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FINAL REPORT

VOLUME II

HYDROLOGICAL SURVEY OF IRAQ

APPENDIX A
HYDROLOGIC NETWORK AND DATA

A REPORT BY

HARZA ENGINEERING COMPANY
CHICAGO

BINNIE & PARTNERS
(FORMERLY BINNIE, DEACON & GOURLEY)
LONDON

IN ASSOCIATION

PREPARED FOR

THE GOVERNMENT OF IRAQ
MINISTRY OF AGRICULTURE

BAGHDAD, IRAQ JULY 1963

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COPY

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June 15, 1964

Air Mail

Mr. Kenneth F. Vernon
Chief, Public Works and Industry Branch
NASA/Engr. Bureau of Near East and South Asia
Agency for International Development
Department of State
1901 Pennsylvania Avenue
Washington, D. C.

Subject: Hydrological Survey of Iraq - Final Report

Dear Ken:

Some last minute rearranging of Exhibit B and Table 7.4 of Volume I of the subject report resulted in several errors of tabulated data. These do not affect the remainder of the report in any way. Corrections were made in ink to most of the originally distributed reports.

Replacements for these two pages are enclosed for insertion in the copy of the report we sent you on November 1, 1963.

Very truly yours,

HARZA ENGINEERING COMPANY

V. A. Koelzer

Enc: 2 correction sheets

correction sheets inserted 12/15/64
MAP

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APPENDIX A

HYDROLOGIC NETWORK AND DATA

Chapter A-1 Stream Gaging
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A-6 Operating Instructions for Meteorological Gages

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Chapter A-1

STREAM GAGING

Stream-Gaging Network

1.1 The extension and improvements that we have planned and executed for the previously existing stream-gaging network is geared to the proposed development program in Iraq. The network of stream gages that has provided reasonably reliable records as far back as 1930 has been very useful in planning work to date. However, several of these gages were in need of improvement, and additional gages were needed for future planning and operational purposes.

1.2 The purpose of the stream-gaging program can best be demonstrated by reference to Exhibit A-1. The new gage at Tusan is intended to furnish data for possible future international discussion of available waters of the Tigris River. The new stations at Ifraz, Goma Zerdala, and Narrows replace old stations nearby where the quality of records was undependable because of the location of the old gages. The new stations at Jindian and Balikian were intended to give more intensive data on the runoff from the Ruwanduz Basin. These stations, in conjunction with more intensive meteorological and snow survey installations, will facilitate hydrologic investigations to add to the knowledge of the runoff characteristics of the mountainous regions of Iraq. The improvements noted at five other stations (Zakho, Tusan, Manquba, Dokan Ferry, and Fatha) are for the purpose of raising the standard of data at these stations that are of prime importance in planning and operation.

1.3 The locations at which we have made new gaging installations or improvements to existing stations are described in detail in Annex A-1 at the end of this appendix. The description of each station includes the location, description of the installation, and statements concerning flow characteristics and control. Site sketches and sections of the gages are shown on Exhibit A-2.

Measurement Procedures

1.4 The following procedures and standards are recommended for discharge observations in Iraq. They are based on experience elsewhere modified by local experience to take into account both conditions and prior usage in Iraq. The procedures were developed by the Hydrological Survey after consultation and agreement with representatives of the Irrigation Directorate.

Frequency of Discharge Measurements

1.5 The frequency of discharge measurements for a particular station should be decided by the supervisor. The general rule should be to obtain two measurements a month during low flow and at least one each week at other times, with a measurement near the peak of each significant rise. Measurements should be more frequent for new stations and for stations subject to shifting of the stage-discharge relationship.

Preliminary Steps

1.6 When visiting a station, the discharge observer should first read all gages, both inside and outside the gage structure, and enter the readings, the time, and the name of the river and station on the measurement

form and the recorder chart. He then should wind the clock, taking care that the clock weight cable on the drum does not overlap itself, as this might stop the clock. He should next remove the used portion of the recorder chart if it has been six weeks or more since it was last removed. He should also check the chart supply roll and install a new roll if there is any likelihood that the supply roll will be exhausted before the observer again visits the gage. He should then flush the intake pipes as described in Chapter A-3. After flushing the intake pipe sufficient time should be allowed for the water level in the gage well to return to river level. The recorder should finally be restarted and all gages read again. The following should be written on the chart:

a. Name of the river and station,

b. Date and time opposite a time mark formed by a slight movement of the float wheel,

c. Readings of all gages,

d. The statement "Intake pipe flushed,"

e. The observer's name,

f. Any other pertinent information.

1.7 The observer should then prepare his equipment for the discharge measurement and read and record all gage readings again immediately before starting the actual measurement and immediately after the measurement. He should check the operation of the automatic recorder again before leaving the station.

Number of Measuring Sections

1.8 The discharge observer should plan the number of vertical sections to be used. He will know from previous measurements the approximate

width of the river and should space the measuring verticals to give about 30 sections. The discharge measurement form has space for about 20 sections, so two sheets will usually be required. An example of a completed discharge measurement form is shown on Exhibit A-4. The distance between verticals should be smaller where the flow is greatest, and an effort should be made to avoid having more than five percent of the total flow represented by any one vertical. Special conditions of turbulence and non-uniform flow, for example near bridge piers, may require additional verticals in the cross section.

Soundings and Angles

1.9 The current of the river will cause the current meter to be carried downstream somewhat so that the sounding line will not be vertical. It therefore is necessary to make corrections to the apparent sounding depth in order to obtain the true depth of the river. The "wet line" correction is necessary for that part of the sounding line below the water surface. An "air line" correction must be applied for the length of line above the water unless the "tag" method is used. The tag method speeds field measurements and office computations and is more accurate; thus it is preferable to the air line correction method. Both methods require that the vertical angle of the sounding line be measured.

1.10 In the tag method pieces of cloth or rubber about ten centimeters long are taped to the sounding line at known distances above the bottom of the sounding weight spaced at one or two-meter intervals. The various tags should be of different colors to help in identification. The current meter is lowered into the water until the last tag that can be submerged is level with the water surface. If this tag should be, say, four meters

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above the bottom of the sounding weight, the depth indcator is then set at four meters and the sounding weight lowered to the bottom. The vertical angle will change very little in this distance, so the depth indicator will register a depth that need be adjusted only for the wet line correction. The spacing of the tags should be checked before each discharge measurement and any loosetags reset and taped firmly to the line. Exhibit A-4 shows both the wet line correction and the dry line correction (for use when applicable) for various vertical angles.

1.11 The two-table method must be used in correcting soundings for vertical angle if tags are not used. The air line correction is made first and the wet line correction last. The use of the tables is illustrated by the following example: For a specific sounding, the distance from the water surface to the sounding reel or sheave is four meters. The bottom of the weight is positioned so that it barely touches the water surface, and the depth indicator is set at zero. The weight is then lowered until it just touches the bottom of the river as indicated by the pull on the sounding line. At this point the depth indicator reads, say, 8.40 meters, while the sounding line is carried downstream ten degrees from the vertical. The air line correction table is entered on the line containing the number "4" in the first column. The correction is found on this line in the column headed 10° and is six centimeters. This is subtrated from the apparent sounding of 8.40 and shows that the length of line (including meter and weight) actually in the water is 8.34 meters. Since the wet line is slightly curved, a furthur correction must be made to determine the vertical distance between the water surface and the bottom. This is done by entering the second or "wet line" table with the value 8.34 in the first column and obtaining the wet line correction of four centimeters (to the nearest centimeter) in the

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column headed 10°. The corrected sounding therefore will be 8.34 meters minus four centimeters or 8.30 meters. Interpolation, both vertically and horizontally, will usually be required, but this can be done visually with sufficient accuracy.

1.12 It is necessary to make a horizontal angle correction for the angle of the current at any section where it is not perpendicular to the measuring section. The corrected velocity is the measured velocity times either the cosine of the angle of deviation from the perpendicular or the sine of the angle between the current and the cross section. Special columns are provided for these corrections on the discharge-measurement forms.

Computations and Accuracy

1.13 The computations of discharge are based on the measurements of width, depth, and average velocity at each vertical. Computations should be made by the mid-section method, in which the depth and velocity at each vertical are considered to be applicable halfway to the adjacent verticals on either side. Computations are made directly on the measurement forms, which are self-explanatory. An example of a completed discharge measurement is shown on Exhibit A-4, where the number of sections has been reduced below the desirable number so that the entire example could be shown on one sheet.

1.14 The discharge observer, where competent to do so, should rate the measurement for probable accuracy. Measurements are considered "excellent" if the error is believed to be less than two percent, "good" if less than five percent, "fair" if less than eight percent, and "poor" if more than eight percent.

Operation and Maintenance of Gaging Stations

1.15 The discharge observer is responsible, under the general direction of his supervisor, for the operation and minor maintenance of the stream-gaging station or stations assigned to him. He will be assisted by the gage reader, to whom some of the responsibility for maintenance can be delegated.

Responsibilities of the Observer

1.16 The discharge observer should make a thorough check of the operation of the gage prior to each discharge measurement, as explained elsewhere. If he lives at the station, he should make a casual check each working day and a thorough check at least once a week.

1.17 Maintenance items include keeping silt deposits away from staff gages and intake pipes, removing accumulated sediment from the gage well, flushing the intake pipes, and keeping the appearance of the station generally neat.

1.18 Items of maintenance that can best be performed by special maintenance personnel include periodic lubrication of cableways, repainting of station markings on cableways, and annual lubrication of the automatic recorder with special lubricant. The clock on the automatic recorder should be cleaned annually by a watch repair specialist, preferably in Baghdad. Adequate spare clocks are available so that operation of the recorder need not be interrupted.

1.19 The discharge observer should make it a point to learn all he can about the cableway and its component parts, specifically all parts that require maintenance. This can be accomplished by assisting the

maintenance crew. He should see that all equipment is properly maintained and in good running order. He should report immediately to his supervisor any deficiency that he cannot correct himself.

1.20 The intake pipe should be flushed before each discharge measurement and at other times if required. The normal procedure is to place the stopper in the flushing tank drain pipe and then close the valve by turning the control wheel in a clockwise direction. The purpose of the valve is to prevent water from flowing from the flushing tank into the gage well during the flushing operation. The flushing tank should then be filled with water by pumping or with a bucket. If it is necessary to prime the pump, the discharge pipe should be filled with water. The discharge observer should then take a position overlooking the end of the intake pipe that is in the river and instruct his assistant to remove the plug from the tank. If the flushing action is effective, he will see muddy water and air bubbles emitted from the intake pipe. The flushing action should be repeated if results are not satisfactory. If two intake pipes are fitted for flushing, they should be flushed separately.

1.21 The amount of accumulated sediment in the bottom of the gage well should then be measured with a stick, and if it is within 25 centimeters of the lowest intake pipe it should all be removed. The recorder float and counterweight should be carefully raised to a position that will avoid damage while removing the sediment.

1.22 It is very important that the valve on the intake pipe be opened by turning the control wheel in a counterclockwise direction after flushing the intake pipe or removing sediment from the gage well.

1.23 The discharge observer should submit a written report to his supervisor each month, mentioning the discharge measurements he has

made, all items of repair or maintenance that need to be done at his stations, and any suggested ideas for improvement. Problems of a more urgent nature, like a defective clock, should be reported immediately.

1.24 The discharge observer should keep a diary, making daily entries in it of the work at his stations, such as flushing the intake pipe, discharge measurements, recorder check, and so forth. He should supply all information and dates for his monthly report from the diary rather than from memory. The diary should be presented for inspection if requested.

The Gage Reader

1.25 The automatic recorder, if operating properly, will provide a complete record of gage height. A gage reader should be employed at each station, if possible, to make regular readings of the external staff gage so that no record will be lost if the recorder becomes inoperative or if the intake pipe from the river to the gage well becomes plugged with sediment between flushings. The gage reader should assist the discharge observer in making discharge measurements and in performing minor maintenance tasks. The supervisor should decide whether to supervise the gage reader directly or to delegate the supervision to the discharge observer.

1.26 The gage readings ought to consist of a daily reading of the external staff gage, with more frequent readings as requested by the supervisor during high flows or during periods when the automatic recorder is inoperative.

1.27 The gage reader should never touch the automatic recorder unless specifically instructed to do so, but he should look at it frequently and report to the discharge observer or supervisor by the quickest possible means if the clock appears to have stopped or if there is any other malfunction that he can recognize.

Chapter A-2

PREPARATION OF RECORDS OF DAILY DISCHARGE

General Office Procedure

2.1 One of the major tasks of the Hydrological Survey of Iraq and its successor is to collect, analyze, and publish basic hydrological data. These data are then used by other agencies in planning and design for the development of Iraq's valuable water resources. These published data are accepted by others as being reliable, accurate and free of mistakes. It should be the responsibility of all individuals concerned with their preparation to fulfill this trust.

2.2 In the computation of basic streamflow data, certain general principles have proved their worth and should be maintained to the fullest extent. Chief among these are standardization, documentation, neatness, and integrity.

2.3 Computations and procedures are standardized for many reasons. Experience of previous workers is put to use; computations can be started by one person and completed by another; and work can be reviewed easily even though the person who did the work may not be available. The use of forms developed by the Hydrological Survey is of considerable assistance in standardization of procedures. Copies of standard forms used for computations of discharge records are shown in Exhibit A-3. Standardization can also be achieved by following these instructions.

2.4 Documentation, especially of methods and procedures not covered herein, is extremely important. Too often work that is done accurately and well must be discarded because it is impossible to determine how it

was done or on what it was based. Filling in the blanks on the standard forms for dates, computer's name, checker's name, and notes also comes under this heading. Any work that is not done on a standard form should have the person's initials and the date and file number in the upper right hand corner.

2.5 Neatness and legibility hardly need explanation. Suffice it to say that much of the work is inspected by people from other offices and judged on appearance as well as accuracy.

2.6 Integrity is needed for the many instances in which work can not or may not be thoroughly checked. Time should be taken to make sure everything is correct, especially in copying data. Mistakes should not be allowed to pass. If a mistake of any sort is noticed, it should be either corrected or called to the attention of a superior. The continued good work of processing hydrologic records will depend on everyone connected with the computation process.

2.7 Field data reports should be given a cursory check on the field and then forwarded to Baghdad. Data should be received, given a file number, and routed to the engineer in charge of current data for a preliminary inspection. The data forms should then be routed to the person in charge of computations; he logs the data on the appropriate bar chart and binds it into the proper folder.

2.8 Three filing folders should be maintained for each river discharge station. They are the discharge measurement file, the gage height file, and the station file. Original discharge measurement field notes and original gage height forms should be bound in their proper files. The station file should contain the current Form 2 and Form 11, the latest rating curve

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and table, the latest deviation graph, and any other forms or computations which pertain to the current data. Data are considered current until they have been published. All work and field data which pertain to published information should be removed from the current files and stored with other background information for the station.

Particular Procedures

Checking Discharge Measurements

2.9 Discharge measurement field notes should be given a thorough arithmetical check soon after they are received in Baghdad. The checking is the responsibility of the chief computer.

2.10 Most of the computations on Form 15 are self-explanatory and straightforward. Checking should proceed by complete columns rather than by rows. A calculating machine should be used whenever possible. Special points to watch are the corrections for vertical and horizontal angles, which are always subtracted; care should be taken to check the angle corrections by looking them up on the proper table. The measured velocity should be checked by using the proper rating table for the current meter used. Even though a calculating machine is used, more than three-figure accuracy should not be used and small changes in the third figure of the field observer's computations should not be made.

2.11 The method coefficient should be checked to make sure it is the proper one for the depth of measurement:0.96 for 0.5 depth method and 1.00 for the 0.6 depth method and the 0.2 and 0.8 depth method. The file number, measurement number, and checker's initials on the other side of the form should be filled in. The summary of data on the front of the

form should agree with the results on the computations side. If any problem or questions of interpretation arise in checking, they should be brought to the attention of the engineer in charge of current data.

2.12 When the measurement notes have been completely checked, the pertinent information should be noted on the particular Form 11 for the station involved.

List of Discharge Measurements

2.13 Pertinent information from each discharge measurement is summarized by station-years on Form 11. The first column is for the number of the discharge measurement. The measurements are numbered consecutively within each water year, assigning the number one to the first discharge measurement made after 1 October. In order to avoid confusion when plotting points to determine a rating curve, each point should be labeled with its number followed by the year. For instance, the fifth measurement made in water year 1957 is labeled "5-57" when plotted as a graph point.

2.14 The next seven columns - "Date," "Made by...," "Width," "Area," "Mean Velocity," "Gage Height," and "Discharge" - are self-explanatory. All these items are copied directly from the discharge measurement form. For easy recognition and to avoid confusion with the American system, dates should be written as "10 Aug. 52" rather than "10-8-52." No numbers should be carried beyond three significant figures because any more figures will imply an accuracy that is inconsistant with the accuracy of the field measurement. The two columns under "Rating" are to be filled in later and are discussed at the end of this section.

2.15 Under "Method" the procedure used in making the measurement should be noted if it was not made by current meter but by "floats" or "slope-area," for example. If the measurement was made by current meter, only the depth of velocity measurement should be noted, such as "0.5," "0.6," "0.2" and 0.8." "Meas. Secs." means the number of separate soundings of depth that were made. "G.H. change" is the change in gage height from the start to the finish of the discharge measurement. If the river stage rose during the measurement, the change should be labeled with a plus sign; a minus sign is used if the river fell. "Time" is the time between start and finish of the discharge measurement. The rating of the measurement as excellent, good, fair, or poor should be noted under "Meas. rated." Water temperature should be noted under "W.T." and any remarks recorded in the remarks column.

2.16 At the time when the station rating is computed, the columns under "Rating" are filled in. When the rating curve or table to be used has been selected, the date of that rating curve or table should be placed in the blank to the right of "Rating." Shift adjustments determined as explained in the section entitled "Application of Shift Adjustments" are noted under "Shift adj." The rating table discharge corresponding to the gage height adjusted for shift is determined. The algebraic difference between the measured discharge and the rating table discharge is divided by the rating table discharge. The result, expressed as a percentage, should be noted under "Percent. diff."

Rating Curves

2.17 Measured discharges are plotted against corresponding gage heights on Form 5 or Form 6. The line of best fit through these points

is known as the station rating curve or the stage-discharge relation. This curve can be used to determine the discharges which correspond to the gage heights measured at the station. Results of discharge measurements should be plotted on the station rating curve and entered on Form 11 immediately after they have been checked.

2.18 When preparing a rating curve for a new station, at least ten discharge measurements, well distributed throughout the range in gage height, should be available. The points should be plotted and labeled, and a smooth curve should be drawn through them. The low-flow portion of the curve may be shown in greater detail at a magnified scale on the same sheet.

2.19 It is frequently helpful to plot the points on Form 6, a logarithimic type of paper, especially when attempting to extend the curve above the highest discharge measurement. When using the logarithimic paper, the gage height corresponding to zero flow in the river should first be estimated, and the lowest point on the vertical scale should be labeled with this approximate gage height. The horizontal scale should start with 0.1, 1.0, 10, or 100 cumecs (depending on the size of the river) on the left end, with each cycle increasing by a factor of ten. When the points are plotted to these scales, the upper end of the curve should approach a straight line, making reasonable extensions along this line possible. A slight adjustment of the gage height scale may bring the rating curve closer to a straight line.

2.20 When the rating is satisfactorily established, the curve should be transferred to a new Form 5 (whether Form 5 or Form 6 was originally used), showing scales, curve, and standard title block but not the points. All succeeding discharge measurements should then be plotted on this

curve. If a series of consecutive points covering a period of a year or more falls away from the curve on one side, it is probably desirable to prepare a new rating curve. Further information on rating curves may be found in Water Supply Paper 888 or the book Stream Flow by Grover and Harrington.

Rating Tables

2.21 A rating table is prepared from the station rating curve in order to simplify the process of converting gage heights to discharges. As a first step, values of discharge for each one-tenth meter of gage height are determined from the rating curve and put on Form 3. The appropriate whole meters are noted in the gage height column to reduce the chances of making a one-meter error in using the table. The difference between each pair of adjacent numbers is determined and written in the difference column. If the rating is a smooth parabolic-type curve, the differences should increase fairly uniformly from low discharge to high discharge. If the differences vary erratically, the numbers are adjusted slightly in the discharge column until the differences show a consistent trend. Sometimes it is helpful to compute the second differences (or differences between the differences); these also show a smooth variation although not necessarily increasing with increasing discharge.

2.22 When the discharges on Form 3 have been smoothed and balanced, they should be copied into the left-hand column of Form 4, with the differences recorded in the far right-hand column. Each difference is divided into ten increments, which are then added cumulatively across the sheet; entries should not be carried to more than three significant figures. When the difference between discharges for gage heights one-tenth meter apart

becomes less than one-half percent, discharges are tabulated only to the nearest tenth-of-a-meter gage height. All the supplementary data called for on both forms should be filled in. The "from" and "to" items represent the period during which the computations of daily discharge were based on this rating table.

Application of Shift Adjustments

2.23 It often happens that the relationship between stage and discharge at a gaging station, referred to as the station rating, changes with time. If the rating changes in a short time and then remains fairly constant, the ordinary practice is to use a different rating curve and rating table after the change. In the usual case, however, the changes occur either continuously or at frequent intervals, making it impracticable to use a different rating after each shift. In such cases the usual practice is to draw an average rating curve that fits all the points as closely as possible and then to make shift adjustments. This curve is then used until such time as measurements start plotting consistently above or below the curve at certain stages. When this shift happens, a new average rating curve affording a better fit to the recent discharge measurements should be drawn.

2.24 The distance that a measurement plots away from the rating curve is made up of two factors. One is the inherent error in the discharge measurements, and the other is the actual shift in the rating from that indicated by the rating curve. It is impossible to make a completely accurate discharge measurement, so there will always be some error, the size of which will depend on the difficulties of the measuring conditions and the skill of the discharge observer.

2.25 Another factor which sometimes affects the distance which a measurement plots away from the average rating curve is the effect of rapidly rising or falling river level. As a river rises rapidly the surface slope becomes steeper than for steady flow. Because of the steeper slope, the velocity is increased, the discharge for a given gage height is greater than that shown on the rating curve, and the measurement will plot to the right of the curve. The opposite is true when a river falls rapidly. In this case, the discharge for a given gage height is less than that shown on the rating curve, and the measurement will plot to the left of the curve. The effect of falling stage is generally much smaller than the effect of rising stage because rivers tend to rise faster than they fall. Effects of changing stage are usually more noticeable on rivers with flat slopes, such as the Tigris at Baghdad. Discharge measurements at frequent intervals during the flood season are necessary for analyzing this phenomenon. Discussions of the effect of changing stage may be found in Water Supply Paper 888 and in Stream Flow by Grover and Harrington.

2.26 A high degree of judgment is required to determine how much of the deviation of the plotted discharge measurement from the average rating curve to assign to error of the measurement and how much to assign to actual shift. This decision should be made by one of the engineers and checked by a highly experienced engineer. No definite rules can be made, but some general principles can be stated as follows:

a. The shift adjustment should be sufficient to reduce the percentage difference to what could reasonably be assigned to error of measurement.

b. If there are large changes in shift in successive discharge measurements, especially in opposite directions, a high proportion of the shifts is probably due to error in measurement.

c. If several consecutive discharge measurements plot about the same distance from the curve on the same side, a large part of the deviation probably is due to shifting.

d. If measurements during rapidly rising stage plot to the right of the curve or during rapidly falling stage to the left of the curve, a large part of the deviation probably is due to changing stage.

2.27 The determination of shift adjustments is simplified by the plotting of a deviation graph on rectangular coordinate paper on which the abscissa represents one calendar year marked in days. A horizontal line is drawn on the graph paper and labeled "zero": This line represents the average rating curve or zero deviation from the curve. The deviation is the difference between the gage height read at the time of a discharge measurement and the gage height corresponding to the measured discharge in the rating table computed from the average rating curve. For convenience the deviations should be plotted as indicated shift adjustments, which are of opposite sign to the deviations. The indicated shift adjustments are determined by subtracting the measurement gage height from the gage height shown in the rating table as corresponding to the measured discharge. The indicated shifts should be plotted above the zero line if they are positive and below the line if they are negative; consecutive points should be connected with a light pencil line. The deviation graph is a very useful aid in visualizing the shifts and is valuable in the review of the computations.

2.28 Shift adjustments should be made after inspection of the deviations and with the above-mentioned general rules in mind. The determination of shift adjustment is based on judgment and a large measure of common sense. Shifts in rating in Iraq are generally due to scour or deposition of silt in the river channel. Scour is indicated by a positive deviation, and

deposition of silt by a negative deviation. Changes in channel configuration due to scour or deposition usually occur at times of high discharge. Deviations due to changing stage occur in the same direction, positive when rising and negative when falling, but they can be distinguished from scour shifts because they occur only during periods of rapidly changing stage. Scour shifts may persist for some time or even be permanent, but changing stage shifts apply only to the period of changing stage.

2.29 A scattering of deviations in discharge of five percent or less and on both sides of the zero line usually indicates that no shift is required. Shifts on the basis of one point are questionable, and shifts to the full extent of deviations should not be made unless several consecutive deviations are consistent. In general, shifts should be kept small. If there is doubt, a shift should not be made.

2.30 The shift adjustments should be indicated on the deviation graph and connected with a heavy pencil or colored line. Changes between shifts should be made gradually except where shifts are apparently due to rapidly changing stage. The shift adjustments should be transferred from the deviation graph to a Form 2, as in the last item on Exhibit A-5, by noting them in small numbers with plus or minus signs just to the right of the gage height column. The deviation graph should be labeled with the year, rating table date, computer's name, and the date before being bound into the station file folder.

2.31 Before discharges are computed, the shift adjustments should be reviewed by an experienced engineer. They are applied algebraically, adding them to the gage heights. Then the adjusted gage heights are used in finding the discharge from the rating table.

Analysis of Recorder Charts

2.32 The Stevens A-35 water-stage recorders installed by the Hydrological Survey automatically plot a graph of water level against time. Such a record is valuable because it shows a complete picture of river stages.

2.33 The time checks on the chart should be inspected, as shown on Exhibit A-5. If the time noted at the check differs from the time scale of the chart, any loss or gain of time should be distributed uniformly between the checks with adjusted midnights shown in red pencil on the chart.

2.34 The reading of the tape or inside staff gage, which should be noted at the time check, should also be checked to assure that it corresponds to the reading shown by the pen line. If there is doubt as to the accuracy of the recorder trace, the observed daily gage height on the chart should be marked with a point inside a circle at the proper elevation and time. If the observed daily gage height is consistently above or below the trace, the recorder is probably out of adjustment by an amount equal to the average deviation. If the daily gage heights observed on the exterior gage gradually drift away from the recorder trace, sediment is probably plugging the intake pipes. Sedimentation can frequently be noted by sudden rises or drops in the trace; these occur when inside and outside water levels differ enough to force the sediment from the pipe. During periods when sedimentation is suspected, greater reliance must be placed on the observed daily gage heights.

2.35 If the variation in river level during a day is small, the average can be determined by inspection or by balancing areas above and below the trace with a transparent straightedge and noting the point where the straightedge crosses the noon line on the chart.

2.36 When the variation during a day is large, it must be studied in greater detail (See sheet 1, Exhibit A-5). Depending on the amount of change, values of gage height are taken from the trace for intervals during the day, using shorter intervals for greater changes. The gage height for an interval is the mean for that interval as determined with a straightedge, as is described above for days of small variation. These values should be noted on the chart because they will be useful when determining daily discharge. Individual values are then averaged to determine the daily average gage height. Selection of the length of time interval to be used in the analysis is largely a matter of judgment and experience.

Summary of Daily Gage Heights and Discharges

2.37 Daily gage heights and discharges are summarized on Form 2. For stations without water-stage recorders, the daily gage heights are generally copied directly onto the form; however, when sizeable daily variations occur and the observer has recorded several heights for such days, a stage hydrograph can be plotted and a more accurate value obtained as described above; values so derived are marked with a capital delta (Δ).

2.38 In all gage-height copying, full meters should be shown, even if it is repeated time after time down a column. In other words, if the gage height for a long period stays within a few hundredths of 2.61, the "2" should be shown on each gage height in the column. The greatest single source of mistakes is an error of one meter due to not following this simple rule.

2.39 Gage heights determined from water-stage recorders are considered more accurate than the observer's gage height if the two differ. If variations in flow require detailed analysis of the recorder chart, the recorder value should be used and marked with a capital delta.

2.40 The highest and lowest instantaneous gage heights for the year are noted in the upper left hand corner of Form 2. Shifts are noted in small numbers written just to the right of the gage height columns, as on the last sheet in Exhibit A-5.

2.41 Discharges are determined by entering the rating table with the shift-adjusted daily average gage height. Discharges for days of large gage-height variation are determined by averaging discharges for shorter time intervals during the day. The short-interval gage heights already noted on the stage recorder chart should be used for this purpose. Discharges determined in this manner should be marked with a capital delta. The days on which discharge measurements were made should be noted with an asterisk, with the number of the discharge measurement in the upper left-hand corner of the discharge space.

2.42 Each column of discharges is added and the mean determined by dividing by the number of days in that month. Monthly totals are added across to find the water-year total, and the water-year mean is determined by dividing by the number of days in that year. The maximum and minimum mean daily discharges for each month are written in the appropriate spaces at the bottom of each month's column, and the maximum and minimum mean daily discharges for the water-year written in the spaces in the bottom right-hand corner of the form. The maximum and minimum instantaneous discharges should be listed in the proper blanks on the left side of the sheet. The minimum can be assumed to be equal to the lowest daily average discharge, but the instantaneous maximum should be determined from the highest shift-adjusted instantaneous gage height.

2.43 All computations on this sheet should be independently checked and the computer's and checker's initials should be put in the space provided.

Any special notes should be written on the dotted lines at the left edge of the sheet.

Comparison of Computed Discharges

2.44 Computed discharges should be plotted on hydrographs since errors tend to be revealed to an experienced engineer when so plotted. The best method is to plot hydrographs for several nearby stations on the same logarithmic coordinates. Comparison is thereby facilitated and an error in any of the records is easily detected.

Chapter A-3

SEDIMENT SAMPLING AND ANALYSIS

Introduction

3.1 River improvements in Iraq, both existing and planned, will change the amount and characteristics of river sediment and also change the sediment-carrying capacity of the rivers. The evaluation of these changes, in amount and characteristics, requires data on sediment carried by the rivers.

3.2 The Hydrological Survey of Iraq set up a network of six stations for obtaining sediment data, all at sites of stream-gaging stations (see Exhibit A-1). They are as follows:

a. Tigris River at Tusan,
b. Greater Zab River at Ifraz,
c. Lesser Zab River at Goma Zerdala,
d. Tigris River at Fatha,
e. Adhaim River at the Narrows,
f. Diyala River at Derbend-i-Khan.

Occasional measurments have been made at some of the other discharge stations. Sediment samplers of the latest type are used, and the sampler developed by the Irrigation Directorate is kept in reserve.

3.3 Samples were analyzed at the laboratory of the Irrigation Directorate in Baghdad. Descriptions of sampling equipment and procedures and of analysis equipment and techniques are included in this chapter. Tabulations of all sediment data are presented in Annex A-2.

Types of Sampler

Depth-Integrating Sampler, Type D-49

3.4 This sampler is one of the standard types developed and used by United States government agencies. The sampler is made of brass, is fish-shaped, and contains a pint bottle for collection of the sample. It is specially designed to obtain a sample which is a true representation of the sediment concentration throughout a vertical section of flowing water.

3.5 Sheet 1 of Exhibit I-4 in the main report shows this sampler with the nose section and nozzle hinged downward and the sample bottle partially removed. The water enters the sampler through a nozzle in the nose. There is no provision for closing off the nozzle; thus water will enter the bottle continually while the sampler is submerged. The bottle rests in the sampler at such an angle that water will circulate through it if the bottle is more than seven-eighths full. Such circulation of water would cause the sample to accumulate too much coarse sediment; hence the time of submergence should be such that the bottle is always less than seven-eighths full.

3.6 Bottles should be well rinsed before sampling and inspected to see that no solid particles remain. In taking the sample, the sampler is first held at the water surface with the nozzle clear of the water. When the sampler is pointed upstream it is lowered at a constant rate to the bottom of the river and immediately raised again at a constant, but not necessarily the same, rate. If the bed is of rock or shingle the sampler may be allowed to touch the bed gently, but if it is of sand or silt the sampler should be raised again from just clear of the bed to guard agains the possibility of the nozzle's picking up bed material. In this case

a careful sounding must first be made with the sampler with no bottle inserted. If after taking the sample the bottle is less than half full or more than seven-eighths full, the contents should be discarded, the bottle checked so that no sediment remains, and a new sample taken.

3.7 The rate of lowering and raising the sampler preferably should not exceed one-third the average velocity of the water at a particular vertical. For instance, if the average velocity of the water is one meter per second, the desirable limiting rate of raising and lowering the sampler would be one meter every three seconds. The sampler is equipped with three sizes of nozzle: 1/8 inch, 3/16 inch, and 1/4 inch. It requires some experience to determine the size of nozzle to use and the rate of lowering and raising to obtain proper filling of the bottle. In this respect, Table A-1 may be of assistance.

