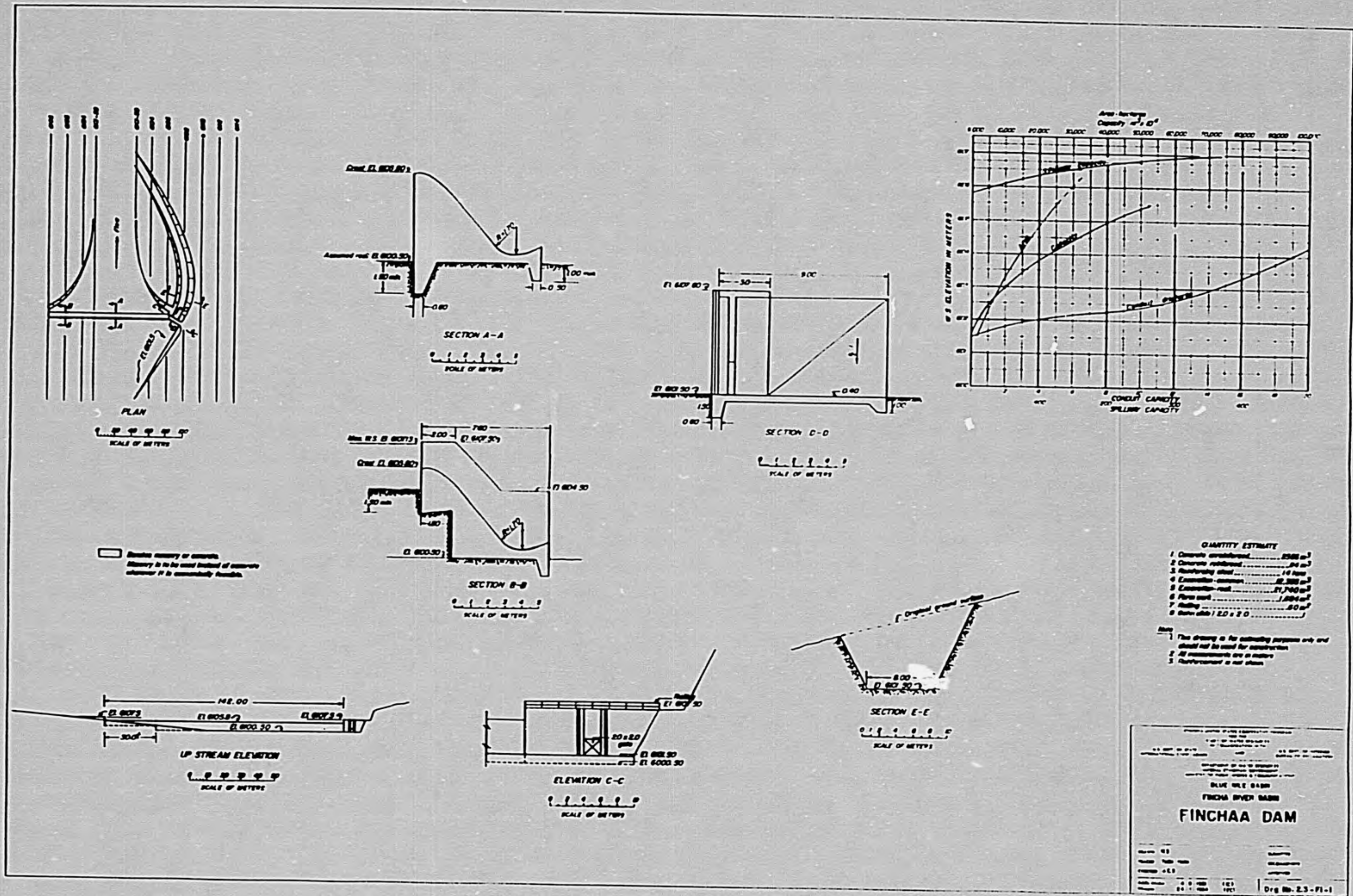
PLAN
SCALE OF METERS
FATO RIVER
GUDER CANAL
FLOW
ELEVATION E-E
ELEVATION A-A
SECTION B-B
SECTION C-C
SECTION D-D
SECTION F-F
SECTION G-G
SECTION H-H
Rock surface approximate
El 2178.00
El 2176.00
El 2180.30
El 2179.00
El 2177.00
QUANTITY ESTIMATE
UPPER GUDER BASIN
FATO DIVERSION DAM
RECONNAISSANCE DESIGN

Figure 4

FIGURE 5

Finchaa Power Dam A

This structure would regulate up to 475,000,000 cubic meters of storage in the Chomen Swamp, serving the Finchaa Power Plant (about 50,000 kva) and the Finchaa Irrigation Project (about 20,000 hectares).



PLAN
SECTION A-A
SECTION B-B
SECTION D-D
SECTION E-E
UP STREAM ELEVATION
ELEVATION C-C
QUANTITY ESTIMATE
BLUE NILE BASIN
FINCHA RIVER BASIN
FINCHAA DAM

Figure 5

FIGURE 6

Profile, Finchaa Hydro-electric Plant

Example of a small, relatively economical installation for near future development.

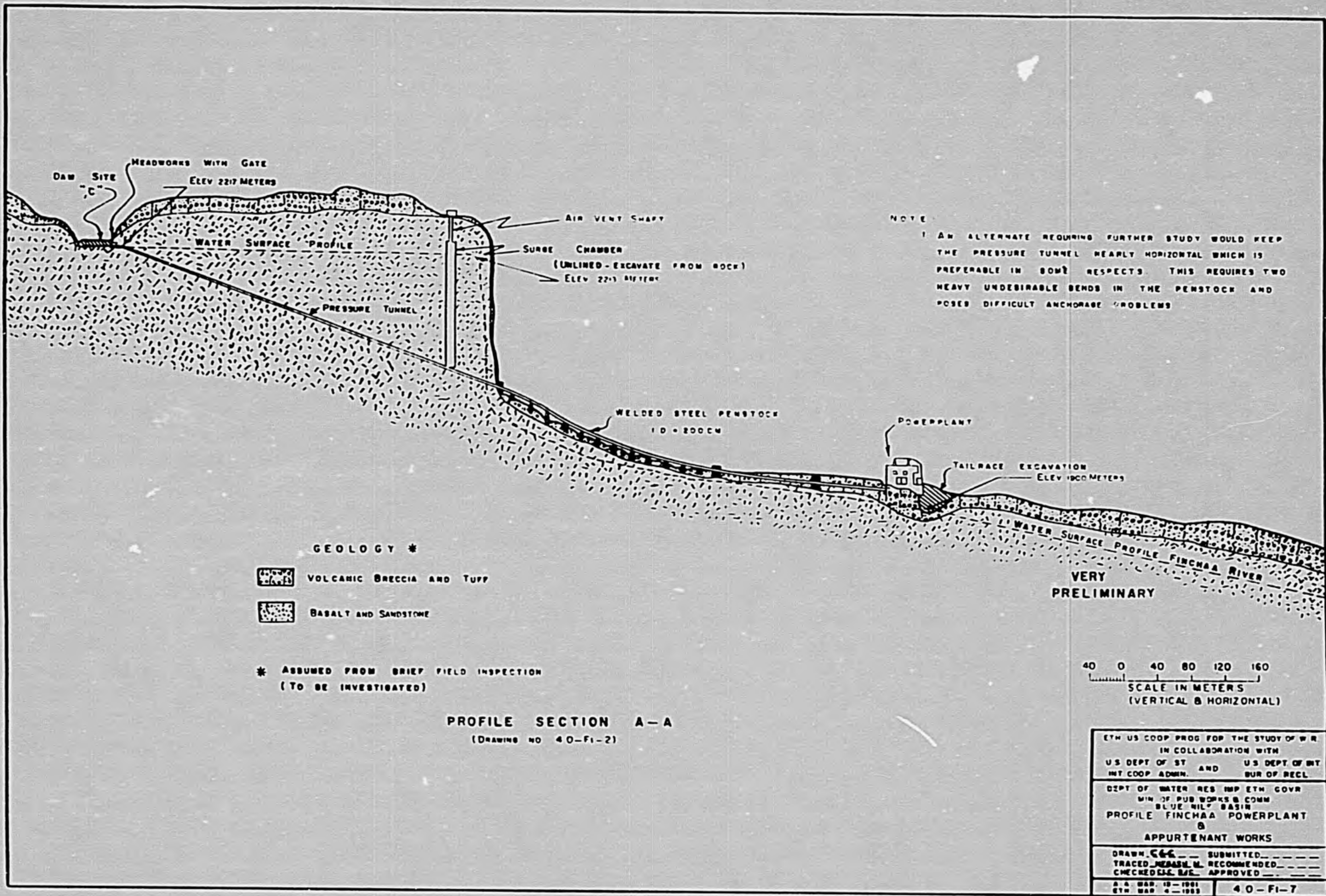
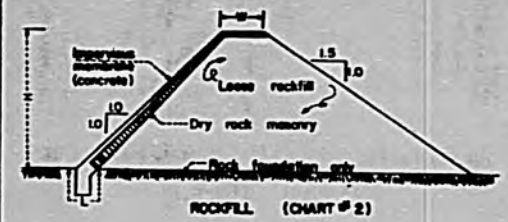

DAM SITE "C"
HEADWORKS WITH GATE
ELEV 2217 METERS
AIR VENT SHAFT
WATER SURFACE PROFILE
SURGE CHAMBER
(UNLINED - EXCAVATE FROM ROCK)
ELEV 2213 METERS
PRESSURE TUNNEL
NOTE
1 AN ALTERNATE REQUIRING FURTHER STUDY WOULD KEEP THE PRESSURE TUNNEL NEARLY HORIZONTAL WHICH IS PREFERABLE IN SOME RESPECTS. THIS REQUIRES TWO HEAVY UNDESIRABLE BENDS IN THE PENSTOCK AND POSES DIFFICULT ANCHORAGE PROBLEMS
WELDED STEEL PENSTOCK
I D = 200 CM
POWERPLANT
TAILRACE EXCAVATION
ELEV 1900 METERS
WATER SURFACE PROFILE FINCHAA RIVER
VERY PRELIMINARY
GEOLOGY *
VOLCANIC BRECCIA AND TUFF
BASALT AND SANDSTONE
* ASSUMED FROM BRIEF FIELD INSPECTION (TO BE INVESTIGATED)
40 0 40 80 120 160
SCALE IN METERS
(VERTICAL & HORIZONTAL)
PROFILE SECTION A—A
(DRAWING NO 40-FI-2)
ETH US COOP PROG FOR THE STUDY OF W R
IN COLLABORATION WITH
U S DEPT OF ST INT COOP ADMIN. AND U S DEPT OF INT BUR OF RECL
DEPT OF WATER RES IMP ETH GOVR
MIN OF PUB WORKS & COMM
BLUE NILE BASIN
PROFILE FINCHAA POWERPLANT & APPURTENANT WORKS
DRAWN C&G SUBMITTED
TRACED RECOMMENDED
CHECKED APPROVED
40-FI-7

Figure 6

FIGURE 7

Dams Reconnaissance Estimates

Example of data developed for estimating possible future dam construction costs.



ROCKFILL (CHART # 2)

MASONRY (CHART # 3)

HOMOGENEOUS (CHART # 4)
(CORE CL OR CH MATERIAL)

ASSUMED DIMENSIONS
EARTH – ROCKFILL DAMS

CREST WIDTH W = 3.62 $H^{1/3}$ (Metric units)
Minimum W = 3.0m
Maximum W = 13.0m
THICKNESS "A"
Top 10 % H, Minimum 1.5m
Bottom 15% H, Minimum 1.5m
FREEBOARD
Minimum 4.0m above normal water surface

ROCKFILL DAMS

CREST WIDTH W = 3.62 $H^{1/3}$
Minimum W = 3.0m
Maximum W = 13.0m
IMPERVIOUS MEMBRANE
Thickness = 1% H above point minimum = 0.30m
DRY ROCK MASONRY – Thickness normal to slope
Top = 10 % H, Minimum 1.5 m
Bottom = 15 % H, Minimum 1.5m
CUT-OFF WALL
Path of percolation L = 25 % H minimum
FREEBOARD
Minimum 4.0 m above normal water surface

MASONRY OR CYCLOPEAN CONCRETE DAMS

FREEBOARD
Minimum 3.0 m above normal water surface

HOMOGENEOUS EARTH DAMS

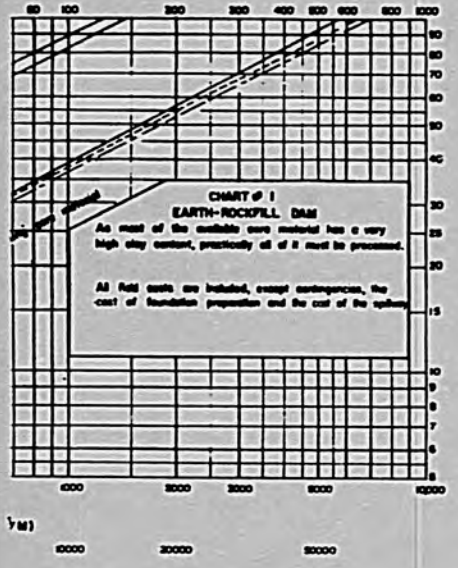
MAXIMUM HEIGHT (H) equals 30 m
CREST WIDTH W = 3.62 $H^{1/3}$
Minimum W = 3.0m
Maximum W = 13.0m
FREEBOARD
Minimum 4.0 m above normal water surface
CORE MATERIAL
80 to 90% passing #200 screen

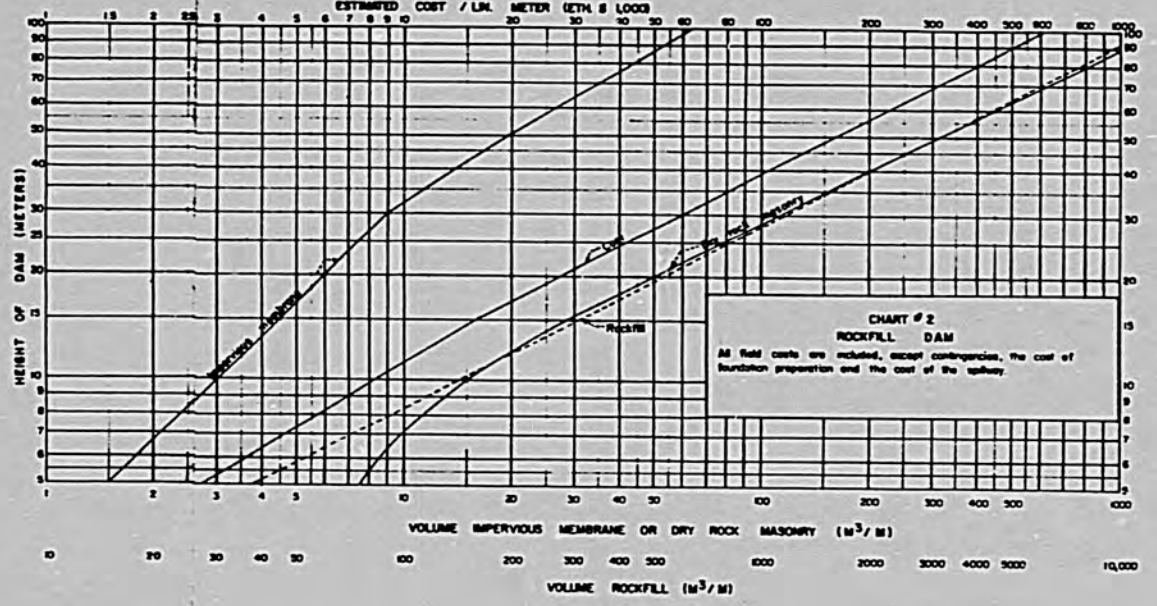
ADDIS ABABA 1958 UNIT PRICES

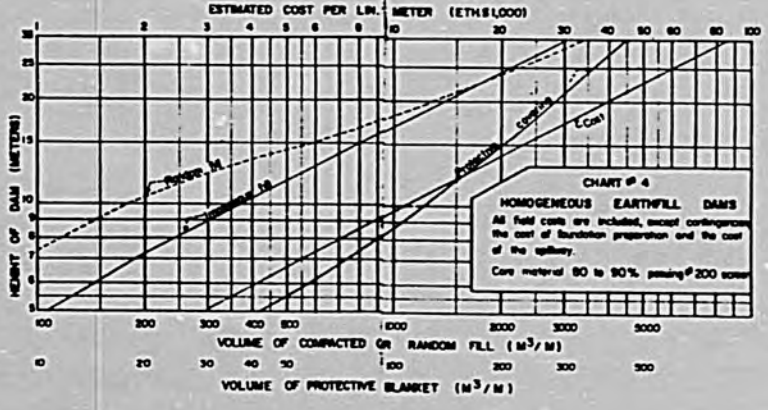
Excavation - common	Eth $ 1.50
Excavation - rock	
Embankment - transportation and compaction	3.50
Rockfill, rip-rap, pervious or semi-pervious material (and excavation)	10.00 15.00
Random fill (including excavation)	3.00
Class "A" concrete (including forms)	130.00
Class "A" masonry	80.00
Dry rock masonry	40.00

The cost of constructing the embankment of dams of types #1, #2, and #4 represents only 39% of the total cost of the dam.

The cost of constructing the masonry dam type #3 represents only 17% of the total cost of the dam.







NOTE

This drawing is to be used for reconnaissance estimating purposes only

Ref appendix "A" USBR Reclamation Instr Series 150

ETHIOPIA-UNITED STATES COOPERATIVE PROGRAM FOR THE STUDY OF WATER RESOURCES IN COLLABORATION WITH THE US DEPT OF STATE AND US DEPT OF INTERIOR

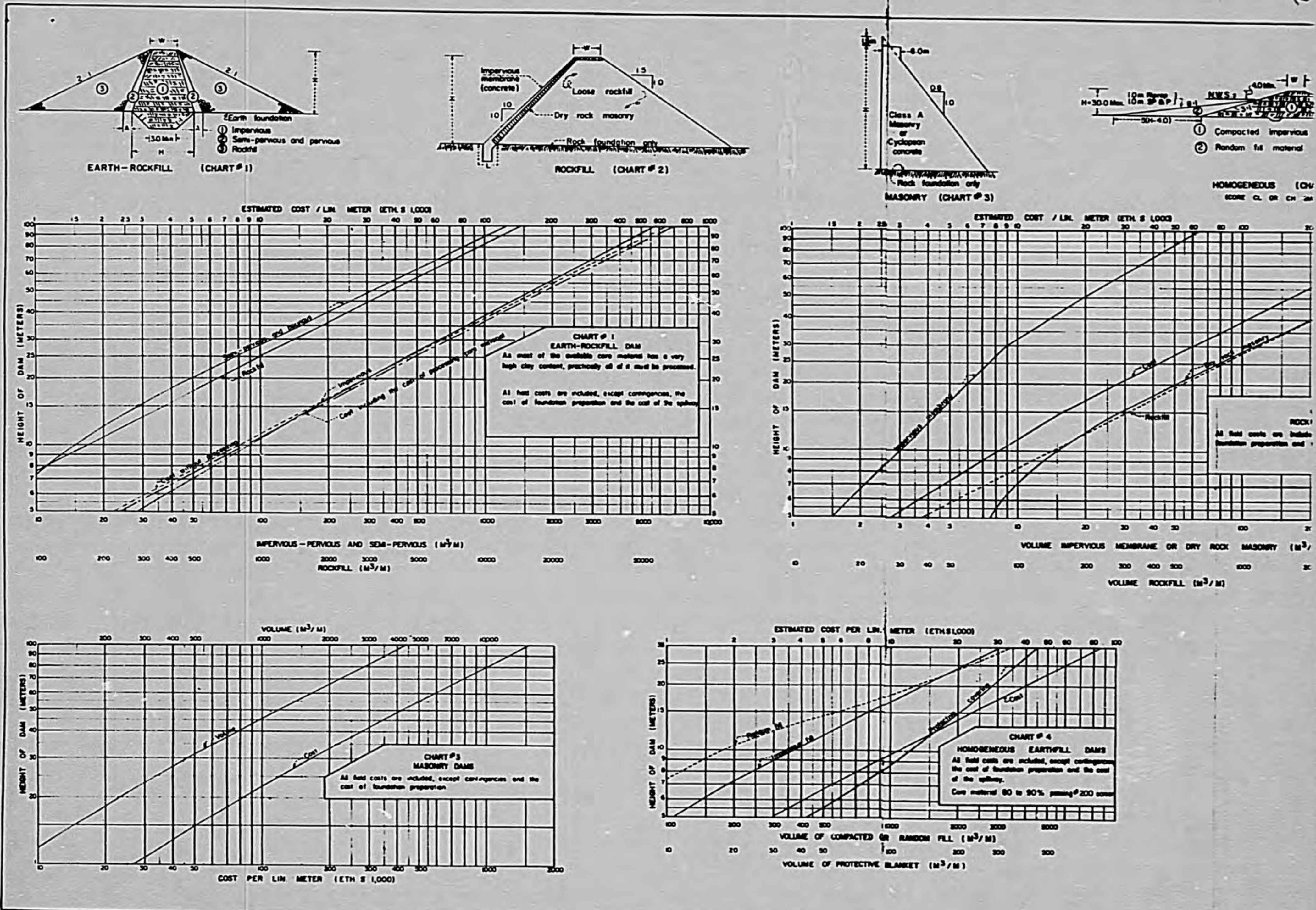
DEPARTMENT OF WATER RESOURCES
MINISTRY OF PUBLIC WORKS & COMMUNICATIONS
BLUE NILE BASIN

DAMS
RECONNAISSANCE ESTIMATES VOLUMES AND 1958 COST

DRAWN AES
TRACED
CHECKED AES
SUBMITTED
RECOMMENDED
APPROVED

2.0-BN-27

Figure 7 A



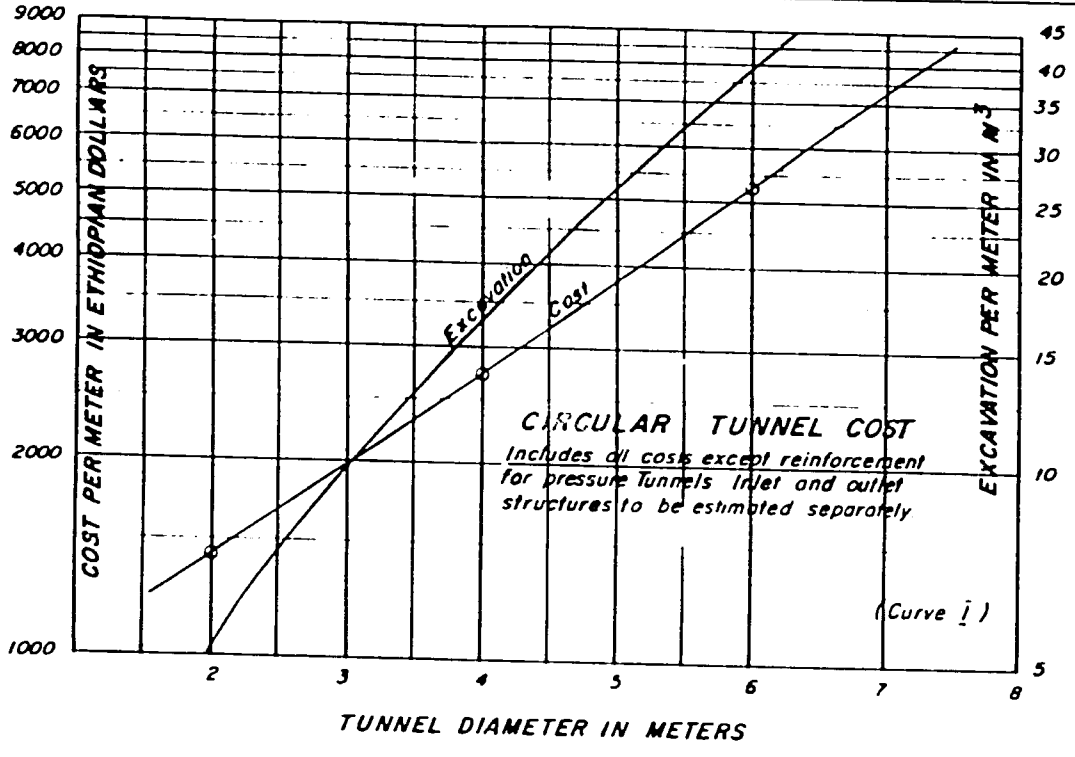
EARTH-ROCKFILL (CHART # 1)
Earth foundation
① Impervious
② Semi-pervious and pervious
③ Rockfill
3.0 Min.
ROCKFILL (CHART # 2)
Impervious membrane (concrete)
Loose rockfill
Dry rock masonry
Rock foundation only
MASONRY (CHART # 3)
Class A Masonry or Cyclopean concrete
Rock foundation only
6.0m
HOMOGENEOUS
N.W.S.
4.0 Min.
① Compacted impervious
② Random fill material
ESTIMATED COST / LIN. METER (ETH. $ 1,000)
HEIGHT OF DAM (METERS)
Semi-pervious and pervious
Rockfill
Impervious
Cost including the cost of processing core material
Cost without processing
CHART # 1
EARTH-ROCKFILL DAM
As most of the available core material has a very high clay content, practically all of it must be processed.
All field costs are included, except contingencies, the cost of foundation preparation and the cost of the spillway.
IMPERVIOUS - PERVIOUS AND SEMI-PERVIOUS (M³/M)
ROCKFILL (M³/M)
ESTIMATED COST / LIN. METER (ETH. $ 1,000)
Impervious membrane
Cost
Dry rock masonry
Rockfill
All field costs are include... foundation preparation and ...
VOLUME IMPERVIOUS MEMBRANE OR DRY ROCK MASONRY (M³/M)
VOLUME ROCKFILL (M³/M)
VOLUME (M³/M)
Volume
Cost
CHART # 3
MASONRY DAMS
All field costs are included, except contingencies and the cost of foundation preparation
COST PER LIN. METER (ETH $ 1,000)
ESTIMATED COST PER LIN. METER (ETH.$1,000)
Random fill
Impervious fill
Protective covering
Cost
CHART # 4
HOMOGENEOUS EARTHFILL DAMS
All field costs are included, except contingencies, the cost of foundation preparation and the cost of the spillway.
Core material 80 to 90% passing # 200 screen
VOLUME OF COMPACTED OR RANDOM FILL (M³/M)
VOLUME OF PROTECTIVE BLANKET (M³/M)

Figure 7 B

FIGURE 8

Tunnel Reconnaissance Estimates

Typical data developed for use in connection with estimating conveyance system costs.



APPROXMATE PERCENT OF COST (Curve I)

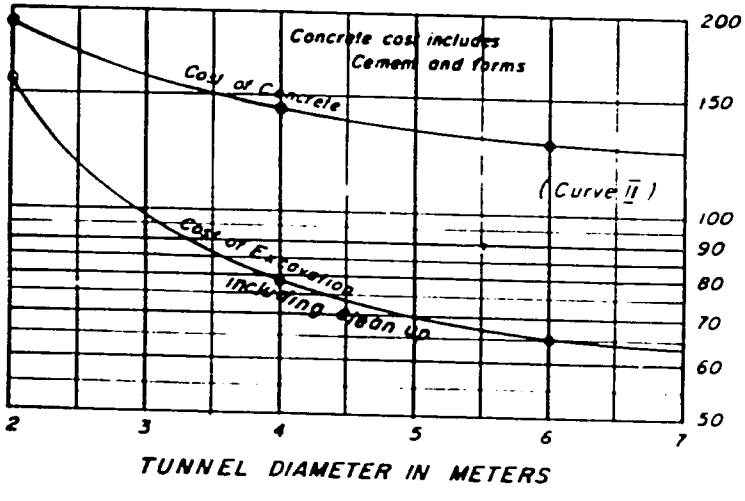
	2 M. Dia	4 M Dia	6 M. Dia
Excavation	55 %	50%	49%
Concrete including cement & forms	24%	24%	25%
Supports & Lagging (75% supported)	13%	17%	17%
Grouting, Drainage & Misc. work	8%	9%	9%

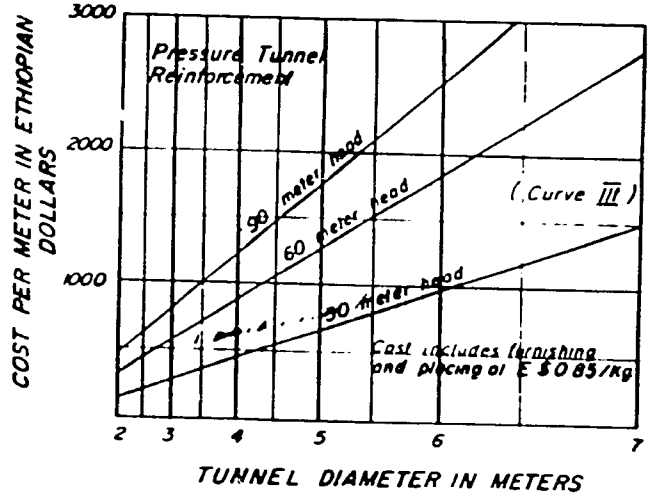
Estimated correction for length (Curve I)

Meters driven from one heading			Cost factor
0	to	800	1.1
800	to	4800	1.0
4800	to	6400	1.1
6400	to	8000	1.2
8000	to	9600	1.3

To the cost from the curves, add 25% contingencies to obtain field cost. Add 15% to field cost for engineering and general expense.

For pressure tunnels, the costs from Curves I & III must be added The thickness of concrete lining in curve I is 8.3 cm per meter of diameter





1958 COSTS

ETHIOPIA UNITED STATES COOPERATIVE PROGRAM FOR THE STUDY OF WATER RESOURCES IN COLLABORATION WITH U.S. DEPT OF ST., INT COOP. ADM. AND U.S. DEPT OF INT BUR OF RECL

DEPARTMENT OF WATER RESOURCES
IMPERIAL ETHIOPIAN GOVERNMENT
MINISTRY OF PUBLIC WORKS & COMMUNICATIONS

BLUE NILE RIVER BASIN

TUNNEL

RECONNAISSANCE ESTIMATES

DRAWN A.P.B.
TRACED
CHECKED G.F.B.
SUBMITTED
RECOMMENDED
APPROVED

Addis Ababa Ethiopia DEC 29 1958 (E.C.)

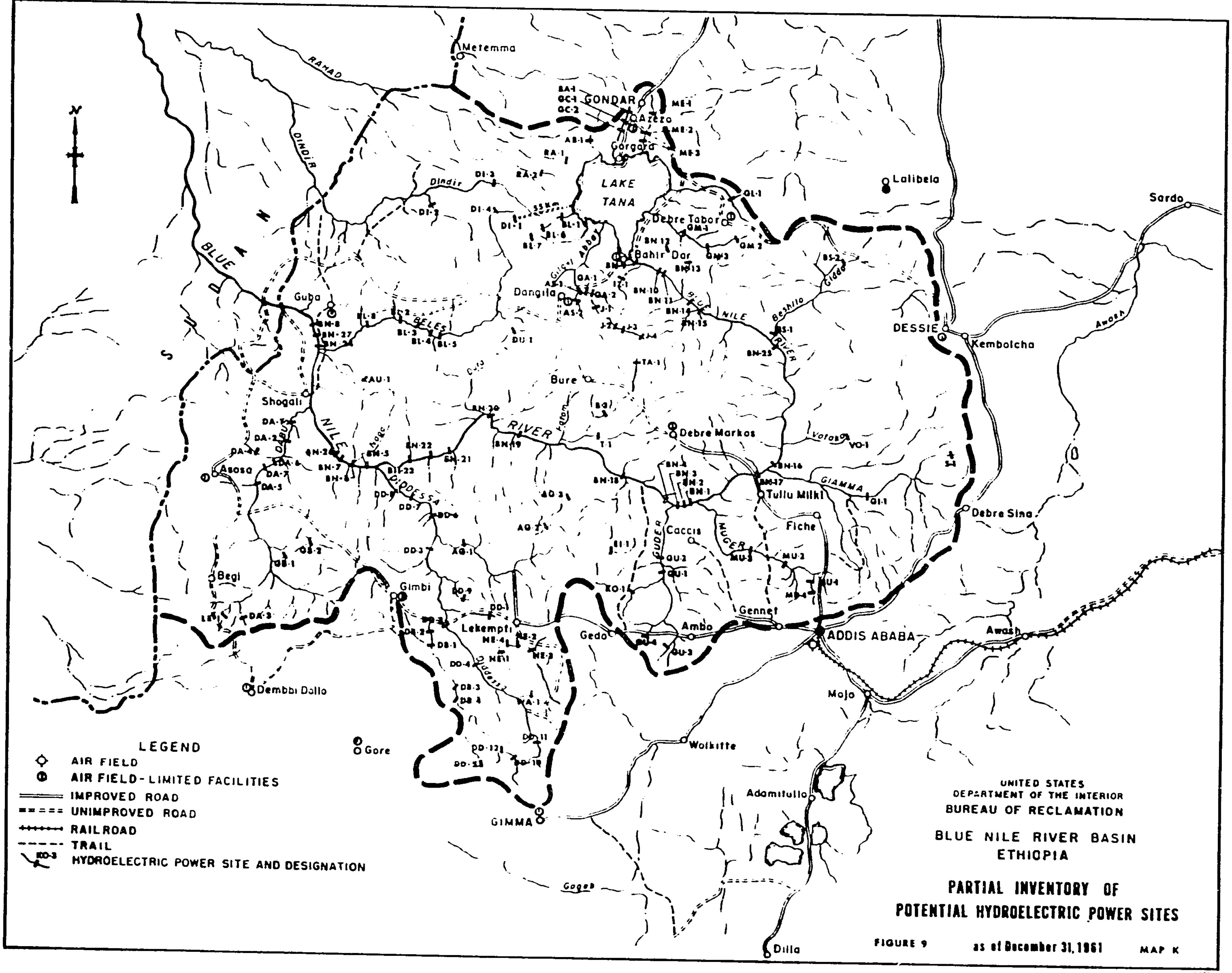
20-BN-28

Figure 8

FIGURE 9

Partial Inventory of Hydroelectric Power Sites

The sites shown on this inventory include all those that have thus far been noted by superficial reconnaissance. Their potentials have been characterized in Power Working Paper No. 4.



PARTIAL INVENTORY OF POTENTIAL HYDROELECTRIC POWER SITES

FIGURE 9 as of December 31, 1961 MAP K

FIGURE 10

Conjectural Ultimate Power System Network

This scheme is representative only of the kind of development that may be expected to follow that gradual increase in demand as the capital structure of the area grows. Estimates of capacity based on firm hydrologic data can be made for only a few stations.

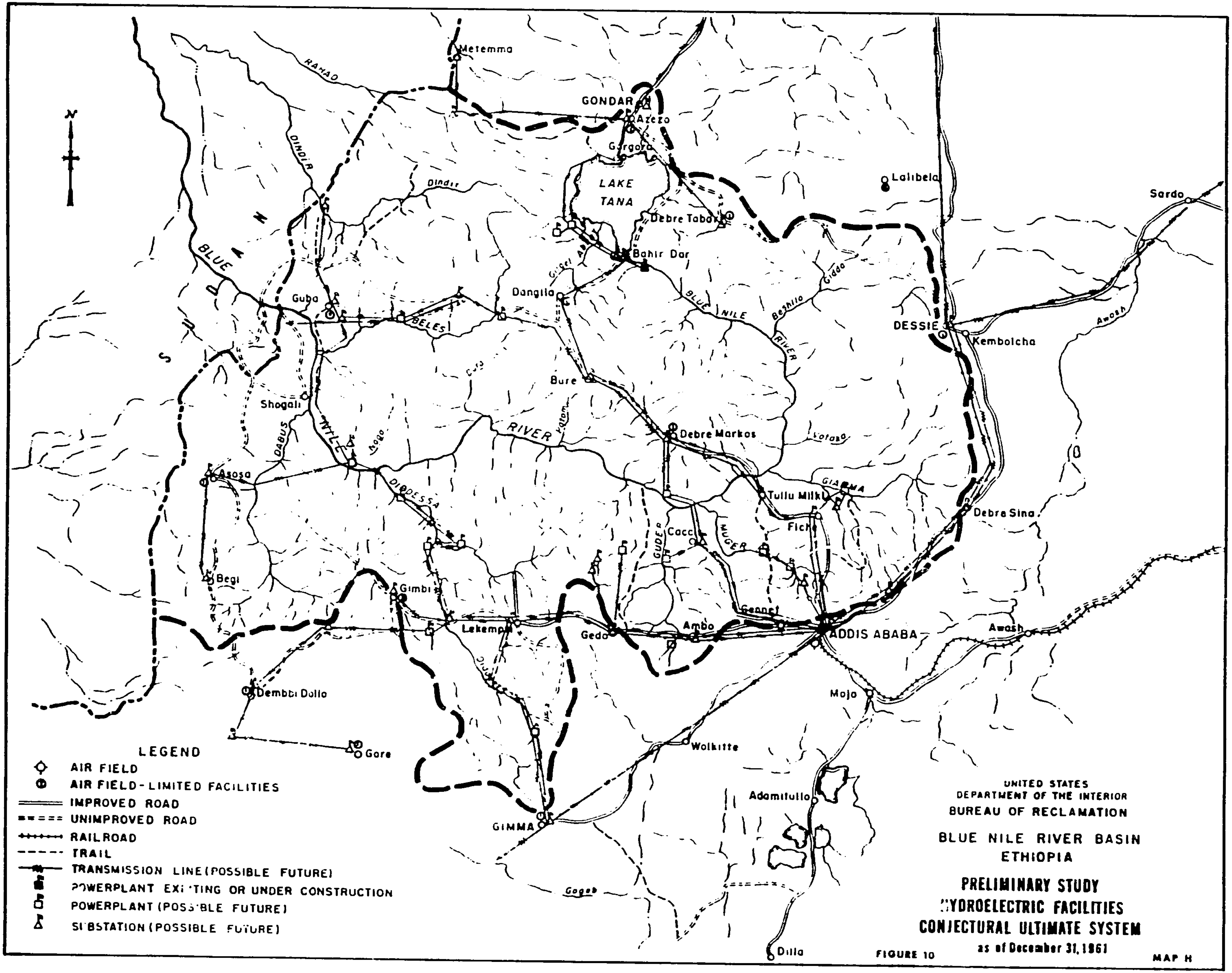

Metemma
RAHAD
GONDAR
Azezo
Gorgora
LAKE
TANA
Lalibela
Sardo
DINDIR
Dindir
Debre Tabor
BLUE
SUDAN
Bahir Dar
Guba
Dangila
BELES
BLUE NILE
Beshilo
Gidda
DESSIE
Kembolcha
Awash
RIVER
Bure
Shogali
NILE
DABUS
RIVER
Debre Markos
Asosa
DIDESSA
Tullu Milki
Debre Sina
GUDER
Cacci
MUGER
Fiche
Begi
Gimbi
Gennet
Lekempt
Ambo
Gedo
ADDIS ABABA
Awash
Dembbi Dollo
Mojo
Gore
Wolkitte
Adamitullo
GIMMA
Gogeb
Dilla
LEGEND
AIR FIELD
AIR FIELD-LIMITED FACILITIES
IMPROVED ROAD
UNIMPROVED ROAD
RAILROAD
TRAIL
TRANSMISSION LINE (POSSIBLE FUTURE)
POWERPLANT EXISTING OR UNDER CONSTRUCTION
POWERPLANT (POSSIBLE FUTURE)
SUBSTATION (POSSIBLE FUTURE)
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
BLUE NILE RIVER BASIN
ETHIOPIA
PRELIMINARY STUDY
HYDROELECTRIC FACILITIES
CONJECTURAL ULTIMATE SYSTEM
as of December 31, 1961
FIGURE 10
MAP H

FIGURE 11

Small Hydroelectric Power Plant

Timochia River - Dembecha
This preliminary drawing illustrates the type and capacity of plant that may be found suitable for early implementation in some areas.