Table A-1

SEDIMENT SAMPLING TIME

Mean Velocity of Stream in meters per second	Time in seconds to obtain a sample of approximately 400 cc		
	1/4 inch Nozzle	3/16 inch Nozzle	1/8 inch Nozzle
0.15	85	150	-
0.30	43	75	166
0.60	21	38	84
0.90	14	25	56
1.20	11	18	41
1.50	-	15	33
2.10	-	11	24
3.00	-	-	17
4.50	-	-	11

A special nozzle, 3/32 inch inside diameter, was constructed in Baghdad for use whenever the 1/8 inch nozzle caused the sample bottle to fill too quickly.

Point-Integrating Sampler, Type P-46

3.8 This sampler is also a standard type developed and used by United States government agencies. The sampler is similar in appearance to, but larger and heavier than, the depth-integrating sampler. It is used for sampling on the larger rivers, where the depth and velocity are too great to permit effective use of the simpler depth-integrating sampler. The sampler has an electrical device for opening and closing the passage from the nozzle to the sample bottle. This sampler also uses a pint bottle for collecting the sample.

3.9 The point-integrating sampler's primary function is to collect a sample, integrated over a period of time, at a fixed point in a river. It can also be used as a depth-integrating sampler by leaving the nozzle passage open. When obtaining depth-integrated samples from a deep river, it may be helpful to lower the sampler to the bottom with the passage closed and raise it with the passage open to collect a sample on the upward trip only or on a predetermined part of the upward trip. As with the D-49 sampler, the bottle must not be allowed to fill more than seven-eighths full.

Sampling Procedures

Frequency of Sampling

3.10 Sediment samples should be obtained each time a discharge measurement is made. The discharge measurement should be completed

first and the gage read again before starting the sediment sampling. If this is done, the width of river and locations of the sampling verticals can be determined before starting.

Location of Sampling Points

3.11 Samples are taken in three verticals across the river. These verticals are subject to change to fit the general cross section. In a stream of fairly uniform depth, the verticals should be at the midstream and quarter points. If the cross section of the river is irregular, one vertical section should be where the river is deepest and the other two vertical sections halfway from the deepest point to each of the two banks. If samples are taken from a bridge having river piers, special care should be exercised to avoid errors due to obstructions from the piers.

3.12 Depth-integrated samples should be taken wherever possible. However, if point samples are being taken, three samples should be taken in each vertical if the water is more than three meters deep, with one sample being taken one-half meter from the water surface, one at mid-depth, and one sample at one-half meter from the bottom. If the depth is between two and three meters, only the top and bottom samples are taken. If the depth is less than two meters, only the mid-depth sample is taken.

Field Notes

3.13 Field notes are taken on Hydrological Survey Form 12 (see Exhibit A-6) at the time of sampling. Carbon paper should be used to secure an original and one copy. River, station, date, and observer's name are entered in the proper spaces. "Beginning time" and "Ending

time" are the times that the first sample and last sample were taken. Gage reading and the time of reading for the gage heights taken before and after the sampling operation are also entered. Water temperature should be measured by putting a thermometer in the water for a full minute at a point where there is a good velocity of water. If this cannot be done from the shore, the temperature of water in a sample bottle can be measured immediately after the sample is taken and before it has had time to change temperature. The line on which the water temperature is entered also has a place for recording the mean gage reading, which normally would be the average of the two readings on the lines above. "Measured discharge" is the result of the measurement made just before sampling. Under "Type of Sampler used," all but the type used should be crossed out, and the size of nozzle used should be checked under "Size of Nozzle."

3.14 The middle part of the form contains space for recording information about the actual sample. The first column has space for the number of the vertical. Normally sampling is done in three verticals, and these are numbered consecutively I, II, and III. The distance of each of these verticals from the cableway or bridge reference point is entered in column 2. The river depth at each vertical should be entered in column 3 and the depth of individual samples in column 4. The sample description code is explained at the bottom of the sheet. Column 5 is reserved for any remarks the observer wishes to make regarding a particular feature of the sampling procedure. More general remarks may be entered near the bottom of the sheet.

Care of Samples

3.15 The observer should be supplied with boxes for receiving the nine (or fewer) bottles of the samples. The bottles should be capped

immediately after the sample is taken, to prevent evaporation or spilling, and then put into the box. The original copy of the notes should be tucked securely into one of the compartments of the box so that it will not be separated from the samples, and the lid of the box should be closed tightly. The observer should keep the carbon copy of the notes. The box should be stored in a safe place, where there is no possibility of freezing in the winter, and left until picked up and taken to a laboratory. Care should be taken to keep the box upright at all times to prevent spilling of the sample.

Analysis of Sediment Samples

3.16 Sediment samples should be delivered to the appropriate laboratory after being received in Baghdad. The steps in the laboratory analysis procedure are as follows:

a. All samples taken in one sampling operation are combined in a clean beaker of known weight. Individual sample bottles should be agitated to ensure that all sediment is poured out. If some particles remain, they may be washed into the beaker with a measured amount of distilled water. Individual samples should be analyzed separately for more detailed information if the sediment concentration varies among the three verticals of the river by more than about 25 percent.

b. The beaker containing the sample is weighted and the weight of the sample determined by subtracting the weight of the empty beaker and any distilled water added.

c. The beaker is allowed to stand for 24 hours, during which time the sediment particles will settle to the bottom. If the top liquid is not clear after 24 hours, it must be allowed to stand longer.

d. The clear water on top of the settled sediment is siphoned off and disposed of. Care must be taken to avoid removing any sediment particles.

e. The remaining water and sediment are placed in an evaporating dish of known weight. If any sediment particles remain in the beaker, they may be washed into the dish with distilled water.

f. The remaining water is evaporated in an oven.

g. The evaporating dish with the dried sediment is weighed and the weight of dry sediment determined by subtracting the weight of the empty dish.

3.17 The concentration of sediment may be expressed in parts per million (p.p.m.) by dividing the weight of dried sediment by the weight of the original sample and multiplying by one million. The sediment load in millions of kilograms per day may be determined by multiplying the concentration in p.p.m. times the mean daily discharge in cubic meters per second times 0.0000864. This form of analysis will include a small weight of dissolved solids in the weight of sediment, but this amount is negligible if most of the clear water is siphoned off the sample after the sediment settles to the bottom.

3.18 If a size analysis of suspended sediment is desired, the dried sediment is washed through an 0.05-millimeter-opening sieve of known weight. The sieve is then oven dried and reweighed, and the weight of coarse material is obtained by subtracting the empty weight of the sieve. Material retained on the sieve is classified as sand and that passing as silt and clay. Other size separations can be made by using different sized sieves or by using one of the methods that depend on the settling rate of solids in a liquid.

3.19 Results of the laboratory analysis are recorded on the field note sheet and the empty bottles returned to the field.

3.20 The detailed data of sediment sampling and analysis carried out by the Hydrological Survey are shown in Annex A-2 at the end of this appendix.

Chapter A-4

SNOW SURVEYING

Introduction

4.1 No routine surveys of the snow cover in the mountain regions of Iraq had been made prior to the inauguration of the Hydrological Survey. As such measurements will be essential for the preparation of the streamflow forecasts required for the proper operation of the present and future reservoir systems, the initiation of snow surveys was one of the major responsibilities of the Hydrological Survey.

4.2 The need for the snow surveys was recognized and the general program to be accomplished was developed by our engineers. We retained the temporary services of Mr. R. A. Work, head of the snow surveys in western United States, who came to Iraq and laid out a specific program. The details of Mr. Work's program were fully described in an internal report, "Recommendations for Development and Practice of Snow Surveys for Runoff Forecasting in Iraq," November 13, 1956. The general pattern of the surveys is that developed by the United States Soil Conservation Service and set forth in their Snow Survey Manual (Preliminary). It involves over-snow travel by parties of two or three men to snow courses located in the mountains. These courses consist of several lines, permanently marked by steel pipes, along which measurements of snow depth and water equivalent are made at fixed intervals. The use of over-snow machines and the observation of markers from light aircraft were alternatives which were considered, but it was decided that neither would be suitable for use in the mountains of Iraq.

4.3 The snow surveys have been made on February first and fifteenth, March first and fifteenth, and April first at all the snow courses and also on April fifteenth and May first at five of the higher courses. A tolerance of plus or minus three days is permitted for the surveys to allow for bad weather and blocked roads and for the observation of several widely separated groups of courses by one party of surveyors. It should be stressed that a snow surveyor must never travel alone in the winter. Parties of two or three are most suitable, for if a party is larger than three the risk of accidents increases.

4.4 The results of the survey of a snow course are average values of the snow depth and water equivalent over the number of points sampled, supported by notes on weather conditions at the time of sampling, soil conditions beneath the snow, the elevation of the snow line, and other relevant data. The values may be regarded as an index of the water stored in solid form in the basin. After several years of records have been collected, these indices may be correlated with summer runoff considered to have been produced by the melting of the snow and ice cover; they thus make possible the forecasting of summer runoff from snow data in future years.

4.5 The snow-survey program involved the establishment and permanent marking of twenty-three snow courses in the mountain regions of Iraq. The network is shown on Exhibit A-7. Two mountain refuge huts were built. Steel route-marker pipes were installed in terrain where the access route might be difficult to follow. Three Iraqi snow surveyors were trained. They were responsible for the routine surveys of seven courses, the remainder being surveyed by two British technicians. Special equipment for making the surveys and clothing suitable for winter mountain travel were obtained. A new pattern of snowshoe was designed and made locally.

4.6 Exhibit A-8 shows a completed field snow-survey form and an example of a surveyor's field snow-course layout map. Sketch maps of the layouts of the individual snow courses are given in Exhibits A-9 through A-31, and snow-course descriptions can be found in Annex A-3. Annex A-4 summarizes the results of the 1957, 1958, and 1959 snow surveys. Detailed 1:20,000-scale maps giving the routes to the snow courses were prepared but are not presented in this report.

Establishing the Network

4.7 The snow-survey fieldwork carried out by the Hydrological Survey was divided into two parts. The first part consisted of the selection and permanent marking of the snow courses, the construction of mountain refuge huts, and the finding and training of Iraqi snow surveyors. The second part was the routine observation of the snow surveys.

4.8 To select the snow-course locations, most of the mountainous regions of Iraq were visited; finally twenty-three courses were sited. Courses were then marked by steel pipe markers between three and five inches in diameter and up to seven meters long; these were set in concrete. They were painted red and yellow in alternate one-meter bands for easy identification. The installation of the courses, involving the transport by road and mules of the pipes, cement, aggregate, and frequently water into remote mountain areas, was a lengthy procedure.

4.9 The approach to most of the courses is fairly straightforward, although under winter conditions compass travel is frequently necessary. The way to Dour Khiniq snow course, high up on Handran Mountain, can be difficult to follow in thick cloud; therefore, three six-meter-long two-inch-pipe markers were installed to assist route-finding.

4.10 Two mountain refuge huts were built and used by the snow surveyors for overnight stops. One was built on the outskirts of Halsho village. The other was built on Handran Mountain close to Sambawakal snow course (1810 meters) and is essential for the surveying of Dour Khiniq snow course. Its location, three hours up a waterless mountain, presented considerable construction difficulties, and it was finally prefabricated in Kirkuk and then transported up the mountain in 130 mule-loads. Both huts were fully equipped for two men. A seven-room permanent house was constructed on the outskirts of Diana village near Ruwanduz for use as an office and base for the snow surveyor there and for visiting discharge observers.

4.11 In Amadia, Penjwin, and Tawela, the snow surveyors must be based locally as these areas are likely to be cut off for considerable periods by heavy snowfalls. It was essential therefore to find suitable men for training as snow surveyors prior to locating these groups of courses.

4.12 The catchment of the Ruwanduz River presents special opportunities for analysis of runoff phenomena. The highest snow courses are located in this catchment as are two river-gaging stations and several meteorological stations. A substantial part of the runoff from the basin is from snow melt and the factors affecting snow melting are measured adequately. Therefore the records for this basin should provide data for determining maximum probable melting rates for flood studies and also day-to-day forecasts of snow melt runoff based on meteorological data.

4.13 During the winter of 1957, routine surveys were made on 13 snow courses by three British snow surveyors. One Iraqi snow surveyor was given training. Routine snow surveys were performed on all 23 snow

courses by three Iraqi and three British surveyors in 1958 and by three Iraqi and two British surveyors in 1959. A British senior snow surveyor gave part-time supervision to the snow surveys over these two years and was responsible for the selection, training, and work of the snow surveyors.

Site Selection for Snow Courses

4.14 The selection of sites for snow courses is a specialized activity which should be attempted only by a man with considerable snow-survey experience and a sound background knowledge of winter conditions in the mountains. For someone without such a background it would probably be impossible to visualize either the manner in which the snow would lie on the proposed snow course location, the influences to which it would then be subject, or the difficulties which future surveyors might experience in reaching the snow course safely and then performing the snow survey.

4.15 Nevertheless, in order to give an idea of the requirements of a good snow-course site, some of the aspects which must be considered are given below:

a. The route to the snow course must lie through avalanche-free terrain. The course itself must be free from snow-slides and should be protected from winds as far as possible so that snow is blown neither in nor out. Care should be taken to avoid blowing effects caused by ridges too close to the snow course.

b. The course must be reasonably accessible and unless observed by a local snow surveyor should not be too far from winter motor roads. The availability of potential snow surveyors is of course a major consideration if a local man is to do this work.

c. The course should be reasonably close to a village or mountain refuge hut where overnight stops can be made if very bad weather conditions set in.

d. The course should be on well-drained ground and on slopes facing between northwest and northeast.

e. The course should be "permanent," i.e., not subject to environmental changes due to tree planting or cutting, etc.

4.16 In siting snow courses valuable assistance can be given by local inhabitants, but their opinions must be considered in the light of personal experience as it is unlikely that they appreciate all the factors which must be taken into account.

4.17 The usual number of sampling points in a snow course is about ten to fourteen, commonly spaced at intervals of between five and thirty meters along one or more measuring lines. Less than this number of samples probably would not give true average values, whereas the accuracy of the results would not be improved significantly by more.

4.18 Snow courses covering a wide range of elevations are often grouped together to give an indication of the variation of snow depth and water content with elevation. The higher courses, which frequently represent major water-producing zones, may yield the most reliable data for correlation with resultant runoff. The lower courses are particularly useful in predicting the total area covered by snow and hence give good indications of the flood potential. During many years there may be little or no snow on the lowest courses; but in those years in which an appreciable amount of snow does accumulate on them, the snow-survey results may be of considerable value because of the increased flood potential in such years.

4.19 An examination of Exhibit A-7 shows the grouping of the snow courses in Iraq covering elevations from 820 meters to 2640 meters. Many of them, particularly the higher ones, lie close to the divide between basins, and they should therefore prove to be of value in forecasting river flows in more than one basin. This is made more likely by the fact that very often most of the snowcover in Iraq is due to precipitation during only a few widespread but major winter storms, and the index to future stream runoff provided by a snow course in one particular catchment is therefore very likely to be representative of conditions in adjacent catchments.

Equipment

4.20 Winter travel in mountains is seldom easy and is frequently both arduous and dangerous. Weather conditions can change extremely rapidly and with little warning, and unless a party is prepared, both by proper training and by being suitably clothed and equipped, to meet any eventualities, frostbite, snowblindness, serious injuries, or even loss of life might result. Furthermore, it should not be assumed because people have lived for generations in mountainous areas that they require no training in winter mountain travel or that their normal clothing is suitable for this. Snow surveys are made to fixed schedules and as a consequence frequently have to be carried out under adverse conditions. It is likely that, in the absence of necessity, local people have traveled little under such conditions and that where they did so, it was with far less safety than modern equipment affords. It should also be remembered that at the end of a possibly very arduous journey to a snow course the surveyors then perform delicate scientific measurements lasting perhaps one to three hours. These may be under near-blizzard wind and snow conditions with the temperature considerably below freezing. It is therefore clearly apparent that if the snow surveyors

are not given the very best clothing and equipment obtainable, not only might it be impossible to complete some surveys satisfactorily, but frequently they would be running unnecessary risks to their safety.

4.21 All those who have been engaged on snow surveys in Iraq have been provided with equipment of the highest quality. A list of the items issued to snow surveyors is as follows:

a. Skis and ski sticks, waxes, etc., or snowshoes,
b. Anorak (windproof hooded jacket),
c. Windproof trousers,
d. Ski boots or special snowshoe boots,
e. Snowgoggles,
f. Traveling gloves and sampling gloves,
g. Pocket prismatic compass,
h. First-aid outfit,
i. Framed rucksack.

4.22 The snow-survey clothing was purchased in London and has proved completely satisfactory. Some snowshoes of the Tubbs 100-T type were purchased from the U.S.A. A smaller, lighter, and simpler form was evolved and made locally in large numbers. It was very successful and can easily be repaired with materials readily available in any mountain village. The initial cost was only about 500 fils per pair. The snow sampling sets used are those made by Messrs. Leupold and Stevens, Portland, Oregon, U.S.A.

4.23 Four-wheel-drive Landrovers equipped with wheel chains were used in traveling to the snow courses up to the point where roads and tracks became impassable because of snow. The surveyors then proceeded to the courses on foot, wearing skis or snowshoes, the time required

to reach the most distant courses being sometimes as much as six or seven hours of fast travel after leaving the vehicle. Mules were sometimes employed for long approaches over snow-free ground during the late-spring surveys.

Sampling Procedures

Care of the Sampler

4.24 The following points should be observed in caring for the sampler:

a. In transporting the sampler, extreme care should be used to guard it against injury because it is very light and can easily be dented. The special wooden carrying box should be used whenever possible.

b. When traversing steep slopes the sampler should not be used as a staff to avoid sliding downhill because the tube is easily bent.

c. The sampler should be kept covered inside and out with a thin coating of kerosene. The inside coating can be applied by pulling through a swab soaked with kerosene. This coating not only prevents corrosion but tends to keep moist snow from adhering to the tube. The inside of the tube should be polished with metal polish after use.

d. Since ice and rock sound and feel alike when struck by the sampler, care should be taken to determine what the substance is; ice will not blunt the cutter, while rocks will.

Spacing of Samples

4.25 Measurements for spacing of samples should always be started from the initial point as shown by the sketch map of the course, and the

spacing for samples should be followed as indicated. Care should be used in spacing by tape measurements so that the samples taken on the same course in different years will be at the same spots.

Taking the Samples

4.26 Plunging the tube should be avoided. In driving, a steady downthrust is preferable to twisting, which allows a small amount of snow to enter the slots. However, a minimum amount of twisting aids in the driving and also facilitates the quick cutting of the thinner crusts. Plunging should be unnecessary. In case the sampler sticks or freezes down, a light twist will usually release it.

4.27 The presence of temperatures below zero degrees centigrade in the snow, while the temperature of the air is above freezing, often causes the snow to adhere firmly to the orifice of the cutter after a depth of from 10 to 12 feet has been reached. This difficulty can be met in the following three ways:

a. The sampler is withdrawn when the cutter becomes clogged, and both cutter and tube are thoroughly cleaned. Then in a new place the tube is pushed rapidly through the snow without stopping until the bottom of the snow is reached. The tube should not be plunged into the snow. If difficulty is again encountered, this procedure is repeated until a complete core is obtained. (A core is complete when its length is approximately equal to the snow depth.)

b. Under very difficult conditions the tube is thrust as deeply as possible without stopping its downward motion. When resistance is felt the tube is withdrawn and weighed and the sample recorded. The core is discarded and the tube very carefully lowered to the bottom of the partial hole. Sampling is continued in this fashion until ground level is reached.

c. The best solution to the problem is to sample when the temperature of the air is at or below freezing, when this is possible.

4.28 If the depth of the core is very much less than the depth of snow, the sample should be discarded and another one taken. Similarly, if the density value determined for a sample is appreciably different from those of the remainder of the samples in the same course, another sample should be taken.

Weighing the Samples

4.29 Before taking each sample, the empty sample tube should be placed in the cradle hanging from the scales. The weight when empty is recorded in the proper column in the field book. After the sample has been taken, the sampler is placed in the cradle and the weight of tubes and core recorded. The water content is given by the difference between the reading for the empty tube and the reading for tube with core.

4.30 Some earth should always be picked up at the bottom of the sample as its presence is a check that none of the core has been lost. However, if earth is picked up, it should be removed with a knife before the sample is weighed, and proper deduction should be made before the length of core is recorded. All loose snow should be cleaned out of the sampling tubes after every measurement.

4.31 When the depth of snow is very small, say two to eight inches, each individual sample should not be weighed separately, for the spring balance will not register such small amounts accurately. The empty sample tube together with a sampling bag should first be weighed and the weight recorded. Several samples are then taken, each being emptied

into the sampling bag after the snow depth and core length are recorded. The total water equivalent and total snow depth of several samples are thus obtained, the average values being determined by dividing by the number of samples combined. Considerable care should be taken when using this method since the accuracy of the individual samples cannot be checked by calculating their densities.

Recording Findings

4.32 A completed snow-survey form and an example of a surveyor's field - course layout map are shown in Exhibit A-8. Sketch maps showing points of observation should be pasted to the insides of the covers of the snow-surveying notebooks. A chart for determination of density should also be included in the field notebook.

4.33 A pencil should be used for recording field measurements. A complete description of the course, survey party, date, etc., should be given in the appropriate space on the form. Density computation should be made at the time of observation to determine whether a check measurement needs to be taken. Remarks should include special notes as to the character of the snow, the nature and conditions of the soil or other bottom reached by the cutter, and whether the soil is wet, dry, frozen, etc.

4.35 Special care should be taken in completing the back of the snow-survey field form. Instructions regarding the disposal of the snow-survey field notes should be issued to each surveyor.

Forwarding and Processing of Data

4.36 On completion of a snow survey the surveyors should check their field forms, making and keeping one copy, and then forward the originals

to the snow-survey supervisor. The supervisor should completely recheck the field forms. The summarized results of the surveys should then be telephoned to the head office as directed.

4.37 During the period of data accumulation prior to the start of forecasting, this method of transmitting the results will be sufficiently rapid, for they are usually received about one week after the survey. However, when forecasting is begun arrangements should be made for the snow surveyors to forward details of their measurements direct to the forecasting office by cable or wireless.

4.38 The original snow-survey field forms were all filed in Baghdad and the summarized results of the surveys entered on the form "Record of Snow Measurements." The results of the 1957, 1958, and 1959 snow surveys are given in Annex A-4.

Personnel and Training

Field Supervision

4.39 The unfortunate consequences of not visiting local observers, checking the way in which they make their measurements in the field, and generally taking an active and personal interest in their work are well known. In snow surveying unless good supervision is fully maintained, a very early breakdown in the observations can be expected. This breakdown would mean that accurate streamflow forecasting would be impossible and also that the considerable time, trouble, and money spent on initiating this work would be wasted. To rebuild a snow survey service after such a breakdown would be a difficult task, and the finding and training of new local snow surveyors might prove impossible.

4.40 It is therefore imperative that there be a senior snow surveyor supervising the work of the other snow surveyors, particularly the local men. Unless it is entirely unavoidable, he should not be restrained by the necessity of making routine surveys himself. It is also essential that this man fully understand all aspects of the work; this requirement means that he himself must have done snow surveying in Iraq and is not merely an outsider put in charge of the surveyors. The duties of the senior snow surveyor should also include the checking of all the snow surveys, which will give him a good idea of when special visits to his surveyors are necessary. When forecasting begins he should take an active part in it. He should hold a snow-survey training course annually prior to the start of the snow surveys and should be responsible for maintaining the present high standard of this work.

Selection and Payment of Snow Surveyors

4.41 Every effort was made to find and train local snow surveyors, and the three who worked in 1958 and 1959 all live in remote areas which an outside man would frequently be unable to reach. Their work was of a very high standard. However, the bulk of the snow surveys, including the most important but most arduous ones, were performed by British snow surveyors. While efforts to find and train suitable Iraqis for this work should be continued, at the time operations were turned over to the Director General of Irrigation there appeared to be no alternative to continuing with the two British snow surveyors if the snow survey program was to be maintained. If such an arrangement is continued one of these would be based at Diana and would be responsible for snow courses in the Hajji Umran, Handran Mountain, and Merga Sor areas. The other, based at Kirkuk or Sulaimania, would survey snow courses in the Halsho, Barsinja, and Lower Penjwin areas.

4.42 Due to the importance of this subject and the very considerable difficulties experienced in finding suitable candidates for this work, the selection and payment of Iraqi snow surveyors warrant detailed discussion. While several approaches to finding suitable Iraqis for training as snow surveyors were tried through official channels by the Hydrological Survey, none proved successful. However, three local snow surveyors were found and trained. They were responsible for the routine snow surveys at seven courses during 1958 and 1959.

4.43 With the experience of three winters of snow surveying in Iraq and a good idea of the type of person who can be trained into a satisfactory and permanent snow surveyor, it is possible to outline the qualifications to be looked for in applicants. It is desirable for the snow surveyor:

a. To be at least 30 years old and preferably more,

b. To read and write good Arabic and to be able to read English numbers (since English depth markings are used on the snow-survey tubes),

c. To be healthy and accustomed to mountain travel, though this will usually be only summer travel or winter travel under fine conditions (A keen hunter will possess these qualifications.),

d. To be a permanent resident, preferably with his home and family in the area where he will work,

e. To have some definite employment (not with the government), but one which he can leave for a day or so at a time to do the surveys; or one which does not occupy him during the winter months (Examples are shopkeeper, farmer, local builder, or craftsman.),

and certainly equally important, but less tangible:

f. To look like the right type of man, one who would work cheerfully and conscientiously under difficult conditions, and

g. To want to do the work, if possible not solely for the money.

4.44 It will be seen that this is not exactly the type of man originally envisioned for this work, more importance being placed on mental suitability for the work than on education, although the latter must of course be adequate. In fact, the lower age limit, 30 years, almost automatically implies that the surveyor will have had no secondary-school education as there were hardly any such schools in these remote areas when he was a boy. The object of this age limit is to avoid young men, the most unlikely to have much sense of duty towards the work or sense of perseverence if conditions are unpleasant. Also, young men are more likely to move out of the area and therefore not to be permanent surveyors. The fourth qualification is intended to ensure permanency, which is also fostered by the fifth qualification. The latter is of more importance than it may appear. The pay, based on a fixed rate per completed survey, cannot be regarded as an income so much as something "extra," and the man who lacks those qualifications is not so likely to stay in one town or village.

4.45 Great importance is thus placed on the permanent nature of the work; this consideration is absolutely vital. The thorough training of a local snow surveyor is a long and not an easy task since the work is completely different from anything he has done previously. It is a waste of time teaching him if he is not going to do this work for more than a few years.

4.46 It should be clearly understood that the local mountain people cannot visualize what the work actually entails until they have been taken

on some snow surveys. Never having practiced winter travel in the mountains under severe conditions, there having been no necessity to do so, they do not seriously believe either that these surveys can be made to a fixed schedule or that people can travel warmly and safely in bad winter weather. Even when, by example, they have been shown that it is possible, not many wish to do it.

4.47 From this fairly detailed analysis of the best type of person for training as a snow surveyor, it is obvious that in a small mountain town or village in Iraq, he is a comparatively unusual man. In practice this fact has been proved by the difficulty of finding suitable candidates. The surveyor performs, usually under only distant supervision, very arduous scientific work which few people are either capable of or willing to carry out. It is therefore essential that he is adequately paid for this work, without regard for academic qualifications or similar considerations.

4.48 No comparable work is being carried out in Iraq, and so no fair comparisons can be made with the rates of pay of existing government posts. It is believed that at the time when operations were assumed by the Director General of Irrigation the payments to local snow surveyors and their assistants were fair to both them and the government. Snow surveyors in different areas were being paid between about I. D. 5. 000 and I. D. 8. 000 per survey, there being a fixed rate for each survey of a particular snow course. The difficulties and time involved were considered in the assessment of the flat rate. The local snow survey assistants were paid about two-thirds of the above amounts. Winter clothing and equipment of the best quality were of course issued to the men.

4.49 The annual cost (for five snow surveys) of a local snow surveyor and his assistant was therefore between approximately I. D. 50 and 80,

depending on the particular courses. It is recommended that a small increase in these rates be made on the satisfactory completion of each three years' sets of surveys.

4.50 One relevant psychological consideration which will help to ensure the reliability of the local surveyor's work is the standing of a snow surveyor among the people in his village. By giving him good pay and the best winter clothing (apart from the absolute necessity of doing so) and by visiting him fairly frequently (also apart from other considerations) his supervisor can forcefully convince the surveyor and his friends of the importance of his work. Under these conditions he is more likely to respond positively and do his job properly.

Snow-Survey Training Courses

4.51 Prior to the start of the routine snow surveys in both 1958 and 1959, snow-survey training courses were held by the senior snow surveyor at Hajji Umran. The purpose of these courses was (a) to instruct all the snow surveyors working in Iraq in the many aspects of snow surveying and winter mountain travel; (b) to give complete training under winter conditions to the new surveyors or to serve as a refresher course to those who had done the work previously; (c) to standardize the work of all the snow surveyors; and (d) to enable the various snow surveyors to meet one another and thus develop a team spirit among themselves.

4.52 A summary of the program of the course held in December 1957, which set the pattern followed in the succeeding course, is given in Table A-2.

Table A-2

SNOW SURVEY TRAINING COURSE 9 THROUGH 17 DECEMBER 1957

Monday	-	(December 9) Assemble in Kirkuk. Stay in Hydrological Survey hostel.
Tuesday	-	(Day 1) General preparations; move at midday to Salahuddin; stay at rest house.
Wednesday	-	(Day 2) Travel to Hajji Umran and move up to the Iraq Petroleum Corporation huts, on which the course was based.
Thursday	-	(Day 3) Explanation of (a) snow-sampling equipment and its care and maintenance, (b) snow-sampling procedure; practice snow sampling on Kandashin course (1980 meters).
Friday	-	(Day 4) Practice sampling in groups on Kalkash course (2510 meters); instruction on (a) use and care of skis and snowshoes, (b) compass traveling.
Saturday	-	(Day 5) Talks on travel in various snow conditions, avalanche dangers, etc; instruction in elementary first aid, including making a ski sledge; survival in the snow; practice traveling.
Sunday	-	(Day 6) Snow survey of Omar Khayat course (2640 meters).
Monday	-	(Day 7) General instruction and practice in any subjects which bad weather conditions previously prevented.
Tuesday	-	(Day 8, December 17) End of course; return to Kirkuk or bases.

4.53 These courses proved completely successful, and it is considered most desirable that they should be held annually. The standards to which the snow surveyors were required to work were identical to those practiced in the United States, and no lowering of them on account of local difficulties of language, etc., was permitted. It is essential that these high standards

be maintained. It is not possible to make checks on the actual observations recorded by snow surveyors, and their integrity and conscientiousness are therefore vital. By choosing the right men for this demanding work and then insisting on the highest standards, reliable and extremely valuable data will be obtained. These snow-survey training courses are considered an essential part of achieving the required standards.

Chapter A-5

METEOROLOGICAL NETWORK

Introduction

5.1 The number of stations collecting meteorological data was relatively small before establishment of the Hydrological Survey of Iraq. This fact was particularly evident in the mountainous regions of the northern part of Iraq, which are the areas of greatest water yield. A network with greater station density was considered necessary to fulfill the requirements of river control and forecasting.

5.2 Standards of observation, especially at isolated stations, were not always high, and inspection of many stations was very infrequent. The meteorological field work, therefore, included installation of new stations and instruments, training of observers, and establishment of uniform standards and supervision. Agreement was reached with the Meteorological Service of the Iraq Government on the standards to be used.

5.3 The locations of stations established or improved by the Hydrological Survey of Iraq are shown on Exhibit A-32, and detailed descriptions of each are included in Annexes A-5 through A-8, which treat stations for recording rain gages, non-recording rain gages, thermographs, and evaporation pans respectively. Instructions for the operation and maintenance of non-automatic rain gages, automatic recording rain gages, and evaporation instruments are found in Chapter A-6. Samples of meteorological field data forms are shown in Exhibit A-33. Annexes A-9 through A-11 contain data gathered on daily precipitation, hourly temperatures at Diana, and monthly values of total evaporation.

Supervision

Field Organization

5.4 The installation of meteorological stations was supervised by engineers of the Hydrological Survey field staff. Initial supervision of station operation was in the hands of these engineers. During this time, Iraqi inspectors were being trained so that they could gradually take over the duties of supervision and inspection, as they later did in November of 1958.

5.5 The entire Hydrological Survey field organization was under the authority of the Field Engineer, whose office was located in Kirkuk. He was responsible for the hiring and supervision of observers, establishment or relocation of stations, maintenance of equipment, and performance of the network. He was assisted by the Meteorological Station Inspector, to whom was delegated authority over the operation of meteorological stations.

5.6 Details of individual observer's duties and qualifications are included in the station descriptions in the annexes; details of the forwarding and processing of data are considered in the following pages.

Inspection and Supervision

5.7 Prior to the establishment of the Hydrological Survey of Iraq, the more distant non-recording rainfall stations of the Meteorological Service were not visited for long periods. Unsatisfactory records frequently were the direct result. During Hydrological Survey operations, considerable supervision was possible. Many of the stations lie on routes that were constantly used by the field staff in the course of other work,

and many visits to them were made. Stations less conveniently located were visited as much as possible whenever the quality of their records indicated the need and often more frequently. It should be emphasized that considerable distances had to be covered, commonly under bad conditions, to reach many of the stations, where perhaps the observer could be found for only a few hours each morning. Some stations have been cut off by snow or mud during part of the winter; and to reach Sidekan, for example, is a full day's trip on mule and foot during the best time of year.