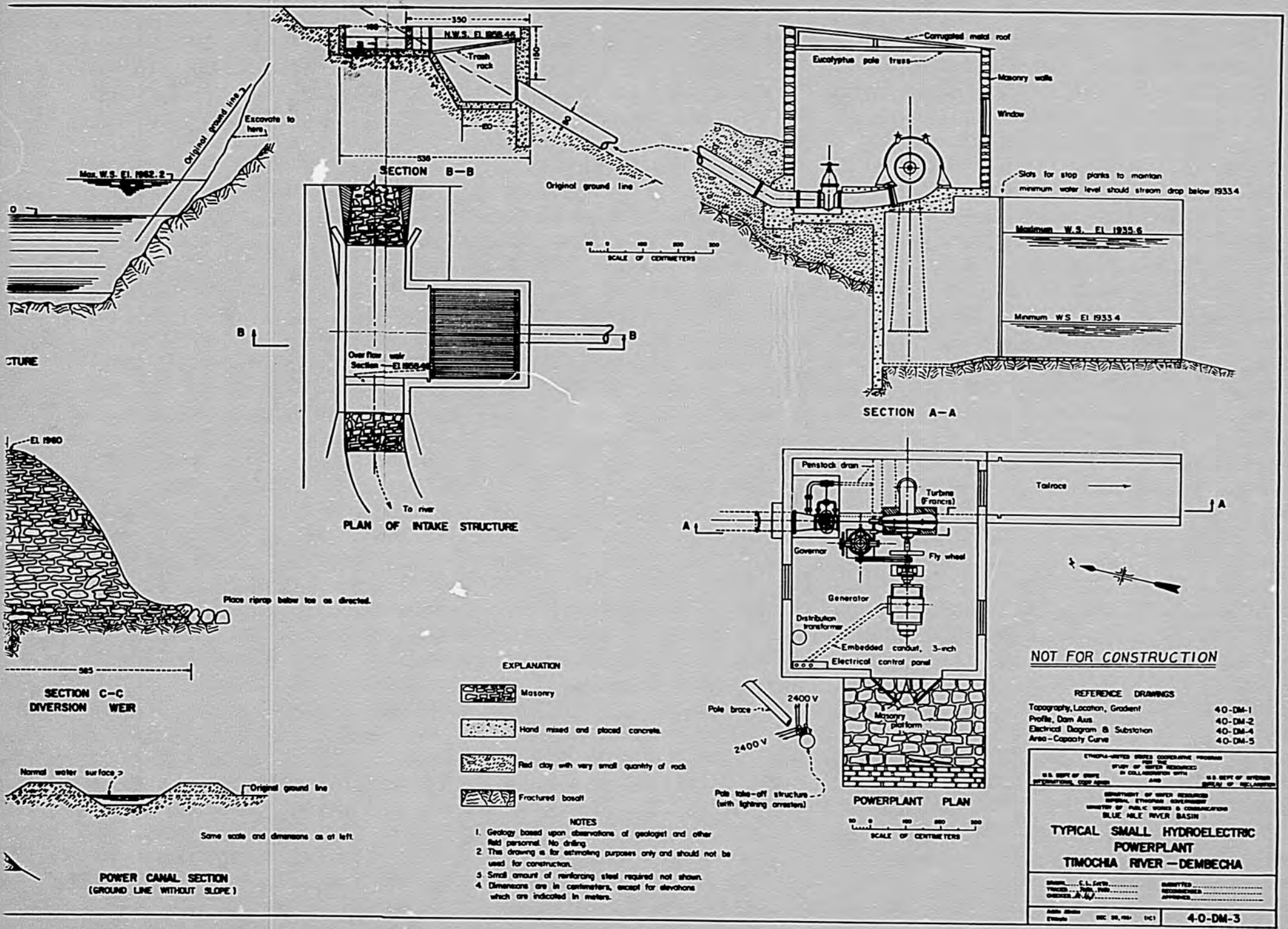

SECTION B—B
N.W.S. El 1958.46
Trash rack
Original ground line
Excavate to here
Max. W.S. El. 1962.2
Original ground line
Over flow weir Section — El 1958.46
To river
PLAN OF INTAKE STRUCTURE
SCALE OF CENTIMETERS
Corrugated metal roof
Eucalyptus pole truss
Masonry walls
Window
Slots for stop planks to maintain minimum water level should stream drop below 1933.4
Maximum W.S. El 1935.6
Minimum W.S. El 1933.4
SECTION A—A
Penstock drain
Turbine (Francis)
Governor
Fly wheel
Generator
Distribution transformer
Embedded conduit, 3-inch
Electrical control panel
Tailrace
Masonry platform
Pole brace
2400 V
2400 V
Pole take-off structure (with lightning arresters)
POWERPLANT PLAN
SCALE OF CENTIMETERS
El. 1980
Place riprap below toe as directed.
SECTION C-C
DIVERSION WEIR
Normal water surface
Original ground line
Same scale and dimensions as at left.
POWER CANAL SECTION
(GROUND LINE WITHOUT SLOPE)
EXPLANATION
Masonry
Hand mixed and placed concrete.
Red clay with very small quantity of rock
Fractured basalt
NOTES
1. Geology based upon observations of geologist and other field personnel. No drilling.
2. This drawing is for estimating purposes only and should not be used for construction.
3. Small amount of reinforcing steel required not shown.
4. Dimensions are in centimeters, except for elevations which are indicated in meters.
NOT FOR CONSTRUCTION
REFERENCE DRAWINGS
Topography, Location, Gradient 40-DM-1
Profile, Dam Axis 40-DM-2
Electrical Diagram & Substation 40-DM-4
Area-Capacity Curve 40-DM-5
ETHIOPIA-UNITED STATES COOPERATIVE PROGRAM
STUDY OF WATER RESOURCES
DEPARTMENT OF WATER RESOURCES
IMPERIAL ETHIOPIAN GOVERNMENT
MINISTRY OF PUBLIC WORKS & COMMUNICATIONS
BLUE NILE RIVER BASIN
TYPICAL SMALL HYDROELECTRIC POWERPLANT
TIMOCHIA RIVER — DEMBECHA
4-0-DM-3

Figure II A

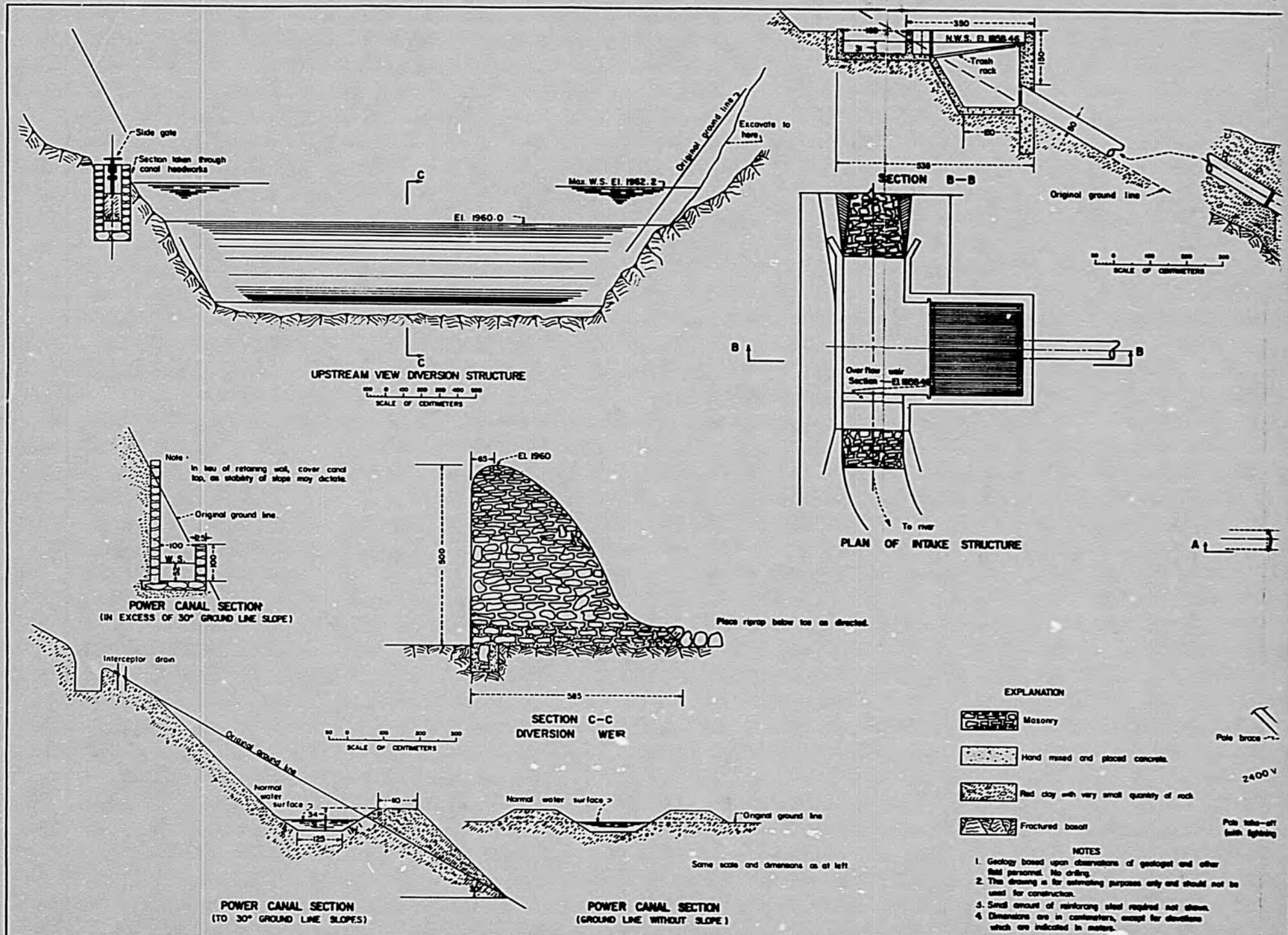
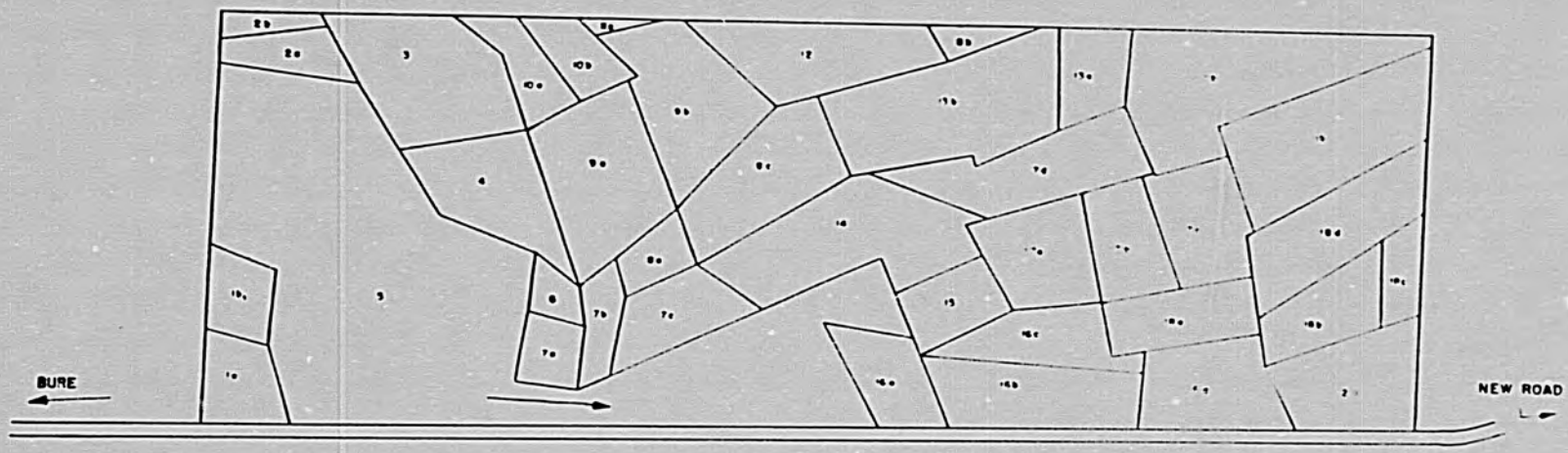

Side gate
Section taken through canal headworks
C
Max. W.S. El. 1962.2
Original ground line
Excavate to here
El. 1960.0
C
UPSTREAM VIEW DIVERSION STRUCTURE
SCALE OF CENTIMETERS
350
N.W.S. El. 1958.46
Trash rack
150
80
538
SECTION B—B
Original ground line
SCALE OF CENTIMETERS
B
B
Over flow weir Section — El. 1958.46
To river
PLAN OF INTAKE STRUCTURE
A
Note :
In lieu of retaining wall, cover canal top, as stability of slope may dictate.
Original ground line
100
W.S.
POWER CANAL SECTION
(IN EXCESS OF 30° GROUND LINE SLOPE)
65
El. 1960
500
Place riprap below toe as directed.
585
SECTION C-C
DIVERSION WEIR
SCALE OF CENTIMETERS
Interceptor drain
Original ground line
Normal water surface
80
34
123
POWER CANAL SECTION
(TO 30° GROUND LINE SLOPES)
Normal water surface
Original ground line
Same scale and dimensions as at left
POWER CANAL SECTION
(GROUND LINE WITHOUT SLOPE)
EXPLANATION
Masonry
Hand mixed and placed concrete.
Red clay with very small quantity of rock
Fractured basalt
Pole brace
2400 V
Pole take-off (with lightning
NOTES
1. Geology based upon observations of geologist and other field personnel. No drilling.
2. This drawing is for estimating purposes only and should not be used for construction.
3. Small amount of reinforcing steel required not shown.
4. Dimensions are in centimeters, except for elevations which are indicated in meters.

Figure 11 B

FIGURE 12

Sample Area for Agricultural Economic Survey

Local population was canvassed for all available information as to agricultural production, methods, and conditions. The survey team members sketched the sample areas in the field with the help of air photos enlarged to a scale of 1:2000.



4225 FF

FIELD NO	1960 CROP	1961 CROP	AREA HECTARES
1a	BARLEY	DAGUSSA	
1b	DAGUSSA	FALLOW	
2a	TEFF	FALLOW	
2b	TEFF	NOUG	
3	TEFF	LUPINS	
4	FALLOW	FALLOW	
5	FALLOW	FALLOW	
6	TEFF	TEFF	
7a	FALLOW	WOOG	

FIELD NO	1960 CROP	1961 CROP	AREA HECTARES
7b	FALLOW	OATS	
7c	FALLOW	TEFF	
7d	BARLEY	DAGUSSA	
8a	BUSH	BUSH	
8b	DAGUSSA	TEFF	
8c	FALLOW	TEFF	
9a	TEFF	DAGUSSA	
9b	DAGUSSA	BARLEY	
10a	FALLOW	BARLEY	

FIELD NO	1960 CROP	1961 CROP	AREA HECTARES
10b	FALLOW	DAGUSSA	
11	WOOG	TEFF	
11b	TEFF	FALLOW	
12	BARLEY	DAGUSSA	
13a	BARLEY	DAGUSSA	
13b	TEFF	TEFF	
14	FALLO	TEFF	
15	TEFF	WOOG	
16a	WOOG	FALLOW	
16b	TEFF	FALLOW	

FIELD NO	1960 CROP	1961 CROP	AREA HECTARES
17a	DAGUSSA	BARLEY	
17b	TEFF	BARLEY	
17c	BARLEY	TEFF	
18a	TEFF	WOOG	
18b	TEFF	WOOG	
18c	TEFF	PLAN	
18d	DAGUSSA	TEFF	
19	BARLEY	DAGUSSA	
20	DAGUSSA	TEFF	

MAPPED BY
ASSEFA TEREFERA
HAILU TEFERA
BANTAYEHU GELAW
AUG 23 1961

GOJJAM PROVINCE
BURE-GIGA AREA
AGRICULTURAL SURVEY

Sample Area for Agricultural Economic Survey Figure 12

Preliminary attention has been given to the preparation and assembly of manuscript material for use in the final report. A file of drafts, illustrations, and data has been started for reference in report writing, and tentative allocations of responsibility for various sections of the report are under consideration. Material for the appendix reports on construction of hydrologic installation and on general geology, prepared by the Hydrology and Geology Divisions respectively, is being reviewed for re-drafting in final style and format.

(H) Agriculture and Economics. During the early part of the year effort was directed toward summarizing the agricultural field data gathered in the months of July, August, and September 1960, in the Provinces of Shoa and Wellegga. The tabulating and summarizing of field data was completed just prior to the beginning of another season of field work in Gojjam Province. Undergraduates from the Imperial Ethiopian Agricultural College worked with the Department during the months of July, August, and September 1961, gathering detailed farm enterprise data in selected areas between Bure and Jiga.

In August, Agricultural Economist Philip Goorian, Ato Hailu Tefera, and Ato Asefa Tefera reported for work with the Agriculture and Economics Section. Ato Hailu and Ato Asefa had just completed their studies at Alem Maya College of Agriculture and Mechanical Arts. In November, Ato Addis Anteneh, a graduate in Agriculture and Economics from the University Illinois, came to work in this Section. This augmented staff has continued with the tabulating and summarizing of data gathered during the field season, having statistical data virtually tabulated at year's end. Ato Asefa has been collaborating with Ato Mohammed of Hydrology in a study of consumptive use at a small irrigated area near Bahir Dar.

A preliminary agricultural economic analysis of the Guder Project was completed, including a benefit-cost analysis. A rationale was developed for the analysis, and basic assumptions were formulated for application to other project areas.

Continuing contacts with the Ministry of Agriculture and the Imperial Ethiopian Agricultural College were maintained to keep abreast of currently available agricultural information. Field trips were made to a number of large farms and plantations for the purpose of collecting agricultural data. Information obtained was incorporated in the preliminary economic studies made during the year.

(I) Administrative Division. Integration of the various projects' property management, warehousing, and motor vehicle functions, into a single Directorate operation was well advanced by the close of the year. Construction of a vehicle repair shop and a warehouse building facilitated the improvement of these operations as did the appointment by the Business Office of Ato Abraham as Motor Supervisor and Chief Mechanic.

Arrival of the Employee Development Officer, Mr. Eugene Read, in July, accelerated the establishment of personnel programs. Ethiopian stenographers were engaged, and have shown rapid progress in mastering the difficult problems of American speech, technical vocabulary, and style. Buildings were constructed at Debre Markos to house the district headquarters there. Many more vaccinations against smallpox and yellow fever were given to employees by the Directorate Dresser, Ato Gebre Beshah; vaccination records were improved. Disciplinary procedures were strengthened.

The incidence of motor vehicle accidents decreased. A comprehensive inventory of Joint Fund property was made. Most employees gained in experience, self-confidence, and efficiency as the year progressed. A board of survey (property) was established and has begun to function actively.

(J) Organization and Training. While the technical operating organization of the Bureau of Reclamation elements of the Blue Nile Investigations remained essentially unchanged during the year, the Ministry of Public Works and Communications adopted a new framework elevating Dr. Haile Georgis Workineh from the post of Director General of the Water Resources Department to Vice Minister of Public Works and re-constituting the Department as a Directorate, with Ato Zaude Bessoufécad as Director General. Ato Abdul Jelil Mohammed, in addition to his duties as Business Manager of the Joint Fund, was made Acting General Services Director, and Ato Kassa Haile, Acting Technical Director of the Directorate.

In order to assist in crystallizing the future operating pattern of the Directorate, the Bureau of Reclamation Project's contacts with the Directorate have been designed to simulate the relationships of the future elements of the Directorate insofar as project service to and support by the Directorate are concerned. With respect to administrative services, the resemblance to the future pattern is highly advanced since the property, procurement, and Ethiopian personnel support for the project operation has been furnished by Joint Fund Business Office and the Departmental Personnel Office from the inception of the project.

Under the newly integrated administrative organization, sparked to a large extent by the determination of His Excellency, Dr. Haile, requests for support funnel from the project nominally to Ato Abdul regardless of whether related to Joint Fund or to Directorate services. As of January 1st, 1962, this channel will be further unified by the elimination of the Joint Fund, and the assumption of its functions by the Directorate in collaboration with a new Master Cooperative Fund established by the Economic and Technical Assistance Board.

The Bureau of Reclamation project elements now, therefore, in fact relay their administrative actions and requests either through the Reclamation Administrative Officer, Property Officer, and Employee Development Officer, to the corresponding Ethiopian officer or directly to the Ethiopian officer concerned. The Reclamation officers are thus able to assist the Ethiopian staff in interpreting the requirements and in developing the practices and procedure required to insure the efficient support of operations.

During the last four months of the year, the Directorate and the project have jointly developed:

1. Forms for (a) Referral for medical services; (b) Annual and sick leave permission and instruction (application and approval); (c) Property clearance; (d) Card form for service record of each employee; (e) Notification of personnel action; (f) Personnel action request; (g) Resignation; (h) Travel authorization and diary of travel performed; (i) Monthly roster and payroll; (j) Probationary and follow-up report on new employees; (k) Application for employment; and, (l) Personnel evaluation report. The first four of these have been adopted.

2. Improved disciplinary procedures.
3. Revised organization for the Personnel Branch of the Directorate Administrative Division.
4. Revised system of pay scales.
5. Improved handling of stores, shipping, receiving, issue, and maintenance.
6. Survey procedures for disposition of questionable property.
7. Improved motor vehicle operation and maintenance procedures.
8. Additional position descriptions.

Formal training for hydrographers was given in a one-month special course held during March and April to insure pre-qualification of all concerned for handling the arduous rainy season schedule of flood flow measurements. On-the-job training continued for all personnel.

A memorandum explaining at length the significance of the training opportunities afforded by the project was addressed to the Director, USOM/E, on March 27, 1961. A copy of this memorandum is attached as Annex C.

IV. PROBLEM AREAS

Logistics

The tragic helicopter crash in April, aside from its poignant personal aspects, grounded the air services for about three months at a critical time. The emergency was met by setting up "remote" camps to be serviced by pack animal, and by detailing engineers from the Project Planning and Reports grouped to assist in field supervision - Section III, (G).

It is gratifying to report marked progress in the development of close and harmonious working relationship between the project staff and the Joint Fund - IEG logistical supporting services - see Section III, (I) and (J). Improved mutual understanding, helpfulness, and patience have resulted in a notable reduction in errors and delays.

Further efforts are required in the training of drivers to reduce destructive operating practices and improve preventive maintenance. This training can be provided by the new motor supervisor only if he can be given the assistance needed to share the heavy work load.

Repair and maintenance of stores is needed to preserve and rehabilitate thousands of dollars worth of equipment. The Business Office staff are well aware of this requirement but need qualified craftsmen to mend canvas, repair lamps, fix flashlights, restore stoves and refrigerators, rehabilitate cots, and generally use a work bench and shop to keep equipment in order.

The introduction of the new Master Cooperative Fund has caused some delays, thus far principally in consequence of errors in applying newly prescribed procedures. These delays could become critical in 1962, considering that time available to this project for accomplishing its mission is strictly limited. Since it may be reasonable to expect any newly constituted group of this kind to require a year or more to familiarize itself with the nature of its service requirements, and since the forthcoming year comprises most of the remaining field time of this project, special effort may be needed to insure that the new procedures do not impose delays and restrictions on the conduct of project operations.

Personnel

Under the present limited concept of project objectives, most of the sub-professional and vocational personnel are adequately trained to continue the work of the Directorate, only if provided with competent Ethiopian leadership. That leadership is still in critically short supply.

Four graduate engineers will return to Ethiopia from participant training with the Bureau of Reclamation in 1962. These will have little more than a year with which to familiarize themselves with the work of the Directorate and to acquire practical experience. Of the nine engineers now with the project, four will have had two to four years experience in limited sectors of the work and five will have had from one to two years of experience. The total number, thirteen, may be just sufficient to carry on the work of the Directorate at a reduced pace, but the lack of seasoned judgment and actual experience in specialized areas will be conspicuous.

It may be added that as yet no engineering geologist and no agricultural graduate interested in soil science have been provided.

Capacity for the conduct of ground survey operations has been limited by the lack of experienced instrumentmen and party chiefs. Whereas a strength capable of manning four separate camps had been planned, it has been possible to muster only two camps, the key instrument work being performed by the one Ethiopian and three American engineers.

The project objectives have now been limited to conform to the existing personnel strength, and additional personnel are no longer being requested.

V. Program For FY 1962 And Beyond

The preparation of this section was delayed for three weeks in order to incorporate the results of consultations with Assistant Commissioner Palmer and Foreign Activities Division Chief Damours in January 1962. As in December 1960, project progress and goals were reassessed, and the program for the remainder of the Project was examined in some detail and tentatively agreed upon in consultations with the Director of USAID Ethiopia.

In short, it is proposed during the remainder of the Project to complete most of the originally planned hydrologic network and the field studies relating to the most promising development areas for both irrigation and power, the priorities resting with the possible upstream irrigation developments, to outline these development potentials in the final report, and to effect a gradual transition of operating staff to IEG control. It is proposed to complete field work by the end of the 1962-63 dry season and to phase out all but small holding party of American staff by July 1, 1963. Any work remaining to be completed in the preparation and editing of the final report thereafter would be handled by key members of the Project staff working in the Denver office.

The work to be completed is outlined in the accompanying "Program 2" which is attached as Annex D. This program was adopted virtually as it stands during the January consultations; except, however, that it was recognized that the completion of the lower gaging station on the Dindir and of the gaging station on the Beshilo would probably not be practical in time to incorporate the results of readings in the Project studies. These two stations have therefore been dropped from Project objectives unless they can be completed under primarily Ethiopian supervision and on IEG budget.

1961 ANNUAL REPORT

BLUE NILE RIVER BASIN INVESTIGATIONS

Annex A

Working Papers and Policy Documents

I. Working Papers

Field Engineering

No. 1 - "Blue Nile Investigations Preliminary Reconnaissance," dated October 1, 1959.

No. 1 - Supplement No. 1 - remainder of "Reconnaissance Notes," dated September 7, 1960.

No. 1 - Supplement No. 2 - "Preliminary Helicopter Reconnaissance," dated March 20, 1961.

No. 2 - "Road Log - Omedla to Addis Ababa," dated April 12, 1960.

Office Engineering

No. 1 - "Status of Gilgel Abbay Development," dated February 10, 1960.

Power

No. 1 - "Guder Trip Report and Notes on Electrical System Characteristics Ethiopia," dated December 29, 1960.

No. 2 - "Preliminary Considerations - Upper Muger Power Development," dated January 23, 1961.

No. 3 - "A Preliminary Reconnaissance Study of the Finchaa River Hydroelectric Development at Falls below Chomen Swamp Outlet," dated April 3, 1961.

No. 4 - "Past and Present Power Supply and Requirements in Ethiopia," dated April 17, 1961.

No. 5 - "Fixed Costs for Electric Power Facilities," dated September 12, 1961.

No. 6 - "Preliminary Inventory of Hydroelectric Power Sites - Blue Nile River Basin," dated November 15, 1961.

Field Surveys

No. 1 - "Tis Abbay Preliminary Survey," dated March 30, 1960.

Small Watershed Development

No. 1 - "Small Watershed Development Program in the Upper Muger Area in Relation to Sango Gebeye (Mulu) Community and Vicinity," dated November 1, 1960.

No. 2 - "Reconnaissance Report on Possible Water Development for the Towns of Kurmuk, Sudan; Dul and Dul-Koro, Ethiopia," dated October 31, 1960.

Agriculture and Economics

No. 1 - "The Reform of Zula Plain (Eritrea)," translated from the Italian, dated November 8, 1960.

No. 2 - "Mission to Italian East Africa," translation of brief extract from the Italian, dated November 9, 1960.

No. 3 - "Indigenous Markets of Ethiopia and Their Functions in the Indigenous Economy Framework," dated November 30, 1960, translated from the Italian, omitted from previous report.

No. 4 - "The Breeding of the Civetcat in the Galla and Sidamo Provinces," dated February 7, 1961, translated from the Italian.

No. 5 - "The Problem of Soil Preparation in Italian Africa," dated February 8, 1961, translated from the Italian.

No. 6 - "Principal Aspects of Economical Life of the Lake Tana People," dated February 15, 1961, translated from the Italian.

No. 7 - "First Report on Coffee Growing in Italian East Africa," dated March 24, 1961, translated from the Italian.

No. 8 - "Cereals of Italian East Africa, Volume 2, 'Teff' (Eragrostis Teff), A Breadstuff Cereal of the Mountainous District of Italian East Africa," dated April 1, 1961; translated from the Italian.

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No. 9 - "Ecologi al-Agronomic and Systematic Observations on Plants Cultivated in Ethiopia - Guizotia, Linum, Avena, Sorghum, Eragrostis, Eleusine, Pennisetum, Hordeum, Triticum," dated June 9, 1961; translated from the Italian.

No. 10 - "Two Diseases Appearing on Safflower Cultivated in the Ethiopian Plateau," dated June 26, 1961; translated from the Italian.

No. 11 - "Study of Vegetation of Western Lowlands beyond the Setit River and Lake Tana Territory," dated June 26, 1961; translated from the Italian.

No. 12 - "Agricultural Reports on Some Areas of the Ethiopian Plateau," dated July 3, 1961; translated from the Italian.

No. 13 - "Data Summary, Blue Nile Basin, 1960 - Guder, Diddessa, and Muger Sub-Basins."

No. 14 - "Practical Considerations of the Problem of Wheat Production in Italian East Africa," dated July 27, 1961; translated from the Italian.

No. 15 - "Edible Tropical Plants Grown in Jimma Province," dated July 27, 1961; translated from the Italian.

No. 16 - "Tanning Material in Italian East Africa," dated July 27, 1961; translated from the Italian.

No. 17 - "Preliminary Study of the Flora of the Blue Nile Basin," dated August 14, 1961.

Land Classification

No. 1 - "Blue Nile River Basin, Lake Tana Area, Reconnaissance Land Classification," dated August 1, 1959.

No. 2 - "Land Classification Methods," dated July 15, 1960.

No. 3 - "Reconnaissance Land Classification, Upper Guder River Area," dated August 9, 1960.

No. 4 - "Reconnaissance Land Classification, Upper Muger River Area," dated September 9, 1960.

No. 5 - "Reconnaissance Land Classification, Birr River Area," dated September 13, 1960.

No. 6 - "Preliminary Reconnaissance and Land Classification of Finchaa Valley," dated September 28, 1960.

Hydrology

No. 1 - "Preliminary Regulation Study," dated September 16, 1959.

No. 2 - "Preliminary Data on the Possibility of Hydroelectric Utilization in Italian East Africa," translated from the Italian, dated June 1, 1960.

No. 3 - "Engineering Problems in Colonial Territories," translated from the Italian, dated October 14, 1960.

No. 4 - "Hydrologic Problems between Ethiopia and Sudan," translated from the French, dated November 10, 1960.

No. 5 - "Hazards to Flying Located within the Blue Nile River Basin in Ethiopia," dated February 1, 1961.

No. 6 - "Report of Hydrology Reconnaissance, Menze Wareda," Giamma Sub-Basin, dated January 23, 1961.

Geology

No. 1 - "Reconnaissance Survey of Limestone Deposits," dated October 15, 1959.

No. 2 - "Minerals Survey and Basin Geology," dated October 20, 1959.

No. 3 - "Useful (Ore) Deposits in Italian East Africa (Ethiopia, Eritrea, and Somaliland)," translated from the German, dated March 11, 1960.

No. 4 - "Notes on Salt in the Danakil Depression and the General Problem of Mineral Exploitation in Ethiopia," dated March 11, 1960.

No. 5 - "Notes on Koka Reservoir Leakage," dated March 16, 1960.

No. 6 - "Geologic Reconnaissance Studies of Main Stream Dam Sites," dated March 28, 1960.

No. 7 - "Summary of Data Furnished by Well Drilling Project," dated April 13, 1960.

No. 8 - "Asbestos Properties and Occurrence," dated April 13, 1960.

No. 9 - "Geology, Vicinity of Lake Tana and Tis Abbay Falls," dated April 15, 1960.

No. 10 - "Geology and Mineral Resources of Ethiopia (Thomas G. Murdock Report)," dated June 8, 1960.

No. 11 - "Geology of Lake Tana Region and Geography of Lake Tana," translated from the Italian, dated June 21, 1960.

No. 12 - "Magnetometer and Geology Survey, Addis Ababa to Asosa and Vicinity," dated July 25, 1960.

No. 13 - "Geology of Africa, Chapter XX, Ge'ologie de l'Afrique," translated from the French, dated November 14, 1960.

No. 14 - "Reconnaissance Geologic Report on Chelga Area Lignite Deposits," dated November 30, 1960.

No. 15 - "Excerpt from Chapter VII, Geology of the Sudan, from Agriculture in the Sudan," dated December 12, 1960.

Organization and Administration

No. 1 - "Organization for Community Water Resources Development," dated May 25, 1959.

No. 2 - "Proposed Standards, Water Resources Drawing Sizes and Title Blocks," dated September 22, 1960.

No. 3 - "Proposed Manning Charts and Tables of Organization," dated August 18, 1959.

No. 4 - "General Training Requirement, IEG Professional Personnel," dated December 1, 1959.

No. 5 - "Personnel Position Descriptions," dated June 28, 1960.

No. 6 - "Tables of Allowances and Catalog of Equipment and Supplies," dated September 1, 1960.

No. 7 - "Procedures for the Conduct of Force Account Operations," dated March 20, 1961.

II. Operations Memos

Operations Memo No. 2 - "Project Planning Guide Lines Anticipating Final Report," dated August 1, 1959.

Operations Memo No. 8 - "Guide to Planning Criteria and Field Survey Practices," dated August 23, 1960.

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Annex B

Personnel Status - 1961

American Personnel

Recruitment of American personnel was continued throughout the year. The following table includes arrival dates of all American personnel in place at the end of the year.

Table I

American Personnel Arrivals

Position	Name	Tour	Date
Deputy Project Engineer	Lyle W. Mabbott	1st 2nd	March 4, 1958 July 31, 1960
Deputy Project Engineer	Clyde E. Burdick	1st 2nd	Aug. 18, 1958 Jan. 12, 1961
Assistant Hydrologist	Wayne V. Halliday	1st 2nd	March 20, 1959 Aug. 19, 1961
Project Engineer	Donald P. Barnes	1st 2nd	March 21, 1959 July 21, 1961
Administrative Officer	Henry L. Lumpee	1st 2nd	July 22, 1959 Oct. 3, 1961
Soils Scientist	Robert G. Thrailkill		Aug. 28, 1959
Agricultural Economist	William W. Fager		Nov. 18, 1959
Civil Engineer	Paul W. Kim		Nov. 25, 1959
Office Services Supervisor	Vernelle E. Austin		Dec. 9, 1959
Assistant Geologist	Murray J. Athearn		Jan. 27, 1960
Hydrologist	Edwin W. Kramer, Jr.		Jan. 27, 1960
Property Officer	William M. Ullmann		March 30, 1960

Position	Name	Date
Survey Engineer	Carl C. Scott	Sept. 19, 1960
Installation & Maintenance Engineer	Edward S. Scott	Oct. 2, 1960
Survey Engineer	Kenneth F. Doering	Oct. 3, 1960
Electrical Engineer	Clell L. Curtis	Nov. 22, 1960
Civil Engineer	J. Edmund Sower	Jan. 8, 1961
Civil Engineer	Homer C. Garton	Feb. 1, 1961
Hydraulic Engineer	Roy T. Sipinen	March 6, 1961
Civil Engineer	Arthur P. Bright	April 21, 1961
Civil Engineer	George M. Abbott	April 26, 1961
Hydraulic Engineer	Ralph H. Borgeson	April 26, 1961
Hydraulic Engineer	A. Milton DeGering	July 5, 1961
Personnel Officer	Eugene V. Read	July 15, 1961
Agricultural Economist	Philip Goorian	Aug. 20, 1961
Survey Engineer	Henry J. Albert	Aug. 23, 1961
Chief Draftsman	George V. Johnson	Oct. 25, 1961

Mr. Howard J. Ferris, Soils Scientist, was with the project from the first of the year until his death in the unfortunate helicopter crash of April 19, 1961.

Mrs. Betty Jo Callaway, Chief Draftsman, returned to the U. S. with her husband in November on home leave and was replaced by Mr. George V. Johnson. Mr. Derwin H. Jepsen, Geologist, returned to the U. S. in December and will continue preparation of the geologic report there.

Ethiopian Personnel

The increase in Ethiopian personnel this year is due largely to the transfer of survey personnel from the Geodetic Survey Project, which was terminated early in the year. During the season of the big rains, twenty-seven (27) students from the Technical School, the University College, the Engineering College, and the College of Agriculture were assigned to the project.

The following table indicates Ethiopian personnel on duty as of the end of the year.

Table II

Ethiopian Personnel in Place - 1961

Name	Fund	Position
	Office Engineering	
Wondwossen Sahale	IEG	Civil Engineer
Tesfaye Mezmur	IEG	Architect
Abdul Selam Mohamed	IEG	Technician
Hailu Tefera	IEG	Assistant Technician
Kelemework Asfaw	IEG	Assistant Technician
Gabre Hiwot Abraham	IEG	Industrial Engineer
	Drafting	
Berhe Negash	JF	Draftsman
Masresha Shiferaw	JF	Draftsman
Asefa Ashegar	JF	Draftsman
Gebre Christos Gebre Mariam	JF	Draftsman
Negash Musa	JF	Draftsman
Tedla Hailu	JF	Draftsman
Berga Kifetew	JF	Assistant Draftsman (Mch. Opr.)
Amaha Getachew	IEG	Assistant Technician
	Administrative	
Adem Raggio	JF	Radio Operator
Haile Selassie Gebre Michael	IEG	Clerk (Timekeeper)

Name	Fund	Position
Bekele Haile Selassie	JF	Accountant Mess Fund
Engdashet Bekele	IEG	Transportation Clerk
Gabre Beshah	IEG	Dresser
Fetene Gessesse	IEG	Paymaster, Cashier, and Timekeeper
Seifu Meshesha	JF	Junior Accountant
Mebrat Abraha	JF	Steno-typist
Tadesa Beyene	JF	Librarian
Teklegzie Gebre Mariam	JF	Messenger (Office Services)
Beresa Sadi	IEG	Storeman
Dejene Wolde Giorgis	IEG	Storeman
Tefera Beyene	IEG	Storeman
Yohannes Fekade	IEG	Storeman
Helen C. Tjobanos	IEG	Secretary
Hiwot Yohannes	JF	Steno-typist
Gesese Tegene	IEG	Typist
Gabre Admassu	IEG	Asst. Technician (Radio Opr.)
Mulugeta Wadaji	IEG	Administrative Assistant
Abraham Wolde Selassie	IEG	Clerk
Drivers and Mechanics		
Adinew Mulat	IEG	Assistant Mechanic
Agonafir Haile Mariam	IEG	Auto Mechanic
Asmelash Baraki	IEG	Heavy Truck Driver
Abraham Tegje	JF	Chief Mechanic
Beleta Tefera	JF	Driver

Name	Fund	Position
Demane Lemicho	JF	Driver
Eshatu Demissie	IEG	Chief Driver
Gebre Selassie Kassa	IEG	Heavy Truck Driver
Gelaye Daba	IEG	Heavy Truck Driver
Hagos Beyene	IEG	Heavy Truck Driver
Haile Tegene	JF	Driver
Haile Zegeye	IEG	Heavy Truck Driver
Kidane Tesfu	IEG	Driver
Kinfe Beyene	IEG	Driver
Makonnen Debas	IEG	Driver
Mohamed Hussein	IEG	Heavy Truck Driver
Negatu Memecha	IEG	Driver
Tadesa Ayele	JF	Heavy Truck Driver
Tefera Asheber	IEG	Driver
Tegete Melese	IEG	Driver
Tesfaye Gebre Michael	IEG	Heavy Truck Driver
Tesfaye Hagos	IEG	Heavy Truck Driver
Wolde Gabriel Tekle Haimanot	IEG	Heavy Truck Driver
Cooks		
Alemayehu Wolde Michael	IEG	Cook
Asfaw Girma	IEG	Cook
Asgedom Tesfaye	IEG	Cook
Asres Gebre Hiwot	IEG	Cook

Name	Fund	Position
Ayele Agedew	JF	Cook
Gebre Meskel Asfaw	IEG	Cook
Tessema Beyene	IEG	Cook
Gesese Asfaw	IEG	Cook
Alemu Negatu	IEG	Assistant Cook
Kebede Beshah	IEG	Assistant Cook
Mohamed Ahmed	IEG	Assistant Cook
Negash Abera	IEG	Assistant Cook
Tadesa Habte	JF	Assistant Cook
Temesgen Melke	IEG	Assistant Cook
Wechefo Said	IEG	Assistant Cook
Zewde Wolde Yohannes	IEG	Assistant Cook
Land Classification		
Bekele Desta	JF	Technician
Zewde Telahun	IEG	Technician
Agriculture and Economics		
Baneyame Demisse	JF	Economic Assistant
Haile Tefera	IEG	Plant Scientist
Asefa Tefera	IEG	Agriculture Engineer
Addis Anteneh	IEG	Agriculture Economist
Geology		
Hailu Zewde	IEG	Geologist Aid
Kesete Kassa	IEG	Geologist Aid
Telahun Fereda	JF	Geologist Aid

Name	Fund	Position
	Hydrology	
Teshome Werkie	IEG	Civil Engineer
Belachew Ketema	JF	Hydro-Technician
Genetew Reda	IEG	Hydro-Technician
Guteta Olika	IEG	Hydro-Technician
Menebera Zelele	IEG	Hydro-Technician
Webeshet Deneke	IEG	Hydro-Technician
Wolde Gabriel Wolde Michael	IEG	Hydro-Technician
Meresa Okabayes	IEG	Hydro-Technician
Nurhussein Abdu	IEG	Hydro-Technician
Admassu Beyene	IEG	Hydro-Technician
Desalegn Bedesa	JF	Hydro-Technician
Mehiret Zewde	JF	Hydro-Technician
Negatu Macco	JF	Hydro-Technician
Shimelis Ageze	IEG	Hydro-Technician
Admassu Makonnen	JF	Hydro-Technician
Amare Isaiaso	JF	Hydro-Technician
Mamo Beleta	IEG	Hydro-Technician
Tezera Sebsibie	JF	Hydro-Technician
Yigezu Ejersa	IEG	Hydro-Technician
Ahmed Omar Edris	IEG	Civil Engineer
Alula Seifu	IEG	Hydro-Technician
Asefa Gebre Yohannes	IEG	Hydro-Technician

Name	Fund	Position
Girma Ashagre	JF	Hydro-Technician
Samuel Mahare	IEG	Hydro-Technician
Ayele Alayou	IEG	Hydro-Technician
Newaye Selassie Mitiku	IEG	Hydro-Technician
Gebre Mariam Tekle	IEG	Hydro-Technician
Getachew Gebre Kidane	JF	Hydro-Technician
Kassa Sinkie	JF	Hydro-Technician
Deribew Negash	IEG	Hydro-Technician
Feleke Gebbi	JF	Hydro-Technician
Kiros Tsegaye	IEG	Hydro-Technician
Mersha Sahle	IEG	Civil Engineer
Masresha Shiferaw	IEG	Hydro-Technician
Abera Dera	IEG	Gage Reader
Amene Shewa Afework	IEG	Gage Reader
Burkaye Naye	IEG	Gage Reader
Eshetu Asfaw	IEG	Gage Reader
Mitiku Gobena	IEG	Gage Reader
Negussie Teklu	IEG	Gage Reader
Wolde Wolde Mariam	IEG	Gage Reader
Bekele Beshah	IEG	Clerk
Abeba Negash	JF	Hydro-Technician
Field Surveys		
Dammaka Metaferia	IEG	Civil Engineer
Mebrahtu Gebre Kidane	IEG	Civil Engineer

Name	Fund	Position
Abdisa Fayessa	IEG	Observer
Mussie Tsegaye	IEG	Observer
Tsehaye Mebrahtu	IEG	Observer
Zerihun Gebre	IEG	Observer
Berhanu Galeta	IEG	Rodman
Gebre Egziabiher Zm. Kidus	IEG	Rodman
Goitome Tsegaye	IEG	Rodman
Tesfaye Michael Haile	IEG	Rodman
Tewelde Hagos	IEG	Rodman
Zewde Babu	IEG	Rodman
Tekle Teffera	IEG	Rodman
Tefera Yegzaw	IEG	Rodman
Atakelt Getahun	JF	Recorder
Endrias Mengesha	IEG	Recorder
Shale Wolde Michael	IEG	Recorder
Solomon Bekele	IEG	Recorder
Tadesa Argaw	IEG	Recorder
Abdulahe Abdu	IEG	Instrument man
Abraham Wolde Michael	IEG	Assistant Mechanic (guard)
Fikere Asfaw	IEG	Observer
	Construction	
Abeba Asfaw	IEG	Civil Engineer
Asmelash Kidane Yesus	IEG	Rodman
Tesfaye Beyene	IEG	Instrument man

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BLUE NILE RIVER BASIN INVESTIGATIONS

Annex C

Experience Offered to Ethiopian Personnel

In connection with conduct of the Blue Nile River reconnaissance - Ethiopia Project No. 3.