5.8 Most of the rainfall stations are more or less on a par; however, the overall standard is not yet as high as it could be. If the degree of supervision is slackened, the quality of the readings will undoubtedly fall rapidly, and some stations might close down altogether. Continued close supervision is therefore essential and probably always will be.

5.9 One Iraqi rainfall-station inspector was trained with the intent that he could be fitted into the future organization of this work, whatever form it might take. Although he had no previous meteorological knowledge, he worked with a British engineer for four months. He accompanied the latter on all visits to rainfall stations; worked at Diana for a week to learn the use and maintenance of the instruments at an evaporation station; made the observations when at the Hydrological Survey rainfall station in Kirkuk; assisted in the processing of the rainfall data at the Kirkuk station; and gained experience in handling the diffculties which are likely to arise, particularly those connected with observers. If he can maintain and improve the standard of the rainfall observations, as seems very likely, he will be doing extremely valuable work.

5.10 The Hydrological Survey meteorological observer at Diana was made responsible, as part of his duties, for the following rainfall stations

in his area: Galala, Rayat (Meteorological Service), Ruwanduz, Sidekan, Merga Sor, and Shaqlawa. His visits to these comparatively remote sites, which occurred at least once every two or three months, considerably assisted meeting inspection requirements and ensured good records for the Ruwanduz and Balikian catchments.

Field Units

Recording Rain-Gage Stations

5.11 Fourteen automatic recording rain gages were installed by the Hydrological Survey of Iraq. In addition to these, gages were installed at the Kirkuk and Baghdad offices of the Hydrological Survey and at Baghdad Airport for training purposes. Companion non-recording (non-automatic) gages were either maintained or installed at all sites that have recording rain gages.

5.12 In most cases, the automatic gages were installed at existing rainfall stations or at sites were competent observation was available. After a few initial troubles, the records were satisfactory. The operation of the gages at the five Meteorological Service stations, the two Iraq Petroleum Corperation stations, the Forestry Service station, and at Dokan Dam can be expected to continue indefinitely at a high standard. However, the gages operated by the Hydrological Survey field staff depend on the future of its field organization. There would be considerable difficulty in replacing the present observers, so every effort should be made to continue their employment.

5.13 All instruments are the Bendix Aviation Corporation Model 775c weighing-type gage. Eight-day clocks are used, and recording is in

millimeters of precipitation up to a maximum of 300 millimeters (with reversing mechanism). All gages are bolted to concrete bases in such a way that the rim height above ground level is 36 inches.

5.14 The recorder charts from all stations were forwarded directly to the Kirkuk field office. At Kirkuk the daily precipitation values on the recorder charts were computed and compared with those from the companion non-recording gages. Any signs of malfunction of the gage or observer error were noted and called to the attention of the observer. Recorder charts were then forwarded to Baghdad, where daily and hourly values of rainfall were read off and recorded and the charts permanently stored.

Non-Recording Rain-Gage Stations

5.15 Seventeen non-recording (non-automatic) rain gages were installed by the Hydrological Survey of Iraq in addition to those at recording rain-gage stations. The gages were made to the standard U. S. Weather Bureau pattern in the Baghdad copper district. The gages were placed in metal stands to give a rim height of 70 centimeters.

5.16 Snow towers which raise the gage rim height to approximately three meters were installed at four stations. Wind shields of the Alter type were fitted. The towers, which are very strong, were made of two-inch angle irons and set in concrete; rungs lead to an observation platform. They were installed in wire-fence enclosures equipped with gates and padlocks. The towers were placed at sites where rain frequently falls when the ground is snow-covered; this rain would not be recorded by a normal installation, which would be buried in the snow.

5.17 In most cases the siting of the gage was largely determined by such factors as its safety and proximity to the observer's home or work. Within these limitations the sites are the best available although some unavoidably suffer from underexposure or overexposure.

5.18 In the past the observers of non-recording rain gages have usually been schoolteachers. Frequently, particularly in the more remote parts, they were the only people capable of making the observations. Government policy forbade them to be paid for this work, which was considered as part of their normal duties. The standard of their observations varied considerably over periods of time and between stations. The work was generally regarded as an unpleasant imposition; therefore, the resulting records were frequently of low quality.

5.19 The Hydrological Survey of Iraq initially adhered to the existing rule of non-payment. This meant that all the observers were necessarily schoolteachers, as no one else would do the work without pay. However, from January 1957, some new stations were observed by policemen, local government personnel, etc., to whom monthly payments of I.D. 2.000 were made. The number of paid observers was gradually increased until only ten, all schoolteachers, received no pay at all either for this work or for connected duties. While this small payment does not ensure reliable observations, it definitely does help toward this end.

5.20 All records from non-recording stations were forwarded to Kirkuk at the end of each month. Delays in their arrival were sometimes unavoidable in the winter time since the more distant stations might be completely cut off by snow or mud. Copies of the records were made in Kirkuk and the originals forwarded to the Baghdad office of the Hydrological Survey. Records from each station were compared with records at nearby Hydrological

Survey and Meteorological Office stations as a check, particularly of the dating of rainfall occurrences when storms were widespread. Any obvious errors were noted and called to the attention of the Meteorological Inspector in Kirkuk. Copies of the records were then forwarded to the Iraqi Meteorological Service, Climatology Department, at Baghdad Airport.

Evaporation Stations

5.21 Three evaporation stations were established by the Hydrological Survey of Iraq to measure evaporation rates for three separate regions. The station at Tusan gives evaporation for reservoirs that might be built on the main stem of the Tigris River. The station at Dokan gives evaporation for reservoirs along the edges of the mountainous area, such as Dokan, Derbend-i-Khan, and Bekhme. The station at Diana gives evaporation for typical valleys in the mountainous regions.

5.22 The evaporation pans used to measure the evaporation were made to the Standard U. S. Weather Bureau class "A" pattern. They are of galvanized steel, four feet in diameter, and ten inches deep, mounted on a wooden grill to permit circulation of air under them.

5.23 There was a choice as to whether to measure the fluctuations of the water level in the pan, between limits, with a hook gage or to keep the water level constant by daily adding water (or removing it in case of a heavy rain) with a calibrated cup or dipper. It was decided to use the cup method because hook gages are difficult for non-technical personnel to read accurately, while it is simple to count the number of cups of water required to return the water surface to the desired level. Our successful use of the cup method, compared with the indifferent results obtained

by others elsewhere with the hook-gage method fully justifies the choice.

5.24 In addition to measuring the daily depth of evaporation from the pan, measurements were made daily or oftener of wind movement over the pan, maximum and minimum air temperatures, wet- and dry-bulb air temperatures (for determining humidity), and precipitation.

Meteorological Conditions in the Mountains

5.25 This section describes the meteorological features characteristic of the mountainous areas of Iraq. It must be stated emphatically that the following material is not based on an analysis of meteorological records, but rather results from the field observations of experienced hydrologists and engineers over a period of a few years. It is intended to aid in checking and analyzing meteorological data.

5.26 Although warm fronts do affect the northern, mountainous areas, they are generally weak; even when they result in a total cloud cover, ensuing precipitation is likely to be slight. The approach of a warm front is often indicated by a typical sequence of cloud formations. Cirrostratus, accompanied by moderate but persistent lunar and solar halos, thickens and lowers to produce a total cover of altostratus or altocumulus. Cloud development is then generally complete, with the cloud base at 8000 to 9000 feet. Such formations do not often yield precipitation, and when they co, no more than small amounts can be expected. Only occasionally does this medium cloud evolve further into the nimbostratus, in which case heavy rainfall may occur.

5.27 Most of the precipitation in the mountainous areas results from very unstable air masses, which frequently give rise to heavy thunderstorms.

These storms evidently depend upon some feature of local topography to trigger the precipitation. Thus this sort of storm tends to be very local in character and to vary considerably in intensity at two places perhaps only a few kilometers apart; such variation is a common feature of mountain storms everywhere. For example, in the neighborhood of Handran Mountain rain frequently falls on Jindian, at the foot of the mountains, while Diana, some six kilometers away, is dry. The difference between Diana and Merga Sor, about 25 kilometers apart, is even more marked; for time and again heavy rain is experienced at the latter site while Diana remains dry.

5.28 This marked variability indicates that it is incorrect to assume that an observer is not entering his rain-gage readings against the proper day just because rain gages on adjacent mountains show precipitation on succeeding days. Alterations of the records are justifiable only when an observer is known to be likely to make such mistakes. Thus, evidence from even a recording rain gage should not invalidate observations at another site unless the storm is known to be general and widespread.

Chapter A-6

OPERATING INSTRUCTIONS FOR METEOROLOGICAL GAGES

Recording Rain-Gage Stations

Description of Gage

6.1 This gage is the weighing type and consists of a receiver through which precipitation is funneled into a bucket mounted on a weighing mechanism. The weight of the precipitation catch is recorded on a clock-driven chart as millimeters of precipitation. The recording gage will record up to a capacity of 300 millimeters on a single chart of one-week duration.

6.2 The gage is equipped with an inspection door in the outer cylindrical shield to provide access to the record chart. The receiver is fitted on top of the shield and is held by a hinge on one side and a padlock hasp on the other; it may be removed from the shield by giving it a slight twist and then lifting it off. Removing the receiver gives access to the bucket.

Changing the Chart

6.3 To change the chart on a gage the observer should:

a. Open the inspection door; make a time check on the chart by touching the weighing mechanism gently so that the pen will make a vertical mark on the trace; then lift the pen from the chart by pulling the pen bar forward;

b. Remove the receiver;

c. Empty and replace the bucket;

d. Grasp the chart cylinder at the top with one hand and with the other gently lift it over the spindle; release the clip holding the chart; (he should avoid touching the chart in such a manner as to smear the trace before it dries);

e. Wind the clock and wrap the new chart around the clock cylinder so that:

   1) The time reads from left to right;

   2) The chart fits smoothly and snugly, with the base of the chart uniformly in contact with the flange of the cylinder;

   3) After the clip has been replaced, the corresponding ends of each centimeter line coincide and the exposed end of the chart extends about one-half centimeter to the right of the clip;

f. Replace the cylinder by lowering it gently over the spindle until the gears have meshed; refill the pen and return it almost to the surface of the chart (the pen should indicate a reading of zero on the chart, allowing a tolerance of one-half of a scale division, 0.5 millimeter); report any pronounced or erratic differences in excess of this tolerance to the supervising official;

g. With the pen almost touching the chart, turn the cylinder clockwise (forward) until the time indicated is a few hours ahead (fast), then turn the cylinder back to the correct time (this move takes up the backlash (slack) in the timing gears); be sure that the time is correctly indicated with respect to a.m. or p.m. hours, as printed on the chart;

h. Replace the receiver; return the pen to the chart and make a vertical time check on the chart; then close the inspection door.

Information on the Chart

6.4 The following items should be entered on the chart:

a. The station name as specified by the supervising office,

b. The date and time (to the nearest minute) that the pen will be placed on a new chart (it is especially important to note a.m. or p.m. when entering time on the chart),

c. The date and time of any intermediate time checks,

d. The date and time of removal of the chart,

e. An arrow (↓) with the word "on" at the time check made when the chart was installed,

f. An arrow (↓) with the word "off" at the time check made when the chart was removed,

g. Any notes that will explain any unusual or missing part of the trace,

h. The observer's name.

Maintenance

6.5 Any mechanical failure such as clock failure or any other trouble that cannot be corrected as outlined herein should be reported immediately to the supervising official. Any breaks or evidence of corrosion should also be reported promptly.

6.6 Gages should be inspected daily where possible to check whether the clock is running and the pen is making a trace and to make a time check on the trace. If the clock is not running and fails to respond to winding, it should be removed and the supervisor or field engineer notified as quickly as possible. Extra care should be taken to record the times of starting

and stopping of rainfall on the note sheet of the companion non-recording rain gage while the recording gage is inoperative.

6.7 The chart should be changed once a week during the season of possible precipitation of September through June unless otherwise directed by the supervisor. If it is decided to use a chart for more than one week because no rain fell in the first week, it is desirable to pour a little water into the gage to separate the two traces. A notation must be made on the chart to explain what was done and when, otherwise the trace may be interpreted as representing actual rainfall.

6.8 The rain gages should be operated through the summer dry season to ensure that the station is operative at the beginning of the rainy season, but one chart may be used for an entire month. In this case, pour in enough water to make the chart read about 80 millimeters. Evaporation will cause the trace to go down and serve to separate the traces for each clock revolution. The clock must be set to the correct day each Monday morning since the chart is one day longer than a week.

6.9 The chart should not be exposed to rain while removing it from the gage because the ink line may smear or spread; it is best to wait until the rain has stopped before changing the chart. During a very heavy or continuous rain, when there is danger that the capacity of the chart be exceeded, the bucket should be emptied but the chart left alone. A notation should then be put on the chart as soon as the weather permits. It should be remembered that the pen reverses at the top of the chart and still has a capacity of 150 millimeters at the time of reversal.

6.10 If snow is expected, the funnel portion of the receiver should be removed, as can be done by giving it a twist to release the clamps along

the edges. The receiver can then be replaced, and snow will fall directly into the bucket. The gage bucket may be charged with an anti-freeze solution to melt snow and ice where heavy snowfalls and freezing weather are expected. Detailed instructions for preparing the anti-freeze solution can be found in the instruction manual supplied by the manufacturer.

6.11 If the pen fails to feed ink, the flow of ink may be started by drawing a piece of cellophane (or other viscose film) or smooth, lint-free paper (preferably bond) between the nibs of the point to clean and wet the inner faces. Thin material should be used, and with care, to prevent the nibs of the point from being permanently bent or separated. It should be inserted into the slot only about half the depth of the slot. The pen should be held away from the chart with the pen bar during the cleaning operation. The material should be drawn through the nibs with a motion directed away from the ink reservoir and toward the point. Whenever the pen is not making a trace at the time the chart is change or nibs cleaned, a small dot may be placed on the chart to mark the position of the pen. The dot can be enclosed in a circle to identify it and a note of explanation entered on the chart.

6.12 The pen should be filled with ink whenever the chart is changed but at intervals no greater than one a week. Care should be taken not to overfill the pen with ink since the ink can absorb water, especially in damp or rainy weather, and is then likely to overflow. When the trace on the chart becomes too faint due to dilution, the ink should be removed from the pen with blotting paper and the pen refilled. The ink bottle should be tightly closed when it is not in use.

6.13 The supervisor should inspect the gage frequently. He should install a recently cleaned clock once each year and send the old one to Baghdad to be cleaned by a competent watch repairman.

Non-Recording Rain-Gage Stations

Description of Gage

6.14 The rain gage consists of an overflow can, a measuring tube, a rainfall receiver, a measuring stick (all shown in Exhibit A-34), and a support. The rainfall receiver acts as a funnel to carry the rain into the measuring tube. In an extremely heavy rain this tube will overflow, and the excess rain will collect in the large overflow can in which the measuring tube rests.

6.15 Any malfunction or leak in this equipment should be reported to the supervisor. The equipment should also be cleaned carefully if dirt or foreign matter enters it.

Method of Measurement

6.16 To determine rainfall the measuring stick is inserted bottom end first through the hole in the rainfall receiver and into the measuring tube until it touches the bottom of the tube. The measuring stick is calibrated in millimeters of rainfall and the graduation at the top of the wetted part of the stick gives the amount. It is very important to remember that because of the small diameter of the measuring tube, the depth of water in it will be ten times the depth of the actual rainfall. Since the measuring stick is calibrated to read depth of rainfall directly, the millimeter marks on the measuring stick are one centimeter apart; the centimeter marks are ten centimeters apart, etc.

6.17 After the water in the measuring tube is determined and the measurement written down, the water from the tube is discarded and the tube and rainfall receiver replaced. If the measuring tube had completely

filled and overflowed, the water from the measuring tube is measured and discarded, and the water from the overflow can is poured carefully into the measuring tube. This water is then measured in the measuring tube in the same manner as before, and the two values are added together to obtain the total rainfall since the last measurement.

6.18 During cold weather, when freezing temperatures and snow are likely, the rainfall receiver and measuring tube are removed, leaving the overflow can exposed to catch any precipitation. Otherwise water might freeze in the measuring tube and split it open. At the time of observation, any water in the overflow can is carefully poured into the measuring tube and the amount noted. When ice or snow are found in the overflow can they must be melted. To do this the measuring tube is filled exactly to the brim with water; this water is added to the overflow can to melt the snow or ice, and then the measuring tube is again filled to the brim, this time with the water from the overflow can. The water in the tube is discarded, and the water remaining in the overflow can is then poured into the measuring tube and measured as usual. If water to do the melting is not available, the snow or ice can be melted by very carefully heating the overflow can, but caution is essential so as not to injure the soldered joints or evaporate any water.

Recording Observations

6.19 Information gathered at non-recording rain-gage stations is recorded on Form 9, a sheet of which serves for an entire month. At the top of the form are entered station name and liwa, observer's name, hour of regular daily gage reading, month and year, and latitude, longitude, and elevation of the station.

6.20 The main portion of the sheet is for rainfall measurements. Column 1 lists the days of the month. Since each measurement represents a 24-hour period, a particular reading is entered next to the date in which most of this period elapsed; thus, if readings are made after 12:00 noon, they are written next to the actual day on which they are made, while readings made before noon are recorded beside the date of the previous day. Column 2 should show the actual time of measurement. Column 3 should record the amount of precipitation measured. When no precipitation has occurred, a point is made in the space for that day. If precipitation has occurred during the last 24 hours but was not enough to measure in the gage, "Tr" (meaning "trace") is written in column 3. If there was precipitation but for some reason it could not be measured, a dash is put in column 3. In such a case the water should be left in the tube and included with the next measurement. In column 4 is written the time that the precipitation started. If it started during the night so that the actual hour is not known, "D. N." (meaning "during night") is written. If it started during the daytime but the time it started was not noticed "D. D." (meaning "during day") is written. In column 5 the time that the precipitation ended is written in the same manner as the time of starting. If it is still raining or snowing at the time of measurement, "Cont." (meaning "continuing") is written. In this case "Cont." is also written in column 4 for the next day.

6.21 If there is snow on the ground at the time of measurement, its depth is measured vertically in several places and an estimated average recorded in column 7. If new snow has fallen during the last 24 hours, the depth of the new snow in centimeters is written in column 6. If the amount of new snow was not enough to measure "Tr" is written in

column 6. A special stick for measuring the depth of snow is supplied to each observer.

6.22 Columns 8, 9, and 10 provide space for noting any unusual events associated with storms. If during the preceding 24 hours there was a thunderstorm near enough to a station for the observer to hear the thunder, an "X" is written in column 8 whether or not there was any rain at the station. If during the preceding 24 hours there was any rain that froze to objects on the ground as it fell, leaving them slippery with ice, an "X" is put in column 9. Column 10 is for hail or sleet, which consist of little balls of frozen rain that will bounce if they strike a hard surface. If, during the preceding 24 hours there was any hail or sleet at a station, an "X" is written in column 10. If the hail stones or balls were very large, the largest ones are measured and their diameter in millimeters is recorded in column 11.

6.23 Column 11 also provides space for writing down any remarks that the observer thinks will be useful for the engineers using the reports. Reports can be much more valuable if any additional information not provided for in the first ten columns is recorded in column 11. For instance, columns 4 and 5 might show that it rained for several hours. If it rained very hard for a short time and then continued as a gentle rain during the rest of the time, it will be very valuable to the engineers if the time of the heavy rainfall is written in column 11. If it was not raining continuously during the period of rainfall shown in columns 4 and 5, and the period during which the rainfall stopped was noted, it can be recorded in column 11.

6.24 A carbon paper should be inserted under the precipitation measurement form before each figure is entered so that the observer will have a copy to keep. The carbon copy must be legible, and where it is not,

corrections should be made in pencil. Finally, the observer's name should be signed at the bottom of the page.

6.25 Daily precipitation values should also be copied onto the cards called "Form Met. 6," which are mailed to Baghdad.

Evaporation Stations

Evaporation Pans

6.26 The equipment used for making evaporation measurements consists of an evaporation pan and fixed-point gage, stilling well, and measuring cup. The pan is of cylindrical design, ten inches deep and 47.5 inches in diameter on the inside, and is mounted about five inches off the ground on a supporting frame so that air can circulate around and under the pan and so that the sides and base of the pan can be inspected without difficulty. The fixed-point gage consists of a pointed rod mounted inside a stilling well, which provides an undisturbed water surface around the gage point. The well is a brass cylinder, open at the top and mounted on a triangular base plate provided with leveling screws and lock nuts in each corner. A short open pipe, extending up into the cylinder through the center of the base plate, dampens oscillations in the well by retarding the flow of water to and from the well. A pointed one-eighth-inch rod is fixed within the stilling well so that the point will be at a level 7.5 inches (19 centimeters) above the bottom of the pan. A measuring cup with a capacity sufficient to raise or lower the depth of water in the evaporation pan by one millimeter is used to measure the amount of water necessary to replace that lost from the pan by evaporation.

6.27 The stilling well is placed so that it rests firmly on the bottom of the pan about 30 centimeters from the north edge. The top of the rim is then leveled by means of the three leveling screws in its base and a spirit level. The pan is first filled to the level of the gage point and thereafter refilled each time a regular observation is made. When heavy rains threaten to overflow the pan, enough water should be removed with the cup to lower its surface to the top of the gage point. The number of cups of water removed should be noted on the record form.

6.28 At the set time for observations, water should be added to the pan (or removed from the pan when there has been rain) until the tip of the point coincides with the surface of the water in the well. As the water approaches the tip of the point, care should be taken by pouring slowly to allow time for water to flow into the well without overfilling. The change in depth of water in the pan due to the addition or removal of water with the measuring cup is determined simply by noting the number of cupfuls added or removed in the appropriate spaces on the record form. The number of cupfuls of water added or removed from the pan is equal to the number of millimeters the water surface in the pan has been lowered by evaporation or raised by precipitation.

6.29 The pan should be carefully inspected for leaks and rust spots, since any leaks will render the measurements valueless. Any leaks found should be reported on the observation form for the month, with both the date the leak was discovered and the date it was repaired. Whenever rust spots begin to develop, the rust should be removed with a wire brush or abrasive material and the spots touched up with aluminum asphalt paint. The pan should be cleaned as frequently as necessary to keep it free from sediment, scum, and particularly oil films, which will materially reduce

the rate of evaporation. During months when freezing conditions are likely, the pan should be emptied, cleaned, and stored.

6.30 The stilling well should be cleaned occasionally and any sediment removed. The level of the well rim should be checked once a month. Whenever cleaning or an adjustment is necessary, the water surface should be brought level with the gage point before and after the adjustment, and the operation should be recorded under "Remarks" on the observation form.

Anemometers

6.31 A three-cup anemometer for measuring wind movement over the evaporation pan is mounted on a post set on the northwest projecting corner of the pan platform with the center of the cups about 15 centimeters above the rim of the pan.

6.32 The anemometer is provided with a five-digit odometer, on which the total movement of the wind can be read. The five digits appearing in the window of the odometer indicate the total wind movement to a tenth of a mile for any total up to 10,000 miles, the right-hand digit giving the tenths of a mile. Five zeros (00000) on the meter indicate 10,000 miles and coincide with zero miles for the succeeding 10,000-mile cycle of operation.

6.33 The anemometer is read at the time of the daily evaporation observation. The reading, to the nearest tenth of a mile, is then entered on the data form. The wind movement over any specified period of time is obtained from the difference between odometer readings taken at the start and at the finish of the time interval: Such data need not be computed or entered on the forms.

6.34 The cups and spindle of the anemometer should be cleaned thoroughly once a month. If everything is prepared beforehand, the time required is so short that no appreciable loss of record will result. The anemometer is first removed from its support with a slight twisting motion after the set screw near the bottom end of the housing has been unscrewed. The nut on the end of the spindle above the cups is removed; the screw in the side of the hub of the cups is unscrewed; and the cups are then removed from the spindle. The spindle and spindle bearing are removed by unscrewing the retaining screw on the back near the enlarged portion of the housing. The spindle and ball bearing should be washed in kerosene. Evidence of noticeable amounts of dirt in the anemometer should be reported to the supervisor. The spindle bearing should always be cleaned with kerosene, and a cloth should be used to clean the outer race of the bearing (in the top end of the spindle housing).

6.35 A drop of oil should be applied to the worm threads and two or three drops to the bearing before reassembling the anemometer. Excess oil must be removed to prevent its becoming a trap for dust, especially abrasive dust particles. Anemometer bearings that lack oil may wear badly in a few hours. A squeaking anemometer should immediately be removed from the support and examined. If not seriously damaged it can be cleaned and oiled; otherwise, the trouble should be reported to the supervisor, who will arrange for a replacement. On the day that the anemometer is cleaned, the note "anemometer cleaned" should be entered on the record form for that day in the space provided for remarks.

Thermometers

6.36 The dial-type thermometers used to measure the maximum and minimum daily temperatures have a bimetallic temperature-sensing element.

Movement of the element in response to temperature changes causes a black pointer to rotate around a graduated scale on a circular dial. The scale is graduated in centigrade degrees.

6.37 In addition to the black pointer on each thermometer, which indicates the current air temperature, one thermometer has a blue pointer, which indicates the minimum temperature, while the other instrument has a red pointer, which indicates the maximum temperature. The pointers are pivoted at the center of the dial.

6.38 As the temperature decreases below the setting of the blue pointer, the black pointer moves the blue with it until the temperature ceases to fall. Similarly, as the temperature rises above that indicated by the red pointer, the black pointer moves the red with it until the temperature ceases to rise. Slight friction at the pivots of the red and blue pointers causes them to remain at the points of highest and lowest temperatures until they are adjusted manually by the knob on the outside of the glass dial cover. These instruments are mounted on a post near the center of the cross board of the instrument shelter, in such a way that air flowing through the shelter can circulate freely around them.

6.39 Thermometers are read and the readings recorded to the nearest whole degree. Below-zero temperatures are recorded with a minus (-) sign prefixed; for example, a temperature of one degree below zero is written as -1; five degrees below zero, -5, etc. A temperature of zero is recorded as 0.

6.40 When reading thermometers there are general precautions against errors which should be observed; the observer should:

a. Stand as far from the thermometer as possible to prevent body heat from changing the indicated readings (this precaution is particularly important in cold weather);

b. Be careful not to touch any part of the instruments from the time the maximum and minimum pointers are set until they have been read at the time of the next observation; and

c. Make sure that the line of sight from the eye is perpendicular to the scale of the thermometer, i.e., that the eye is directly in front of the pointer that is being read.

Psychrometers

6.41 Dry- and wet-bulb temperatures as read from the dry- and wet-bulb thermometers of a psychrometer are used in the determination of dew point and relative humidity. The current air temperature is the current reading of the dry-bulb thermometer. The psychrometer used consists of dry- and wet-bulb thermometers mounted on a common back. Both thermometers are mercury-filled glass thermometers of identical construction. The bulb of one thermometer has a close-fitting tubular cover of loosely woven muslin wicking to adapt it for use as the wet-bulb thermometer. A wooden handle and a short length of chain are provided for whirling the psychrometer to ventilate it.

6.42 The procedure used in moistening the wet bulb depends on the temperature and humidity of the air. If it is hot (above 30°C) and dry, the wick should be moistened a few minutes before whirling the psychrometer and then moistened again just before each measurement. For temperatures between 30°C and 3°C, the wick is moistened by dipping it into a cup of water just before making the measurement. When the

dry-bulb temperature is below 3°C (37°F), the wick is moistened thoroughly ten to fifteen minutes before the reading is taken. This time interval will permit the latent heat, released if the water freezes, to be dissipated before forced ventilation is started. If the wet-bulb temperature is at or below freezing point before ventilation is started, water at room temperature is used to melt any accumulation of ice on the wet bulb, since only a thin coating of ice during the ventilation is necessary for accurate results at these wet-bulb temperatures.

6.43 *To ventilate the sling psychrometer, the observer should:*

a. Select a shady spot free from obstructions that might damage the psychrometer while it is whirled;

b. Face into the wind;

c. Whirl the psychrometer at least two revolutions per second and as far in front of the body as possible;

d. Ventilate the psychrometer at least ten to fifteen seconds between each reading (longer when the temperature is near or below freezing), after each period of ventilation, bringing the psychrometer quickly and smoothly to a stop and reading the thermometers to the nearest one-tenth degree immediately;

e. Repeat the ventilation operation until two successive readings of the wet bulb are the same; (At this point, the wet bulb must still be moist or ice-coated, as appropriate. A rise in the temperature of the wet bulb between two successive readings, without a corresponding rise in the temperature of the dry bulb, usually indicates that the wick is dry. The wick should be moistened again and the ventilation process repeated, after permitting the wet bulb to precool to as low a temperature as possible from natural ventilation. However, when the bulb is still wet and the temperature rises to 0°C (32°F) between readings, the water is at the point of freezing, and additional ventilation

is required to dissipate the latent heat of freezing and to reduce the temperature to the true wet-bulb temperature. When the water remains unfrozen at a wet-bulb temperature below 0°C, in spite of the usual ventilation, freezing may be induced by touching the wick with a cool object, preferably snow or ice, and continuing the ventilation, if necessary, until the wick is frozen.)

f. Record the lowest wet-bulb reading obtained in step e. and the corresponding dry-bulb reading. Enter these readings to the nearest one-tenth degree in the appropriate spaces of the forms in use.

Instructions for Observation and Maintenance

6.44 Readings should be made at 0900 hours, but should this be impossible, the actual time of observation must be recorded. Following the indicated order, the observer should:

a. Read and set dial thermometers as follows:

1) Record the current air temperature (black pointer of maximum thermometer);

2) Record maximum temperature (red pointer);

3) Record minimum temperature (blue pointer);

4) Reset red and blue pointers, being sure that the red pointer is on the clockwise side of its black pointer and the blue pointer is on the counterclockwise side of its black pointer;

b. Read wet-bulb and dry-bulb thermometers as follows:

1) Wet the wick of the wet-bulb thermometer;

2) Whirl the thermometers for about 30 seconds;

3) Immediately read the wet-bulb thermometer and record on a separate sheet;

4) Repeat step 3 until the two lowest temperatures obtained are equal; record this temperature on the data form to the nearest one-tenth degree;

5) Record the dry-bulb temperature to the nearest one-tenth degree;

c. Service rain gages as follows:

1) Read the non-recording (non-automatic) rain gage following the appropriate instructions;

2) Inspect the automatic recording rain gage, following the appropriate instructions;

d. Read the anemometer as follows:

1) Inspect the anemometer to see that it is revolving freely and quietly;

2) Record all the numbers showing in the window;

e. Service the evaporation pan as follows:

1) Inspect the pan for signs of leakage or corrosion;

2) Add or remove water with the standard cup until the level just touches the tip of the point gage; record the number of cups in or cups out in the proper column.

6.45 Two copies of the observations should be made. When each month of readings is completed, the original copy should be sent to headquarters, and the carbon copy should be kept by the observer until asked for. The person who actually makes the readings should sign his name at the bottom of each sheet.

6.46 All instruments must be kept clean and free from dust and sediment. A soft wet cloth should be used to clean the various units on the first day of each week or more frequently if required. The wick on the wet-bulb thermometer should be changed on the first day of each week and more frequently if necessary to keep a clean wick on the bulb. If the pan water becomes dirty or its surface oily, it should be changed as quickly as possible immediately after the 0900-hours reading is completed. The pan should be cleaned and refilled immediately. A note saying that the water was changed should be put under "Remarks."

6.47 The pan should be thoroughly inspected on the first day of each month for leaks or rusty places. These should be repaired immediately if found and the fact noted under "Remarks" on the form.

6.48 The grass inside the enclosure should be encouraged to grow but should be kept cut to a length of about five centimeters.

APPENDIX A

ANNEXES

Annex A- 1 Description of Gaging Stations Improved

A- 2 Observations of Suspended Sediment

A- 3 Description of Snow Courses

A- 4 Record of Snow Measurements

A- 5 Descriptions of Recording Rain-Gage Stations

A- 6 Descriptions of Non-Recording Rain-Gage Stations

A- 7 Description of Thermograph Station

A- 8 Description of Evaporation Stations

A- 9 Daily Precipitation Records

A-10 Temperature Data

A-11 Monthly Values of Total Evaporation

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ANNEX A-1

DESCRIPTION OF GAGING STATIONS IMPROVED

(As of April 1959)

KHABOUR RIVER AT ZAKHO

Location. Lat. 37°08' N., long. 42°41' E., elevation approx. 440 m.

Description of installation. The staff gage consists of five one-meter gage plates fixed to the outside (landward face) of the 20-inch-diameter pipe which serves as a gage well for the automatic water-stage recorder on the left bank. The recorder is located in a small bay in the left bank, the pipe being supported by two horizontal steel I-beams anchored in concrete at each end. The pipe opens to the river through a two-inch-diameter conical constriction at the lower end. Access to the recorder house over the pipe (floor level at a gage height of about ten meters) is by a two-meter-long walkway and ladder from the river bank.

The 100-meter-span cableway for discharge measurements is situated 300 meters downstream of the stage recorder. It is supported by a steel A-frame four meters high on the left bank and a ten-meter steel tower on the right bank. The landing platform and traversing winch are on the left bank. A secondary staff gage (zero to four meters) is installed on the left bank near the cableway so that changes in stage during measurements can be recorded.

Sketches of all gaging stations, including location plans and some elevations, are given in Exhibit A-2.

Flow characteristics and control. The river flows over an irregular rocky bed between steep rock banks. Flow is turbulent at medium and high stages. Control is provided by the channel downstream from the site and is considered to be stable.

TIGRIS RIVER AT TUSAN

Location. Lat. 37°00' N., long. 42°28' E., approx. eight km. downstream from Paish Khabur; elevation approx. 330 m.

Description of installation. The staff gage consists of eight one-meter gage plates fixed inside the gage well of the automatic water-stage recorder on the right bank. An external staff gage consists of one-meter plates fixed to teak posts a few meters upstream from the gage well.

The recorder house and gage well are constructed of concrete brick with angle-iron bracing at the corners.

The lowest intake pipe, of three-inch diameter, lies at gage height 0.3 meters and is 15 meters long. An additional three-inch intake pipe passes through the wall of the recorder tower at gage height 1.5 meters. An access door, 60 by 80 centimeters, is provided near the base of the tower. A steel ladder is fixed to the inside of the tower, and a walkway eight meters long gives access to the recorder house from the river bank. The floor of the recorder house is at gage height eight meters. (Gage heights are referred to an arbitrary datum.)

The 300-meter-span class-I cableway for discharge measurements is situated 200 meters downstream of the recorder tower. The cable is supported by two steel towers 25 meters high. The car is traversed, raised, and lowered by a diesel engine on the left bank; alternatively it can be operated by a hand windlass.

Flow characteristics and control. Flow characteristics at the station are suitable, the gage and cableway being in the center of a straight reach of river several hundred meters long, with the flow confined between steep banks. Control is provided by the channel downstream from the station and is likely to prove stable.

RUWANDUZ RIVER AT JINDIAN

Location. Lat. 36°38' N., long. 44°34' E., elevation approx. 570 m.

Description of installation. The internal staff gage consists of ten one-meter gage plates fixed inside the gage well of the automatic water-stage recorder on the right bank. The upper five plates (two to seven meter range) of the external gage are attached to timber back-boards mounted on two-inch-diameter galvanized iron pipes set in concrete; the one-to-three-meter plate is attached to a rock in the river close to the recorder-well intake pipes. No zero-to-one-meter plate is necessary here.

The recorder house is constructed of cement block. The gage well is excavated in the conglomerate and shale of the river bank and is lined for the upper three meters with corrugated steel pipe. The lower intake pipe of three-inch diameter is placed with its top at gage height zero meters and is 20 meters long. An additional three-inch intake pipe enters the gage well at gage height 2.0 meters. Part of it lies inside a five-inch steel pipe to facilitate replacement should this be necessary.

Both pipes enter the gage well in a sealed adit driven through the shale bank. A steel ladder is provided inside the well. The floor of the recorder house is at gage height ten meters. A flushing tank and valves are provided on both intake pipes, but a small spring entering the gage well from the hillside has kept the water clear, and no silting has been observed. There is a 1.3-meter-deep silt sump below the lower intake pipe. The gage is set to an arbitrary datum. Bench marks A and B consist of angle iron set in concrete and have levels of 100.00 meters and 81.847 meters respectively. The gage zero level is 72.629 meters. Gage level of zero flow is approximately 0.8 meters.

The cableway for discharge measurements is situated 40 meters downstream from the recorder tower. The cable is supported by two steel A-frames on the left bank (the main road passing between them) and is anchored in concrete in the hillside of the right bank. The span is 94 meters. The landing platform and traversing winch are on the right bank. A cement-block storehouse for cableway equipment has been built on the right bank.

Flow characteristics and control. The flow characteristics at the site are good, the approach channel being straight and uniform for 200 meters upstream from the site. The bed is of shingle and shows no irregularities in cross section. The rock to which the one-to-two-meter plate of the external gage is attached is sufficiently far upstream for its turbulent effect at the measuring section to be negligible. Low-flow discharge measurements are made by wading at the cableway site. A special tagline is stretched between permanent concrete anchor blocks during each wading measurement.

The low-flow control consists of a long riffle of rock and boulder whose head is 50 meters downstream from the cableway. This section is stable and is used by the local people as a ford. At high flows the ford section tends to be drowned out, and the control effect becomes less localized but still fairly stable.

BALIKIAN RIVER AT BALIKIAN

Location. Lat. 36°39' N., long. 44°30' E., elevation approx. 535 m.

Description of installation. The internal staff gage consists of fourteen one-meter gage plates fixed inside the gage well of the automatic water-stage recorder on the left bank. The two-to-eighteen-meter plates of the external gage are attached to the outside of the recorder tower; it is intended that the lowest two meters of the gage should consist of sloping gage plates set in the undisturbed rock of the river bed.

The recorder house and gage well are constructed of cement blocks with steel reinforcing on a three-meter-high reinforced concrete base. The lower two meters of the gage well are excavated in the undisturbed rock of the bank. The lowest intake pipe, of three-inch diameter, lies at gage height 0.3 meters and is 20 meters long.

Two additional three-inch intake pipes pass through the wall of the tower at gage heights of 2.0 meters and 6.25 meters. A 60-centimeter-square steel access door is provided near the base of the tower on the downstream face, and a steel ladder is fixed inside the tower. The floor of the recorder house is at gage height 14 meters. A six-meter-long steel walkway gives access to the recorder house from the river bank. A flushing tank and valve are provided on the lowest intake pipe. There is a 1.5-meter-deep silt sump below the lowest intake pipe. The gage is set to an arbitrary datum.

The 95-meter-span cableway for discharge measurements is situated 25 meters upstream from the recorder tower. The cable is anchored in concrete in the hillside of the left bank and is supported by an eight-meter-high steel tower on the right bank.

The landing platform and traversing winch are on the right bank.

Flow characteristics and control. The river channel is cut in undisturbed rock, and though there is a shingle bar on the right bank at the site, the cross section is considered to be fairly stable. The approach channel is straight and fairly uniform for 150 meters upstream from the site. The cross section at the cableway is irregular. At high flows errors in discharge measurement introduced by these irregularities will not be serious. Low flows are measured at a wading section 200 meters upstream; permanent concrete tagline anchor blocks are installed, the tagline being stretched between them at the time of measurement.

The low-flow control consists of a rock and boulder section of channel 20 meters downstream of the recorder tower. At high flows this control is drowned out; the water surface slope steepens, and control is exercised by the channel further downstream and, at exceptionally high flows, by the constriction at the bridge and gorge 400 meters downstream from the recorder tower. All high-stage controls are considered stable.

GREATER ZAB RIVER AT IFRAZ

Location. Lat. 36°24' N., long. 43°48' E., elevation approx. 280 m. The station is about 20 kilometers upstream from the station at Eski Kelek and about three kilometers downstream from the Bastura Chai confluence.

Description of installation. The internal staff gage consists of eight one-meter gage plates fixed inside the gage well of the automatic water-stage recorder on the left bank. The upper four one-meter plates of the external gage are attached to the outside downstream face of the recorder tower; the lower four one-meter plates are fixed to concrete piers descending into the river in one-meter steps.

The recorder tower house and gage well are constructed of concrete blocks with angle-iron bracing at the corners. The lowest intake pipe, of three-inch diameter, lies at gage height 0.3 meters and is 18 meters long.

Additional three-inch intake pipes pass through the wall of the tower at gage height of about 3.5 meters and seven meters. A 60-centimeter-square access door is provided near the base of the tower on the upstream face, and a steel ladder is fixed to the outside of the tower. The recorder house floor level is at gage height 12 meters, and a six-meter-long walkway gives access to the recorder house from the river bank. A flushing tank and valve are provided on the lowest intake pipe.

The 550-meter-span class-I cableway for discharge measurements at high stages is situated 440 meters downstream from the recorder tower. The cable is supported by two steel towers 32 meters high and is designed for a maximum working load of two and a quarter tons. The cablecar is traversed, raised, and lowered by a diesel engine housed at the base of the left-bank tower. A secondary cableway of 600-meter span, is situated ten meters upstream from the recorder tower and is used to maintain boat position for boat measurements. This cable is anchored in concrete in

the hillside of the left bank and supported by a steel A-frame six meters in height on the right bank. The boat (consisting of two locally made 12-meter-long boats joined by a timber platform) is held from a pulley on the cable; it is fitted with an outboard motor. The boat station is unsuitable for measurements above about 1000 cumecs (or three-meter gage height) as flow then bypasses the cableway on the right bank and velocities become dangerously high for boat operation.

A house, office, and storeroom for the discharge observer have been built on the left bank near the cableway.

Flow characteristics and control. The main cableway is at the downstream end of an almost straight and uniform reach of channel two kilometers long. At high stages good discharge measurements can be made from the cableway; however, at medium and low stages the flow is oblique to the cableway, and over much of the section the river flows rapidly at shallow depth over a shingle bank. At these stages measurements are made at the boat station, where the cross section and flow characteristics are good.

The control consists of a shingle bar which starts below the cableway and extends downstream. Movement of the shingle bar and, possibly, the growth of aquatic vegetation in the summer season result in shifting of the stage-discharge relation, particularly at low flows.

KHAZIR RIVER AT MANQUBA

Location. Lat. 36°18' N., long. 43°33' E., elevation 250 m., at bridge on Mosul-Erbil highway.

Description of installation. The internal staff gage consists of eight one-meter gage plates fixed inside the gage well of the automatic water-stage recorder. An external staff gage, installed by the D. G. I. (Director General of Irrigation) in 1943, is fixed to the downstream side of the left pier of the former bridge, except for the lowest one-meter length, which is fixed to an upright steel beam two meters away.

The recorder gage well is constructed of 1.22-meter-diameter corrugated steel piping built up in sections and is attached to the downstream end of the left central pier of the bridge. The recorder well is founded on a concrete slab (1.5 x 1.5 x 1.0 meters) set in the river bed at gage height

-0.3 meters. The lowest intake consists of a three-inch-diameter pipe at gage height 0.8 meters. No further intake pipes are required as there are small apertures at each of the pipe section joints of the recorder well. An access door is provided near the base of the well. A steel ladder is fixed inside the well. The floor of the recorder house is at gage height eight meters. A flushing tank and valve are provided on the intake pipe. The gage is set to G.T.S. (Greater Trigonometric Survey) datum.

LESSER ZAB AT DOKAN FERRY

Location. Lat. 35°53' N., long. 44°58' E., elevation approx. 410 m.

Description of installation. The internal staff gage consists of eight one-meter gage plates fixed inside the gage well of the automatic water-stage recorder on the left bank. An external staff gage is to be added.

The former gage, installed by the D.G.I. in 1952, is one kilometer upstream from the present gage and consists of eight one-meter gage plates fixed to steel beams. The lowest gage plate is driven into the river bed, and the others are set in concrete steps on the left bank.

The recorder house, constructed of hollow precast concrete blocks, surmounts a 1.2-meter-diameter well of corrugated steel piping.

The lower intake pipe, of three-inch diameter, is at gage height 0.3 meters and is 21 meters long. The upper three-inch intake pipe passes through the wall of the recorder well at gage height 0.6 meters. A one-meter-square access door is provided near the base of the well, and a steel ladder inside the well extends from the recorder house to the base of the well. A four-meter long walkway gives access to the recorder house from the roadway. The floor of the recorder house is at gage height ten meters. A flushing tank and valves on both intake pipes are provided.

The gage heights at the new gage are referred to an arbitrary datum, the level of the junction between the recorder house and recorder well being specified as gage height 8.0 meters. A contractor's bench mark on a culvert at the bend of the old road between the new gage and the main road to the dam is at a known elevation with reference to the arbitrary datum. The difference in elevation between this reference point and a G.T.S. bench mark beside the D.G.I. gage (near the cableway) is known, but the elevation of the G.T.S. bench mark is as yet unknown.

The 150-meter-span cableway for discharge measurements is situated ten meters upstream from the D. G. I. staff gage. The cable is supported by steel masts six meters high on each bank. Both ends of the cable are anchored in concrete. The landing platform and traversing winch are on the left bank.

Flow characteristics and control. Flow characteristics at the cableway are adequate, with flow concentrated towards the right bank. At very high stages some flow would by-pass the left-bank cableway mast, but such conditions are unlikely since the construction of Dokan Dam. The control, consisting of a distinct riffle about 50 meters downstream from the cableway, is adequate at all stages though owing to its wide, almost horizontal crest it is somewhat insensitive at low stages.

LESSER ZAB RIVER AT GOMA ZERDALA

Location. Lat. 35°47' N., long. 44°11' E., elevation approx. 255 m.

Description of installation. The internal staff gage consists of ten one-meter gage plates fixed inside the gage well of the automatic water-stage recorder on the right bank. The external staff gage consists of one-meter gage plates fixed to the downstream face of the recorder tower, with the lowest four one-meter plates attached to steel beams grouted into the rock.

The recorder house and gage well are constructed of concrete bricks with angle-iron bracing at the corners. The lowest intake pipe of three-inch diameter, lies at gage height 0.5 meters and is three meters long. An additional two-inch intake pipe passes through the wall of the gage well at gage height 1.5 meters. An eight-inch-diameter pipe stub is provided in the middle of the downstream face near the base of the well; through it a suction hose can be passed for the removal of silt from the well. This pipe is normally covered with a steel plate on the outside. A 60-centimeter-square access door in the upstream face was provided in January 1959. A steel ladder is fixed to the outside of the well, and a six-meter-long walkway gives access to the recorder house from the river bank. The floor of the recorder house is at gage height nine meters. A flushing tank and valve are provided on the lowest intake pipe.

Gage heights are referred to an arbitrary datum. There is a bench mark at the left-bank abutment of the railroad bridge downstream from the gage.

Near the gage a concrete block used as the H. S. I. reference point has not yet been leveled.

The 180-meter-span cableway for discharge measurements is situated ten meters downstream of the recorder tower. The cable is supported by a 4.5-meter-high steel A-frame on the right bank and a nine-meter-high steel mast on the left bank. The landing platform and traversing winch are on the right bank.

Flow characteristics and control. The gage and cableway are on a slight bend to the left in the river. The left bank shelves gently into the river from a high, almost level shingle flood plain about 200 meters wide at the gage height of about two meters. The right bank, into which the recorder tower is built, consists of conglomerate and forms a cliff. Maximum depth and velocity occur near the right bank. The flow characteristics and cableway section are good for discharge measurement at all stages. At very high stages it is possible that a small flow will bypass the left bank cableway tower, but since the completion of Dokan Dam this is unlikely.

The control consists of a shingle bank across the river about one kilometer downstream of the recorder tower. The control is considered to be fairly stable though small shifts may occur.

TIGRIS RIVER AT FATHA

Location. Lat. 35°03' N., long. 43°33' E., elevation approx. 110 m.

Description of installation. Two gages are in current use for the computation of daily discharge, the gage on the transporter of the I. P. C. (Iraq Petroleum Company) and the automatic water stage recorder gage. There are also two other gages, the I. P. C. gage and the D. G. I. gage, which are no longer used for discharge computation.

The transporter gage consists of nine one-meter gage plates fixed to the downstream, shoreward corner of the right pier of the transporter. The automatic gage is located on the right bank about three kilometers upstream of the transporter gage. The internal gage consists of eight one-meter gage plates fixed inside the well. The lowest three one-meter gage plates of the external gage at the recorder site are fixed to steel beams

grouted in rock about 100 meters from the gage well; the plates for gage heights 3.0 to 6.0 meters are fixed to steel beams grouted into a rock platform about 60 meters upstream from the recorder well; and the plates for gage heights 6.0 to 8.0 meters are fixed to the downstream face of the well.

The recorder house and gage well are constructed of concrete brick. The excavated section of the gage well is lined with corrugated steel pipe backfilled with concrete.

The lowest intake pipe, of three-inch diameter, is at gage height 0.3 meters and is 30 meters long. An additional two-inch intake pipe passes through the wall of the recorder tower at gage height six meters. A 60-centimeter-square access door is provided near the base of the tower in the side facing the river. A steel ladder is fixed to the inside of the tower. The recorder house is approached by a 13-meter-long walkway from the river bank. The floor of the recorder house is at gage height ten meters. A flushing tank and valve are provided on the lowest intake pipe.

Gage heights at both transporter and stage recorder gages are referred to G. T. S. datum. A bench mark exists on the pier of the transporter.

Discharge measurements at Fatha are made by arrangement with the I. P. C. from its 400-meter-span cableway. The cable is supported by two steel towers 30 meters high and is designed for a maximum working load of two and a quarter tons. A car has been provided by the H. S. I. for discharge measurements. The car is traversed, raised, and lowered by a diesel engine on the right bank.

Flow characteristics and control. The stage-discharge relationship at the transporter gage is controlled by the river channel conditions for an indeterminate distance downstream from the gage. The relationship for the recorder gage is controlled in part by a gradual riffle near the upstream end of a shingle island about one kilometer downstream from the gage.

ADHAIM RIVER AT THE NARROWS

Location. Lat. 34°30' N., long. 44°31' E.

Description of installation. The internal staff gage consists of ten one-meter gage plates fixed inside the gage well of the automatic water-stage

recorder on the left bank. The external staff gage consists of one-meter gage plates fixed to the sandstone cliff, except for the lowest two plates, which are fixed to steel beams set in concrete in the river bed.

The recorder well is excavated in the sandstone cliff and lined with a corrugated steel pipe 1.22 meters in diameter. The brick gage house is on the top of the cliff.

The lowest intake pipe, of three-inch diameter, lies at gage height 0.5 meters and is 20 meters long. An additional three-inch intake pipe passes through the wall of the recorder well at gage height four meters. A steel ladder is fixed on the inside of the gage well. The floor of the recorder house is at gage height ten meters. A flushing tank and valve are provided on the lowest intake pipe.

Gage heights are referred to an arbitrary datum. A concrete block used by H.S.I. as a reference point is situated to the left of the gage house entrance.

The 300-meter-span class-I cableway for discharge measurements is situated 30 meters downstream of the recorder tower. The cable is supported by two steel towers 18 meters high and is designed for a maximum operating load of two and a quarter tons. The car is traversed, raised, and lowered by a diesel engine. The landing platform and traversing winch are housed on the left bank. Low flows are measured by wading at a point about 400 meters upstream of the gage.

Flow characteristics and control. The observed discharge of the Adhaim River varies from zero flow to about 3000 cumecs, and changes in stage occur very rapidly. The river flows over soft silts and small shingle, and it is impossible to find a gage and discharge site fulfilling all requirements. The present site is the best that could be found and replaces that at Injana, four kilometers downstream. The river is confined at all stages between high banks; the approach channel is fairly straight and uniform for 500 meters upstream of the cableway. The bed is of pebbles and sand, and the cableway measuring section is good except at very low stages, when measurements are made by wading.

Control is provided by the river channel downstream of the gage at medium and high stages and by a riffle, or break in slope in the river bed, 400 meters downstream at low stages. Shifts in the control occur, affecting the stage-discharge relation, particularly at very low stages.

DIYALA RIVER AT DERBEND-I-KHAN

Location. Lat. 35°08' N., long. 45°45' E., elevation ("D" gage) 375 m.

Description of installation. The former ("D") gage consisted of three one-meter gage plates bolted to steel beams set in concrete on the right bank about one-half kilometer downstream from the dam site. This site was affected and the gage destroyed in 1957 by construction activities in connection with Derbend-i-Khan dam. A temporary ("E") gage was installed about 1.2 kilometers further downstream and will be in use until "D" gage site is again clear. The installation of the automatic water-stage recorder at "D" gage is delayed until the site is clear. "E" gage consists of eight overlapping two-meter gage plates bolted to angle irons set in concrete.

A correction of 1.81 meters must be added to the gage heights read on both "D" and "E" gages to convert to G.T.S. datum. A bench mark set at G.T.S. elevation 372.68 meters is situated near the old D.G.I. building.

The 135-meter-span cableway for discharge measurements is situated 40 meters upstream of "D" gage. The cable is supported by a reinforced anchor block set in the cliff on the right bank and by a steel A-frame on the left bank. The landing platform and traversing winch are on the right bank.

Flow characteristics and control. The control section for "D" gage site consists of a well-defined riffle on both sides of an island downstream from the site. This riffle will be very unstable until completion of construction activities at the dam site. The control for the "E" gage site is a long riffle of shingle downstream from the site.

ANNEX A-2

OBSERVATIONS OF SUSPENDED SEDIMENT

KHABOUR RIVER AT ZAKHO

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1958							
3 July	36	1			65	40	0.12
		2			22		
		3			32		
16 July	23	1			51	31	0.062
		2			24		
		3			17		
31 July	16	1			15	22	0.030
		2			21		
		3			29		
14 Aug.	13	1			36	47	0.053
		2			61		
		3			45		
31 Aug.	14	1			22	20	0.024
		2			15		
		3			22		
1959							
17 Mar.	58	1	293	960	1253		
		2			386		
		3			626		
18 Mar.	87	1	307	792	1099		
		2	259	861	1120		
		3	247	873	1120		

Note 1: Measured from left bank water's edge;
Vertical 1 is 1/4 distance across river;
Vertical 2 is 1/2 distance across river;
Vertical 3 is 3/4 distance across river.

2: Particles larger than 0.05 mm diameter designated coarse, smaller designated fine.

OBSERVATIONS OF SUSPENDED SEDIMENT

KHABOUR RIVER AT ZAKHO (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1959							
19 Mar.	74	1			517		
		2			587		
		3			681		
22 Mar.	60	1			168		
		2			148		
		3			187		
23 Mar.	93	1	126	1522	1648		
		2	107	1855	1962		
		3	151	1630	1781		
24 Mar.	75	1			281		
		2			296		
		3			255		
15 Dec. 1/	11	1			48		
		2			34		
		3			29		
1960							
10 Jan.	53	1	45	1800	1845		
		2	78	2026	2104		
		3	58	1777	1835		
16 Jan.	19	1			128		
		2			185		
		3			284		
18 Jan.	29	1			46		
		2			24		
		3			35		

1/ Data for the Tigris and its tributaries after completion of H. S. I. field work in the spring of 1959 are furnished through the courtesy of the Irrigation Directorate.

OBSERVATIONS OF SUSPENDED SEDIMENT

KHABOUR RIVER AT ZAKHO (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1960							
22 Feb.	54	1			276		
		2			234		
		3			247		
27 Feb.	41	1			109		
		2			86		
		3			108		
16 Apr.	259	1	-	-	-		
		2	252	1452	1704		
		3	213	2484	2697		
14 May	218	1	1358	551	1909		
		2	1507	513	2020		
		3	636	589	1225		
3 July	22	1			71		
		2			72		
		3			63		
25 July	14	1			106		
		2			76		
		3			43		
10 Sept.	9	1			41		
		2			30		
		3			35		
12 Nov.	10	1			94		
		2			46		
		3			64		
20 Nov.	35	1	45	2118	2163		
		2	117	1981	2098		
		3	85	1932	2017		

OBSERVATIONS OF SUSPENDED SEDIMENT

KHABOUR RIVER AT ZAKHO (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1961							
10 May		1			698		
		2			968		
		3			1093		
17 May	175	1			1117		
		2			891		
		3			879		
13 Aug.	9	1			33		
		2			29		
		3			67		
17 Oct.	9	1			18		
		2			16		
		3			34		
17 Nov.	10	1			30		
		2			19		
		3			41		
22 Nov.	206	1	2709	3117	5826		
		2	885	4500	5385		
		3	1659	4634	6293		
26 Nov.	20	1			61		
		2			97		
		3			39		
9 Dec.	22	1	113	3992	4105		
		2	93	4264	4357		
		3	99	4366	4465		

OBSERVATIONS OF SUSPENDED SEDIMENT

KHABOUR RIVER AT ZAKHO (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1961							
15 Dec.	157	1	264	3139	3403		
		2	393	3750	4143		
		3	432	4253	4685		
21 Dec.	22	1			13		
		2			21		
		3			18		
25 Dec.	46	1			99		
		2			102		
		3			152		
1962							
3 Jan.	24	1			22		
		2			23		
		3			12		
6 Jan.	61	1			293		
		2			328		
		3			349		
10 Jan.	47	1			67		
		2			21		
		3			80		
17 Jan.	32	1			9		
		2			252		
		3			7		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT TUSAN

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1958							
29 Jan.	1570	2			2980	2980	404
23 Feb.	914	1			1370	1833	145
		2			1710		
		3			2420		
24 Feb.	1180	1			1060	1490	152
		2			1320		
		3			2090		
5 Mar.	1560	1			4430	4403	593
		2			4080		
		3			4700		
10 Mar.	2000	1			5060	5980	1030
		2			6140		
		3			6740		
25 Mar.	2260	1			2800	4333	846
		2			5600		
		3			4600		
20 Apr.	1930	1	880	1549	2429	2266	378
		2	1000	1185	2185		
		3	846	1337	2183		
3 July	327	1			72	84	2.37
		2			84		
		3			97		
17 July	243	1			57	66	1.39
		2			75		
		3			67		

Note: Particles larger than 0.05 mm diameter designated coarse, smaller designated fine.

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT TUSAN (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1958							
31 July	191	1			69	64	1.06
		2			75		
		3			49		
14 Aug.	164	1			76	74	1.05
		2			80		
		3			67		
31 Aug.	143	1			32	39	0.48
		2			46		
		3			40		
14 Sept.	137	1			37	41	0.49
		2			47		
		3			38		
2 Oct.	141	1			42	38	0.46
		2			41		
		3			30		
23 Oct.	135	1			24	28	0.33
		2			34		
		3			25		
18 Nov.	150	1			34	48	0.62
		2			72		
		3			39		
9 Dec.	940	1	739	3793	4532	4356	354
		2	675	3675	4350		
		3	528	3658	4186		
1959							
5 Feb.	410	1			209		
		2			206		
		3			216		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT TUSAN (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1959							
18 Feb.	254	1			98		
		2			72		
		3			71		
8 Mar.	376	1			516		
		2			579		
		3			330		
14 Mar.	671	1	84	1434	1518		
		2	72	974	1046		
		3	630	6842	7472		
4 Apr.	964	1			754		
		2			124		
		3			434		
6 Apr.	1914	1	473	1387	1860		
		2			3417		
		3	228	2127	2355		
15 Apr.	1768	1	959	2450	3409		
		2	593	2226	2819		
		3	118	1610	1728		
2 Aug.	182	1			19		
		2			164		
		3			106		
31 Aug.	115	1			150		
		2			64		
		3			120		
28 Sept.	158	1			213		
		2			165		
		3			220		
27 Oct.	298	1	52	6136	6188		
		2	46	6870	6916		
		3	52	7726	7778		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT TUSAN (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1959							
16 Nov.	161	1			87		
		2			66		
		3			53		
20 Dec.	150	1			81		
		2			77		
		3			66		
1960							
21 Jan.	471	1			461		
		2			582		
		3			750		
13 Feb.	394	1			187		
		2			142		
		3			188		
9 Mar.	1940	1	630	3583	4213		
		2	703	4654	5357		
		3	206	8664	8870		
16 Mar.	684	1			231		
		2			242		
		3	714	429	1143		
6 Apr.	1565	1	551	1134	1685		
		2	904	4665	5569		
		3			493		
13 Apr.	1498	1	309	907	1216		
		2	311	1012	1323		
		3	867	1157	2024		
27 Apr.	2521	1	1381	1696	3077		
		2	1789	4079	5868		
		3	6068	6046	12 114		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT TUSAN (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
28 May	794	1			381		
		2			353		
		3			772		
3 Aug.	152	1			119		
		2			107		
		3			61		
3 Aug.	152	1			234		
		2			397		
		3			52		
1961							
14 Mar.	252	1			78		
		2			101		
		3			130		
23 Mar.	1073	1			847		
		2			737		
		3	638	787	1425		
23 Nov.	1314	1	294	6046	6340		
		2	390	5795	6185		
		3	503	6733	7236		
10 Dec.	300	1	70	1041	1111		
		2	104	1144	1248		
		3	149	1080	1229		
12 Dec.	901	1	308	3102	3410		
		2	387	3030	3417		
		3	351	3532	3883		
15 Dec.	1818	1	359	4631	4990		
		2	473	5103	5576		
		3	515	8342	8857		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT TUSAN (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1961							
17 Dec.	1263	1	314	2968	3282		
		2	325	3109	3434		
		3	184	2646	2830		
19 Dec.	669	1			785		
		2			814		
		3			804		
1962							
5 Jan.	1389	1	108	4669	4777		
		2	24	3676	3700		
		3	207	4111	4318		
12 Jan.	510	1			75		
		2			99		
		3			158		
28 Jan.	350	1			119		
		2			86		
		3			26		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT MOSUL

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1958							
6 Oct.	139	1			31		
					39		
					69		
		2			42		
					51		
					41		
		3			44		
					36		
					19		
		4			204		
					41		
					95		
11 Nov.	191	1			62		
					115		
					56		
		2			67		
					73		
					101		
		3			66		
					72		
					73		
		4			74		
					78		
					70		
9 Dec.	287	1			105		
					95		
					78		

Note: Particles larger than 0.05 mm diameter designated coarse, smaller designated fine.