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BLUE NILE RIVER BASIN INVESTIGATIONS

Annex C

Experience Offered to Ethiopian Personnel

I. Purpose

1. The purpose of this report is to clarify the nature and extent of experience offered to Ethiopian personnel by the Project and to present the accomplishments and expectations to date. It emphasizes particularly the large measure of responsibility already carried by the Ethiopian personnel, outlines the calendar in accordance with which new subjects have been or remain to be introduced, and touches upon certain handicaps to full realization of experience benefits.

II. Operational Scope of the Project

2. The USBR contract calls for the conduct of engineering and economic investigations to be summarized in a report in 1964. Such investigations represent only one of four phases of water resources development with which a future Water Resources Department may be concerned:

a. Preliminary Investigations and Planning
b. Preparation of Designs and Specifications
c. Construction
d. Operation and Maintenance

3. The organization required to conduct the Blue Nile Basin Investigations bears considerable resemblance to that of the Planning Group of a future department. However, the preparation of sketchy designs for estimating purposes should not be confused with the preparation of designs and specifications for construction, nor should the installation and maintenance of gaging stations be confused with the construction and operation of dams, canal systems, and power plants. The experience that can be provided on the job by the project is limited therefore to the elements of a planning investigation. For professional personnel, this may be supplemented by practical work at the Bureau of Reclamation in a broader range of subjects under the participant training program.

III. Nature of Experience Offered

4. Training Levels. There is considerable difference between the nature of the training experience to be provided to subprofessional and vocational personnel on the one hand, and to professional personnel on the other.

a. Subprofessional and Vocational Personnel. In order to meet operational objectives overseas, such personnel, with some exceptions, must be trained from entirely inexperienced sources. For the subprofessionals, it has generally been possible to obtain high school graduates.

The training objectives for the subprofessional and vocational people are well defined. They include the development of reasonable proficiency in such technical skills as drafting, surveying, hydrography, simple computing (reduction of data), clerical work, and vocational work. They also include the development of section chiefs, crew chiefs, foremen, and superintendents on the basis of demonstrated aptitudes.

The instruction of subprofessionals and vocationals is generally of such a nature that it can be carried out in formal lectures and exercises followed by careful coaching and supervision on the job. Of necessity, classes and drills have been held for surveyors and hydrographers in 1959, 1960, and 1961, and additional classes are scheduled. Participants from such classes with acting crew or party chiefs in charge, have now been carrying on the field work of the project as a matter of course for from a half to two years (depending on subject).

b. Professional Personnel. "Training" is un unwelcome term to the average college graduate, either in Ethiopia or in the United States, though in point of fact many state licensing laws in the United States list graduates as "engineers-in-training" during their first four years. For some of its career personnel, State Department has borrowed from the medical profession the word "intern" to describe recent graduates during their first years of service. In military service, the "lieutenant" is the officer in training.

In contrast to the subprofessional, the college graduate has received instruction, once-over-lightly, in the principal subjects of his degree. The remaining objectives of his initial years of experience may therefore be summarized as follows:

(1) To expand his academic knowledge to cover numerous supplemental fields of specialization.

(2) Under experienced supervision, to apply academic knowledge to a wide variety of practical problems, many previously untouched in the degree curriculum.

(3) Through the foregoing experience, to acquire speed and sureness of execution. This point is especially pertinent to the present situation because, while intelligence, basic training, initiative, and other qualities may be sufficient to warrant a professional being given independent responsibility where time is not a critical factor, speed and sureness are essential qualities where performance requirements must be met in a given time.

(4) To learn to direct the work of others. Here are at least three levels to be considered:

(a) Directing the work of subprofessional and vocational staff.

(b) Directing the work of basic (starting) level professionals.

(c) Directing the work of major organizational elements.

A young engineer should be able to direct the work of subprofessionals in any one field of specialization after perhaps one year, if he applies himself under competent supervision, to learning the work of the parties in detail. To be of any assistance to other professionals under his direction, however, he should have several years of intensive experience in personally dealing with the particular kinds of problems to be handled in his organizational compartment.

Higher levels of supervision, though dealing with only one of the major subdivisions of a profession (such as hydraulics, irrigation, highways, or power systems), nevertheless require an extended acquaintance with each of several component subjects within his general field. For example, the Chief Hydrologist should be acquainted not only with the field techniques for stream gaging, meteorology, estimating historical floods, measuring groundwater flow, sampling silt load and water quality, and installing instruments and cableways, but also should be acquainted with the office work involved in developing rating curves, forecasting run-off, determining storage requirements, flood routing, and project operations studies.

5. Fields of Experience. As mentioned in paragraph 2, the present operational commitment is limited to an engineering-economic reconnaissance study. Within this limitation, the work to be performed covers the following major specialties:

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Subprofessional

a. Surveying
b. Hydrography
c. Drafting
d. Computing
e. Soil Science (Agriculture)
f. Geology
g. Laboratory
h. Agriculture-Economics
i. Accounting
j. Library
k. Personnel
l. Office Services
m. Secretarial Services

Vocational

a. Motor Vehicle Operation
b. Mechanics
c. Rigging
d. Construction (Light)
e. Cooking
f. Radio Operation
g. Radio Electricity
h. Duplicating
i. Steno-Typing
j. Filing and Clerical Duties
k. Stores Handling
l. Stores Maintenance
m. Custodial Services

Professional

a. Civil Engineering - Surveying and Mapping
b. Civil Engineering - Hydrology, Hydraulics
c. Civil Engineering - Project Planning (General)
d. Civil Engineering - Irrigation and Drainage
e. Civil Engineering - Power Planning
f. Civil Engineering - Domestic Water Supply and Sanitation
g. Electrical Engineering - Power Planning (General)
h. Mechanical Engineering - Industry
i. Mechanical Engineering - Hydraulics
j. Geology - General
k. Geology - Engineering
l. Geology - Engineering
m. Agriculture - Soil Science
n. Economics - General

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o. Economics - Agricultural
p. Administration - General
q. Administration - Personnel and Training
r. Administration - Supply
s. Administration - Secretarial Work

6. Subprofessional Subjects. With respect to the subprofessional subjects, training is provided by the experienced professional personnel from the Bureau of Reclamation. In general, subprofessional subjects are those subjects in which a college student would receive at least basic training during his first two years, or which may sometimes be taught to high school graduates who may not wish to pursue a full college curriculum.

Formal instruction in subprofessional subjects is given in surveying, hydrography, drafting, and secretarial service. For the other subjects, informal instruction by the supervisors during conduct of the work is sufficient. In exceptional cases, overseas training may be desirable in order to develop a fully qualified subprofessional supervisor, or to convert a subprofessional to a professional.

The subjects generally partake of the nature of the broad professional field with which they are associated, may lead to full professional qualification if pursued to that end, but usually are limited to a narrower range and depth of treatment than the fully professional subjects. A subprofessional who develops a high degree of proficiency or an advanced knowledge of his subject and an aptitude for handling people may become a subprofessional supervisor.

7. Vocational Subjects. With respect to the vocational subjects also, training is provided by the professional personnel from the Bureau of Reclamation, among whom, collectively, all the necessary vocational experience is amply available. Formal instruction, training, and check-out are probably necessary only in the fields of motor vehicle operation and maintenance. For the other subjects, on-the-job apprenticeship may be sufficient.

8. Professional Subjects. With respect to the professional subjects, specialists in most of these fields have been or are to be provided in accordance with the planned build-up of American staff. All of the specialties represented are required by the performance commitment. None has been scheduled for training purposes, except as essential to building the staff required to meet the performance commitment; nevertheless, the range of subjects provides everything needed to develop the staff of a Water Resources Department limited to the first or investigational phase of water resources development (see para. 2).

As to the provision of experience in the design, construction and operation phases of water resources development, on-the-job experience at the Bureau of Reclamation is offered through the participant training program, in addition to similar experience in aspects of the investigational phase (hydrology, project planning, irrigation and drainage).

This experience at the Bureau of Reclamation is recognized as a virtual prerequisite to the development of confidence, initiative, and responsible engineering judgment in young engineers of many countries, including the United States. Some countries have made the provision of this experience the prime object of their arrangements with the Reclamation organization.

IV. Calendar of Experience Offered

9. It is believed that some misunderstanding has arisen from unfamiliarity with the programmed build-up of the project functions. While project activities were substantially initiated in F.Y. 1958, the staff was only at about half strength at the end of F.Y. 1960, and will reach approximately full strength only in F.Y. 1962. Consequently, the experience offered by the project during the initial years has been limited to those subjects in which the work has been fully mobilized.

The following table indicates the approximate periods during which the project has been and will be active in the principal specialized subjects. The first date shown for each subject indicates the first year in which full-time supervision became available for that subject.

Table I

Calendar for Mobilization of Activities

SUBJECT	1958	1959	1960	1961	1962	1963	1964
Air Reconnaissance	x	x	x				
Hydrology - Field	x	x	x	x	x	x	x
Geology	x	x	x	x	x	x	
Land Classification		x	x	x	x	x	
Hydrology (Light Construction)		x	x	x	x	x	
Administration - General		x	x	x	x	x	x
Administration - Property			x	x	x	x	x
Hydrology - Office			x	x	x	x	x
Surveying			x	x	x	x	
Drafting			x	x	x	x	
Agricultural Economics			x	x	x	x	
Project Planning - Preliminary			x	x	x	x	
Project Planning - Small Watersheds			x	x	x	x	
Hydrology - Project Operation Studies				x	x	x	
Project Planning - Designs and Estimates				x	x	x	
Power Planning				x	x	x	
Administration - Personnel Training				x	x	x	x

V. Experience Benefits to Date

10. Sub-professional and Vocational. With respect to sub-professional and vocational experience, probably the most significant point to be made for the purposes of this report is that all of such work for the project is and has been carried out from the beginning by Ethiopian personnel, the majority of whom have received all their training on the project.

In some cases, Ethiopian sub-professional and vocational supervisors are in charge of crews and functions appropriate to their ultimate positions. In other cases, the function performed does not lead to supervisory duties. In the following discussion the different subjects are taken up approximately in the order of their occurrence in Table I.

a. Hydrology. In one case only, that of Ato Shimelis, has a subprofessional been sent abroad for study under the participant training program. Ato Shimelis returned from the United States in January 1961, and was immediately assigned as Chief Hydrographer in the "Hydrologic Service", as this Division of the Project has been called in anticipation of its future role in the Ethiopian Water Resources Department. His duties will include supervision of field measurement under the guidance of a graduate engineer, but he will not be expected to perform original analyses for which he would need a more complete engineering education.

Subprofessional hydrologic personnel now on the project, other than Shimelis, include 31 technicians and assistant technicians. All have received both formal and on-the-job instructions, have learned to make stream flow measurements under a variety of conditions, and have been trained to record and reduce data. An additional course of formal instruction was conducted in May to provide supplemental training for the first full season of measurements from cableways during the high floods.

Several other Ethiopians assigned to the hydrologic service beginning in December 1960 have worked with construction forces to become familiar with gage installation and maintenance.

One of the sub-professionals in the Hydrologic Service, Ato Wolde Gabriel, has had special instruction from the the Climatology Institute in the installation, care, and operation of weather station equipment. For nearly two years he has had independent responsibility checking and servicing the weather stations in the Blue Nile Basin,

installing new ones, and arranging for observers and the collection of records. He also reduces and collates the weather station data as received, either directly or from the Climatology Institute. On field work he travels alone or with drivers and other assistants. He shows a high sense of responsibility and is learning to contend with a wide variety of situations. Except for the Blue Nile workload, he could be sent anywhere in Ethiopia by the Water Resources Department at any time to perform similar work, given suitable guidance by a qualified Civil Engineer or Meteorologist.

b. Geology. With respect to subprofessionals in this field, the project scope calls only for one or two geologist aids or geologist draftsmen. The aid or draftsman learns something about formations and aerial interpretation. He completes the gological maps as blocked out by the professional geologist and acquires certain skills in presentation.

One draftsman, Wolde Gideon Semat, has shown promise; that is, initiative, understanding, and skill. He has now been sent to Germany on scholarship (not U. S.) for further training. While this may deprive the Geology Division of his services permanently, it must be admitted that a good geologist aid in a small group of this kind will probably never stay long because of the lack of opportunity for advancement.

The future Water Resources Department Geologist must probably expect a turn-over every few years, possibly drawing upon the drafting room pool each time for someone with an interest in geological mapping as an added speciality, at least until he finds one content to stay in the field. At present, no graduate Ethiopian geologist has been made available.

c. Land Classification. Probably the most outstanding subprofessional in the project is Ato Zaudie, Soil Science Aid. Previously trained as a laboratory technician at Alem Maya College of Agriculture and Mechanic Arts under Professor Murphy, in his four years with the project he has acquired considerable maturity of judgment as to soil properties and potentials, in addition to being able to handle all the customary field and laboratory sampling and testing techniques. Under the guidance of experienced graduate soil scientists he has been sent to the field with one or two assistants to complete certain of the classification surveys on his own responsibility.

Ato Zaudie has been cited by His Imperial Majesty for outstanding performance. Unfortunately, arrangements made last year by both IEG and Point 4 for degree training for Ato Zaudie at Alem

Maya broke down, and some other solution is being sought. In the meantime, he is being given more responsibility, and it may be that he can be given enough general professional experience to fill the professional Soil Scientist position, for which no other Ethiopian candidate has yet appeared. As a sub-professional he is already qualified considerably beyond the usual standard.

A draftsman aid is also developing considerable skill at land classification mapping. Another aid has shown considerable ability but has been transferred to agricultural economics under Mr. Fager to fill a position for which he appears to have more aptitude. This group, like the geology group, will probably remain small.

d. Administration. In 1959 (O.W.P. No. 3), the project outlined its administrative support requirements in a framework designed to meet the needs of the future Water Resources Department, suggesting how the existing administrative elements of the Joint Fund and the Department might eventually be integrated with project administrative elements. Integration has been progressive under the Department's Acting General Services Director. The following personnel have been reassigned from the project to Administration: Drivers, Mechanics, Assistant Mechanics, Cooks, Assistant Cooks, Accountant, and Assistant Accountant, Clerks (including Timekeepers and Storemen), Typists, Steno-Typists, Administrative Assistants, Dresser, Radio Operator, and Librarian.

These personnel are in addition to the Bureau of Reclamation Administrative Officer, Property Officer, Office Services Supervisor, and Employee Development Officer.

These personnel have been in place long enough to have learned their tasks reasonably well. The personnel office services assistant (Ato Mulugeta), the Motor Traffic Supervisor (Ato Gesese), the Chief Mechanic (Ato Abraham), Mechanic (Ato Agonafir) and the Radio Traffic Controller (Ato Adem) exercise varying measures of Supervisory responsibility at the present time.

A substantial start has been made toward assisting in the development of administrative procedural patterns. In particular the following may be cited.

(1) At request of Dr. Haile, development of a simplified personnel evaluation report form subsequently adopted and modified by the Department.

(a) A leave application and approval form, a medical services referral form, and a property clearance form were designed and adapted.

(2) Establishment of drafting standards, filing system, and title blocks adapted to Departmental use.

(3) Development of project correspondence, technical, photo, and computation file systems in form suited to future use by Department.

(4) Provision of a Departmental technical library containing a wide range of standard references and periodicals. Cataloguing system initiated, though still incomplete.

(5) Provision of detailed manning charts (O.W.P. No. 3, 1959) with explanation of functional responsibilities of principal organizational elements and positions, This has provided the basic pattern in accordance with which adjustments are currently being studied to meet changing needs of Department, especially the proposed new integrated administrative division. These charts also provide the framework for both manpower planning and procurement planning.

(6) Preparation of a technical study of professional training requirements (O.W.P. No. 4, 1959) outlining the needs of the Department, characterizing the kinds of experience required, and suggesting how the needs might be met under the practical limitations then (1959) apparent. The reasoning in the paper remains pertinent, though through lack of assignment of sufficient professional personnel and prematurely accelerated advancement of others the full potential for practical experience then anticipated cannot now be realized.

(7) Preparation of a technical study (O.W.P. No. 5) of a position classification system with pay scales and job descriptions adapted to the needs of the project and the Department. Forty-one job descriptions have now been prepared and are in use by the Joint Fund and the Department as a basis for recruiting and employment. The pay scales are naturally a subject of controversy, but the proposed system provides a point of departure from which Department and other interested officials of IEG can develop a system meeting their own needs at any time.

(8) Preparation of comprehensive Tables of Allowances and Catalogue of Equipment (O.W.P. No. 6). This study is an essential prerequisite to planned procurement, including budgeting. Dr. Haile has expressed approval of this study, and steps are being taken to implement it more fully. In the meantime, it has been used as the basis for requisitioning for the last nine months.

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(9) Establishment of a stenographic pool (in March 1961) where three Ethiopian steno-typists are being acquainted with the style and presentation techniques for project correspondence including standards required by IEG, Joint Fund, USOM/E, and various project reports. A style manual has been drafted and is being edited for duplication. These steno-typists are also confronted with the difficult task of acquiring both English and Amharic technical vocabularies and idioms as well as becoming acquainted with the many different speech characteristics of American and Ethiopian authors when receiving dictation.

(10) Preparation of a manual for the conduct of force account construction operations (O.W.P. No. 7). This has been designed to meet minimum needs for clarification and guidance on procedures affecting financial and property controls, legal position of personnel, and assignments of responsibility. It is applicable to light construction (gage installations, access roads, etc.) and should be a useful point of departure for guidance of future work by the Department under similar arrangements. The manual is currently in force and is being duplicated for routine distribution.

(11) Organization functional statements and organization chart were prepared and approved for the personnel branch of the Department.

e. Surveying. Although a small force of surveyors began field operations in 1959 collecting topographic details in 1959 and 1960 for the Gilgel Abbay project with some success, funds for additional survey personnel became available only at the beginning of Fiscal Year 1961 (through Joint Fund). At the same time, level party personnel (about 10 subprofessionals) from the terminating geodetic project were added to the four already engaged on survey work by this project to make a total subprofessional survey party strength of fourteen, not counting six temporary summer employees.

All survey personnel were then brought together under full time supervision and given formal instruction and exercises in the methods and procedures used by the project (somewhat different from the geodetic project as to instruments, organization, and objectives). This group completed project layout and topographic work on the Upper Guder during the remainder of calendar year 1960.

In January 1961, additional survey personnel, including about seven subprofessionals, were transferred from the geodetic project.

These teams are performing reasonably satisfactory work under the supervision of the graduate civil engineers. The speed and precision of the parties will improve as time passes, provided existing inequities in pay and allowances can be rectified, provided new set backs to morale can be avoided, and provided the flow of supplies and services can be maintained.