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT MOSUL (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1958							
9 Dec.		2			162		
					171		
					157		
		3			156		
					146		
					139		
		4			92		
					105		
					106		
11 Dec.	1524	1	131	3099	3230		
			281	5521	5802		
			657	4604	5261		
		2	370	3359	3729		
			356	3435	3791		
			356	3360	3716		
		3	375	3418	3793		
			373	3340	3713		
			382	3368	3750		
		4	287	3421	3708		
			241	3291	3532		
			373	3545	3918		
1959							
11 Jan.	967	1	246	2845	3091		
			182	2985	3167		
			176	2987	3163		
		2	178	2916	3094		
			175	2940	3115		
			237	2970	3207		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT MOSUL (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1959							
11 Jan.		3	223	2885	3108		
			159	2874	3033		
			153	2838	2991		
		4	232	2859	3091		
			182	2826	3008		
			643	2251	2894		
17 Feb.	356	1			69		
					75		
					72		
		2			105		
					88		
					58		
		3			83		
					60		
					85		
		4			83		
					59		
					94		
19 Mar.	1502	1	203	1987	2190		
			205	1966	2171		
			183	1977	2160		
		2	411	1937	2348		
			381	2067	2448		
			147	1843	1990		
		3	112	1490	1602		
			527	2219	2746		
			362	2010	2372		
		4	277	2022	2299		
			291	2037	2328		
			83	1904	1987		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT MOSUL (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1959							
17 Apr.	3121	1	661	3435	4096		
			556	3919	4475		
			448	3409	3857		
		2	309	3449	3758		
			404	3580	3984		
			655	3681	4336		
		3	382	3585	3967		
			630	3560	4190		
			792	3918	4710		
		4	487	3574	4061		
			381	3459	3840		
			473	3458	3931		
14 June	679	1			241		
					246		
					214		
		2			213		
					230		
					246		
		3			234		
					231		
					237		
		4			219		
					242		
					246		
20 Sept.	144	1			19		
					19		
					8		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT MOSUL (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1959							
20 Sept.	144	2			46		
					50		
					37		
		3			32		
					8		
					39		
		4			40		
					41		
					20		
11 Oct.	139	1			55		
					172		
					275		
		2			97		
					64		
					61		
		3			75		
					58		
					28		
		4			84		
					66		
					108		
27 Oct.	244	1			163		
					160		
					150		
		2			160		
					185		
					172		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT MOSUL (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1959							
27 Oct.		3			160		
					121		
					122		
		4			115		
					101		
					96		
15 Nov.	221	1			65		
					49		
					55		
		2			62		
					49		
					67		
		3			34		
					49		
					57		
3 Dec.	178	1			43		
					21		
					28		
		2			41		
					32		
					41		
		3			34		
					32		
					43		
19 Dec.	180	1			6		
					36		
					23		
		2			13		
					15		
					8		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT MOSUL (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1959							
19 Dec.		3			23		
					8		
					39		
1960							
9 Jan.	453	1			903		
					884		
					870		
		2			896		
					901		
					910		
		3			812		
					875		
					834		
		4			823		
					853		
					830		
6 Feb.	430	1			219		
					248		
					231		
		2			245		
					261		
					259		
		3			247		
					270		
					304		
		4			268		
					300		
					292		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT MOSUL (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
26 Feb.	910	1	62	1766	1828		
			78	1801	1879		
			106	1922	2028		
		2	103	1788	1891		
			69	1847	1916		
			100	1974	2074		
		3	51	1769	1820		
			76	1837	1913		
			91	1777	1868		
		4	49	1751	1800		
			87	1767	1854		
			76	1770	1846		
6 Mar.	663	1			288		
					269		
					275		
		2			294		
					289		
					297		
		3			296		
					310		
					296		
		4			311		
					308		
					295		
20 Mar.	532	1			129		
					154		
					207		
		2			172		
					177		
					204		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT MOSUL (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
20 Mar.		3			163		
					156		
					150		
		4			163		
					138		
					181		
6 Apr.	1545	1			762		
					985		
			277	810	1087		
		2	162	855	1017		
					952		
					978		
		3	124	979	1103		
			257	810	1067		
			330	756	1086		
		4			881		
					998		
			251	773	1024		
27 Apr.	2214	1	1167	1215	2382		
			194	1183	1377		
			284	1218	1502		
		2	178	1123	1301		
			407	1317	1724		
			283	1117	1400		
		3	186	1275	1461		
			136	1081	1217		
			295	1266	1561		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT MOSUL (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
27 Apr.		4	246	1306	1552		
			247	1309	1556		
			424	1385	1809		
10 May	1685	1			511		
					535		
					475		
		2			529		
					505		
					504		
		3			570		
					552		
					424		
		4			456		
					604		
					436		
15 June	374	1			215		
					139		
					131		
		2			95		
					158		
					207		
		3			138		
					127		
					105		
		4			137		
					185		
					101		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT MOSUL (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
11 July	213	1			93		
					77		
					78		
		2			117		
					75		
					181		
		3			89		
					149		
					102		
		4			99		
					106		
					238		
15 Aug.	115	1			74		
					150		
					866		
		2			164		
					48		
					72		
		3			239		
					122		
					152		
		4			174		
					245		
					77		
18 Sept.	104	2			26		
		3			49		
					63		
					72		
		4			57		
					31		
					46		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT MOSUL (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
23 Oct.	115	2			150		
		3			116		
					64		
					144		
		4			71		
					77		
					61		
15 Nov.	115	2			88		
		3			85		
					104		
					140		
		4			97		
					109		
					75		
1961							
22 Jan.	1020	1	159	3396	3555		
			222	5281	5503		
			447	5555	6002		
		2	599	5587	6186		
			517	5333	5850		
			448	5169	5617		
		3	503	5212	5715		
			612	5381	5993		
			516	5251	5767		
		4	368	5626	5994		
			339	5088	5427		
			342	5183	5525		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT MOSUL (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1961							
5 Feb.	226	1			34		
					43		
					45		
		2			56		
					55		
					50		
		3			61		
					485		
					68		
		4			64		
					98		
					68		
4 Apr.	908	1	96	1369	1465		
			60	1306	1366		
			90	1391	1481		
		2	73	1332	1405		
			97	1281	1378		
			137	1423	1560		
		3	129	1360	1489		
			107	1295	1402		
			102	1367	1469		
		4	60	1289	1349		
			92	1286	1378		
			190	1513	1703		
25 Apr.	1221	1			606		
					662		
					655		
		2			575		
					795		
					554		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT MOSUL (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1961							
25 Apr.		3			724		
					530		
					522		
		4			689		
					664		
					584		
9 May	1711	1	53	4277	4330		
			65	3141	3206		
			77	4557	4634		
		2	253	4978	5231		
			198	3451	3649		
			230	4154	4384		
		3	118	4359	4477		
			386	4635	5021		
			266	4450	4716		
		4	301	4328	4629		
			334	6177	6511		
			288	4402	4690		
11 June	453	1			167		
					246		
					194		
		2			181		
					179		
					162		
		3			178		
					186		
					221		
		4			181		
					184		
					169		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT MOSUL (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1961							
13 July	175	1			208		
					29		
					25		
		2			29		
					27		
					35		
		3			42		
					40		
					42		
		4			63		
					53		
					45		
30 July	135	1			38		
					29		
					51		
		2			36		
					48		
					29		
		3			34		
					34		
					51		
26 Aug.	103	2			72		
		3			26		
					30		
					38		
		4			21		
					34		
					19		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT MOSUL (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1961							
14 Sept.	97	2			84		
		3			58		
					95		
					78		
		4			50		
					67		
					71		
31 Oct.	107	1			32		
		2			37		
					36		
					32		
		3			30		
					30		
					42		
26 Nov.	484	1	159	2149	2308		
			221	1986	2207		
			189	2161	2350		
		2	137	2256	2393		
			157	2221	2378		
			209	2156	2365		
		3	237	2172	2409		
			253	2146	2399		
			223	2157	2380		
		4	147	2235	2382		
			144	2161	2305		
			186	2181	2367		
16 Dec.	1991	1	192	4631	4823		
			221	4707	4928		
			236	4854	5090		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT MOSUL (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1961							
16 Dec.		2	210	4829	5039		
			216	4810	5026		
			224	4618	4842		
		3	231	4746	4977		
			224	4938	5162		
			283	4853	5136		
		4	154	4586	4740		
			498	4830	5328		
			376	4908	5284		
1962							
14 Jan.	464	1			155		
					91		
					85		
		2			131		
					113		
					82		
		3			134		
					59		
					118		
		4			166		
					83		
					123		
12 Feb.	884	1			462		
					485		
					455		
		2			502		
					458		
					799		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT MOSUL (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1962							
12 Feb.		3			642		
					463		
					653		
		4			522		
					534		
					504		
22 Feb.	2960	1	136	6607	6743		
			245	7377	7622		
			188	6321	6509		
		2	299	6837	7136		
			303	6793	7096		
			173	6296	6469		
		3	129	6209	6338		
			358	6421	6779		
			206	6171	6377		
		4	154	6214	6368		
			245	6549	6794		
			190	6277	6467		
18 Mar.	1059	1			322		
					218		
					473		
		2			211		
					244		
					302		
		3			229		
					487		
					232		
		4			228		
					458		
					484		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT MOSUL (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1962							
7 Apr.	1681	1	50	991	1041		
			99	1091	1190		
			92	1077	1169		
		2	173	1106	1279		
			107	970	1077		
			82	1081	1163		
		3	123	1038	1161		
			82	967	1049		
			139	1119	1258		
		4	142	1096	1238		
			177	1124	1301		
			122	1085	1207		
30 Apr.	2040	1	240	2756	2996		
			159	2599	2758		
			142	2699	2841		
		2	252	2933	3185		
			407	2839	3246		
			416	2991	3407		
		3	277	2801	3078		
			290	2729	3019		
			137	2589	2726		
		4	319	3043	3362		
			413	2825	3238		
			386	2788	3174		
26 May	725	1			244		
					202		
					194		
		2			203		
					236		
					199		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT MOSUL (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1962							
26 May		3			311		
					186		
					261		
		4			221		
					208		
					227		
27 June	321	1			107		
					60		
					Broken		
		2			86		
					56		
					77		
		3			27		
					83		
					Broken		
		4			40		
					92		
					84		

OBSERVATIONS OF SUSPENDED SEDIMENT

RUWANDUZ RIVER AT RUWANDUZ

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1958							
4 Oct.	3.4	1			21	31	0.0091
		2			21		
		3			52		

OBSERVATIONS OF SUSPENDED SEDIMENT

RUWANDUZ RIVER AT JINDIAN

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1958							
30 Jan.	15	1			293	259	0.34
		2			267		
		3			261		
		4			225		
		5			249		
7 July	9.6	1			32	30	0.025
		2			31		
		3			28		
3 Aug.	5.2	1			54	42	0.019
		2			33		
		3			38		
2 Sept.	4.1	1			57	64	0.023
		2			71		
		3			65		
18 Sept.	3.5	1			45	42	0.013
		2			57		
		3			24		

Note: River divided into five sections of equal discharge.

Note 1: Measured from right bank water's edge;
Vertical 1 is 1/4 distance across river;
Vertical 2 is 1/2 distance across river;
Vertical 3 is 3/4 distance across river.

2: Particles larger than 0.05 mm diameter designated coarse, smaller designated fine.

OBSERVATIONS OF SUSPENDED SEDIMENT

RUWANDUZ RIVER AT JINDIAN (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1958							
21 Oct.	3.6	1			14	34	0.011
		2			39		
		3			48		
5 Nov.	4.2	1			25	30	0.011
		2			24		
		3			41		
22 Nov.	3.8	1			28	16	0.0053
		2			3		
		3			17		
25 Dec.	6	1			29		
		2			30		
		3			29		
1959							
1 Jan.	5	1			62		
		2			51		
		3			43		
11 Feb.	5	1			45		
		2			43		
		3			87		
25 Feb.	8	1			45		
		2			116		
		3			104		
8 Mar.	7	1			55		
		2			41		
		3			50		
22 Mar.	28	1			450		
		2			471		
		3			459		

OBSERVATIONS OF SUSPENDED SEDIMENT

RUWANDUZ RIVER AT JINDIAN (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1959							
7 Apr.	64	1			549		
		2			444		
		3			454		
15 Apr.	97	1	206	2527	2733		
		2	166	2483	2649		
		3	148	2640	2788		
2 Aug.	8	1			68		
		2			43		
		3			35		
31 Aug.	5	1			49		
		2			33		
		3			40		
2 Oct.	3	1			43		
		2			24		
		3			44		
21 Nov.	4	1			29		
		2			12		
		3			25		
1960							
14 Jan.	5	1			10		
		2			10		
		3			47		
1 Feb.	6	1			194		
		2			14		
		3			21		
22 Feb.	34	1			849		
		2			744		
		3			893		

OBSERVATIONS OF SUSPENDED SEDIMENT

RUWANDUZ RIVER AT JINDIAN (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
8 Mar.	17	1			34		
		2			34		
		3			23		
23 Mar.	43	1			740		
		2			886		
		3			675		
12 Apr.	48	1	121	1121	1242		
		2	82	1229	1311		
		3	100	1166	1266		
24 Apr.	55	1			335		
		2			274		
		3			272		
7 May	61	1			355		
		2			370		
		3			24		
23 May	42	1			173		
		2			145		
		3			126		
22 June	24	1			118		
		2			133		
		3			121		
16 July	9	1			31		
		2			32		
		3			61		
8 Sept.	4	1			72		
		2			47		
		3			40		
5 Oct.	3	1			47		
		2			64		
		3			14		

OBSERVATIONS OF SUSPENDED SEDIMENT

RUWANDUZ RIVER AT JINDIAN (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
21 Nov.	9	1			91		
		2			77		
		3			113		
28 Nov.	28	1	103	1656	1759		
		2	53	1796	1849		
		3	85	1628	1713		
1961							
2 Mar.	14	1			96		
		2			75		
		3			110		
15 Mar.	11	1			100		
		2			74		
		3			82		
13 Apr.	47	1			954		
		2			1160		
		3			805		
25 Apr.	69	1			52		
		2			95		
		3			97		
29 Apr.	92	1	102	2000	2102		
		2	103	2215	2318		
		3	445	1640	2085		
25 Dec.	14	1			134		
		2			76		
		3			120		
1962							
26 Jan.	10	1			74		
		2			23		
		3			79		

OBSERVATIONS OF SUSPENDED SEDIMENT

RUWANDUZ RIVER AT JINDIAN (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1962							
4 Feb.	51	1			397		
		2	258	1846	2104		
		3	103	2319	2422		
24 Feb.	22	1			66		
		2			61		
		3			172		
20 Mar.	44	1			458		
		2			401		
		3			339		
3 Apr.	43	1			315		
		2			307		
		3			306		
19 Apr.	50	1			136		
		2			139		
		3			181		
22 May	56	1			198		
		2			185		
		3			252		
17 June	32	1			142		
		2			112		
		3			187		

OBSERVATIONS OF SUSPENDED SEDIMENT

BALIKIAN RIVER AT BALIKIAN

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1958							
8 July	2.6	1			27	31	0.0070
		2			29		
		3			37		
4 Aug.	1.2	1			41	68	0.0071
		2			57		
		3			107		
1 Sept.	0.8	1			421	414	0.029
		2			406		
		3			414		
17 Sept.	0.8	1			140	139	0.0096
		2			126		
		3			150		
5 Oct.	0.8	1			109	107	0.0074
		2			110		
		3			103		
20 Oct.	1.0	1			83	92	0.0079
		2			87		
		3			106		
24 Nov.	1.4	1			17	27	0.0033
		2			36		
		3			27		

Note 1: Measured from right bank water's edge;
Vertical 1 is 1/4 distance across river;
Vertical 2 is 1/2 distance across river;
Vertical 3 is 3/4 distance across river.

2: Particles larger than 0.05 mm diameter designated coarse, smaller designated fine.

OBSERVATIONS OF SUSPENDED SEDIMENT

BALIKIAN RIVER AT BALIKIAN (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1958							
10 Dec.	20.2	1			503		
		2			545		
		3			569		
11 Dec.	18.6	1			114		
		2			161		
		3			235		
27 Dec.	3	1			27		
		2			21		
		3			22		
1959							
2 Jan.	3	1			45		
		2			20		
		3			28		
20 Jan.	10	1			93		
		2			110		
		3			121		
12 Feb.	4	1			64		
		2			34		
		3			45		
9 Mar.	12	1			17		
		2			64		
		3			49		
23 Mar.	70	1			453		
		2			913		
		3			756		
23 Apr.	28	1			293		
		2			289		
		3			301		

OBSERVATIONS OF SUSPENDED SEDIMENT

BALIKIAN RIVER AT BALIKIAN (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
1 Feb.	9	1			6		
		2			15		
		3			27		
23 Feb.	28	1			104		
		2			75		
		3			75		
26 Mar.	45	1			109		
		2			72		
		3			102		
13 Apr.	46	1			316		
		2			174		
		3			188		
25 Apr.	46	1			488		
		2			50		
		3			434		
8 May	39	1			575		
		2			493		
		3			213		
24 May	29	1			446		
		2			519		
		3			279		
21 June	11	1			77		
		2			63		
		3			43		
15 July	4	1			52		
		2			40		
		3			42		
9 Sept.	1	1			53		
		2			47		
		3			51		

OBSERVATIONS OF SUSPENDED SEDIMENT

BALIKIAN RIVER AT BALIKIAN (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
6 Oct.	1	1			45		
		2			42		
		3			25		
22 Nov.	5	1			70		
		2			48		
		3			41		
27 Nov.	6	1	85	1731	1816		
		2	73	1677	1750		
		3	63	1783	1846		
1961							
3 Mar.	31	1			94		
		2			86		
		3			67		
16 Mar.	33	1			53		
		2			74		
		3			53		
13 Apr.	36	1			555		
		2			446		
		3			313		
25 Apr.	98	1	526	3326	3852		
		2	124	3355	3479		
		3	321	3264	3585		
30 Apr.	100	1	896	4066	4962		
		2	530	4073	4603		
		3	429	5632	6061		
1962							
6 Jan.	51	1			263		
		2			338		
		3			342		

OBSERVATIONS OF SUSPENDED SEDIMENT

BALIKIAN RIVER AT BALIKIAN (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1962							
8 Feb.	79	1			925		
		2			1744		
		3			727		
20 Mar.	35	1			211		
		2			127		
		3			145		
8 Apr.	46	1			215		
		2			319		
		3			251		
3 May	39	1			177		
		2			190		
		3			193		
28 May	24	1			146		
		2			108		
		3			272		
18 June	13	1			96		
		2			69		
		3			38		

OBSERVATIONS OF SUSPENDED SEDIMENT

GREATER ZAB RIVER AT IFRAZ

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1958							
25 Mar.	735	1			631	664	42.2
					650		
					695		
		2			636		
					828		
					730		
		3			583		
					595		
					624		

Note: Sampling depths 1/2 meter from surface, mid-depth, and 1/2 meter from bottom.

22 Apr.	683	1			55	125	7.38
		2			124		
		3			195		
17 May	676	1			446	484	28.3
		2			502		
		3			505		
11 June	379	1			160	143	4.68
		2			140		
		3			130		
18 June	325	1			49	60	1.68
		2			68		
		3			62		

Note: Measured from left bank water's edge;
Vertical 1 is 1/4 distance across river;
Vertical 2 is 1/2 distance across river;
Vertical 3 is 3/4 distance across river.

OBSERVATIONS OF SUSPENDED SEDIMENT

GREATER ZAB RIVER AT IFRAZ (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1958							
25 June	270	1			43	77	1.80
		2			63		
		3			125		
8 July	212	1			46	51	0.93
		2			60		
		3			46		
23 July	168	1			403	256	3.72
		2			100		
		3			265		
7 Aug.	146	1			37	37	0.47
		2			41		
		3			32		
3 Sept.	119	1			197	201	2.07
		2			220		
		3			185		
20 Sept.	99	1			67	77	0.66
		2			91		
		3			72		
7 Oct.	98	1			29	30	0.25
		2			35		
		3			26		
19 Oct.	94	1			17	23	0.19
		2			30		
		3			22		
9 Nov.	103	1			22	27	0.24
		2			23		
		3			37		
27 Nov.	91	1			11	19	0.15
		2			30		
		3			15		

OBSERVATIONS OF SUSPENDED SEDIMENT

GREATER ZAB RIVER AT IFRAZ (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1958							
13 Dec.	165	1			104		
		2			52		
		3			101		
20 Dec.	613	1			609		
		2			221		
		3			217		
1959							
11 Feb.	514	1			73		
		2			750		
		3			55		
23 Feb.	105	1			56		
		2			64		
		3			122		
24 Mar.	544	1			593		
		2			778		
		3			580		
19 May	1168	1			481		
		2			5381		
		3			546		
26 July	135	1			60		
		2			52		
		3			68		
1 Sept.	126	1			11		
		2			59		
		3			52		
20 Sept.	107	1			11		
		2			15		
		3			40		

OBSERVATIONS OF SUSPENDED SEDIMENT

GREATER ZAB RIVER AT IFRAZ (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1959							
2 Nov.	117	1			21		
		2			34		
		3			88		
20 Dec.	105	1			16		
		2			81		
		3			16		
1960							
31 Jan.	156	1			182		
		2			74		
		3			46		
21 Feb.	342	1			46		
		2			82		
		3			75		
2 Apr.	671	1			501		
		2			368		
		3			500		
19 Apr.	965	1			662		
		2			702		
		3			714		
26 Apr.	1160	1			578		
		2			588		
		3			538		
12 May	774	1			61		
		2			73		
		3			176		
1961							
15 Oct.	73	1			85		
		2			263		
		3			33		
9 Nov.	96	1			26		
		2			21		
		3			21		

OBSERVATIONS OF SUSPENDED SEDIMENT

GREATER ZAB RIVER AT IFRAZ (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1961							
17 Dec.	277	1			101		
		2			119		
		3			142		
1962							
28 Jan.	209	1			86		
		2			77		
		3			36		
18 Feb.	367	1			212		
		2			205		
		3			263		
8 Apr.	594	1			120		
		2			170		
		3			190		
23 Apr.	484	1			123		
		2			123		
		3			100		

OBSERVATIONS OF SUSPENDED SEDIMENT

KHAZIR RIVER AT MANQUBA

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1959							
22 Mar.	53	1			221		
		2			166		
		3			153		
30 Mar.	35	1			111		
		2			117		
		3			60		
20 Apr.	25	1			87		
		2			98		
		3			123		
1961							
24 Dec.	314	1	67	4315	4382		
		2	27	4242	4269		
		3	24	4378	4402		
25 Dec.	70	1			256		
		2			266		
		3			278		
1962							
27 Jan.	35	1			364		
		2			371		
		3			346		
24 Apr.	22	1			100		
		2			40		
		3			80		

Note: Particles larger than 0.05 mm diameter designated coarse, smaller designated fine.

OBSERVATIONS OF SUSPENDED SEDIMENT

LESSER ZAB RIVER AT DOKAN

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1958							
19 Mar.	208	1			215	199	3.58
		2			175		
		3			206		
8 Apr.	229	1			91	151	2.99
		2			179		
		3			184		
30 Apr.	172	1			154	148	2.20
		2			135		
		3			156		
16 June	83	1			101	108	0.77
		2			104		
		3			119		

Note: Measured from left bank water's edge;
Vertical 1 is 1/4 distance across river;
Vertical 2 is 1/2 distance across river;
Vertical 3 is 3/4 distance across river.

OBSERVATIONS OF SUSPENDED SEDIMENT

LESSER ZAB RIVER AT GOMA ZERDALA

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1958							
17 June	96	1			115	120	1.00
		2			109		
		3			135		
21 July	46	1			35	49	0.19
		2			55		
		3			57		
31 July	42	1			39	40	0.15
		2			40		
		3			40		
13 Aug.	35	1			51	47	0.14
		2			37		
		3			53		
1 Sept.	30	1			34	32	0.083
		2			33		
		3			29		
20 Sept.	29	1			57	37	0.093
		2			28		
		3			27		
6 Oct.	28	1			21	23	0.056
		2			21		
		3			28		
19 Oct.	31	1			55	45	0.12
		2			42		
		3			39		
3 Nov.	36	1			22	20	0.062
		2			30		
		3			9		

Note 1: Measured from right bank water's edge;
Vertical 1 is 1/4 distance across river;
Vertical 2 is 1/2 distance across river;
Vertical 3 is 3/4 distance across river.
2: Particles larger than 0.05 mm diameter designated coarse, smaller designated fine.

OBSERVATIONS OF SUSPENDED SEDIMENT

LESSER ZAB RIVER AT GOMA ZERDALA (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1958							
18 Nov.	40	1			31	44	0.15
		2			49		
		3			51		
2 Dec.	41	1			21	16	0.057
		2			13		
		3			15		
20 Dec.	176	1			172	163	2.48
		2			152		
		3			166		
1959							
11 Feb.	47	1			36	36	0.15
		2			36		
		3			37		
28 Feb.	68	1			660	760	4.47
		2	295	920	1215		
		3			404		
16 Mar.	75	1			109	123	0.80
		2			126		
		3			135		
23 Mar.	220	1	825	17,141	17,966	19,232	365
		2	1365	21,120	22,485		
		3	469	16,776	17,245		
15 Apr.	67	1			526	554	3.21
		2			565		
		3			572		
21 Apr.	51	1			102	97	0.43
		2			93		
		3			97		

OBSERVATIONS OF SUSPENDED SEDIMENT

LESSER ZAB RIVER AT GOMA ZERDALA (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1961							
7 May	45	1			940		
		2			596		
		3			749		
14 May	43	1			218		
		2			215		
		3			226		
15 Oct.	184	1			91		
		2			71		
		3			92		
5 Nov.	112	1	80	1557	1637		
		2	38	1699	1737		
		3	63	1500	1563		
25 Nov.	138	1			197		
		2			124		
		3			157		
16 Dec.	223	1	76	4283	4359		
		2	52	4178	4230		
		3	72	4352	4424		
1962							
14 Jan.	245	1			158		
		2			166		
		3			229		
29 Jan.	230	1			230		
		2			167		
		3			194		
10 Feb.	250	1			269		
		2			353		
		3			303		

OBSERVATIONS OF SUSPENDED SEDIMENT

LESSER ZAB RIVER AT GOMA ZERDALA (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1962							
24 Feb.	233	1			173		
		2			108		
		3			109		
26 Mar.	106	1			151		
		2			66		
		3			63		
22 Apr.	139	1	62	1723	1785		
		2	27	1863	1890		
		3	112	1515	1627		
19 May	104	1			143		
		2			131		
		3			254		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT FATHA

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1958							
26 Apr.	2330	1			611	932	188
		2			946		
			541	627	1168		
			584	800	1384		
		3			808		
					763		
					846		

Note: Sampling depths 1/2 meter from surface, mid-depth, and 1/2 meter from bottom.

9 June	1390	1	191	967	1158	1183	142
		2	228	1034	1262		
		3	179	951	1130		
16 June	1100	1			220	218	20.7
		2			247		
		3			187		
5 July	634	1			107	408	22.3
		2			700		
		3			416		
20 July	430	1			57	69	2.41
		2			82		
		3			67		
5 Aug.	334	1			164	144	4.16
		2			138		
		3			131		

Note 1: Measured from right bank water's edge;
Vertical 1 is 1/4 distance across river;
Vertical 2 is 1/2 distance across river;
Vertical 3 is 3/4 distance across river.

2: Particles larger than 0.05 mm diameter designated coarse, smaller designated fine.

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT FATHA (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1958							
17 Aug.	284	1			364	418	10.3
		2			269		
		3			621		
7 Sept.	268	1			87	103	2.38
		2			76		
		3			145		
28 Sept.	260	1			43	55	1.24
		2			90		
		3			32		
27 Oct.	264	1			35	52	1.19
		2			82		
		3			40		
11 Nov.	338	1			190	151	4.41
		2			125		
		3			138		
1959							
18 Feb.	476	1			29	46	
		2			49		
		3			59		
8 Mar.	770	1			354	300	
		2			323		
		3			223		
11 Mar.	601	1			338	218	
		2			171		
		3			145		
17 Mar.	1344	1			391	561	
		2			613		
		3			680		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT FATHA (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1959							
18 Mar.	1849	1			406	389	
		2			385		
		3			377		
19 Mar.	2145	1	145	1092	1237	1266	
		2	159	1074	1233		
		3	115	1212	1327		
2 Apr.	1563	1			314	353	
		2			316		
		3			429		
6 Apr.	3933	1	104	925	1029	1129	
		2	117	900	1017		
		3	81	1259	1340		
15 Apr.	2313	1			287	297	
		2			331		
		3			273		
17 Apr.	3591	1	111	2167	2278	2219	
		2	154	2000	2154		
		3	73	2153	2226		
19 Apr.	3037	1	71	973	1044	1041	
		2	74	981	1055		
		3	115	910	1025		
7 May	1748	1			140	135	
		2			139		
		3			126		
11 May	2216	1			396	353	
		2			373		
		3			291		
17 May	1770	1			275	235	
		2			233		
		3			197		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT FATHA (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1959							
24 May	2215	1			990	972	
		2			983		
		3			944		
27 Aug.	364	1			68	38	
		2			22		
		3			24		
6 Sept.	354	1			80	83	
		2			77		
		3			92		
19 Oct.	330	1			74	76	
		2			98		
		3			55		
1 Nov.	355	1			420	470	
		2			427		
		3			562		
16 Dec.	477	1			56	63	
		2			54		
		3			78		
1960							
12 Jan.	1118	1	55	974	1029	987	
		2			789		
		3	49	1093	1142		
26 Jan.	1148	1			620	640	
		2			667		
		3			633		
13 Feb.	722	1			82	116	
		2			132		
		3			135		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT FATHA (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
22 Feb.	881	1			185	218	
		2			238		
		3			230		
27 Feb.	1180	1	39	1205	1244	1615	
		2	65	1293	1358		
		3	73	2171	2244		
12 Mar.	1713	1	20	1846	1866	1319	
		2	65	1730	1795		
		3			296		
17 Mar.	1091	1			304	516	
		2			337		
		3			908		
2 Apr.	1408	1			148	154	
		2			195		
		3			120		
3 Apr.	1941	1			786	863	
		2			899		
		3			904		
12 Apr.	3070	1			362	302	
		2			271		
		3			274		
18 Apr.	2002	1			353	348	
		2			342		
		3			349		
27 Apr.	3119	1			448	347	
		2			406		
		3			188		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT FATHA (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
8 May	2925	1	343	1428	1771	881	
		2			390		
		3			481		
11 June	1023	1			159	153	
		2			142		
		3			157		
4 Sept.	423	1			109	98	
		2			60		
		3			125		
8 Oct.	457	1			179	157	
		2			146		
		3			146		
23 Oct.	361	1			76	55	
		2			12		
		3			77		
7 Nov.	416	1			108	93	
		2			71		
		3			100		
5 Dec.	583	1			265	274	
		2			273		
		3			284		
1961							
8 Jan.	425	1			572	322	
		2			160		
		3			233		

OBSERVATIONS OF SUSPENDED SEDIMENT

ADHAIM RIVER AT ADHAIM

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1959							
18 Feb.	8	1	109	1,711	1,820		
		2	77	1,636	1,713		
		3	97	1,885	1,982		
3 Mar.	419	1	4184	34,929	39,113		
		2	1089	48,508	49,597		
		3	1163	49,990	51,153		
2 Apr.	21	1			473		
		2			489		
		3			528		
5 May	4	1			172		
		2			107		
		3			215		
1961							
3 Apr.	60	1	167	14,955	15,122		
		2	182	20,609	20,791		
		3	455	15,925	16,380		
8 Apr.	75	1	417	22,745	23,162		
		2	353	21,270	21,623		
		3	325	19,902	20,227		
1 May	220	1	2183	32,545	34,728		
		2	437	47,843	48,280		
		3	3180	70,237	73,417		
10 May	12	1			252		
		2			345		
		3			178		
27 Dec.	35	1	38	3,258	3,296		
		2			3,086		
		3	15	3,048	3,063		

OBSERVATIONS OF SUSPENDED SEDIMENT

ADHAIM RIVER AT ADHAIM (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1962							
22 Jan.	68	1			29,940		
		2	238	31,332	31,570		
		3	211	2,793	3,004		
14 Feb.	13	1			191		
		2			219		
		3			127		
14 Mar.	7	1			1,002		
		2			2,042		
		3	1485		1,528		
6 Apr.	7	1	21	1,699	1,720		
		2	40	1,779	1,719		
		3	46	2,108	2,154		
6 May	5	1			341		
		2			425		
		3			245		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1958							
12 Oct.	28	1			108		
					64		
					43		
		2			42		
					61		
					38		
		3			60		
					44		
					51		
		4			61		
					81		
					60		
		5			71		
					61		
					60		
19 Oct.	197	1			62		
					38		
					36		
		2			42		
					38		
					42		
		3			47		
					49		
					36		
		4			34		
					48		
					43		

Note 1. River divided into five sections of equal discharge.