The exercise of supervisory responsibility by the subprofessional personnel as instrument men and party chiefs is approximately normal now, though shifting and adjustments will continue as additional experience of individual aptitudes is gained, and as additional personnel become available. Additional personnel are needed to handle the work load. Also, some attrition of the more qualified personnel must be expected if they cannot be upgraded from the vocational level at which they are paid, though performing in subprofessional capacities. Layout and checking of work and general supervision and direction of survey parties of course will continue to require the services of graduate civil engineers.

f. Drafting. Whereas two to four draftsmen have been assigned to the project since 1959 or before, part time supervision by engineers doing other work proved inadequate to develop the needed degrees of skill and attention to detail. An experienced full time Chief Draftsman was therefore appointed in the fall of 1960. At about the same time, additional recruits were employed to bring the staff up to eight draftsmen (after losses).

While these draftsmen demonstrate varying degrees of skill, they are gradually learning the fundamentals of accurate line work, the art of contrast and arrangement, and the numerous conventional symbols peculiar to electrical, mechanical, irrigation, structural, land classification, geologic, topographic, hydrologic, road, and architectural maps and drawings. Charts, graphs and other illustrations for reports comprise another variety of work handled by the drafting room.

The large backlog of work in arrears has prevented the carrying out of formal instruction and exercises as originally planned. However, the draftsmen are gradually acquiring the necessary techniques through individual instruction on assigned work. The development of the more advanced drafting skills with which to undertake simple engineering designs and graphic computations will be limited to draftsmen with mathematical training and aptitudes and may not be taken up before 1963.

Since 1959, the drafting unit has been operating as the "Central Drafting Services", handling miscellaneous assignments from

the Department and the Ministry. On March 23, Dr. Haile reviewed the drafting room work load with the Project Engineer and authorized the recruitment of two additional draftsmen, partially in recognition of the volume of the non-Blue Nile elements of the work load.

A chief draftsman may be either a graduate engineer or a subprofessional engineer with advanced qualifications, depending upon the practice of the organization and the level of work to be undertaken. Ato Tesfaye, trained in landscape architecture in Germany, was originally assigned to the post of Chief Draftsman by the IEG. However, the drafting room work being more engineering than architectural, Ato Tesfaye has been allowed to concentrate on other fields.

At present, none of the Ethiopian draftsmen has demonstrated sufficient skills, knowledge of the work, or leadership to warrant selection as alternate to the project chief draftsman, considering the heavy responsibility that rests with the chief draftsman in checking and editing all the drafting room production.

g. Agriculture Economics. Six students from Alem Maya College were employed during the summer of 1960 on a field canvass of marketing and land use statistics. Six students were also employed for the summer of 1961.

h. Others. Sub-professionals have relatively small roles in the remaining subjects listed in Table I, except possibly as engineering aid computers or specialized draftsmen. While several positions worth retaining may develop, they may be disregarded for the purposes of this report.

11. Professional. The experience offered by Bureau of Reclamation to professional personnel of the IEG on the project is necessarily limited by (a) the number and qualifications of such personnel associated with the project by the IEG and (b) the nature and status of the work being undertaken.

Personnel requirements postulated for the project in October 1959 listed 30 positions for which college graduates would be desirable. To date 14 engineers, 2 plant scientists, an agriculture economist, and one business manager have been associated with the project. At the close of the year 1961, there were 10 engineers, (including Ato Kassa) one plant scientist and one agriculture economist still associated with the project. The business manager became the acting general services director for the Department but still functions as business manager for the project. Four additional engineers have been earmarked in the United States for assignment to the Water Resources Department after a period of practical work in the domestic program of the Bureau of Reclamation.

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The requirement for thirty professionals (including 23 technical and seven non-technical) may be discounted to say 15 or 20 if a shrinkage of program is anticipated. On the other hand, the other river basins of the country and the necessity for introducing the implementation phases of water resources development would produce a counter trend. Nevertheless, the work of the Department can undoubtedly be carried on with difficulty at some sort of broken pace if the present trained sub-professionals can be held together and 10 or 15 engineers provided.

In considering the accomplishments of the present ten engineers, especially in relation to an evaluation of U. S. expenditures for training, it is important to emphasize some of the following points:

a. None of these ten received degree training at U.S. expense.

b. One only, Ato Kassa, received practical experience at the Bureau of Reclamation at "Participant Training Program" expense.

c. Ato Kassa's principal field of interest while at the Bureau of Reclamation was engineering organization and administration, a fact that matches well with his present duties as assistant to the Vice Minister for the Awash study and as acting technical director for the Department.

d. The experience of each of the eleven should be compared with the dates of association with the project and the status of project mobilization at the time as given in Table I.

(1) Ato Demmaka: arrived 1958-59, engaged in helicopter reconnaissance 1958-59, ground surveys 1959-60. Ground surveys mobilized under experienced full time supervisor in July 1960.

(2) Ato Mebrahtu: arrived 1959, engaged in various duties until assigned in charge of surveys in January 1960. Appointed Chief of Surveys (IEG), July 1960.

(3) Ato Kassa: arrived about December 1959, engaged in project studies until appointed Deputy Project Chief in July 1960. In August 1961 he was appointed acting technical director of the Department.

(4) Ato Teshome: arrived in 1960, engaged in small watershed development continuously until October 1961 when he was assigned to the Hydrology Division.

(5) Ato Wandwoosen: transferred from geodetic project late in 1960, engaged in designs and estimates continuously. Extended duty with Webi Shibeli project March 1961. Also worked on Zula Plains project the last three months of 1961.

(6) Ato Abdul: close association with the project began in March 1961 in connection with the proposed integration of administrative services. He is now acting general services director for the Department.

(7) Ato Gebre Hewoit Abraham: arrived September 1961, engaged in industrial planning.

(8) Ato Asefa Tefera: arrived July 1961, engaged in agricultural economics.

(9) Ato Ahmed Omer Edris: arrived July 1961, engaged in hydrology duties in the field.

(10) Ato Mersha Sahle: arrived July 1961, engaged in hydrology duties in both the field and office.

(11) Ato Abeba Asfaw: arrived July 1961, engaged in light construction duties.

It should be observed that, except as to sub-professional Ato Shimelis, previously discussed, the United States participant training program has contributed thus far only to the support of Ato Kassa, the expense of practical (on-the-job) experience with the project being almost entirely chargeable to the operational objectives (the Blue Nile Basin Investigations).

Nevertheless, the accomplishment of the several engineers in terms of responsibilities assumed has been substantial.

12. Significance of Professional Experience. From the foregoing, it will be seen that the Ethiopian professional engineers have been exposed to important experience, each within the field of activity available to him at the time of his arrival. In consequence, each has been given a measure of responsibility. If the promotion of some has been premature, this may have prevented the further assimilation of important basic engineering knowledge, but has not prevented the assumption of advanced duties not requiring such knowledge in a creditable manner.

Experience in the exercise of independent responsibilities is, as has been shown, a part of the present activities of the Ethiopian engineers. This has not thus far implied exclusive control of work in a sense independent of the project organization. It does mean that they have had and will continue to have opportunities to serve in responsible charge of sections of the work sometimes with and sometimes without counterpart assistance.

To the question of whether exclusive control of work should be granted to sections of the organization to operate under an authority such

as the Department outside the project line organization, the following discussion may be pertinent:

a. In any organization of this kind, each level of supervision operates under another. Where there is no counterpart, the incumbent exercises exclusive supervision at his level.

b. This exercise of exclusive supervision by a single incumbent of a supervision position is not to be confused with the exclusive responsibilities of a contractor. The incumbent is subject to organic supervision, guidance, and control of all his activities by the next level of supervision.

If, by exclusive supervision we mean supervision without the presence of a counterpart at the same level, the issue is simplified. The question becomes one of how well the remaining incumbent could perform his duties alone. Given other necessary qualifications, two considerations affect the answer, (a) the adequacy of basic (academic) training, and (b) the sureness and speed developed by experience.

It may be possible to turn over work to an incumbent having inadequate experience, provided time is not a factor. Thus, whatever the state of the experience of the Ethiopian engineers, if their basic training has been good, they may be able to carry on with the eventual development of the Department, learning by experience as they go. On the other hand, it does not follow that the project, with its performance commitment, can withdraw from line supervision of the work and yet remain responsible for its timely execution.

Nevertheless, at the end of the year plans were being made to transfer all hydrologic field work to Ethiopian engineers for the conduct of the 1962 flood season investigations, the American staff remaining available to provide assistance if required.

VI. Conclusion

13. In summary, perhaps the following conclusions may be drawn:

a. The total experience benefit of the project to date includes a large body of trained subprofessional and vocational workers most of whom are already at an acceptable performance level, but subject to considerable improvement by the end of the project; an insufficient but potentially capable small number of professionals to be augmented before the end of the project; a considerable body of formalized practices, procedures, and standards adapted to the specific needs of the future Department; the beginnings of integration between the project machinery and the future Departmental machinery assuring a smooth transition on termination of the project operations. (The hydrologic network and other capital assets do not fit into the category of "experience".)

b. Additional Ethiopian professional staff, additional academic training, and additional practical work experience at the Bureau of Reclamation are needed to bring the professional staff up to minimum levels to carry on the work of the Department on conclusion of the project.

c. Practical work experience on the project will give the best possible preparation to incoming Ethiopian engineers for the handling of the work of the future Department in those fields in which the project is active.

d. Continued consultations with the Director General to arrange adjustments and improvements in work assignments and improvements in procedures anticipating future integration with the Departmental structure are in order from time to time as individual cases arise.

1961 ANNUAL REPORT

BLUE NILE RIVER BASIN INVESTIGATIONS

Annex D

Program for FY 1962, 1963

This program outlines the work proposed to be undertaken in the remainder of F.Y. 1962 and in F.Y. 1963,* consistent with guide lines furnished jointly by AID/W and BuRec/W. The work remaining to be scheduled has been programed on the accompanying 18-Month Production Schedule form, and the following explanation refers to this schedule by line items.

Explanation of Production Schedule

1. The Engineering Surveys scheduled on line 1-15, sheet 1, are transit and level surveys, as indicated.** They consist of 3 or 4 cross sections across a reservoir area tied together with a transit traverse for orientation, from which, by using aerial photographs, a rough topographic map of the reservoir area and dam site can be developed. This in turn provides a rough area capacity curve for determining the height of dam required to store the water available or required for project development. If power production is contemplated, a determination of power head and penstock location and tail water conditions may be required. In the case of irrigation development, a few level shots or a cross section across the irrigable land to indicate where the water might be delivered to the project area are the minimum requirements. A diversion dam would require a cross section or other brief survey.

These surveys have now been completed for the Megech and Ribb River projects, and surveys are underway on the Gumara.

The projects (lines 1-15), which have been selected for this type of survey, were chosen because the terrain is such that the work can be accomplished with ground forces requiring a minimum of helicopter support.

The surveys indicated on line 16-19, sheet 1, are to be made in an area that is practically inaccessible by truck or other ground transportation. These surveys require establishing control points by tellurometer and triangulation from the geodetic control points in the area to provide the minimum basic controls from which topography with 10-meter contour intervals can be developed.

*Program 2 as of December 1961. See page 25 as to modifications.
**See DNG No. 201-BNS sheets 1, 2, and 3.

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Line 18, sheet 1, Nile-Diddessa, covers an area on the main stream from below the Diddessa junction upstream to the upper limits of the reservoir area.

Line 17, sheet 1, provides for control points along the escarpment west of Lake Tana, which will provide topography at 10-meter contour intervals to determine the most desirable location and other details for a diversion from Lake Tana to the Dindir, Rahad, or Beles Rivers.

Line 16, sheet 1, covers the main stream from below the Guder River junction upstream, including the Giamma River, to the upper limits of the reservoir areas on those streams. These surveys have been completed.

Line 19, sheet 1, provides for control points in the Diddessa River Basin, which is the greatest contributor to the Blue Nile and in which several projects, irrigation and power, may develop.

2. Lines 21-24, sheet 1, provide for supplemental picture point elevations required for mapping by the Aerial Survey Project. This work is all to be performed using a helicopter for transportation and two or more survey altimeters to determine the elevation of the pre-determined picture points.

Lines 25-30, sheet 1, cover the preparation of topographic maps by the Aerial Survey Project and are shown on this schedule to indicate the time required and the time that they may become available to the Bureau of Reclamation for use in project layout. Maps for the Birr River project have now been completed, and those for the Finchaa are underway.

3. Geology, as shown on lines1-4, sheet 2, covers the general geologic mapping of the basin and brief geologic examination of potential dam sites to determine the suitability of the sites from a geologic standpoint and to evaluate the local construction materials.

The field work for the general geologic mapping has been completed and an appendix report is being drafted by Mr. Jepsen, who recently returned to the U. S. Site geology and reconnaissance construction material evaluation remain to be studied on about 40 percent of the sites to be considered in the report.

4. Hydrology, as scheduled on lines8-17, sheet 2, covers the entire field of hydrologic activity. Line 9 provides for completion of the network of recording stream gaging stations. Work is now underway on the

Beles River gage and cableway and should be completed within two months. It is then proposed to complete stations on the Dindir, Rahad, and Beshilo Rivers where no previous measurements have been obtained, but are considered to be essential in the over-all hydrologic analysis of the basin. A recorder well and instruments are to be installed on the Dabus River to complete that station. It is proposed to continue the construction under the Branz employment agreement until this work has been completed.* A small construction and maintenance crew will be organized with Ethiopian personnel to maintain the installed system and to construct new stations as may be required.

Line 10, sheet 2; field buildings have been completed at Bahir Dar and Debre Markos and in Addis Ababa. No further building construction is contemplated, except insofar as necessary resources may be furnished by IEG.

Line 11, sheet 2, irrigation water use studies. This is a two-man observation and study of an existing irrigation operation near Bahir Dar that will be completed at the end of this irrigation season. If possible, arrangements will be made for one or two additional similar studies. Personnel performing this work are engaged on Ministry payroll.

Line 12, sheet 2, complete previous stream flow records. This provides for the necessary checking and computation of stream flow measurements that have been obtained during the last year and the plotting of these measurements on rating curves from which the annual flow charts are prepared. Since only meager hydrologic data will be available, it is essential that measurements be checked and that all possible measurements be taken into account in the planning studies.

Line 13, sheet 2, sediment studies. Suspended sediment samples have been taken at strategic points in the basin. The effects of sediment will be taken into account in the planning studies.

Lines 14 and 15, sheet 2, indicate the stream flow measuring program. Since many measurements have been made during periods of low flows, measurements during that period are now held to a minimum in order to utilize the Ethiopian personnel in checking and computing previous measurements. During the season of high flows, maximum efforts utilizing both Ethiopian and American personnel in the field, will be made to obtain additional measurements. Planning and direction of the work this year will be turned over to Ethiopian supervisors.

Line 16, sheet 2, project operation studies. This provides for an analysis of water requirement and supply, utilizing data available

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*See modification on page 25.

from stream flow measurements correlated with records of longer duration from the Sudan or other stations.

Line 17, sheet 2, basin operation studies and report, covers an analysis of the hydrologic operation of all projects within the basin to determine the overall consumptive use within the basin and the preparation of the hydrology appendix report.

5. Lines 21-25, sheet 2, Land Classification. A very brief land classification survey has been accomplished for all projects in the basin, except in the Beles, Dindir, and Rahad River basins. It is proposed to complete the classification in those areas by about June 30, 1962. The remaining time will be spent in collecting supplemental data found necessary in connection with the analysis of the basic data and preparation of the land classification appendix report. This will cover, in addition to the classification of irrigable lands, a general classification of all lands within the basin with recommendations regarding development and use of the dry lands.

6. Lines 1-24, sheet 3, Project Planning. This item covers the engineering planning and layout of projects of all types. The project layout is brief, showing the location of reservoirs, a general paper location of canals and other works, based on whatever information is available, plus the use of judgment and experience. Cost estimates are prepared using curves adjusted to local conditions. No detail designs are made, and typical drawings to demonstrate the type of structure are utilized to a great extent. Again, experience and judgment supplement field data.

Power studies will include an analysis of the present situation and the anticipated rate of growth. Estimates of power production and costs will be made, using estimating curves, experience, and judgment. A few typical sample projects or power plants for small scale initial development will be included. Brief studies of several potential industries, to determine their power requirements, will be made. As each project is studied and as the supporting data become available, appropriate portions of the appendix report will be prepared.

Plans for a small pilot irrigation project will be completed in some detail to demonstrate the requirements for initial development.

7. Lines 27-32, sheet 2, Agriculture and Economics. During the past years field investigations in several areas, on a sample basis, have been conducted to determine the existing agricultural and economic situation. An analysis of these data will be completed by about March 1, 1962, and will be used in the agriculture and economic studies of individual projects and the basin as a whole. The economic analysis, due to the lack of basic data, will require the use of judgment and experience extensively.

A brief analysis of each project will be made and included in the agriculture and economics appendix. As part of the preparation of the over-all plan for basin development, attention will be given to requirements for industries, management requirements, access roads, extension services, transport services, trade development, marketing facilities, exports, imports, and other related economic factors.

In general, the Blue Nile report, to be of the greatest value to the Ethiopian Government, must include not only the analysis of power and irrigation projects, but must also consider the total broad economic development of all resources within the basin.

Transition to IEG Departmental Operation

In order to continue both the field and the office work effectively, it is essential that American personnel continue to provide assistance in the coordination and development of administrative support. This is reflected in the continuance of American administrative personnel on the attached proposed staffing charts.

Anticipating the forthcoming rainy season, Ethiopian personnel will be requested to outline the work schedules in detail, and will be assisted in supervising the conduct of the season's operations. During the following dry season, additional emphasis will be placed on supervision of the survey work by Ethiopian engineers.

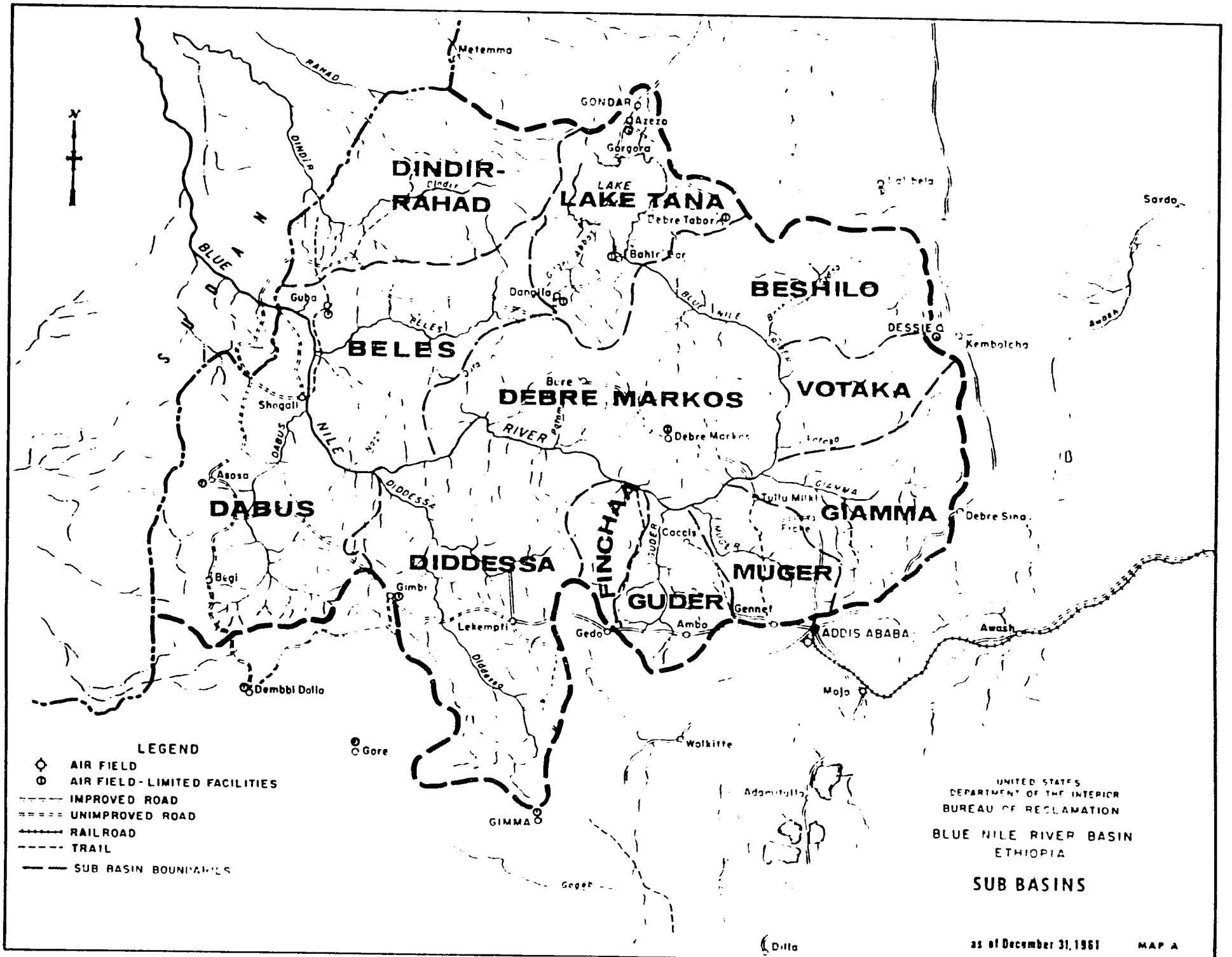
Additional Ethiopian engineers will be arriving from the United States during the year. These will be given all possible orientation in field and office so that they can be turned over to their Ethiopian supervisors by the end of American participation in the project.