2. Sampling depths 1/2 meter from surface, mid-depth, and 1/2 meter from bottom.

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1958							
19 Oct.		5			40		
					50		
					40		
26 Oct.	218	1			64		
					43		
					49		
		2			43		
					31		
					51		
		3			40		
					37		
					32		
		4			26		
					46		
					40		
		5			36		
					59		
					46		
2 Nov.	220	1			42		
					38		
					27		
		2			40		
					41		
					34		
		3			32		
					25		
					34		
		4			46		
					34		
					27		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1958							
2 Nov.		5			35		
					34		
					29		
9 Nov.	255	1			90		
					48		
					32		
		2			107		
					42		
					38		
		3			65		
					45		
					40		
		4			108		
					45		
					49		
		5			43		
					27		
					28		
16 Nov.	245	1			132		
					131		
					142		
		2			80		
					89		
					116		
		3			133		
					122		
					86		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1958							
16 Nov.		4			96		
					100		
					115		
		5			152		
					122		
					130		
23 Nov.	236	1			121		
					96		
					93		
		2			100		
					94		
					76		
		3			93		
					76		
					127		
		4			77		
					128		
					100		
		5			69		
					96		
					126		
30 Nov.	230	1			48		
					24		
					46		
		2			43		
					26		
					61		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1958							
30 Nov.		3			63		
					73		
					65		
		4			35		
					29		
					41		
		5			69		
					111		
					56		
7 Dec.	242	1			40		
					23		
					33		
		2			34		
					17		
					45		
		3			26		
					24		
					29		
		4			30		
					34		
					30		
		5			50		
					63		
					34		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1958							
13 Dec.	1622	1	163	4888	5051		
			149	5128	5277		
			110	5174	5284		
		2	122	4604	4726		
			54	3475	3529		
			58	3049	3107		
		3	49	4715	4764		
			38	3860	3898		
			35	3554	3589		
		4	84	3977	4061		
			43	4229	4272		
			42	3698	3740		
		5	107	4564	4671		
			56	4387	4443		
			102	4933	5035		
21 Dec.	616	1			903		
					929		
					903		
		2			823		
					622		
					891		
		3			862		
					806		
					848		
		4			886		
					858		
					878		
		5			447		
					812		
					841		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1958							
28 Dec.	419	1			203		
					193		
					156		
		2			194		
					156		
					165		
		3			188		
					148		
					155		
		4			175		
					150		
					170		
		5			153		
					150		
					160		
1959							
4 Jan.	356	1			133		
					100		
					110		
		2			101		
					118		
					117		
		3			117		
					90		
					101		
		4			101		
					87		
					91		
		5			97		
					80		
					85		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1959							
11 Jan.	305	1			32		
					69		
					95		
		2			60		
					75		
					60		
		3			89		
					90		
					104		
		4			88		
					100		
					100		
		5			54		
					70		
					52		
18 Jan.	500	1			660		
					617		
					631		
		2			650		
					510		
					618		
		3			627		
					606		
					632		
		4			467		
					585		
					585		
		5			546		
					551		
					636		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1959							
25 Jan.	1092	1			643		
					634		
					645		
		2			720		
					588		
					630		
		3			677		
					591		
					560		
		4			545		
					633		
					531		
		5			543		
					612		
					573		
1 Feb.	544	1			769		
					776		
					744		
		2			732		
					728		
					730		
		3			741		
					673		
					726		
		4			828		
					787		
					800		
		5			791		
					734		
					800		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1959							
8 Feb.	521	1			122		
					115		
					102		
		2			135		
					102		
					88		
		3			125		
					141		
					87		
		4			116		
					100		
					81		
		5			72		
					79		
					94		
15 Feb.	427	1			123		
					98		
					59		
		2			79		
					70		
					72		
		3			70		
					66		
					63		
		4			34		
					66		
					64		
		5			42		
					44		
					47		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1959							
22 Feb.	389	1			121		
					47		
					65		
		2			48		
					72		
					61		
		3			59		
					63		
					65		
		4			17		
					74		
					76		
		5			67		
					70		
					66		
1 Mar.	412	1			198		
					125		
					97		
		2			104		
					125		
					98		
		3			99		
					68		
					108		
		4			89		
					59		
					77		
		5			68		
					85		
					68		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1959							
8 Mar.	682	1	73	1851	1924		
			67	1892	1959		
			44	1987	2031		
		2	63	1893	1956		
			57	1707	1764		
			72	1713	1785		
		3	62	1702	1764		
			59	1745	1804		
			42	1898	1940		
		4	45	1761	1806		
			52	1577	1629		
			85	1838	1923		
		5	84	1545	1629		
			58	1772	1830		
			54	1602	1656		
15 Mar.	556	1			311		
					337		
					330		
		2			364		
					250		
					353		
		3			319		
					323		
					180		
		4			286		
					297		
					327		
		5			330		
					286		
					279		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1959							
22 Mar.	1788	1	105	1660	1765		
			110	1596	1706		
			83	1591	1674		
		2	68	1459	1527		
			89	1467	1556		
			56	1436	1492		
		3	59	1342	1401		
			81	1325	1406		
			83	1463	1546		
		4	78	1405	1483		
			71	1427	1498		
			80	1454	1534		
		5	107	1096	1203		
			67	1363	1430		
			99	1383	1482		
29 Mar.	1361	1			442		
					310		
					284		
		2			282		
					311		
					255		
		3			234		
					248		
					294		
		4			255		
					283		
					227		
		5			299		
					215		
					248		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1959							
5 Apr.	1301	1			759		
					1074		
					932		
		2			963		
					843		
					950		
		3			811		
					898		
					853		
		4			688		
					830		
					833		
		5			926		
					926		
					906		
12 Apr.	1857	1	82	1325	1407		
			32	1111	1143		
			66	1082	1148		
		2	90	1264	1354		
			40	1318	1358		
			28	1327	1355		
		3	36	1343	1379		
			60	1340	1400		
			76	984	1060		
		4	75	1121	1196		
			86	1329	1415		
			54	1305	1359		
		5	52	1302	1354		
			44	1373	1417		
			78	1335	1413		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1959							
19 Apr.	2081	1			281		
					297		
					356		
		2			339		
					347		
					404		
		3			335		
					347		
					415		
		4			352		
					361		
					359		
		5			292		
					289		
					283		
26 Apr.	2246	1	387	8042	8429		
			59	6352	6411		
			400	7252	7652		
		2	133	6745	6878		
			285	6666	6951		
			191	7392	7583		
		3	244	5631	5875		
			207	4339	4646		
			147	7390	7537		
		4	538	7098	7636		
			317	7689	8006		
			186	5907	6093		
		5	243	7905	8148		
			352	8019	8371		
			659	7944	8603		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1959							
3 May	1246	1			277		
					274		
					242		
		2			244		
					276		
					278		
		3			262		
					515		
					291		
		4			210		
					263		
					103		
		5			228		
					225		
					244		
10 May	1829	1			194		
					216		
					199		
		2			179		
					217		
					216		
		3			208		
					173		
					156		
		4			185		
					167		
					206		
		5			98		
					144		
					180		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1959							
31 May	1800	1			361		
					278		
					322		
		2			304		
					255		
					275		
		3			251		
					242		
					273		
		4			239		
					276		
					239		
		5			228		
					229		
					218		
7 June	1244	1			262		
					185		
					232		
		2			210		
					174		
					200		
		3			162		
					162		
					209		
		4			176		
					184		
					156		
		5			183		
					171		
					178		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1959							
14 June	228	1			432		
					221		
					228		
		2			240		
					233		
					193		
		3			225		
					239		
					194		
		4			204		
					227		
					182		
		5			166		
					193		
					181		
21 June	790	1			99		
					105		
					85		
		2			107		
					95		
					122		
		3			103		
					139		
					97		
		4			131		
					122		
					148		
		5			102		
					85		
					112		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1959							
28 June	644	1			131		
					115		
					113		
		2			107		
					101		
					123		
		3			166		
					110		
					82		
		4			91		
					154		
					208		
		5			100		
					106		
					92		
5 July	508	1			148		
					155		
					145		
		2			166		
					154		
					171		
		3			169		
					175		
					188		
		4			143		
					187		
					196		
		5			139		
					155		
					131		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1959							
20 July	532	1			179		
					86		
					95		
		2			113		
					78		
					110		
		3			118		
					102		
					110		
		4			93		
					101		
					93		
		5			108		
					113		
					101		
26 July	393	1			294		
					387		
					403		
		2			129		
					213		
					360		
		3			45		
					265		
					141		
		4			186		
					200		
					162		
		5			208		
					250		
					190		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1959							
2 Aug.	373	1			300		
					186		
					130		
		2			181		
					182		
					217		
		3			160		
					191		
					158		
		4			191		
					112		
					132		
		5			78		
					98		
					85		
9 Aug.	321	1			129		
					160		
					142		
		2			125		
					194		
					176		
		3			126		
					167		
					125		
		4			143		
					108		
					147		
		5			129		
					95		
					106		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1959							
16 Aug.	317	1			119		
					120		
					122		
		2			108		
					108		
					104		
		3			104		
					127		
					146		
		4			81		
					101		
					77		
		5			74		
					104		
					74		
23 Aug.	299	1			66		
					57		
					57		
		2			69		
					57		
					50		
		3			52		
					61		
					67		
		4			47		
					42		
					49		
		5			50		
					56		
					63		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1959							
30 Aug.	283	1			75		
					56		
					60		
		2			53		
					65		
					66		
		3			67		
					64		
					54		
		4			55		
					64		
					58		
		5			45		
					61		
					68		
6 Sept.	266	1			168		
					54		
					40		
		2			53		
					49		
					39		
		3			55		
					51		
					46		
		4			40		
					36		
					39		
		5			56		
					62		
					47		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1959							
13 Sept.	250	1			225		
					36		
					49		
		2			38		
					21		
					32		
		3			42		
					24		
					35		
		4			46		
					26		
					51		
		5			28		
					40		
					39		
4 Oct.	274	1			69		
					51		
					53		
		2			75		
					47		
					84		
		3			57		
					47		
					44		
		4			56		
					49		
					44		
		5			52		
					47		
					56		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1959							
25 Oct.	276	1			86		
					88		
					46		
		2			55		
					39		
					44		
		3			78		
					81		
					74		
		4			47		
					80		
					68		
		5			74		
					93		
					74		
1 Nov.	313	1			96		
					87		
					85		
		2			98		
					86		
					88		
		3			62		
					110		
					72		
		4			70		
					60		
					49		
		5			204		
					56		
					63		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1959							
29 Nov.	504	1			423		
					473		
					466		
		2			444		
					375		
					439		
		3			466		
					483		
					432		
		4			439		
					468		
					464		
		5			468		
					424		
					453		
13 Dec.	455	1			108		
					78		
					102		
		2			103		
					103		
					84		
		3			70		
					114		
					94		
		4			81		
					90		
					91		
		5			63		
					87		
					117		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
24 Jan.	698	1			325		
					329		
					326		
		2			329		
					340		
					298		
		3			303		
					323		
					111		
		4			266		
					302		
					334		
		5			51		
					294		
					265		
14 Feb.	574	1			208		
					176		
					223		
		2			163		
					254		
					228		
		3			201		
					184		
					157		
		4			179		
					202		
					176		
		5			203		
					186		
					208		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
22 Feb.	550	1			189		
					113		
					182		
		2			155		
					133		
					113		
		3			121		
					149		
					113		
		4			104		
					141		
					123		
		5			108		
					109		
					124		
27 Feb.	1350	1	77	1136	1213		
			86	1153	1239		
			64	1130	1194		
		2	70	983	1053		
					894		
			49	968	1017		
		3			941		
					936		
					885		
		4			891		
			38	985	1023		
					883		
		5			998		
			73	1022	1095		
			49	1076	1125		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
6 Mar.	965	1			405		
					426		
					429		
		2			369		
					380		
					407		
		3			402		
					367		
					292		
		4			355		
					339		
					360		
		5			253		
					396		
					263		
13 Mar.	1688	1	72	1756	1828		
			84	1537	1621		
			67	1549	1616		
		2	69	1595	1664		
			75	1227	1302		
			97	1302	1399		
		3	87	1534	1621		
			81	1420	1501		
			132	1365	1497		
		4	69	1621	1690		
			69	1601	1670		
			98	1307	1405		
		5	118	1412	1530		
			99	1922	2021		
			82	1473	1555		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
19 Mar.	1091	1			509		
					480		
					475		
		2			494		
					495		
					488		
		3			562		
					463		
					463		
		4			482		
					441		
					446		
		5			445		
					497		
					535		
26 Mar.	1785	1	79	1490	1569		
			95	1472	1567		
			54	1455	1509		
		2			907		
			62	1313	1375		
			81	1395	1476		
		3	30	1409	1439		
			47	1283	1330		
			21	1447	1468		
		4	41	1429	1470		
			24	1527	1551		
			59	1325	1384		
		5	41	1063	1104		
			28	1393	1421		
			38	1300	1338		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
3 Apr.	1223	1			425		
					427		
					408		
		2			423		
					392		
					392		
		3			431		
					403		
					361		
		4			370		
					343		
					390		
		5	68	2534	2602		
					423		
					369		
10 Apr.	1867	1			878		
					777		
					862		
		2			666		
					732		
					743		
		3			705		
					661		
					665		
		4			672		
					644		
					626		
		5			627		
					606		
					579		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
18 Apr.	1987	1	220	985	1205		
			30	1163	1193		
			86	1116	1202		
		2	52	1111	1163		
			45	1091	1136		
			19	1131	1150		
		3	77	1022	1099		
			58	1056	1114		
			48	1128	1176		
		4	93	1170	1263		
			43	1204	1247		
			53	1171	1224		
		5	30	1090	1120		
			32	1159	1191		
			26	1098	1124		
23 Apr.	2296	1	49	1243	1292		
			22	1301	1323		
			52	1300	1352		
		2	70	1285	1255		
			61	1260	1321		
			75	1309	1384		
		3	106	1278	1384		
			50	1239	1289		
			33	1202	1235		
		4	106	1179	1285		
			28	1280	1308		
			45	1216	1261		
		5	6	1218	1224		
			27	1228	1255		
			58	1216	1274		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
1 May	3339	1			948		
					939		
					794		
		2			848		
					915		
					919		
		3			775		
					789		
					806		
		4			721		
					761		
					796		
		5			788		
					808		
					782		
8 May	2570	1			285		
					263		
					238		
		2			310		
					242		
					282		
		3			350		
					251		
					252		
		4			265		
					283		
					265		
		5			297		
					297		
					270		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
15 May	2406	1			300		
					318		
					363		
		2			348		
					410		
					281		
		3			296		
					294		
					340		
		4			421		
					298		
					231		
		5			303		
					530		
					280		
22 May	1711	1			284		
					251		
					220		
		2			291		
					260		
					269		
		3			323		
					239		
					197		
		4			318		
					416		
					249		
		5			215		
					264		
					189		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
29 May	1425	1			246		
					213		
					204		
		2			211		
					196		
					221		
		3			234		
					298		
					245		
		4			301		
					182		
					166		
		5			231		
					229		
					125		
7 June	1009	1			166		
					119		
					130		
		2			126		
					123		
					120		
		3			142		
					101		
					79		
		4			166		
					120		
					146		
		5			73		
					196		
					197		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
10 June	449	1			157		
					108		
					234		
		2			148		
					101		
					156		
		3			160		
					173		
					142		
		4			168		
					137		
					155		
		5			90		
					120		
					135		
12 June	766	1			137		
					111		
					784		
		2			108		
					99		
					119		
		3			180		
					90		
					111		
		4			140		
					115		
					140		
		5			145		
					74		
					78		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
19 June	744	1			293		
					230		
					267		
		2			203		
					204		
					170		
		3			161		
					171		
					241		
		4			178		
					150		
					194		
		5			163		
					217		
					438		
25 June	621	1			649		
					170		
					182		
		2			648		
					183		
					185		
		3			215		
					166		
					200		
		4			166		
					158		
					176		
		5			200		
					195		
					164		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
3 July	487	1			119		
					116		
					113		
		2			367		
					169		
					170		
		3			188		
					135		
					141		
		4			141		
					166		
					100		
		5			128		
					105		
					94		
17 July	494	1			150		
					121		
					58		
		2			146		
					143		
					128		
		3			141		
					126		
					156		
		4			156		
					123		
					132		
		5			127		
					110		
					112		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
24 July	406	1			145		
					117		
					110		
		2			109		
					116		
					81		
		3			84		
					55		
					87		
		4			107		
					79		
					116		
		5			69		
					89		
					111		
31 July	367	1			160		
					96		
					166		
		2			138		
					95		
					163		
		3			119		
					125		
					118		
		4			123		
					106		
					152		
		5			95		
					123		
					145		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
7 Aug.	324	1			235		
					226		
					233		
		2			238		
					207		
					217		
		3			230		
					170		
					220		
		4			141		
					173		
					220		
		5			136		
					143		
					165		
14 Aug.	292	1			129		
					123		
					153		
		2			93		
					137		
					212		
		3			150		
					181		
					134		
		4			132		
					104		
					175		
		5			175		
					139		
					126		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
21 Aug.	273	1			166		
					92		
					83		
		2			78		
					80		
					95		
		3			85		
					96		
					96		
		4			104		
					79		
					82		
		5			90		
					78		
					123		
28 Aug.	246	1			146		
					77		
					79		
		2			104		
					58		
					89		
		3			65		
					77		
					84		
		4			77		
					67		
					81		
		5			58		
					49		
					90		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
4 Sept.	283	1			97		
					47		
					86		
		2			97		
					68		
					85		
		3			95		
					88		
					89		
		4			69		
					73		
					63		
		5			65		
					54		
					65		
11 Sept.	292	1			69		
					47		
					50		
		2			53		
					52		
					56		
		3			55		
					69		
					96		
		4			64		
					67		
					75		
		5			68		
					72		
					51		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
18 Sept.	303	1			96		
					88		
					67		
		2			96		
					86		
					82		
		3			80		
					88		
					40		
		4			79		
					91		
					86		
		5			90		
					80		
					94		
25 Sept.	273	1			107		
					87		
					98		
		2			101		
					86		
					93		
		3			64		
					113		
					95		
		4			83		
					80		
					84		
		5			83		
					93		
					83		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
2 Oct.	356	1			122		
					88		
					136		
		2			115		
					90		
					102		
		3			107		
					115		
					106		
		4			92		
					56		
					104		
		5			87		
					109		
					103		
9 Oct.	365	1			124		
					148		
					138		
		2			104		
					54		
					111		
		3			48		
					54		
					59		
		4			72		
					60		
					77		
		5			68		
					68		
					77		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
10 Oct.	359	1			60		
					62		
					71		
		2			81		
					78		
					80		
		3			75		
					64		
					61		
		4			79		
					80		
					53		
		5			96		
					66		
					112		
23 Oct.	324	1			60		
					72		
					50		
		2			89		
					71		
					84		
		3			61		
					74		
					61		
		4			104		
					79		
					72		
		5			76		
					56		
					70		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
30 Oct.	351	1			92		
					69		
					73		
		2			95		
					96		
					83		
		3			73		
					110		
					60		
		4			103		
					77		
					75		
		5			104		
					60		
					30		
6 Nov.	332	1			91		
					52		
					62		
		2			83		
					101		
					94		
		3			104		
					95		
					92		
		4			83		
					76		
					83		
		5			51		
					80		
					72		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
13 Nov.	378	1			251		
					198		
					200		
		2			259		
					236		
					209		
		3			241		
					234		
					202		
		4			168		
					246		
					243		
		5			268		
					212		
					207		
20 Nov.	2309	1	179	5,129	5,308		
			322	53,488	56,810		
			235	5,017	5,252		
		2	135	10,690	10,825		
			273	12,680	12,953		
					11,161		
		3	281	12,105	12,386		
			128	11,153	11,281		
			108	8,688	8,796		
		4	113	12,571	12,684		
			70	7,589	7,659		
			99	8,637	8,736		
		5	142	15,211	15,353		
					18,036		
			174	17,420	17,594		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
24 Nov.	859	1	88		6,201		
			82		6,558		
			84		6,327		
		2	122		6,273		
			71		6,415		
			94		6,045		
		3	74		6,166		
			67		8,389		
			45		6,417		
		4	72		5,861		
			52		6,479		
			62		6,170		
		5	55		5,930		
			61		6,270		
			94		6,459		
27 Nov.	634	1	34	2064	2,098		
			51		51		
			80	2110	2,190		
		2	94	1979	2,073		
			48		48		
			53	2183	2,236		
		3	57	2098	2,155		
			43	2115	2,158		
			57	1884	1,941		
		4	32	917	949		
			68	1068	1,136		
			36	1264	1,300		
		5	98	1980	2,078		
			73	2100	2,173		
			92	1987	2,079		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
4 Dec.	727	1	24	1445	1469		
			849		849		
			26	1337	1363		
		2	53	1336	1389		
			47	1303	1350		
			47	1402	1449		
		3	67	1265	1332		
			41	1248	1289		
			47	1089	1136		
		4	74	1044	1118		
			30	1057	1087		
			50	1040	1090		
		5	763		763		
			37	1281	1318		
			784		784		
11 Dec.	460	1			289		
					326		
					298		
		2			325		
					331		
					309		
		3			320		
					279		
					283		
		4			286		
					296		
					257		
		5			351		
					295		
					316		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
18 Dec.	366	1			189		
					222		
					209		
		2			204		
					213		
					197		
		3			185		
					201		
					231		
		4			175		
					156		
					187		
		5			204		
					183		
					191		
21 Dec.	406	1			274		
					301		
					288		
		2			284		
					301		
					303		
		3			263		
					265		
					285		
		4			408		
					299		
					243		
		5			210		
					245		
					259		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1960							
25 Dec.	366	1	66	1008	1074		
			53	1227	1280		
			66	1172	1238		
		2	42	1008	1050		
					821		
			41	1254	1295		
		3			1909		
					505		
					574		
		4			338		
					253		
					384		
		5			388		
					257		
					382		
1961							
1 Jan.	288	1			96		
					79		
					53		
		2			78		
					66		
					77		
		3			85		
					71		
					94		
		4			132		
					83		
					88		
		5			92		
					125		
					72		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1961							
8 Jan.	479	1	72	2442	2514		
			66	2315	2381		
			50	2456	2506		
		2	68	2147	2215		
			79	2442	2521		
			52	2592	2644		
		3	66	1887	1953		
			47	1955	2002		
			88	1739	1827		
		4	89	1330	1419		
			38	1113	1151		
			46	1306	1352		
		5			832		
					789		
					865		
15 Jan.	465	1	67	1825	1892		
			50	1863	1913		
			68	1866	1934		
		2	74	1962	2036		
			74	1871	1945		
			79	1717	1796		
		3	49	1641	1690		
			45	1631	1676		
			67	1669	1736		
		4	70	1523	1593		
			37	1580	1617		
			30	1570	1600		
		5	38	1363	1401		
			45	1415	1460		
			84	1611	1695		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1961							
21 Jan.	616	1			665		
					658		
					660		
		2			641		
					651		
					634		
		3			549		
					674		
					652		
		4			557		
					517		
					537		
		5			502		
					474		
					502		
29 Jan.	788	1	79	1266	1345		
			55	1058	1113		
			75	1609	1684		
		2	92	1270	1362		
			79	1368	1447		
			87	1296	1383		
		3	87	1160	1247		
			78	1080	1158		
			58	1192	1250		
		4	70	981	1051		
			346	996	1342		
			83	1060	1143		
		5			902		
			74	1133	1207		
			70	939	1009		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1961							
5 Feb.	540	1			274		
					282		
					139		
		2			263		
					285		
					292		
		3			235		
					235		
					231		
		4			253		
					268		
					250		
		5			230		
					233		
					249		
12 Feb.	886	1			523		
					525		
					487		
		2			616		
					404		
					415		
		3			754		
					539		
					677		
		4			560		
					812		
					887		
		5			671		
					737		
					643		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1961							
19 Feb.	115	1	85	2972	3057		
			68	3044	3112		
			113	3026	3139		
		2	69	2797	2866		
			101	2875	2976		
			92	3058	3150		
		3	83	3027	3110		
			74	3049	3123		
			84	2903	2987		
		4	74	2836	2910		
			95	2983	3078		
			78	2894	2972		
		5	66	2633	2699		
			58	2824	2882		
			72	2605	2677		
26 Feb.	687	1			359		
					291		
					256		
		2			281		
					283		
					97		
		3			46		
					71		
					262		
		4			285		
					284		
					263		
		5			250		
					261		
					311		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1961							
5 Mar.	703	1			323		
					243		
					243		
		2			249		
					269		
					257		
		3			304		
					214		
					310		
		4			277		
					204		
					245		
		5			306		
					307		
					277		
12 Mar.	601	1			230		
					121		
					122		
		2			146		
					130		
					104		
		3			143		
					176		
					111		
		4			154		
					137		
					150		
		5			138		
					136		
					101		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1961							
22 Mar.	1120	1			760		
					776		
					797		
		2			693		
					795		
					750		
		3			596		
					774		
					665		
		4			607		
					611		
					730		
		5			642		
					727		
					620		
26 Mar.	821	1			733		
					719		
					649		
		2			757		
					670		
					689		
		3			700		
					753		
					732		
		4			734		
					681		
					686		
		5			730		
					626		
					612		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1961							
2 Apr.	269	1			725		
					501		
					621		
		2			493		
					651		
					575		
		3			581		
					571		
					660		
		4			569		
					541		
					583		
		5			557		
					583		
					616		
9 Apr.	1134	1			856		
					808		
					843		
		2			848		
					886		
					837		
		3			793		
					793		
					882		
		4			855		
					853		
					826		
		5			817		
					818		
					775		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1961							
16 Apr.	1493	1	39	1624	1663		
			45	1631	1676		
			41	1600	1641		
		2	54	1754	1808		
			57	1764	1821		
			39	1634	1673		
		3	41	1633	1674		
			43	1814	1857		
			82	1779	1861		
		4	73	1824	1897		
			46	1728	1774		
			70	1721	1791		
		5	41	1576	1617		
			77	1822	1899		
			80	1833	1913		
18 Apr.	2330	1	94	8316	8410		
			105	8355	8360		
			53	8157	8210		
		2	58	7679	7737		
			83	8015	8098		
			68	7806	7874		
		3	63	7583	7646		
			62	6923	6985		
			52	6321	6373		
		4	56	6741	6797		
			66	7450	7516		
			112	7614	7726		
		5	67	6890	6957		
			58	7022	7080		
			61	6097	6158		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date 1961	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
23 Apr.	1493	1			936		
					763		
					849		
		2			712		
					706		
					820		
		3			791		
					748		
					814		
		4			846		
					832		
					822		
		5			664		
					658		
					601		
30 Apr.	1326	1	58	1398	1456		
			53	1382	1435		
			66	1465	1531		
		2	51	1193	1244		
			39	1249	1288		
			47	1379	1426		
		3	32	1444	1476		
			56	1413	1469		
			46	1250	1296		
		4	43	1402	1445		
			28	1385	1413		
			34	1379	1413		
		5	38	1125	1163		
			26	1293	1319		
			15	1229	1244		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1961							
2 May	2936	1	178	10,276	10,454		
			311	10,171	10,482		
			87	10,678	10,765		
		2	121	12,260	12,381		
			75	10,203	10,278		
			299	9,950	10,249		
		3	113	7,900	8,013		
			74	8,322	8,396		
			64	7,696	7,760		
		4	79	9,674	9,753		
			44	10,039	10,083		
			129	10,298	10,427		
		5	68	8,664	8,732		
			53	7,461	7,514		
			55	8,604	8,659		
7 May	1842	1			697		
					612		
					673		
		2			551		
					589		
					538		
		3			566		
					534		
					570		
		4			556		
					566		
					555		
		5			587		
					515		
					462		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1961							
14 May	2109	1			511		
					545		
					483		
		2			561		
					443		
					414		
		3			521		
					439		
					361		
		4			440		
					401		
					361		
		5			505		
					347		
					355		
21 May	1819	1			58		
					244		
					278		
		2			264		
					212		
					231		
		3			224		
					261		
					228		
		4			205		
					249		
					253		
		5			244		
					246		
					248		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1961							
29 May	1167	1			105		
					166		
					209		
		2			395		
					155		
					149		
		3			211		
					297		
					203		
		4			137		
					103		
					119		
		5			184		
					202		
					89		
4 June	887	1			222		
					125		
					167		
		2			148		
					176		
					214		
		3			180		
					171		
					159		
		4			187		
					138		
					176		
		5	336	2251	2587		
					181		
					194		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1961							
11 June	873	1			143		
					119		
					146		
		2			146		
					122		
					166		
		3			147		
					112		
					131		
		4			131		
					131		
					135		
		5			112		
					135		
					150		
18 June	757	1			207		
					137		
					166		
		2			130		
					159		
					187		
		3			155		
					136		
					109		
		4			107		
					110		
					129		
		5			139		
					120		
					122		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1961							
25 June	590	1			153		
					144		
					160		
		2			94		
					108		
					153		
		3			163		
					144		
					123		
		4			148		
					135		
					186		
		5			145		
					170		
					174		
2 July	508	1			107		
					84		
					117		
		2			68		
					21		
					116		
		3			96		
					109		
					71		
		4			87		
					85		
					80		
		5			85		
					89		
					103		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1961							
9 July	416	1			101		
					88		
					81		
		2			61		
					21		
					113		
		3			86		
					88		
					63		
		4			92		
					91		
					81		
		5			93		
					77		
					89		
23 July	497	1			113		
					77		
					88		
		2			128		
					107		
					89		
		3			104		
					120		
					92		
		4			109		
					65		
					78		
		5			73		
					106		
					103		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1961							
30 July	357	1			188		
					156		
					204		
		2			211		
					178		
					180		
		3			216		
					203		
					204		
		4			212		
					169		
					194		
		5			188		
					220		
					192		
6 Aug.	347	1			181		
					136		
					164		
		2			186		
					173		
					170		
		3			143		
					131		
					144		
		4			127		
					118		
					160		
		5			152		
					127		
					152		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1961							
13 Aug.	326	1			177		
					126		
					94		
		2			168		
					164		
					159		
		3			134		
					118		
					115		
		4			117		
					124		
					114		
		5			123		
					93		
					93		
20 Aug.	295	1			161		
					126		
					150		
		2			136		
					122		
					125		
		3			114		
					158		
					118		
		4			115		
					96		
					106		
		5			80		
					89		
					122		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1961							
27 Aug.	287	1			103		
					125		
					112		
		2			145		
					148		
					239		
		3			109		
					134		
					114		
		4			138		
					107		
					150		
		5			85		
					90		
					133		
3 Sept.	267	1			151		
					73		
					48		
		2			69		
					81		
					94		
		3			107		
					70		
					60		
		4			101		
					101		
					75		
		5			102		
					79		
					88		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1961							
10 Sept.	315	1			78		
					124		
					110		
		2			70		
					79		
					95		
		3			108		
					93		
					94		
		4			102		
					75		
					114		
		5			112		
					114		
					100		
17 Sept.	333	1			218		
					129		
					163		
		2			176		
					154		
					157		
		3			137		
					158		
					143		
		4			127		
					111		
					82		
		5			93		
					107		
					127		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1961							
24 Sept.	348	1			173		
					106		
					107		
		2			158		
					104		
					134		
		3			86		
					75		
					107		
		4			97		
					65		
					76		
		5			71		
					92		
					103		
1 Oct.	329	1			105		
					85		
					144		
		2			109		
					100		
					124		
		3			104		
					111		
					143		
		4			115		
					117		
					130		
		5			89		
					84		
					127		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1961							
8 Oct.	339	1			108		
					115		
					151		
		2			97		
					176		
					144		
		3			78		
					136		
					158		
		4			109		
					141		
					94		
		5			115		
					126		
					106		
15 Oct.	305	1			107		
					101		
					122		
		2			134		
					100		
					132		
		3			111		
					93		
					81		
		4			123		
					113		
					87		
		5			83		
					96		
					68		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1961							
22 Oct.	311	1			196		
					216		
					126		
		2			162		
					180		
					166		
		3			105		
					119		
					126		
		4			136		
					128		
					186		
		5			132		
					158		
					126		
29 Oct.	319	1			123		
					76		
					73		
		2			77		
					96		
					93		
		3			52		
					68		
					55		
		4			74		
					86		
					94		
		5			56		
					97		
					73		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1961							
5 Nov.	460	1			184		
					104		
					162		
		2			198		
					220		
					192		
		3			242		
					287		
					246		
		4			235		
					261		
					237		
		5			262		
					221		
12 Nov.	476	1	113	1199	1312		
			54	1168	1222		
			47	1135	1182		
		2			494		
			52	1287	1339		
					983		
		3			372		
					391		
					667		
		4			872		
					562		
					402		
		5	92	1022	1114		
					584		
					874		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg. per day)
1961							
19 Nov.	320	1			381		
					394		
					419		
		2			397		
					417		
					381		
		3			359		
					366		
					308		
		4			329		
					353		
					406		
		5			319		
					351		
					360		
26 Nov.	1298	1	28	3140	3168		
			33	3280	3313		
			11	3359	3370		
		2	85	2574	2659		
			87	2396	2483		
			11	2707	2718		
		3	24	2693	2717		
			9	1756	1765		
			57	2454	2511		
		4	72	1660	1732		
			11	1702	1713		
			26	2266	2292		
		5	89	1835	1924		
			7	1924	1931		
			66	1067	1133		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1961							
4 Dec.	435	1			647		
					627		
					600		
		2			620		
					556		
					593		
		3			589		
					595		
					566		
		4			605		
					537		
					610		
		5			585		
					591		
					692		
10 Dec.	1193	1	281	13,923	14,204		
			180	13,331	13,511		
			204	13,322	13,526		
		2	328	7,193	7,521		
			215	3,544	3,759		
			158	4,936	5,094		
		3	133	7,077	7,210		
			105	6,128	6,233		
			176	9,906	10,082		
		4	199	6,492	6,691		
			151	9,728	9,879		
			148	7,273	7,421		
		5	121	10,331	10,452		
			263	2,838	3,101		
			234	6,355	6,589		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1961							
17 Dec.	1712	1	142	2847	2989		
			126	2934	3060		
			53	2844	2987		
		2	57	1985	2042		
			36	1717	1753		
			36	1352	1388		
		3	33	2588	2621		
			82	2640	2722		
			49	2910	2959		
		4	32	2103	2135		
			26	1700	1726		
			39	2303	2342		
		5	36	2538	2574		
			27	1960	1987		
			24	2205	2229		
24 Dec.	980	1	43	996	1039		
			52	957	1009		
			43	1033	1076		
		2	54	1002	1056		
			35	1052	1087		
			51	1024	1075		
		3	65	952	1017		
					966		
					994		
		4	100	928	1028		
					998		
					871		
		5			926		
					889		
					894		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1961							
31 Dec.	1122	1			852		
					890		
					860		
		2			822		
					755		
					859		
		3			841		
					802		
					763		
		4			773		
					810		
					677		
		5			762		
					746		
					786		
1962							
8 Jan.	900	1			385		
					339		
					348		
		2			376		
					340		
					325		
		3			309		
					311		
					320		
		4			352		
					281		
					300		
		5			311		
					298		
					312		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1962							
14 Jan.	1562	1	122	1651	1773		
			57	1649	1706		
			56	1827	1883		
		2	90	1637	1727		
			42	1690	1732		
			87	1781	1868		
		3	84	1532	1616		
			66	1744	1810		
			40	1660	1700		
		4	83	1617	1700		
			27	1653	1680		
			66	1536	1602		
		5	98	1563	1661		
			21	1751	1772		
			76	1509	1585		
23 Jan.	829	1			313		
					287		
					267		
		2			260		
					293		
					290		
		3			264		
					216		
					262		
		4			269		
					239		
					190		
		5			254		
					289		
					236		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1962							
28 Jan.	778	1			406		
					432		
					430		
		2			443		
					463		
					471		
		3			390		
					429		
					457		
		4			448		
					443		
					389		
		5			418		
					399		
					397		
4 Feb.	771	1			332		
					364		
					362		
		2			359		
					351		
					386		
		3			323		
					306		
					383		
		4			374		
					368		
					373		
		5			387		
					397		
					385		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1962							
10 Feb.	1681	1	18	1020	1038		
			15	1030	1045		
					981		
		2			816		
					778		
					972		
		3			873		
					919		
			28	994	1022		
		4	30	1013	1043		
			28	1006	1034		
					983		
		5			753		
			19	981	1000		
			19	994	1013		
18 Feb.	1139	1			431		
					365		
					467		
		2			390		
					384		
					354		
		3			392		
					334		
					358		
		4			311		
					364		
					340		
		5			419		
					384		
					454		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1962							
25 Feb.	2573	1	40	1958	1998		
			97	2182	2279		
			44	1914	1958		
		2	62	2121	2183		
			20	2169	2189		
			113	2055	2168		
		3	83	1164	1247		
			42	1456	1498		
			98	1941	2039		
		4	40	1489	1529		
			35	1840	1875		
			62	1949	2011		
		5	62	1445	1507		
			37	1406	1443		
			46	1518	1564		
4 Mar.	1353	1			460		
					412		
					387		
		2			430		
					374		
					400		
		3			339		
					379		
					314		
		4			323		
					356		
					298		
		5			348		
					325		
					359		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1962							
11 Mar.	1367	1			406		
					339		
					358		
		2			424		
					442		
					395		
		3			380		
					322		
					349		
		4			303		
					341		
					336		
		5			311		
					335		
					319		
14 Mar.	2564	1			672		
					602		
					727		
		2			679		
					732		
					714		
		3			636		
					596		
					646		
		4			599		
					651		
					606		
		5			613		
					618		
					627		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1962							
18 Mar.	1632	1	6	1683	1689		
			24	1578	1602		
			46	1671	1717		
		2	24	1518	1542		
			15	1861	1876		
			6	1561	1567		
		3	26	1426	1452		
			46	1553	1599		
					849		
		4	9	1445	1454		
			9	1563	1572		
			2	1514	1516		
		5			1573		
			11	1510	1521		
			6	1510	1516		
25 Mar.	1913	1			599		
					574		
					64		
		2			578		
					496		
					618		
		3			574		
					523		
					579		
		4			609		
					594		
					545		
		5			597		
					573		
					577		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1962							
1 Apr.	1745	1			393		
					318		
					280		
		2			303		
					273		
					279		
		3			305		
					292		
					363		
		4			328		
					315		
					291		
		5			280		
					293		
					297		
8 Apr.	2061	1			499		
					600		
					670		
		2			431		
					434		
					649		
		3			505		
					501		
					529		
		4			552		
					476		
					527		
		5			492		
					495		
					533		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1962							
15 Apr.	2046	1			392		
					357		
					372		
		2			259		
					292		
					359		
		3			256		
					288		
					331		
		4			339		
					286		
					315		
		5			267		
					303		
					319		
22 Apr.	1767	1			199		
					170		
					204		
		2			156		
					246		
					168		
		3			173		
					176		
					132		
		4			167		
					114		
					144		
		5			133		
					138		
					152		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1962							
29 Apr.	1575	1			274		
					286		
					215		
		2			279		
					231		
					290		
		3			234		
					293		
					313		
		4			255		
					218		
					333		
		5			349		
					228		
					220		
6 May	1674	1			294		
					302		
					317		
		2			269		
					268		
					272		
		3			252		
					286		
					279		
		4			269		
					303		
					283		
		5			288		
					263		
					234		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1962							
13 May	1655	1			184		
					204		
					170		
		2			219		
					186		
					216		
		3			248		
					177		
					199		
		4			199		
					261		
					220		
		5			216		
					190		
					239		
20 May	1658	1			226		
					221		
					232		
		2			217		
					200		
					223		
		3			215		
					246		
					232		
		4			296		
					201		
					334		
		5			213		
					205		
					236		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1962							
27 May	1541	1			226		
					158		
					114		
		2			174		
					171		
					218		
		3			202		
					165		
					138		
		4			151		
					132		
					148		
		5			125		
					107		
					177		
3 June	1261	1			112		
					99		
					109		
		2			140		
					99		
					72		
		3			113		
					92		
					104		
		4			127		
					98		
					67		
		5			92		
					67		
					122		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1962							
10 June	1129	1			161		
					128		
					145		
		2			187		
					158		
					116		
		3			159		
					134		
					160		
		4			165		
					193		
					198		
		5			206		
					139		
					190		
17 June	855	1			169		
					103		
					228		
		2			159		
					124		
					144		
		3			146		
					121		
					120		
		4			138		
					103		
					92		
		5			182		
					110		
					111		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1962							
24 June	723	1			114		
					99		
					84		
		2			143		
					118		
					120		
		3			84		
					80		
					105		
		4			127		
					95		
					90		
		5			97		
					97		
					148		
1 July	616	1			152		
					141		
					76		
		2			127		
					111		
					138		
		3			111		
					95		
					126		
		4			67		
					48		
					103		
		5			92		
					153		
					79		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1962							
8 July	510	1			116		
					154		
					92		
		2			146		
					81		
					132		
		3			114		
					183		
					101		
		4			131		
					96		
					65		
		5			123		
					72		
					130		
16 July	441	1			137		
					123		
					101		
		2			95		
					94		
					48		
		3			113		
					79		
					186		
		4			75		
					58		
					89		
		5			77		
					65		
					80		

OBSERVATIONS OF SUSPENDED SEDIMENT

TIGRIS RIVER AT BAGHDAD (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1962							
22 July	528	1			172		
					92		
					142		
		2			126		
					131		
					172		
		3			107		
					91		
					170		
		4			129		
					134		
					80		
		5			148		
					96		
					149		

OBSERVATIONS OF SUSPENDED SEDIMENT

DIYALA RIVER AT DERBEND-I-KHAN

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1958							
17 Mar.	296	1	746	851	1597	1574	40.3
		2	618	689	1307		
		3	1055	762	1817		
23 Mar.	307	1	599	677	1276	1572	41.7
		2	690	783	1473		
		3	1129	837	1966		
2 Apr.	235	1			635	742	15.1
		2			658		
		3			932		
9 Apr.	203	1			544	635	11.1
		2			597		
		3			764		
16 Apr.	158	1			376	360	4.91
		2			350		
		3			354		
14 May	81	1			179	183	1.28
		2			91		
		3			278		
21 May	68	1			122	126	0.74
		2			107		
		3			149		

Note 1: Measured from right bank water's edge;
Vertical 1 is 1/4 distance across river;
Vertical 2 is 1/2 distance across river;
Vertical 3 is 3/4 distance across river.

2: Particles larger than 0.05 mm diameter designated coarse, smaller designated fine.

OBSERVATIONS OF SUSPENDED SEDIMENT

EUPHRATES RIVER AT HIT

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1958							
24 Oct.	294	1			106		
					102		
					87		
		2			94		
					100		
					87		
		3			120		
					94		
					100		
		4			98		
					80		
					97		
		5			104		
					102		
					74		

Note 1: Euphrates River data are furnished through the courtesy of the Irrigation Directorate.

2: River divided into five sections of equal discharge.

3. Sampling depths 1/2 meter from surface, mid-depth, and 1/2 meter from bottom.

4. Particles larger than 0.05 mm diameter designated coarse, smaller designated fine.

OBSERVATIONS OF SUSPENDED SEDIMENT

EUPHRATES RIVER AT HIT (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1958							
21 Nov.	354	1			137		
					140		
					133		
		2			134		
					130		
					157		
		3			150		
					129		
					136		
		4			146		
					112		
					135		
		5			156		
					146		
					151		
1959							
16 Jan.	533	1			338		
					362		
					320		
		2			320		
					341		
					360		
		3			360		
					324		
					331		
		4			348		
					343		
					378		
		5			325		
					413		
					552		

OBSERVATIONS OF SUSPENDED SEDIMENT

EUPHRATES RIVER AT HIT (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1959							
28 Jan.	661	1			589		
					509		
					485		
		2			493		
					495		
					451		
		3			454		
					494		
					485		
		4			471		
					451		
					459		
		5			429		
					347		
					364		
23 Apr.	2774	1			454		
					494		
					393		
		2			407		
					352		
					395		
		3			334		
					393		
					335		
		4			345		
					343		
					357		
		5			357		
					333		
					303		

OBSERVATIONS OF SUSPENDED SEDIMENT

EUPHRATES RIVER AT HIT (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1959							
29 May	1747	1	77	2444	2521		
			44	2733	2777		
			30	2872	2902		
		2	129	3043	3172		
			115	3028	3143		
			108	2533	2641		
		3	51	2375	2426		
			44	2933	2977		
			103	2740	2843		
		4	62	3054	3116		
			48	2841	2889		
			99	3000	3099		
		5	72	2655	2727		
			42	2937	2979		
			51	2740	2791		
26 June	694	1			768		
					711		
					783		
		2			794		
					796		
					772		
		3			838		
					725		
					750		
		4			722		
					829		
					755		
		5			735		
					766		
					749		

OBSERVATIONS OF SUSPENDED SEDIMENT

EUPHRATES RIVER AT HIT (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1959							
24 July	278	1			87		
					109		
					90		
		2			102		
					78		
					99		
		3			72		
					120		
					87		
		4			137		
					83		
					80		
		5			110		
					109		
					86		
25 Aug.	198	1			70		
					69		
					57		
		2			87		
					139		
					93		
		3			73		
					38		
					84		
		4			99		
					106		
					114		
		5			106		
					110		
					107		

OBSERVATIONS OF SUSPENDED SEDIMENT

EUPHRATES RIVER AT HIT (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1959							
25 Sept.	215	1			73		
					198		
					74		
		2			70		
					74		
					57		
		3			59		
					60		
					71		
		4			78		
					71		
					46		
		5			71		
					66		
					61		
23 Oct.	305	1			161		
					143		
					168		
		2			153		
					118		
					126		
		3			155		
					152		
					143		
		4			110		
					138		
					137		
		5			95		
					146		
					135		

OBSERVATIONS OF SUSPENDED SEDIMENT

EUPHRATES RIVER AT HIT (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1959							
26 Nov.	476	1			240		
					164		
					152		
		2			160		
					187		
					143		
		3			118		
					162		
					128		
		4			130		
					136		
					136		
		5			140		
					117		
					97		
1960							
19 Feb.	581	1	66	2378	2444		
			79	2465	2544		
			89	2505	2594		
		2	68	2196	2264		
			48	2175	2223		
			73	2496	2569		
		3	115	2156	2271		
			68	2002	2070		
			50	2379	2429		
		4	38	2000	2038		
			44	2062	2106		
			76	2352	2428		
		5	64	1862	1926		
			75	2087	2162		
			37	2038	2075		

OBSERVATIONS OF SUSPENDED SEDIMENT

EUPHRATES RIVER AT HIT (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1960							
29 Feb.	1186	1			562		
					985		
			177	1180	1357		
		2	184	1146	1330		
			66	965	1031		
					849		
		3			918		
					505		
					381		
		4			511		
					734		
					981		
		5			755		
			101	1066	1167		
					796		
15 Mar.	1661	1	164		3028		
			56		2439		
			77		1976		
		2	113		2046		
			51		2274		
			81		2581		
		3	24		2009		
			68		2670		
			60		2639		
		4	73		2220		
			52		1749		
			67		2766		
		5	62		2826		
			1		2963		
					1606		

OBSERVATIONS OF SUSPENDED SEDIMENT

EUPHRATES RIVER AT HIT (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1960							
1 Apr.	1530	1	145	2304	2449		
			114	2534	2648		
			74	2505	2579		
		2	121	2327	2448		
			201	2696	2897		
			164	2453	2617		
		3	36	2162	2198		
			70	2107	2177		
			180	2784	2964		
		4	109	2388	2497		
			148	2600	2748		
			72	2093	2165		
		5	40	2424	2464		
			112	2293	2405		
			84	2247	2331		
8 Apr.	2805	1	75	5329	5404		
			56	5176	5232		
			56	5106	5162		
		2	32	4605	4637		
			75	4221	4296		
			38	4602	4640		
		3	63	4716	4779		
			35	4453	4488		
			106	5157	5263		
		4	98	4700	4798		
			61	5278	5339		
			82	5124	5206		
		5	153	5613	5766		
			51	5054	5105		
			81	4458	4539		

OBSERVATIONS OF SUSPENDED SEDIMENT

EUPHRATES RIVER AT HIT (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1960							
26 Apr.	3198	1	60	2336	2396		
			58	2426	2484		
			143	2816	2959		
		2	23	2419	2442		
			48	2221	2269		
			95	2511	2606		
		3	104	2224	2328		
			53	2107	2160		
			69	2257	2326		
		4	45	1910	1955		
			64	2271	2335		
			66	2028	2094		
		5	124	2546	2670		
			75	2564	2639		
			42	2049	2091		
4 May	3946	1	68	2042	2110		
			81	2719	2800		
			56	2641	2697		
		2	45	2106	2151		
			66	2315	2381		
			112	2839	2951		
		3	121	2238	2359		
			58	2317	2375		
			106	2524	2630		
		4	28	2115	2143		
			32	2185	2217		
			49	2027	2076		
		5	43	2052	2095		
			43	1931	1974		
			28	1981	2009		

OBSERVATIONS OF SUSPENDED SEDIMENT

EUPHRATES RIVER AT HIT (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1960							
24 June	758	1			611		
					439		
					510		
		2			528		
					499		
					498		
		3			612		
					859		
					471		
		4			527		
					570		
					422		
		5			541		
					607		
					644		
22 July	343	1			662		
					771		
					295		
		2			193		
					230		
					239		
		3			145		
					250		
					171		
		4			187		
					138		
					382		
		5			128		
					131		
					108		

OBSERVATIONS OF SUSPENDED SEDIMENT

EUPHRATES RIVER AT HIT (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1960							
23 Aug.	354	1			84		
					95		
					74		
		2			126		
					102		
					108		
		3			182		
					99		
					107		
		4			113		
					88		
					101		
		5			83		
					95		
					91		
23 Sept.	242	1			76		
					93		
					90		
		2			113		
					116		
					134		
		3			127		
					82		
					120		
		4			108		
					97		
					98		
		5			104		
					101		
					102		

OBSERVATIONS OF SUSPENDED SEDIMENT

EUPHRATES RIVER AT HIT (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1960							
21 Oct.	351	1			127		
					140		
					138		
		2			143		
					163		
					140		
		3			131		
					123		
					121		
		4			128		
					118		
					121		
		5			147		
					111		
					121		
25 Nov.	361	1			688		
					681		
					663		
		2			719		
					713		
					728		
		3			582		
					610		
					612		
		4			585		
					530		
					732		
		5			732		
					442		
					597		

OBSERVATIONS OF SUSPENDED SEDIMENT

EUPHRATES RIVER AT HIT (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1960							
23 Dec.	373	1			137		
					140		
					126		
		2			134		
					138		
					144		
		3			154		
					118		
					129		
		4			180		
					145		
					149		
		5			150		
					99		
					141		
1961							
20 Jan.	414	1			812		
			62	979	1041		
					294		
		2			790		
					920		
					786		
		3	20	982	1002		
					904		
					654		
		4	73	929	1002		
					909		
					903		
		5			274		
					753		
					866		

OBSERVATIONS OF SUSPENDED SEDIMENT

EUPHRATES RIVER AT HIT (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1961							
24 Feb.	760	1			813		
					843		
					718		
		2			809		
					826		
					804		
		3			807		
					818		
					799		
		4			817		
					815		
					771		
		5			813		
					819		
					810		
24 Mar.	556	1			328		
					290		
					298		
		2			296		
					321		
					315		
		3			300		
					273		
					327		
		4			285		
					314		
					284		
		5			282		
					273		
					278		

OBSERVATIONS OF SUSPENDED SEDIMENT

EUPHRATES RIVER AT HIT (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1961							
21 Apr.	1634	1			1506		
					1860		
					1537		
		2			1715		
					1485		
					1740		
		3			1830		
					1827		
					1716		
		4			1357		
					1608		
					1746		
		5			2089		
					1694		
					1694		
19 May	1181	1			665		
			109	2904	3013		
			79	2690	2769		
		2	108	3621	3729		
			138	3323	3461		
			136	3479	3615		
		3	172	3465	3637		
			97	3103	3200		
			117	3103	3220		
		4	46	3042	3088		
			78	3376	3454		
			109	3867	3976		
		5	45	2159	2204		
			53	2558	2611		
			36	2721	2757		

OBSERVATIONS OF SUSPENDED SEDIMENT

EUPHRATES RIVER AT HIT (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1961							
23 June	422	1			903		
					863		
					853		
		2			898		
					880		
					812		
		3			921		
					619		
					872		
		4			851		
					900		
					868		
		5			869		
					881		
					886		
21 July	162	1			88		
					91		
					81		
		2			122		
					151		
					127		
		3			97		
					87		
					109		
		4			116		
					77		
					162		
		5			105		
					125		
					127		

OBSERVATIONS OF SUSPENDED SEDIMENT

EUPHRATES RIVER AT HIT (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1961							
27 July	137	1			101		
					120		
					77		
		2			127		
					77		
					96		
		3			77		
					73		
					92		
		4			96		
					80		
					70		
		5			66		
					116		
					86		
11 Aug.	112	1			53		
					89		
					59		
		2			80		
					73		
					118		
		3			69		
					44		
					99		
		4			80		
					94		
					170		
		5			45		
					67		
					114		

OBSERVATIONS OF SUSPENDED SEDIMENT

EUPHRATES RIVER AT HIT (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1961							
25 Aug.	91	1			126		
					110		
					154		
		2			146		
					181		
					134		
		3			151		
					131		
					107		
		4			148		
					119		
					205		
		5			101		
					81		
					136		
15 Sept.	96	1			102		
					129		
					187		
		2			117		
					97		
					147		
		3			133		
					131		
					49		
		4			145		
					97		
					104		
		5			91		
					83		
					136		

OBSERVATIONS OF SUSPENDED SEDIMENT

EUPHRATES RIVER AT HIT (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1961							
26 Sept.	135	1			191		
					171		
					180		
		2			172		
					171		
					213		
		3			163		
					142		
					170		
		4			99		
					136		
					178		
		5			82		
					165		
					171		
19 Oct.	237	1			149		
					156		
					155		
		2			112		
					160		
					129		
		3			160		
					132		
					147		
		4			119		
					154		
					82		
		5			97		
					125		
					109		

OBSERVATIONS OF SUSPENDED SEDIMENT

EUPHRATES RIVER AT HIT (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1961							
27 Nov.	334	1			591		
					571		
					591		
		2			599		
					586		
					573		
		3			611		
					608		
					534		
		4			627		
					575		
					580		
		5			581		
					589		
					614		
21 Dec.	1612	1	63	3179	3242		
			40	3013	3053		
			76	3104	3180		
		2	47	3068	3115		
			59	3291	3350		
			66	3178	3244		
		3	53	3219	3272		
			36	3281	3317		
			51	2974	3025		
		4	43	3289	3332		
			133	3181	3314		
			82	3131	3213		
		5	82	3166	3248		
			102	3266	3368		
			87	3068	3155		

OBSERVATIONS OF SUSPENDED SEDIMENT

EUPHRATES RIVER AT HIT (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1962							
22 Jan.	668	1			479		
					506		
					420		
		2			451		
					448		
					414		
		3			375		
					442		
					427		
		4			293		
					422		
					444		
		5			398		
					378		
					387		
19 Feb.	862	1	19	1028	1047		
			24	991	1015		
					964		
		2			975		
					953		
					996		
		3	39	961	1000		
					949		
					944		
		4			994		
					890		
			19	1020	1039		
		5			931		
					983		
					818		

OBSERVATIONS OF SUSPENDED SEDIMENT

EUPHRATES RIVER AT HIT (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1962							
16 Mar.	1489	1			856		
					1052		
					944		
		2	4	1050	1054		
					894		
					1070		
		3			889		
			7	1070	1077		
			13	1422	1435		
		4	4	1130	1134		
			163	965	1128		
					963		
		5			935		
			10	1102	1112		
			15	1073	1088		
12 Apr.	2100	1	433	1142	1575		
			451	910	1361		
			229	1151	1380		
		2	396	946	1342		
			296	1401	1697		
			253	1283	1536		
		3	496	723	1219		
			344	1040	1384		
			364	1028	1392		
		4	340	801	1141		
			263	892	1155		
			491	892	1383		
		5	757	1466	2223		
			496	1506	2002		
			361	1321	1682		

OBSERVATIONS OF SUSPENDED SEDIMENT

EUPHRATES RIVER AT HIT (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1962							
28 May	1253	1			904		
					944		
					942		
		2			939		
					921		
			99	946	1045		
		3	38	985	1023		
					953		
					955		
		4	17	983	1000		
					928		
					974		
		5	59	1002	1061		
					908		
					979		
21 June	583	1			591		
					624		
					604		
		2			634		
					606		
					667		
		3			626		
					572		
					599		
		4			614		
					612		
					592		
		5			638		
					609		
					603		

OBSERVATIONS OF SUSPENDED SEDIMENT

EUPHRATES RIVER AT SHINAFIYAH

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1958							
14 Oct.		1			321		
					351		
			778	326	1104		
		2			357		
					276		
					237		
		3			250		
					513		
					391		
29 Oct.	154	1			344		
					253		
					644		
		2			356		
					419		
					448		
		3			282		
					301		
					391		

Hit had 305 cumecs on Oct. 23

Note 1: Euphrates River data are furnished through the courtesy of the Irrigation Directorate.

2: Sampling depths 1/2 meter from surface, mid-depth, and 1/2 meter from bottom.

3: Particles larger than 0.05 mm diameter designated coarse, smaller designated fine.

OBSERVATIONS OF SUSPENDED SEDIMENT

EUPHRATES RIVER AT SHINAFIYAH (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1958							
31 Dec.	186	1			852		
			262	749	1011		
			477	668	1145		
		2			816		
					925		
			369	635	1004		
		3			770		
					820		
					911		
1959							
13 Jan.	99	1			292		
					513		
					643		
		2			177		
					260		
					277		
		3			147		
					197		
					163		
1960							
17 Jan.	711	1	259	3756	4015		
			184	3849	4033		
			138	2934	3072		
		2	341	3808	4149		
			623	3908	4531		
			1623	4288	5911		
		3	225	3693	3918		
			389	3862	4251		
			1479	4144	5623		

OBSERVATIONS OF SUSPENDED SEDIMENT

EUPHRATES RIVER AT SHINAFIYAH (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1960							
21 Feb.	346	1			466		
Hit had 760 on Feb 27					545		
					599		
		2			525		
					963		
					835		
		3			635		
					855		
			483	599	1082		
15 Mar.	635	1	158	1282	1440		
Hit had 556 on March 24			227	1325	1552		
			162	1282	1444		
		2	168	1371	1539		
			513	1388	1901		
			1521	1426	2947		
		3	237	1142	1379		
			195	1317	1512		
			1089	1565	2654		
15 May	1301	1			638		
Hit had 1181 on May 19					737		
			156	862	1018		
		2			789		
					972		
			230	781	1011		
		3			881		
			255	765	1020		
					853		

OBSERVATIONS OF SUSPENDED SEDIMENT

EUPHRATES RIVER AT SHINAFIYAH (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1960							
13 July	89	1			279		
					299		
Hit had 16 2 on July 21					282		
		2			252		
					352		
					358		
		3			239		
					273		
					251		
16 Aug.	39	1			155		
					275		
Hit had 112 on Aug 11 and 91 on Aug 25					198		
		2			221		
					162		
					162		
		3			130		
					223		
					193		
31 Aug.	168	1			334		
					353		
					376		
		2			340		
					358		
					381		
		3			329		
					356		
					337		

OBSERVATIONS OF SUSPENDED SEDIMENT

EUPHRATES RIVER AT SHINAFIYAH (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1960							
30 Sept.	111	1			440		
					724		
Hit had 135 on Sept. 26			1024	564	1588		
		2			468		
					487		
					523		
		3			369		
					392		
					422		
1961							
17 Jan.	233	1	647	410	1057		
Hit had 668 on Jan 22					308		
					255		
		2			353		
					313		
					585		
		3			334		
					301		
					376		
12 Feb.	153	1			435		
Hit had 862 on Feb 19					461		
					497		
		2			459		
					474		
					593		
		3			366		
					380		
					395		

OBSERVATIONS OF SUSPENDED SEDIMENT

EUPHRATES RIVER AT SHINAFIYAH (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1961							
28 Feb.	385	1			877		
					943		
			237	833	1070		
		2			885		
			241	842	1083		
			801	1042	1843		
		3			797		
			240	808	1048		
			1013	1026	2039		
30 Mar.	202	1			397		
					677		
					976		
Hit had 1489 on March 16		2			540		
					443		
					927		
		3			339		
					370		
					487		
5 June	244	1			396		
					410		
Hit had 583 on June 21 and 1252 on May 28					418		
		2			314		
					403		
					439		
		3			317		
					312		
					315		

OBSERVATIONS OF SUSPENDED SEDIMENT

EUPHRATES RIVER AT SHINAFIYAH (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1961							
1 Oct.	61	1			418		
					893		
					255		
		2			190		
					194		
					235		
		3			352		
					341		
					422		
22 Oct.	79	1			492		
					480		
					444		
		2			529		
					473		
					446		
		3			440		
					520		
					582		
26 Nov.	136	1			280		
					355		
					269		
		2			407		
					305		
					327		
		3			316		
					281		
					285		

OBSERVATIONS OF SUSPENDED SEDIMENT

EUPHRATES RIVER AT SHINAFIYAH (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1962							
24 Jan.	269	1			624		
					615		
					640		
		2			697		
					631		
					695		
		3			739		
					584		
					649		
24 Feb.	467	1			650		
					597		
					643		
		2			641		
					652		
					633		
		3			656		
					657		
					649		
25 Apr.	933	1	28	999	1027		
					993		
					905		
		2	99	965	1064		
			71	980	1051		
			69	1199	1268		
		3	36	1247	1283		
			47	1159	1206		
			78	1178	1256		

OBSERVATIONS OF SUSPENDED SEDIMENT

EUPHRATES RIVER AT SHINAFIYAH (cont'd.)

Date	Discharge (cumecs)	Vertical	Sediment Concentration (parts per million) Coarse	Fine	Total	Average	Sediment Load (million kg per day)
1962							
29 May	829	1			195		
					179		
					193		
		2			223		
					217		
					168		
		3			189		
					205		
					143		

ANNEX A-3

DESCRIPTION OF SNOW COURSES

DESHTI TAWANISH (Amadia Group, Mosul Liwa)

Latitude: 37°08'25" N. Longitude: 45°29'42" E. Elevation: 1685 m.
Major drainage: Greater Zab River
Aspect: North
Exposure: Large, open, bowl-shaped area of cultivated land at foot of steep north slopes of Perasi Mt. ridge.
Maps: 1:20,000 90/530
1/4 inch Iran-Iraq J - 38N
Exhibit A-9

Detailed location and route. Surveys start from Hessi village (reached from Suluf on main Amadia road, via Galli Mazurka and Ser Amadia; may be impassable in winter, and Galli could be dangerous). From Hessi climb on bearing approx. 130° mag., to Suwerta Naodeshti (65 min.). Cross Naodeshti to Suwerta Tawanish, 20 min. on 120° mag. and 15 min. on 75° mag. Descend to snow course on bearing 75° mag. (20 min.). Total time Hessi to Deshti Tawanish S. C., 2 hrs., but may take up to 4 hrs. under bad winter conditions. Route is completely safe and straightforward, but must be strictly adhered to. Many lives have been lost in blizzards on Naodeshti.

Remarks

Snow Surveyor (1959): Zaia Yelda Salary: I.D. 9.000
Assistant (1959): Adam Joseph Salary: I.D. 6.000
Method of travel: Foot/snowshoe from Hessi village involving 12 km. of foot/snowshoe travel per measurement.
History: Sited September 1957 by M. Mansell-Moullin. Installed October 1957 and marked by four steel pipe markers. Surveys started 1958.

Land owned by Hajji Hassan, Tawanish village. Zaia lives in Mergaji village and Adam in Hessi village, 20 min. away. Salaries shown are the totals for each survey of the three courses, Deshti Tawanish, Zavi Sur, and Kani Bahri.

ZAVI SUR (Amadia Group, Mosul Liwa)

Latitude: 37°08'35" N. Longitude: 43°26'01" E. Elevation: 1420 m.
Major drainage: Tigris River Minor drainage: Khabur River
Aspect: Northeast
Exposure: Sheltered site among fairly thick 20'-25' scrub oak trees.
Maps: 1:20,000 90/520
1/4 inch Iran-Iraq J - 38N
Exhibit A-10

Detailed location and route. Surveys start from Hessi village (reached from Suluf on main Amadia road, via Galli Mazurka and Ser Amadia; may be impassable in winter, and Galli could be dangerous). From Hessi proceed along track to Kani Rash (spring), 30 min. on bearing 185°. Then turn west and climb towards low col, which leads over to Galli Karaba. Course is reached after 10 min. Hessi to Zavi Sur S. C. approx. 40 min.

Remarks

Snow Surveyor (1959): Zaia Yelda Salary: I. D. 9.000
Assistant (1959): Adam Joseph Salary: I. D. 6.000
Method of travel: Foot/snowshoe from Hessi village involving 4 km. of foot/snowshoe travel per measurement.
History: Sited September 1957 by M. Mansell-Moullin. Installed October 1957 and marked by four steel pipe markers. Surveys started 1958.

Land owned by Rais Isha, Hessi village. Zaia lives in Mergaji village and Adam in Hessi village, 20 min. away. Salaries shown are the totals for each survey of the three courses, Deshti Tawanish, Zavi Sur, and Kani Bahri.

KANI BAHRI (Amadia Group, Mosul Liwa)

Latitude: 37°10'18" N. Longitude: 43°26'34" E. Elevation: 1190 m.
Major drainage: Tigris River Minor drainage: Khabur River
Shive Kujain
Aspect: North
Exposure: Small piece of cultivated land, in undulating scrub oak covered area.
Maps: 1:20,000 90/520
1/4 inch Iran-Iraq J - 38 N
Exhibit A-11

Detailed location and route. Surveys start from Hessi village (reached from Suluf on main Amadia road, via Galli Mazurka and Ser Amadia; may be impassable in winter, and Galli could be dangerous). From Hessi proceed to Mergaji village and then turn northeast along main track to Kani Mase. Snow course lies close to track on west side, 10 min. from Mergaji. Hessi to Kani Bahri S. C., 30 min.

Remarks

Snow Surveyor (1959): Zaia Yelda Salary: I. D. 9.000
Assistant (1959): Adam Joseph Salary: I. D. 6.000
Method of travel: Foot/snowshoe from Hessi village involving 3-4 km. of foot/snowshoe travel per measurement.
History: Sited September 1957 by M. Mansell Moullin. Installed October 1957 and marked by four steel pipe markers. Surveys started 1958.

Land owned by Yohanna Odishu, Mergaji village. Zaia lives in Mergaji village and Adam in Hessi village, 20 min. away. Salaries shown are the totals for each survey of the three courses, Deshti Tawanish, Zavi Sur, and Kani Bahri.

OMAR KHAYAT (Hajji Umran Group, Erbil Liwa)

Latitude: 36°37'09" N. Longitude: 45°00'59" E. Elevation: 2640 m.
Major drainage: Greater Zab River Minor drainage: Ruwanduz River
Aspect: North
Exposure: Moderately sheltered summer camping ground near head of valley.
Maps: 1:20,000 84/660
1/4 inch Iran-Iraq J - 38/U
Exhibit A-12

Detailed location and route. Surveys start from Hajji Umran village, approx. 5 km. from Persian border on main road from Ruwanduz. Road may be impassable as far down as Darband, approx. 4 hrs. on foot from Hajji Umran.

Proceed to I. P. C. huts, on northern slopes south of Hajji Umran, average time 1 hr. Way to Omar Khayat lies up ridge to S. S. W., general bearing

210°; time 2-3 hrs. on skis. For details of route see route map. Route is perfectly safe under all conditions but should not be varied. Under bad conditions route finding can be very difficult and must be entirely on compass bearings. Care must be taken to avoid cornices.

Way down is via Kalkash S. C. From Omar Khayat proceed 10 min. on bearing 290° to small col. Five min. north is a cave which could be used for shelter (check for bears). From col proceed to Kalkash S. C. along lower slopes of Kudu Mt. on bearing approx. 10° mag. Avoid swinging to east into dangerous gullies, cornices. Omar Khayat S. C. to Kalkash S. C. takes approx. 1 1/2 hrs. depending on conditions. Route finding can be very difficult, rely on compass bearings. General bearing Kalkash S. C. to I. P. C. huts 30° mag., but follow route shown on route map.

Remarks

Snow Surveyor (1959): L. F. Morris (H. S. I.)
Assistant (1959): Ali Nabi or Abdulla Nabi (brothers) Salary: I. D. 6.000
Method of travel: Landrover as far as road is open/ski (snowshoes much slower and more tiring) involving between 100 and 140 km. Landrover travel from Diana to Hajji Umran and return (Diana to Darband 50 km., to Rayat 60 km., to Hajji Umran 70 km.) and 0-40 km. ski travel; and 5-8 hrs. ski travel from Hajji Umran to Omar Khayat S. C. depending on conditions.
History: Course sited and installed December 1956 by Moullin and assistants. Course marked by four steel pipe markers. Surveys started 1957. Snow surveyor 1957, M. Mansell-Moullin (H.S.I.); 1958, D. A. Clark (H. S. I.). Assistant snow surveyor 1957 and 1958 Ali Nabi (Hajji Umran).
Estimate of value for forecasting: Will probably prove of greatest value for summer flow forecasts.

Assistant snow surveyor from Hajji Umran village. Salary shown above is that for each survey of the four courses of the Hajji Umran group. Rest house in Hajji Umran (closed during winter). Use of I. P. C. huts is essential; permission has kindly been granted each year by the I. P. C., Kirkuk, on personal application. Appreciable knowledge of winter travel in mountains is essential if survey schedule is to be maintained under all conditions. Use of skis is desirable. Assistants ski.

KALKASH (Hajji Umran Group, Erbil Liwa)

Latitude: 36°37'49" N. Longitude: 45°00'46" E. Elevation: 2510 m.
Major drainage: Greater Zab River Minor drainage: Ruwanduz River
Aspect: North
Exposure: High, sheltered summer camping ground only open to north and northeast.
Maps: 1:20,000 84/660
1/4 inch Iran-Iraq J - 38/U
Exhibit A-13

Detailed location and route. Surveys start from Hajji Umran village, approx. 5 km. from Persian border on main road from Ruwanduz. Road may be impassable as far down as Darband, approx. 4 hrs. on foot from Hajji Umran.

Proceed to I. P. C. huts on northern slopes south of Hajji Umran, average time one hr. Course is normally sampled as surveyor returns from Omar Khayat S. C. For full details of route see description of Omar Khayat, S. C.