Incidental to the necessity for continuing administrative advice and assistance in connection with the completion of the reconnaissance report, it is hoped that by the end of the period the Water Resources Directorate will be in a position to:

1. Continue its technical operations at a limited scale.

2. Preserve and be able to keep in operational condition the greater part of the present very large investment in vehicles and equipment.

3. Carry on a considerably improved administrative operation covering personnel, property, and finance.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BELES
DEBRE MARKOS
VOTAKA
GIAMMA
DABUS
DIDDESSA
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MUGER
GUDER
Metemma
GONDAR
Azezo
Gorgora
Debre Tabor
Bahir Dar
Dangila
Guba
Shogali
Bure
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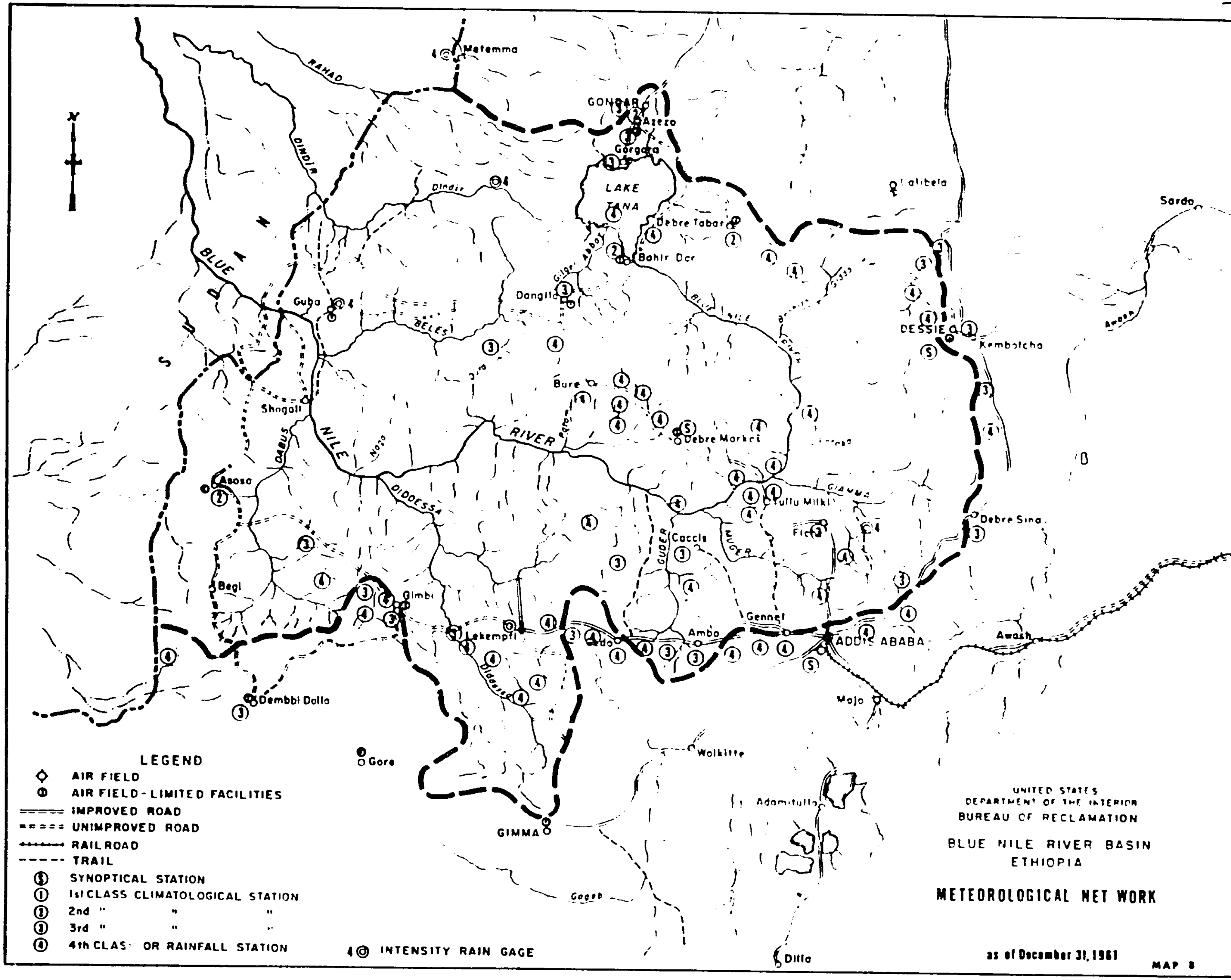
Asosa
Begi
Gimbi
Lekempti
Gedo
Ambo
Gennet
Coccis
Tullu Milki
Debre Sina
Kembolcha
DESSIE
Sardo
ADDIS ABABA
Awash
Mojo
Dembbi Dollo
Gore
Wolkitte
Adamitulu
GIMMA
Dilla
RAHAD
DINDIR
BLUE NILE
DABUS
DIDDESSA
FINCHA
GUDER
MUGER
GIAMMA
LEGEND
AIR FIELD
AIR FIELD - LIMITED FACILITIES
IMPROVED ROAD
UNIMPROVED ROAD
RAILROAD
TRAIL
SUB BASIN BOUNDARIES
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
BLUE NILE RIVER BASIN
ETHIOPIA
SUB BASINS
as of December 31, 1961
MAP A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BLUE
SUDAN
Guba
Dangila
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DESSIE
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Awash
Bure
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NILE
RIVER
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Asosa
DIDDESSA
GIAMMA
Tullu Milki
Debre Sina
Caccia
GUDER
MUGER
Fiche
Begi
Gimbi
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Ambo
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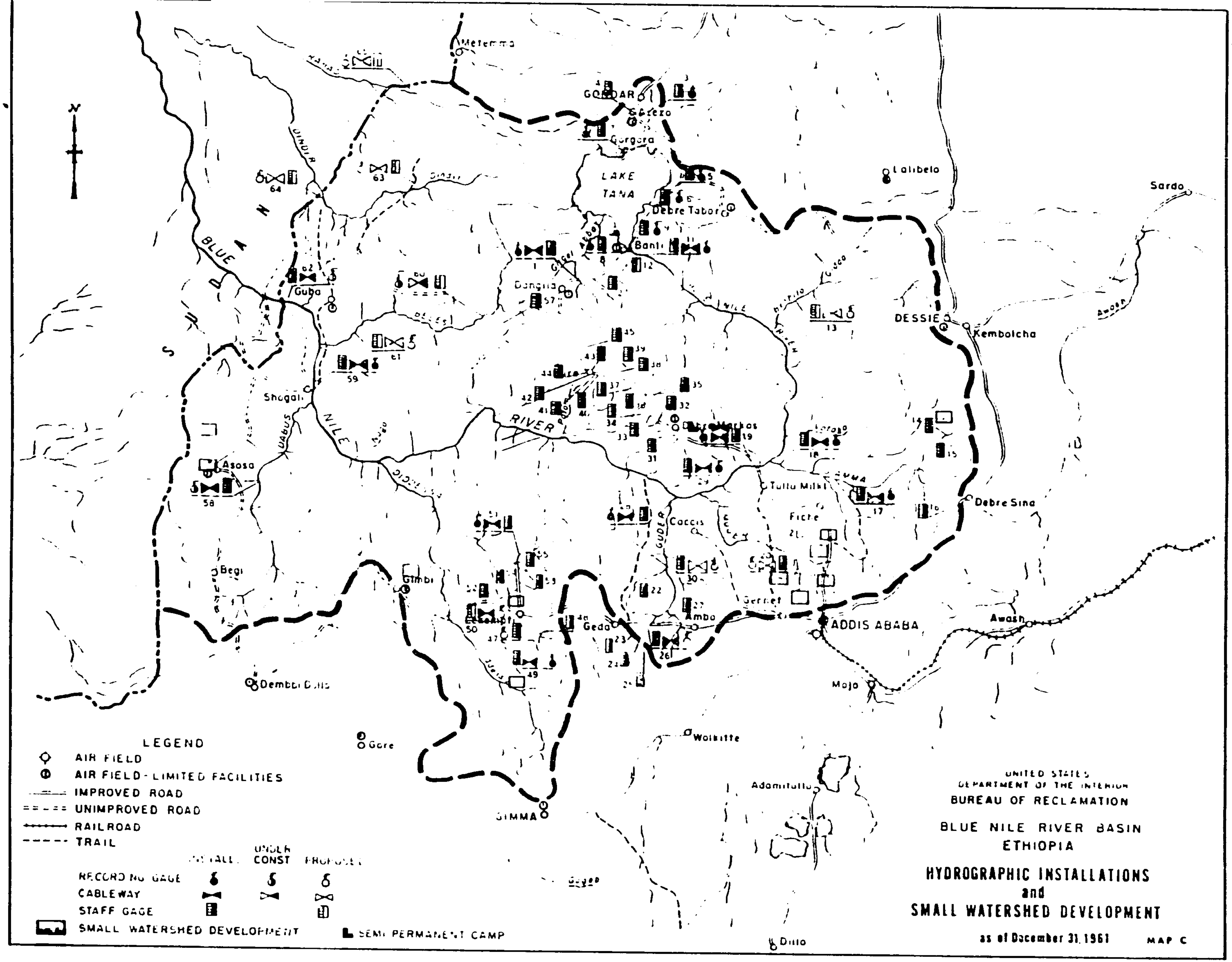
ADDIS ABABA
Awash
Dembi Dollo
Mojo
Gore
Wolkitte
Adamitullo
GIMMA
Gogeb
Dilla
LEGEND
AIR FIELD
AIR FIELD-LIMITED FACILITIES
IMPROVED ROAD
UNIMPROVED ROAD
RAILROAD
TRAIL
SYNOPTICAL STATION
1st CLASS CLIMATOLOGICAL STATION
2nd " " "
3rd " " "
4th CLASS OR RAINFALL STATION
INTENSITY RAIN GAGE
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
BLUE NILE RIVER BASIN
ETHIOPIA
METEOROLOGICAL NET WORK
as of December 31, 1961
MAP 8



UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
BLUE NILE RIVER BASIN
ETHIOPIA
HYDROGRAPHIC INSTALLATIONS
and
SMALL WATERSHED DEVELOPMENT
as of December 31, 1961
MAP C
LEGEND
AIR FIELD
AIR FIELD - LIMITED FACILITIES
IMPROVED ROAD
UNIMPROVED ROAD
RAILROAD
TRAIL
UNDER CONST
RECORDING GAGE
CABLEWAY
STAFF GAGE
SMALL WATERSHED DEVELOPMENT
SEMI PERMANENT CAMP
N
SUDAN
BLUE NILE RIVER
LAKE TANA
Metemma
Gondar
Gorgora
Lalibelo
Sardo
Debre Tabor
Banti
Dangila
DESSIE
Kembolcha
Guba
Shogali
Asosa
Debre Markos
Tullu Milki
Fiche
Debre Sina
Coccis
GUDER
Begi
Gimbi
Geda
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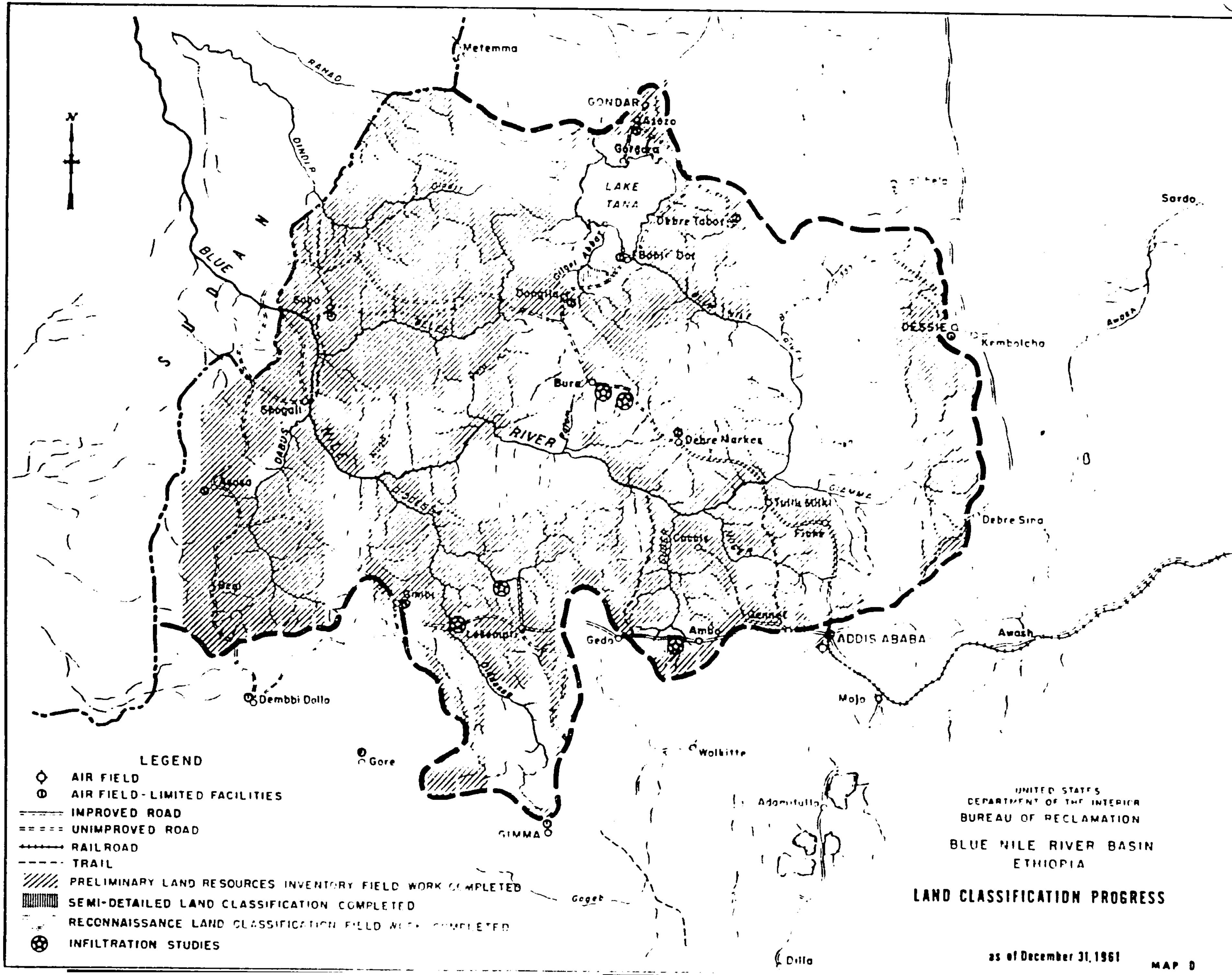
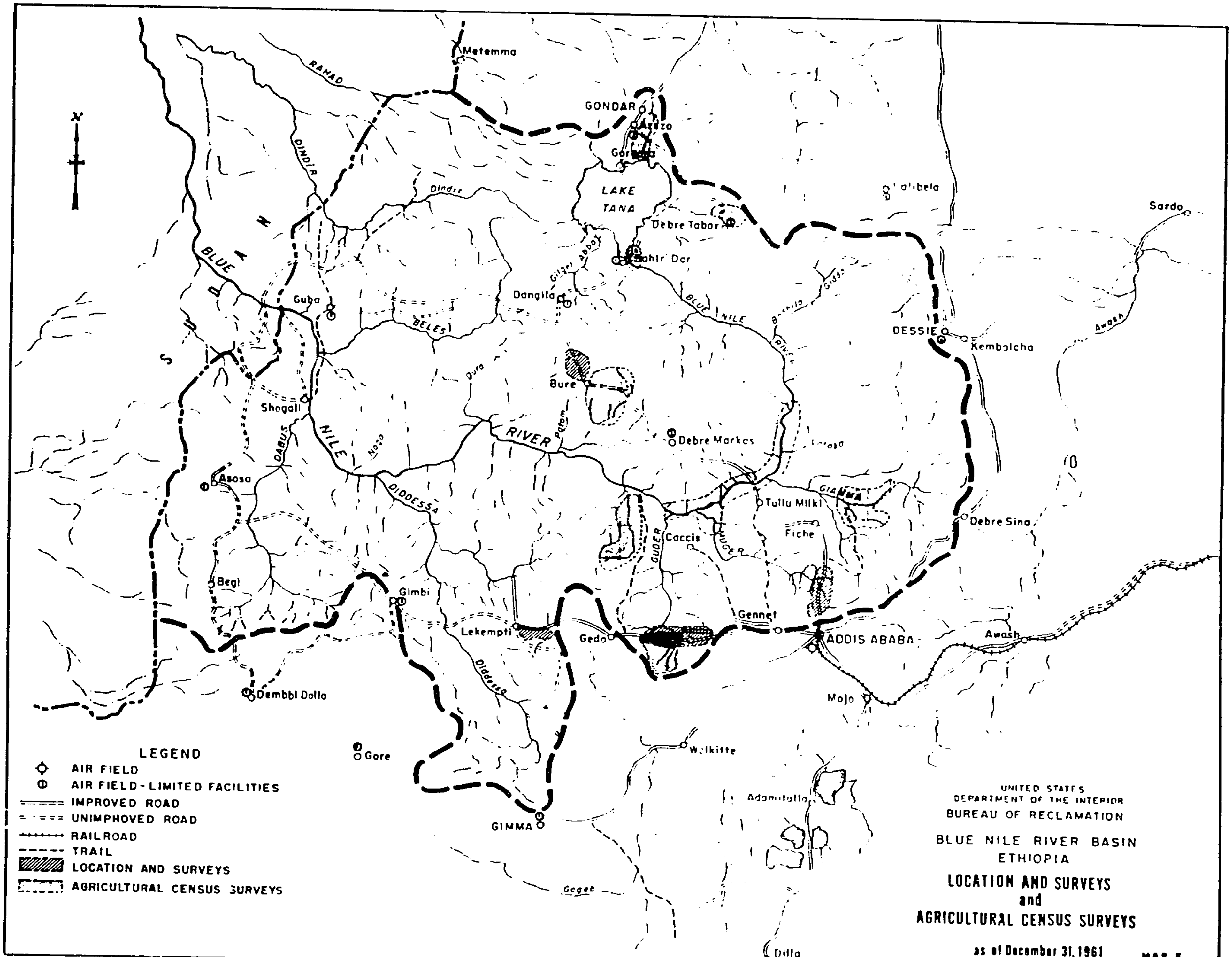
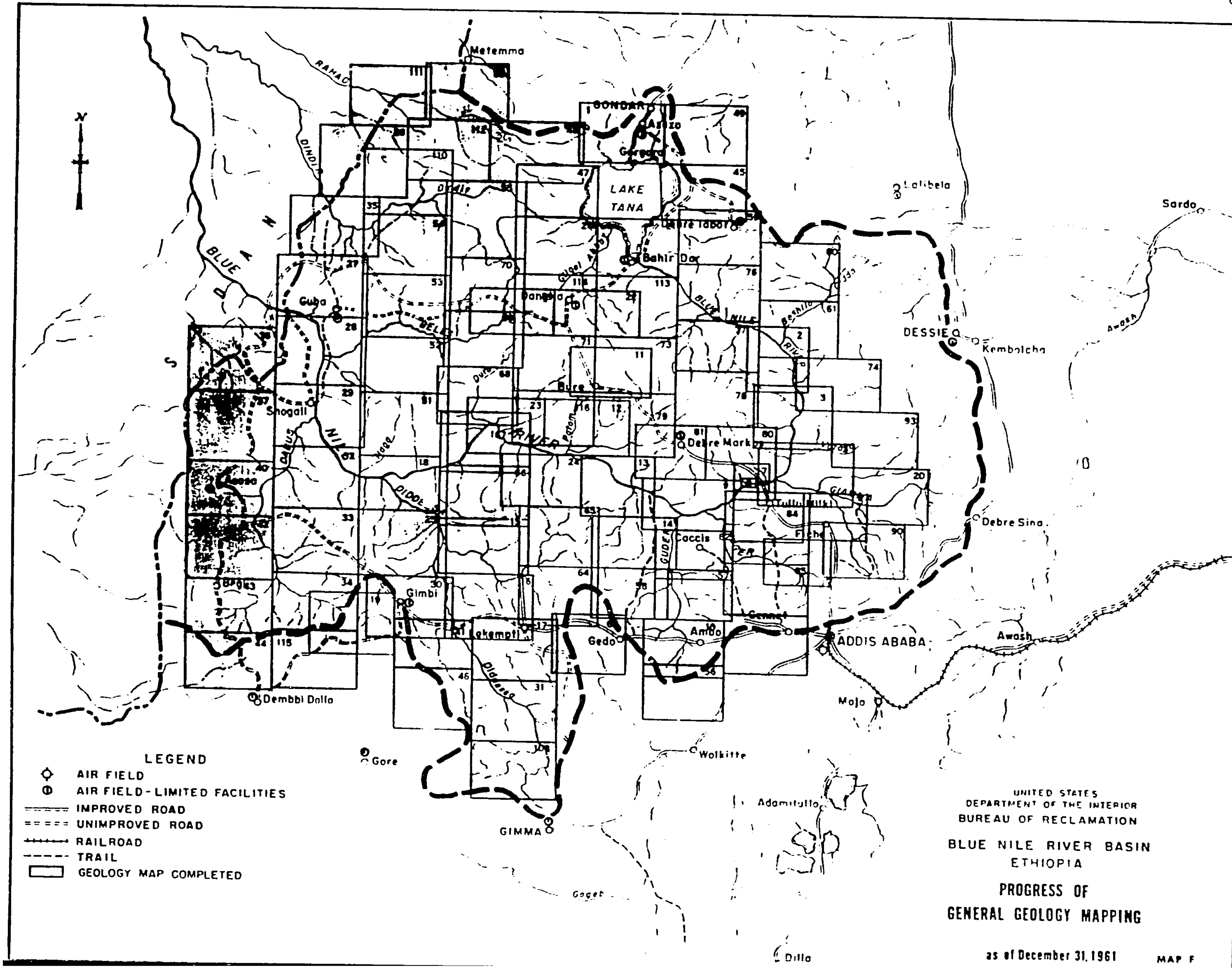
GIMMA
Dillo
DABUS
DINDIR



Metemma
GONDAR
Azezo
Gordara
LAKE TANA
Debre Tabor
Bahir Dar
Dangila
Sardo
DESSIE
Kembolcha
BLUE NILE RIVER
SUDAN
Bure
Debre Markos
Debre Sina
Gedo
Ambo
ADDIS ABABA
Awash
Mojo
Lekempti
Dembi Dollo
Gore
GIMMA
Wolkitte
Dilla
Adamitulla
LEGEND
AIR FIELD
AIR FIELD-LIMITED FACILITIES
IMPROVED ROAD
UNIMPROVED ROAD
RAILROAD
TRAIL
PRELIMINARY LAND RESOURCES INVENTORY FIELD WORK COMPLETED
SEMI-DETAILED LAND CLASSIFICATION COMPLETED
RECONNAISSANCE LAND CLASSIFICATION FIELD WORK COMPLETED
INFILTRATION STUDIES
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
BLUE NILE RIVER BASIN
ETHIOPIA
LAND CLASSIFICATION PROGRESS
as of December 31, 1961
MAP D



Metemma
RAHAD
GONDAR
Azezo
Gorgora
LAKE TANA
Debre Tabor
Lalibela
Sardo
DINDIR
Dindir
Bahir Dar
Gilgel Abbay
Dangila
Guba
BELES
BLUE NILE RIVER
Bashilo
Gidda
DESSIE
Kembolcha
Awash
SUDAN
BLUE
Dura
Bure
Shogali
NILE
RIVER
Patom
Debre Markos
DABUS
Nasa
Asosa
DIDDESSA
Tullu Milki
GIAMMA
Debre Sina
GUDER
Caccia
MUGER
Fiche
Begi
Gimbi
Gennet
Lekempti
Gedo
ADDIS ABABA
Awash
Diddessa
Mojo
Dembi Dollo
Gore
Walkitte
Adamitullo
GIMMA
Gogeb
Dilla
LEGEND
AIR FIELD
AIR FIELD - LIMITED FACILITIES
IMPROVED ROAD
UNIMPROVED ROAD
RAILROAD
TRAIL
LOCATION AND SURVEYS
AGRICULTURAL CENSUS SURVEYS
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
BLUE NILE RIVER BASIN
ETHIOPIA
LOCATION AND SURVEYS
and
AGRICULTURAL CENSUS SURVEYS
as of December 31, 1961
MAP E



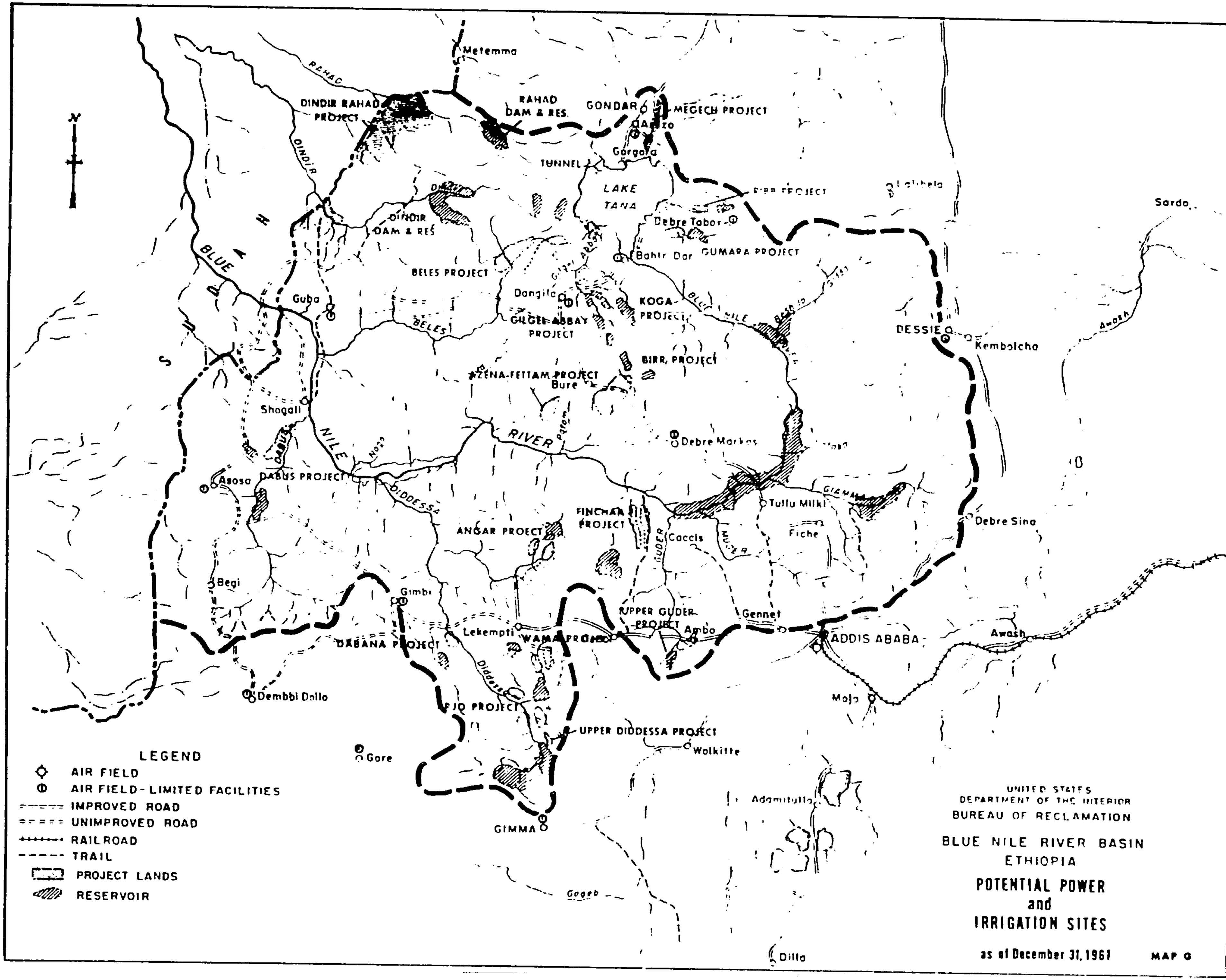
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION

BLUE NILE RIVER BASIN
ETHIOPIA

PROGRESS OF GENERAL GEOLOGY MAPPING

as of December 31, 1961

MAP F


Metemma
RAHAD
DINDIR RAHAD PROJECT
RAHAD DAM & RES.
GONDAR
MEGECH PROJECT
Azezo
Gorgora
TUNNEL
DINDIR
LAKE TANA
Debre Tabor
Lalibela
Sardo
DINDIR DAM & RES
GUMARA PROJECT
Bahir Dar
BLUE
BELES PROJECT
Dangila
KOGA PROJECT
GILGEL ABBAY PROJECT
BLUE NILE
Guba
BELES
DESSIE
Kembolcha
AWASH
S U D A N
BIRR PROJECT
AZENA-FETTAM PROJECT
Bure
Shogali
NILE
RIVER
Debre Markos
DABUS
Asosa
DABUS PROJECT
DIDDESSA
GIAMMA
Tullu Milki
Debre Sina
FINCHAA PROJECT
ANGAR PROJECT
GUDER
Caccia
MUGER
Fiche
Begi
Gimbi
UPPER GUDER PROJECT
Gennet
Lekempti
WAMA PROJECT
Ambo
ADDIS ABABA
Awash
DABANA PROJECT
Diddessa
Dembbi Dollo
BIJO PROJECT
Mojo
UPPER DIDDESSA PROJECT
Gore
Wolkitte
GIMMA
Adamitullo
Gogeb
Dilla
LEGEND
AIR FIELD
AIR FIELD - LIMITED FACILITIES
IMPROVED ROAD
UNIMPROVED ROAD
RAILROAD
TRAIL
PROJECT LANDS
RESERVOIR
UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
BLUE NILE RIVER BASIN
ETHIOPIA
POTENTIAL POWER
and
IRRIGATION SITES
as of December 31, 1961
MAP 0

USBR

ETHIOPIA PROJECT NO. 3

BLUE NILE INVESTIGATIONS — WATER RESOURCES AND ECONOMIC DEVELOPMENT STUDIES

USOM/E

WATER STUDIES PRO.

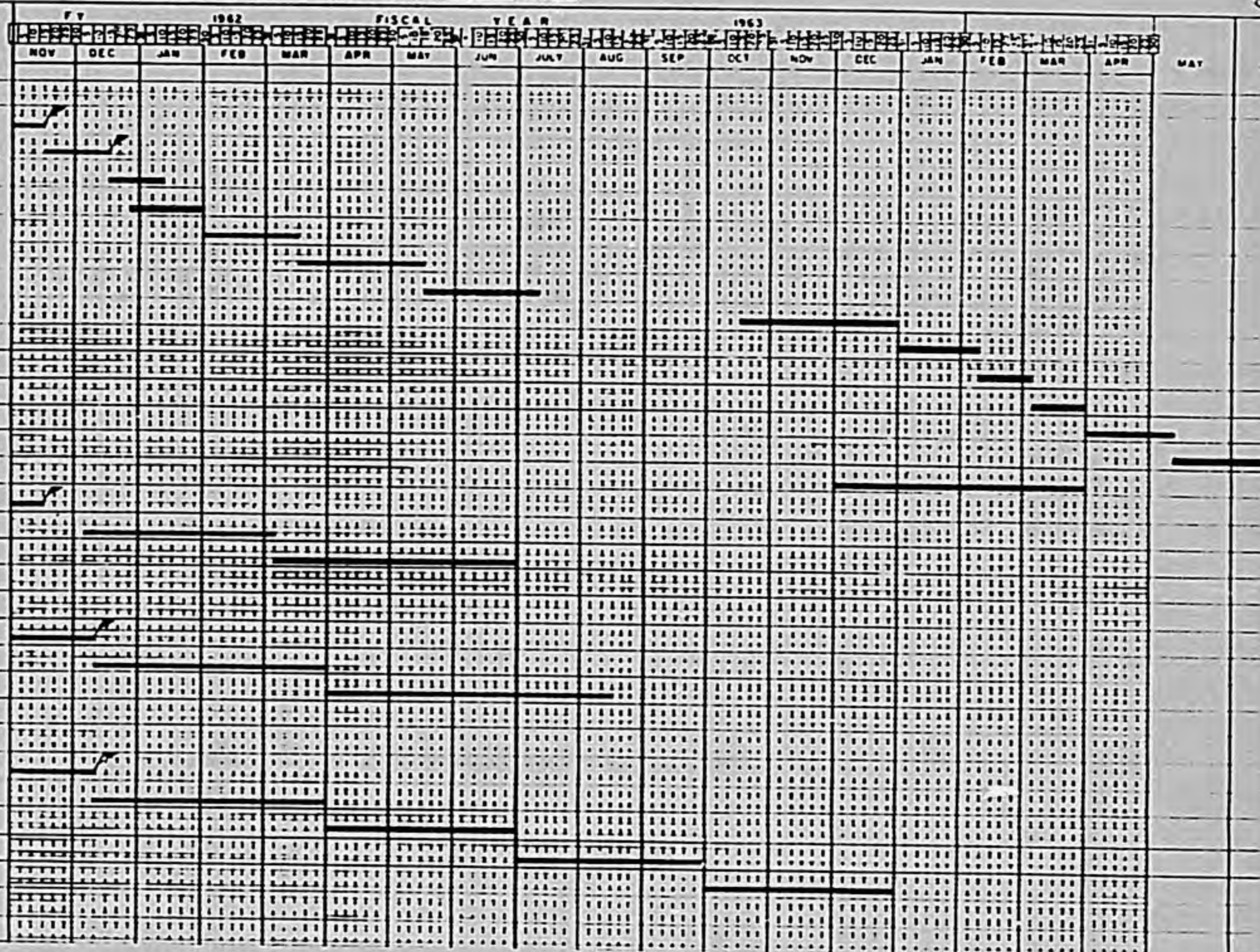
18 MONTH PRODUCTION SCHEDULE

SUBJECT

DATE OF THIS REVISION 12/12 1961

LINE NO.	PROGRAM ITEM
1	ENGINEERING SURVEYS
2	MEGETCH RIVER PROJECT
3	RIBB " "
4	GUMARA " "
5	LAKE TANA DIVERSION
6	RAHAD RIVER PROJECT
7	DINDER
8	BELES
9	UPPER DIDDESSA
10	ARJO
11	WAMA
12	ANGAR
13	DABANA
14	DABUS
15	NILE DIDDESSA
16	NILE GIAMMA (Telurometer Survey)
17	LAKE TANA DIVERSION WEST (Telurometer)
18	NILE DIDDESSA (Telurometer)
19	DIDDESSA RIVER PROJECTS (Contingent)
20	PICTURE POINT ELEVATIONS & CHECK COMPUTATIONS
21	NILE RIVER GUDER & GIAMMA
22	LAKE TANA DIVERSION WEST
23	NILE DIDDESSA
24	DIDDESSA RIVER PROJECTS
25	PHOTO COMPILATION & MAP PRODUCTION
26	BIRR RIVER PROJECTS
27	FINCHAA
28	NILE RIVER GUDER & GIAMMA
29	LAKE TANA DIVERSION WEST
30	NILE DIDDESSA
31	
32	

(Lines 2–15: TRANSIT & LEVEL SURVEYS)



KEY

Current Projection ▬

Schedule Accomplished ┌

Revision approved 13 Jan 1962

D. P. Barnes

Project Engr.

Recommended Clyde E. Burdick 1/15/62
Deputy Project Engr (Office) (Date)

Recommended
Deputy Project Engr (Field) (Date)

Approved
Project Engr (Date)

Ethiopia United States Cooperative Prog
for Water Resources Development
in collaboration with
US Dept of State Intl Cooperation Admin and US Dept of Int Bureau of Reclam
Water Resources Department
Ministry of Public Works and Communications
Imperial Ethiopian Government

REPRODUCIBLE DWG NO ______ DATE ______

Sheet 1 of 3

USBR

ETHIOPIA PROJECT NO. 3

BLUE NILE INVESTIGATIONS — WATER RESOURCES AND ECONOMIC DEVELOPMENT STUDIES

18 MONTH PRODUCTION SCHEDULE

SUBJECT

DATE OF THIS REVISION 12/12 1961

USOM/E

WATER STUDIES PROJECT

LINE NO.	PROGRAM ITEM	FY 1962 FISCAL YEAR 1963 NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE
1	GEOLOGY																				
2	GENERAL BASIN MAPS																				
3	PROJECT SITE GEOLOGY																				
4	ASSEMBLE GEOLOGIC DATA & REPORTS																				
5																					
6																					
7																					
8	HYDROLOGY																				
9	CONSTRUCT STREAM GAGING STATIONS																				
10	COMPLETE CONSTRUCTION OF FIELD BUILDINGS																				
11	IRRIGATION WATER USE STUDIES (BAHAR DAR)																				
12	COMPUTE PREVIOUS FLOW RECORDS																				
13	SEDIMENT STUDIES																				
14	STREAM FLOW MEASUREMENTS (MINIMUM CREW)																				
15	STREAM FLOW MEASUREMENTS (MAXIMUM EFFORT)																				
16	PROJECT OPERATION STUDIES																				
17	BASIN OPERATION STUDIES & REPORT																				
18																					
19																					
20																					
21	LAND CLASSIFICATION																				
22	BELES RIVER PROJECT																				
23	DIDDER BAHAD PROJECT																				
24	FIELD WORK ON PREVIOUS CLASSIFIED AREAS																				
25	STUDIES & REPORTS																				
26																					
27																					
28																					
29																					
30																					
31																					
32																					

KEY

Current Projection ——

Schedule Accomplished ✓

Revision approved 13 Jan 1962

O. P. James

Project Engr.

Recommended Lily B E Burdick Water Deputy Project Engr (Office) (Date)

Recommended _____ Deputy Project Engr (Field) (Date)

Approved O. P. James Project Engr 15 Jan 62 (Date)

Ethiopia United States Cooperation Program for Water Resources Development

in collaboration with

US Dept of State Int Cooperation Admin and US Dept of Interior Bureau of Reclamation

Water Resources Department Ministry of Public Works and Communications Imperial Ethiopian Government

Sheet 2 of 3

REPRODUCIBLE DWG NO _____ DATE _____

USBR
ETHIOPIA PROJECT NO. 3

BLUE NILE INVESTIGATIONS — WATER RESOURCES AND ECONOMIC DEVELOPMENT STUDIES

USOM/E
WATER STUDIES PROJECT

18 MONTH PRODUCTION SCHEDULE
SUBJECT

DATE OF THIS REVISION 12/12 1961

LINE NO.	PROGRAM ITEM	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	JULY	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUNE
		FY 1962 FISCAL YEAR 1963																			
1	PROJECT PLANNING																				
2	GUDER RIVER PROJECT																				
3	MUGER " " (Power Storage)																				
4	BIRR " "																				
5	BIRR " PILOT PROJECT																				
6	FINCHAA " PROJECT																				
7	MEGETCH " "																				
8	RIBB " "																				
9	GUMMARA " "																				
10	LAKE TANA STORAGE																				
11	LAKE TANA DIVERSION WEST																				
12	BELES RIVER PROJECT																				
13	DINDER-RAHAD PROJECT																				
14	NILE-GUDER STORAGE																				
15	NILE DIDDESSA "																				
16	GIAMMA "																				
17	UPPER DIDDESSA PROJECT																				
18	ARJO "																				
19	WAMA "																				
20	ANGAR "																				
21	DABANA "																				
22	DABUS RIVER "																				
23	HYDRO-ELECTRIC POWER PLANT																				
24	INTEGRATED SYSTEM PLANNING																				
25																					
26																					
27	AGRICULTURE & ECONOMICS																				
28	ANALYSIS OF DATA (Present Situation)																				
29	IRRIGATED AGRICULTURE STUDIES																				
30	PROJECT STUDIES (Irrigation)																				
31	AGRICULTURE ECONOMICS STUDIES																				
32	GENERAL ECONOMICS & FINANCIAL ANALYSIS																				

KEY

Current Projection ————

Revision approved 13 Jan 1962

D. P. Barnes
Project Engr

Recommended: *Clyde E. Burdick* [illegible]
Co-op Project Engr (Official) (Date)

Recommended ________ ________ ________
Deputy Project Engr (Field) (Date)

Approved *D. P. Barnes* 15/1/62
Project Engr (Date)

Ethiopia United States Cooperative Program for Water Resources Development
in collaboration with
US Dept of State Int Cooperation Admin and US Dept of Interior Bureau of Reclamation
Water Resources Department
Ministry of Public Works and Communications
Imperial Ethiopian Government

REPRODUCIBLE DWG NO ________ DATE ________

Sheet 3 of 3

MASTER [illegible]