Remarks

Snow Surveyor (1959): L. F. Morris (H. S. I.)
Assistant (1959): Ali Nabi or Abdulla Nabi (brothers) Salary: I. D. 6.000
Method of travel: Landrover as far as road is open/ski (snowshoes much slower and more tiring) involving between 100 and 140 km. of Landrover travel from Diana (Diana to Darband 50 km., to Rayat 60 km., to Hajji Umran 70 km.) and 0-40 km. ski travel; and 5-8 hrs. ski travel from Hajji Umran, via Omar Khayat S. C.
History: Course sited October 1956 by Work, Moullin, Brown and assistants. Course installed December 1956 and marked by four steel marker pipes. Surveys started 1957. Snow surveyor 1957, M. Mansell-Moullin (H. S. I.); 1958, D. A. Clarke (H. S. I.). Assistant snow surveyor 1957 and 1958, Ali Nabi (Hajji Umran).
Estimate of value for forecasting: Will probably prove of greatest value for summer forecasts.

Assistant snow surveyor from Hajji Umran village. Salary shown above is that for each survey of the four courses of the Hajji Umran Group. Rest house in Hajji Umran (closed during winter). Use of I. P. C. huts

is essential; permission has kindly been granted each year by the I. P. C., Kirkuk, on personal application. Appreciable knowledge of winter travel in mountains is essential if survey schedule is to be maintained under all conditions. Use of skiis is desirable: Assistants ski.

KANDASHIN (Hajji Umran Group, Erbil Liwa)

Latitude: 36°39'06" N. Longitude: 45°01'56" E. Elevation: 1980 m.
Major drainage: Greater Zab River Minor drainage: Runwanduz River
Aspect: Northeast
Exposure: Course lies beside stream in sheltered, north-facing gully.
Maps: 1:20,000 84/660
1/4 inch Iran-Iraq J - 38/U
Exhibit A-14

Detailed location and route. Surveys start from Hajji Umran village, approx. 5 km. from Persian border on main road from Ruwanduz. Road may be impassable as far down as Darband, approx. 4 hrs. on foot from Hajji Umran.

Proceed to I. P. C. huts, on northern slopes south of Hajji Umran, average time 1 hr. Course lies about 150 m. to east.

Remarks

Snow Surveyor(1959): L. F. Morris (H. S. I.)
Assistant (1959): Ali Nabi or Abdulla Nabi (brothers) Salary: I. D. 6.000
Method of travel: Landrover as far as road is open/ski involving between 100 and 140 km. of landrover travel from Diana (Diana to Darband 50 km., to Rayat 60 km., to Hajji Umran 70 km.) and 0-40 km. ski travel; and 1 1/2-2 hrs. ski travel from Hajji Umran to course and return.
History: Course sited October 1956 by Work, Moullin, Brown and assistants. Course installed December 1956 and marked by four steel pipe markers. Survey started 1957. Snow surveyor 1957, M. Mansell-Moullin (H. S. I.); 1958, D. A. Clark (H. S. I.). Assistant snow surveyor 1957 and 1958, Ali Nabi (Hajji Umran).

Assistant snow surveyor from Hajji Umran village. Salary shown above is that for each survey of the four courses of the Hajji Umran group. Rest

house in Hajji Umran (closed during winter). Permission to use the I. P. C. huts has kindly been granted each year by the I. P. C., Kirkuk, on personal application. Use of skis is desirable: Assistants ski.

CHIKAN (Hajji Umran Group, Erbil Liwa)

Latitude: 39°40'07" N. Longitude: 44°58'36" E. Elevation: 1600 m.
Major drainage: Greater Zab River Minor drainage: Ruwanduz River
Aspect: Northeast
Exposure: Undulating, cultivated plateau backed on east, south, and west by a continuous ring of high precipitous mountains.
Maps: 1:20,000 84/660
1/4 inch Iran-Iraq J - 38/U
Exhibit A-15

Detailed location and route. Surveys start from Rayat police post, 60 km. from Diana on main road to Hajji Umran and Iran. Road may be impassable beyond Darband, 2 hrs. on foot from Rayat.

Route to course runs obliquely to S. W. up slopes behind police post until the lip of the plateau is reached, when the snow course is clearly visible to the south. Time, police post to Chikan S. C. 20-30 min. Return by same route.

Remarks

Snow Surveyor (1959): L. F. Morris (H. S. I.)
Assistant (1959): Ali Nabi or Abdulla Nabi, brothers Salary: I. D. 6.000
Method of travel: Landrover as far as road is open/ski: snowshoe involving between 100 and 120 km. of landrover travel from Diana (Diana to Darband 50 km.; to Rayat 60 km.) and 0-20 km. ski travel, depending on conditions; and 1 hr. travel up to snow course and return.
History: Course sited October 1956 by Work, Moullin, Brown and assistants. Course installed December 1956 and marked by four steel pipe markers. Surveys started 1957. The 24 sampling points were reduced to 12 (1957) and the early surveys have been adjusted for this change. Snow Surveyor 1957, M. Mansell-Moullin (H. S. I.); 1958, D. A. Clarke (H. S. I.). Assistant snow surveyor 1957 and 1958, Ali Nabi (Hajji Umran).

Assistant snow surveyor from Hajji Umran village. Salary shown above is that for each survey of the four courses of the Hajji Umran group. Rest house in Hajji Umran (closed during winter).

DOUR KHINIQ (Handran Mt. Group, Erbil Liwa)

Latitude: 36°34'16" N. Longitude: 44°36'56" E. Elevation: 2300 m.
Major drainage: Greater Zab River Minor drainage: Ruwanduz River
Aspect: North
Exposure: At head of north-draining gully high up on western flank of Handran Mountain.
Maps: 1:20,000 83/630
1/4 inch Iran-Iraq J - 38/U
Exhibit A-16

Detailed location and route. Diana to Jindian village by road (9 km.). Well defined mule track leads S. S. E. up the mountain, parallel to and on the east side of Galli Sambawakal. About 2 3/4 hrs. from Jindian turn into Galli and follow it up until reaching mule track which leads up its west side to Sambawakal S. C. Route is not difficult but can be very arduous in deep snow. Jindian to Sambawakal S. C. approx. 3 hrs. Mountain refuge hut is just above course. An alternative route down, which leads directly to Gora Ripne S. C., can be used, but it is slightly longer.

The route from Sambawakal S. C. to Dour Khiniq S. C., which has three route markers, is detailed below.

Remarks

Snow Surveyor (1959): L. F. Morris (H. S. I.)
Assistant (1959): Ramazan Salary: I. D. 3.000
Method of travel: Car/foot: snowshoe involving 18 km. of car travel and approx. 9 hrs. of foot/snowshoe travel per measurement, from Diana.
History: Course sited October 1956 by Work, Moullin, Brown and assistants. Course installed September 1957 and marked by three steel pipe markers. Survey started 1958. Snow surveyor 1958, D. A. Clark (H. S. I.).

Assistant snow surveyor from Jindian village. Salary shown above is that for each survey of the three courses on Handran Mt. H. S. I. accomodation

in Diana, and mountain refuge hut at Sambawakal S. C. Hut is fully equipped for overnight stops (2 people) except for food. Broken into, damaged, and equipment stolen in 1958 and 1959. The course cannot be surveyed from Diana in one day except possibly at the end of the snow season.

Route from H. S. I. Handran Mountain Hut (Sambawakal) to Dour Khiniq Snow Course.

Total time (min.)	Time interval (min.)	
0	0	Leave hut.
10	10	Southeast to center of Galli Sambawakal, at treeline.
45	35	Follow straight up gully to lone tree on the east side (bearing 150° mag. approx.)
50	5	Gully swings to east and first "route marker pipe."
65	15	First to second "route marker pipes." Direct route, involving a short steep climb near second pipe (bearing 105° mag.)
90	25	Second to third "route marker pipes." Direct route over rising, undulating ground (bearing 130° mag.) Pipe 3 is set on final col near large, prominent rock.
95	5	Sharp descent to snow course (bearing 60° mag.)

Notes: 1. Times are approximately correct proportionally. Total time is usually 1 1/2-2 hrs., depending on conditions.

Notes: (continued)

2. Markers are 2" pipes 20 ft. long with triangular plates bolted to their tops. They are set in concrete.

3. This route should not be varied. Under bad winter conditions it would be both easy and serious to get lost in this area.

SAMBAWAKAL (Handran Mt. Group, Erbil Liwa)

Latitude: 36°35'23" N. Longitude: 44°35'33" E. Elevation: 1810 m.
Major drainage: Greater Zab River Minor drainage: Ruwanduz River
Aspect: North
Exposure: Sloping ground backed to south by cliffs. Good cover scrub oak and wild pears (4-6 m.)
Maps: 1:20,000 83/620
1/4 inch Iran-Iraq J - 38U
Exhibit A-17

Detailed location and route. Diana to Jindian village by road (9 km.) Well defined mule track leads S. S. E. up the mountain, parallel to and on the east side of Galli Sambawakal. About 2 3/4 hrs. from Jindian turn into Galli and follow it up until reaching mule track which leads up its west side to Sambawakal S. C. Route is not difficult but can be very arduous in deep snow. Jindian to Sambawakal S. C. approx. 3 hrs. Mountain refuge hut is just above course. An alternative route down, which leads directly to Gora Ripne S. C., can be used, but it is slightly longer.

Remarks:

Snow Surveyor (1959): L. F. Morris (H. S. I.)
Assistant (1959): Ramazan Salary: I. D. 3.000
Method of travel: Car/foot: snowshoe; involves 18 km. of car travel and approx. 6 hrs. of foot/snowshoe travel per measurement, from Diana.
History: Course sited October 1956 by Work, Moullin, Brown and assistants. Course installed December 1956 and marked by four steel pipe markers; layout different from that of October 1956. Surveys started 1958. Snow surveyor 1958, D. A. Clarke (H. S. I.)

Assistant surveyor from Jindian village. Salary shown above is that for each survey of the three courses on Handran Mt. H. S. I. accomodation in Diana and mountain refuge hut just above course. Hut is fully equipped for overnight stops (2 people) except for food. Broken into, damaged, and equipment stolen in 1958 and 1959.

GORA RIPNE (Handran Mt. Group, Erbil Liwa)

Latitude: 36°36'43" N. Longitude: 44°33'10" E. Elevation: 820 m.
Major drainage: Greater Zab River Minor drainage: Ruwanduz River
Aspect: North
Exposure: Large, open, moderately sheltered hollow on lower slopes of Handran Mountain.
Maps: 1:20,000 84/620
1/4 inch Iran-Iraq J - 38U
Exhibit A-18

Detailed location and route. Diana via Jindian to culvert just before reaching Ruwanduz army post (12 km.). Road always open. Follow up much used track to southeast until arriving at Gora Ripne plateau (20 min.), when snow course is visible to south. Course lies on lower slopes of Handran Mt.

Remarks:

Snow Surveyor (1959): L. F. Morris (H. S. I.)
Assistant (1959): Ramazan Salary: I. D. 3. 000
Method of travel: Car/foot involving 24/3 km. of travel per measurement from Diana.
History: Course sited October 1956 by Work, Moullin, Brown and assistants. Course installed December 1956 and marked by five steel pipe markers. Surveys started 1957. Snow surveyor 1957, M. Mansell-Moullin (H. S. I.); 1958, D. A. Clarke (H. S. I.).

Assistant snow surveyor from Jindian village. Salary shown above is that for each survey of the three courses on Handran Mt. H. S. I. accomodation in Diana.

NEWAKHWIN (Merga Sor Group, Erbil Liwa)

Latitude: 36°49'30" N. Longitude: 44°17'36" E. Elevation: 1525 m.
Major drainage: Greater Zab River Minor drainage: Balikian River
Aspect: Northeast
Exposure: High, gently sloping area thickly covered with scrub oak and backed on south and west by line of high cliffs.
Maps: 1:20,000 86/600
1/4 inch Iran-Iraq J - 38U
Exhibit A-19

Detailed location and route: Diana to Merga Sor village (48 km.) Poor track in winter and may be impassable beyond Mazna (24 km.) due to snow or mud. Final 6 km. to Merga Sor commonly impassable for part of winter.

From police post proceed straight up hill slopes to S. W. and after approx. 30 min., south to Newakhwin plateau; route is well known locally. Total time Merga Sor Police Post to Newakhwin S. C. approx. 1 hr.

Remarks

Snow Surveyor (1957):L.F. Morris (H. S. I.)
Assistant (1957): Ahmad Quadir Salary: I. D. 3.000
Method of travel: Landrover/foot normally involving approx. 5 hrs. landrover/2 hrs. snowshoe travel per measurement from Diana.
History: Site selected October 1956 by Work, Moullin and assistants. Course installed December 1956 and marked by four steel pipe markers. Surveys started 1957. Snow surveyor 1957, Hassan Fouad, Merga Sor (under training); 1958, D. A. Clarke (H. S. I.).

Snow surveyor should be a local Merga Sor man due to difficulty of access in bad winters; no suitable man found to date. Salary shown for assistant snow surveyor is that for each survey of the two courses, Newakhwin and Gunda Nawandi; he lives in Merga Sor.

GUNDA NAWANDI (Merga Sor Group, Erbil Liwa)

Latitude: 36°50'08" N. Longitude: 44°18'26" E. Elevation: 1100 m.
Major drainage: Greater Zab River Minor drainage: Balikian River
Aspect: Northeast
Exposure: Gently sloping cultivated land near valley floor.
Maps: 1:20,000 86/600
1/4 inch Iran-Iraq J - 38U
Exhibit A-20

Detailed location and route. Diana to Merga Sor village (48 km.). Poor track in winter and may be impassable beyond Mazna (24 km.) due to snow or mud. Final 6 km. to Merga Sor commonly impassable for part of winter.

Course lies in a cultivated field on the right side of the road on entering Merga Sor. The marker pipes are visible from the road. Field is adjacent to house of Ahmad Aga.

Remarks

Snow Surveyor(1959): L. F. Morris (H.S.I.)
Assistant (1959): Ahmad Quadir Salary: I.D. 3.000
Method of travel: Landrover, normally involving approx. 5 hrs. travel per measurement, from Diana. Skiing or snowshoeing sometimes necessary.
History: Course sited and installed December 1956 by Moullin and assistants. Course marked by four steel marker pipes. Surveys started 1957. Snow surveyor 1957, Hassan Fouad, Merga Sor (under training); 1958, D. A. Clarke (H.S.I.)

Snow surveyor should be a local Merga Sor man due to difficulty of access in bad winters, no suitable man found to date. Salary shown for assistant snow surveyor is that for each survey of the two courses, Newakhwin and Gunda Nawandi; he lives in Merga Sor. Land owned by Ahmad Aga, Merga Sor.

SALARAH (Halsho Group, Sulaimania Liwa)

Latitude: 36°11'20" N. Longitude: 45°17'41" E. Elevation: 1890 m.
Major drainage: Lesser Zab River

Aspect: Northwest
Exposure: Open summer pasture, draining to southwest. Low ridge to northwest and broken slopes leading to minor peaks to south east.
Maps: 1:20,000 79/690
1/4 inch Iraq-Iran J - 38V
Exhibit A-21

Detailed location and route. Take guide/police from Qala Dizeh to Halsho village; 3 hrs. walk. H. S. I. hut at Halsho (1080 m.). Follow left bank up Halsho stream 1 km. and turn south up tributary, 1 km. to Nurista S. C. and summer village. Proceed S. E. to col, approx. 20 min. Turn east along track on side of steep south-facing slopes of valley. At head of valley track zig zags to col, then turns south around head of valley. Track then leads east up open valley to Salarah S. C. The track is a standard summer route from Halsho to Kanirash Pass on the Iranian border. Route finding requires care under bad winter conditions. Time Halsho to Salarah, 1 1/2 to 3 hrs. depending on conditions.

Remarks

Snow Surveyor (1959): K. Pope (H. S. I.)
Assistant (1959): Mahmud Rasul (or brother) Salary: I. D. 1.500
Method of travel: Foot/snowshoe involving approx. 10 km. of foot/snowshoe travel per measurement from Halsho.
History: Area of course chosen October 1956 by Work, Moullin, Brown and assistants. Course installed January 1957 and marked by four steel pipe markers. Surveys started 1957. Snow surveyor 1957, T. Whieldon Brown; 1958, K. Thompson, both on staff of R. E., Dokan Dam.

Assistant snow surveyor lives at Halsho village. Salary is total for each survey at the three courses, Salarah, Nurista, and Halsho. The H. S. I. mountain refuge hut at Halsho, near village school, is fully equipped for overnight stops (two people), except for food.

NURISTA (Halsho Group, Sulaimania Liwa)

Latitude: 36°11'50" N. Longitude: 45°15'59" E. Elevation: 1340 m.
Major drainage: Lesser Zab River Minor drainage: Halsho River
Aspect: Northeast

Exposure: Moderately sheltered cultivated terrace on side of north-sloping valley.
Maps: 1:20,000 79/680
1:100,000 Iraq-Iran J - 38V/SW
1/4 inch Iraq-Iran J - 38V
Exhibit A-22

Detailed location and route. Take guide/police from Qala Dizeh to Halsho by much used track across the plains; 3 hrs. walk. H.S.I. hut at Halsho (1080m.). Follow up Halsho stream on left bank 1 km. and turn south up tributary.

One km. to Nurista S.C. and summer village. Snow course is beside track on left hand side and near large spring. Time Halsho village to Nurista, approx. 1/2 hr.

Remarks

Snow Surveyor (1959): K. Pope (H.S.I.)
Assistant (1959): Mahmud Rasul or brother Salary: I.D. 1.500
Method of travel: Foot/snowshoe involving approx. 4 km. of foot/snowshoe per measurement from Halsho.
History: Course sited October 1956 by Work, Moullin, Brown and assistants. Course installed January 1957 by H.S.I. and marked by one steel pipe marker and one steel-plate tree marker. Surveys started 1957. Snow surveyor 1957, T. Whieldon Brown; 1958, K. Thompson, both on staff of R.E. Dokan Dam.

Assistant snow surveyor lives at Halsho village. Salary shown is the total for each survey at the three courses, Salarah, Nurista, and Halsho. The H.S.I. mountain refuge hut at Halsho, near village school, is fully equipped for overnight stops (two people), except for food.

HALSHO (Halsho Group, Sulaimania Liwa)

Latitude: 36°12'06" N. Longitude: 45°15'12" E. Elevation: 1250 m.
Major drainage: Lesser Zab River Minor drainage: Halsho River
Aspect: North
Exposure: Fairly open cultivated ground backed by high ridge to the south.

Maps: 1:20,000 79/680
1:100,000 Iraq-Iran J - 38V
1/4 inch Iraq-Iran J - 38V/SW
Exhibit A-23

Detailed location and route. Take guide/police from Qala Dizeh to Halsho by much used track across the plains; 3 hrs. walk. H.S.I. hut at Halsho (1080 m.). Climb squarely up the slope behind the hut to lip of plateau. Snow course is then visible on bearing approx. 240 degrees mag. Time Halsho hut to Halsho S.C. approx. 20 min.

Remarks

Snow Surveyor (1959): K. Pope (H.S.I.)
Assistant (1959): Mahmud Rasul (or brother) Salary: I.D. 1.500
Method of travel: Foot/snowshoe involving approx. 2 km. of foot/snowshoe travel per measurement from Halsho.
History: Course sited October 1956 by Work, Moullin, Brown and assistants. Course installed January 1957. Snow surveyor 1957, T. Wheildon Brown; 1958, K. Thompson, both on staff of R.E. Dokan Dam.

Assistant snow surveyor lives at Halsho village. Salary shown is the total for each survey of the three courses, Salarah, Nurista, and Halsho. The H.S.I. mountain refuge hut at Halsho, near village school, is fully equipped for overnight stops (two people), except for food.

KORA KZAW (Barsinja Group, Sulaimania Liwa)

Latitude: 35°34'33" N. Longitude: 45°42'02" E. Elevation: 1780 m.
Major drainage: Diyala River Minor drainage: Av-i-Chaqan
Aspect: Southeast
Exposure: On fairly open steep slope just below crest of ridge and near rocky peak of Kora Kzaw. Thick cover of low scrub oak.
Maps: 1:20,000 72/720
1:100,000 Iraq-Iran I - 38D/NE
1/4 inch Iraq-Iran I - 38D
Exhibit A-24

Detailed location and route. Main road Sulaimania, Halabja as far as turn-off to Barsinja, km. 35, 12 km. south of Arbet. This road not closed

by snow for more than 2-3 days. Thirteen km. up track to Barsinja, at top of zig zags, Barsinja plain is reached; this section may be closed after exceptionally heavy snowfalls, in which case Barsinja is inaccessible by foot. Barsinja village is 11 km. across plain, along very poor muddy track which may be impassable for landrovers.

Barsinja to Kora Kzaw S. C. Proceed N. E. from village to top of ridge behind it, up ridge on 340° mag. bearing for 1 1/2 km., then along ridge for 1 1/4 km. on 50° bearing to minor peak. North along this ridge leads to the snow course, which is just below the ridge crest on the eastern slope. Time Barsinja village to snow course, 1 1/2 to 2 1/2 hrs.

Remarks

Snow Surveyor (1959): K. Pope (H. S. I.)
Assistant (1959): Hamid Sur Salary: I. D. 2. 000
Method of travel: Foot/snowshoe involving 8-9 km. of foot/snowshoe travel per measurement from Barsinja village.
History: Course sited October 1956 by Work, Moullin and assistants. Course installed October 1957 by H. S. I. and marked by four steel pipe markers. However, surveys made in 1957. Snow surveyor 1957 and 1958, B. Gilpen (H. S. I.)

Assistant snow surveyor lives in Barsinja village. Salary shown is the total for each survey of the three Barsinja-group courses. Rest house in Barsinja.

TUSTAN (Barsinja Group, Sulaimania Liwa)

Latitude: 35°33'38" N. Longitude: 45°40'26" E. Elevation: 1520 m.
Major drainage: Lesser Zab River Minor drainage: Mawakan Chai

Aspect: North
Exposure: In shallow re-entrant halfway up side of wide open valley.
Maps: 1:20,000 72/720
1:100,000 Iran-Iraq I - 38D/NE
1/4 inch Iran-Iraq I - 38D
Exhibit A-25

Detailed location and route. Main road Sulaimania-Halabja as far as turn-off to Barsinja, km. 35, 12 km. south of Arbet. This road not closed by snow for more than 2-3 days. Thirteen km. up track to Barsinja, at

top of zig zags, Barsinja plain is reached; this section may be closed after exceptionally heavy snowfalls, in which case Barsinja is inaccessible by foot. Barsinja village is 11 km. across plain, along very poor muddy track which may be impassable for landrovers.

Barsinja to Tustan S. C. Follow up valley running N. W. from Barsinja along track on west-facing slopes, until reaching col at head of valley. Cross col, and course is 5 min. beyond it on west side of further valley and slightly lower than col. Barsinja to Tustan S. C., 3/4 hr.

There is a direct route to Kora Kzaw S. C. from Tustan S. C. which follows ridge tops to the east (see route map).

Remarks

Snow Surveyor (1959): K. Pope (H. S. I.)
Assistant (1959): Hamid Sur Salary: I. D. 2. 000
Method of travel: Foot/snowshoe involving 5-6 km. of foot/snowshoe travel per measurement from Barsinja village.
History: Sited and installed October 1957 by Moullin and assistants to replace Dowli Swarah S. C., which proved unsatisfactory. Marked by three steel pipe markers. Surveys started 1958. Snow surveyor 1958, B. Gilpen (H. S. I.)

Assistant snow surveyor lives in Barsinja village. Salary shown is the total for each survey of the three Barsinja-group courses. Rest house in Barsinja.

DOWLI TERSCHAKEN (Barsinja Group, Sulaimania Liwa)

Latitude: 35°27'29" N. Longitude: 45°41'38" E. Elevation: 1220 m.
Major drainage: Lesser Zab River Minor drainage: Mawakan Chai
Aspect: Northeast
Exposure: In small sheltered valley on west side of high, level plain.
Maps: 1:20,000 71/720
1:100,000 Iraq-Iran I - 38D/SE
1/4 inch Iraq-Iran I - 38D
Exhibit A-26

Detailed location and route. Main road Sulaimania-Halabja as far as turn-off to Barsinja, km. 35, 12 km. south of Arbet. This road not closed by snow for more than 2-3 days. Thirteen km. up track to Barsinja, at top of zig zags, Barsinja plain is reached; this section may be closed after exceptionally heavy snowfalls, in which case Barsinja is inaccessible by foot. Barsinja village is 11 km. across plain, along very poor muddy track which may be impassable for landrovers.

One and a half km. from last hairpin bend of zig zags there are two large bushes on either side of the track. When these four bushes are in line the snow course can be seen to the West, 1 km. distant.

Remarks

Snow Surveyor (1959): K. Pope (H. S. I.)
Assistant (1959): Hamid Sur Salary: I. D. 2. 000
Method of travel: Landrover/foot involving 20/2 km. of car/foot travel per measurement from Barsinja, if road open. Otherwise all by foot/mule.
History: Course sited November 1956 by Work, Moullin and assistants. Course installed January 1957 by H. S. I. and marked by three steel pipe markers. Surveys started 1957. Snow surveyor 1957 and 1958, B. Gilpen (H. S. I.)

Assistant snow surveyor lives in Barsinja village. Salary shown is the total for each survey of the Barsinja-group courses. Rest house in Barsinja.

MIYAN MAMEK (Penjwin Group, Sulaimania Liwa)

Latitude: 35°36'45" N. Longitude: 45°52'55" E. Elevation: 1690 m.
Major drainage: Lesser Zab River Minor drainage: Cham-i-Qizilja
Aspect: North
Exposure: High, open summer camping ground backed by long ridge to south.
Maps: 1:20, 000 73/740
1:100, 000 Iran-Iraq I - 38D/NE
1/4 inch Iran-Iraq I - 38D
Exhibit A-27

Detailed location and route. Surveys start from Penjwin, which is 54 km. from Sayed Sadiq, on main Sulaimania-Halabja road. It may be cut off by snowslides, etc., for a month or more in winter, although efforts are made to keep it open by machinery.

From Penjwin travel 6 km. by car, mule, foot (depending on conditions) towards Malakawa Pass on main road to Sayed Sadiq. Cross stream in valley bottom and follow S. W. up opposite valley, passing head of valley in which Malakawa S. C. lies. Continue to col at head of valley 1. 8 km. from road. Follow up ridge on bearing approx. 290°, and then cross broken ground on same bearing to snow course, approx. 1 1/2 km. from col. Time to Miyan Mamek S. C. from main road 1-1 1/2 hrs.

Remarks

Snow Surveyor (1959): Jamil Mirza Said — Salary: I. D. 8. 000
Assistant (1959): Mohd Said, and — Salary: I. D. 3. 000
Said Sala — Salary: I. D. 3. 000
Method of travel: Car or mule or snowshoe and foot involving 12/7 km. of travel per measurement from Penjwin.
History: Course sited November 1956 by Work, Moullin and assistants. Course installed November 1957 and marked by four steel pipe markers; layout different from that of November 1956. Surveys started 1958.

Snow surveyors all live in Penjwin. Salaries shown are those for each survey of the two courses. Miyan Mamek and Malakawa. Routine surveys of this course can only be maintained by a surveyor based on Penjwin, due to the inaccessability of the area in years of heavy snowfall.

MALAKAWA (Penjwin Group, Sulaimania Liwa)

Latitude: 35°36'51" N. Longitude: 45°54'18" E. Elevation: 1400 m.
Major drainage: Lesser Zab River Minor drainage: Cham-i-Qizilja
Aspect: North
Exposure: Small, sheltered, north-facing valley.
Maps: 1:20,000 73/740
1:100,000 Iran-Iraq I - 38D/NE
1/4 inch Iran-Iraq I - 38D
Exhibit A-28

Detailed location and route. Surveys start from Penjwin, which is 54 km. from Sayed Sadiq, on main Sulaimania-Halabja road. It may be cut off by snowslides, etc., for a month or more in winter, although efforts are made to keep it open by machinery.

From Penjwin travel 6 km. by car, mule, foot (depending on conditions) towards Malakawa Pass on main road to Sayed Sadiq. Cross stream in valley bottom and follow track S. W. up opposite valley for 5 min. Malakawa S. C. is then visible 100 m. to the south in small, sheltered, tributary valley. Route to Miyan Mamek S. C., which is usually surveyed on the same day, lies on up the main valley. Main road to Malakawa S. C. 5 min.

Remarks

Snow Surveyor (1959): Jamil Mirza Said — Salary: I. D. 8. 000
Assistant (1959): Mohd Said, and — Salary: I. D. 3. 000
Said Sala — Salary: I. D. 3. 000
Method of travel: Car or mule or snowshoe and foot involving a total of 13 km. of travel per measurement from Penjwin.
History: Course sited November 1956 by Work, Moullin and assistants. Course installed November 1957 and marked by four steel pipe markers; layout different to that of November 1956 in order to improve drainage. Surveys started 1958.

Snow surveyors all live in Penjwin. Salaries shown are those for each survey of the two courses, Miyan Mamek and Malakawa. Routine surveys of this course can only be maintained by a surveyor based on Penjwin due to the inaccessability of the area in years of heavy snowfall.

DOWLASUR (Penjwin Group, Sulaimania Liwa)

Latitude: 35°31'32" N. Longitude: 45°51'28" E. Elevation: 890 m.
Major drainage: Diyala River Minor drainage: Av-i-Chaqan
Aspect: Northeast
Exposure: On gently sloping ground between small river and foot of steep slope in fairly sheltered valley.
Maps: 1:20,000 72/740
1:100,000 Iraq-Iran I - 38D/NE
1/4 inch Iraq-Iran I - 38D
Exhibit A-29

Detailed location and route. From Sayed Sadiq, on the Sulaimania-Halabja road, proceed N. on the Penjwin road. Half a km. after the village of Dowla Sur (Dollasur), 21 km. have been passed; the road fords a small river. A 1/2 km. further on, the road bends sharply to the right. From the apex of the bend the snow course can be seen 1/2 km. to the west, with its two higher poles hidden behind a group of trees in a graveyard. Road to course probably never blocked by snow, although frequently closed near Kani Spika, a few km. on towards Penjwin.

Remarks

Snow Surveyor (1959): K. Pope (H. S. I.)
Method of travel: Car and foot involving 44/1 km of car/foot travel per measurement from Sayed Sadiq.
History: Course sited November 1956 by Work, Moullin and assistants. Course installed January 1957 by H. S. I. and marked by four steel pipe markers. Surveys started 1957. Snow surveyor 1957 and 1958, B. Gilpen (H. S. I.)

There is no permanent assistant for this course. In 1959 the British snow surveyors had to be accompanied everywhere by an Iraqi member of the Development Board, who was used as an assistant for this course. Similar arrangements were made in 1957 and 1958. Halabja rest house is 47 km. from snow course.

HARNECLA (Tawela Group, Sulaimania Liwa)

Latitude: 35°12'40" N. Longitude: 46°11'07" E. Elevation: 1620 m.
Major drainage: Diyala River Minor drainage: Sirwan River
Aspect: Northwest
Exposure: Course lies near bottom of narrow, terraced, steep-sided valley with dense mulberry and walnut orchards.
Maps: 1:20,000 68/770
1:100,000 Iran-Iraq I - 38E/SW
1/4 inch Iran-Iraq I - 38E
Exhibit A-30

Detailed location and route. Surveys start from Tawela, which is 35 km. from Halabja along an unsurfaced mountain track. Route is frequently blocked by snow or is impassable due to mud.

Go northwards up valley of Rubari-aw-i-sird for approx. 20 min. Track then swings eastward with the river and course is beside it on the left bank. Kani-aw-i-sird (spring) is about 10 min. further up the valley. Tawela to Harnecla S. C., 30 min.

Remarks

Snow Surveyor (1959): Mohd Hajji Salary: I. D. 6. 000
Assistant (1959): Kaka Nadir Salary: I. D. 2. 000
Method of travel: Foot/snowshoe involving a total of 1 hr. travel per measurement from Tawela.
History: General area of course selected November 1956 by Work, Moullin and assistants. Course sited by Moullin, November 1957 and installed December 1957; marked by one steel pipe marker and one steel-plate tree marker. Surveys started 1958.

Both snow surveyors live in Tawela village. Salaries shown are those for each survey of the two courses, Harnecla and Harnessi Su. Routine surveys of this course can only be maintained by a surveyor based on Tawela, because of the inaccessability of the area during most winters, particularly in years of heavy snowfall. Rest house accomodation in Tawela. Land is owned by Hamin Aziz, Tawela.

HARNESSI SU (Tawela Group, Sulaimania Liwa)

Latitude: 35°12'04" N. Longitude: 46°10'54" E. Elevation: 1480 m.
Major drainage: Diyala River Minor drainage: Sirwan River
Aspect: Northeast
Exposure: Course lies in bottom of narrow, terraced, steep-sided valley with dense mulberry and walnut orchards.
Maps: 1:20,000 68/770
1:100,000 Iran-Iraq I - 38E/SW
1/4 inch Iran-Iraq I - 38E
Exhibit A-31

Detailed location and route. Surveys start from Tawela, which is 35 km. from Halabja along an unsurfaced mountain track. Route is frequently blocked by snow or is impassable due to mud.

Course is 5 min. north of Tawela on right bank of the stream, Rubari aw-i-sird.

Remarks

Snow Surveyor (1959): Mohd Hajji Salary: I. D. 6. 000
Assistant (1959): Kaka Nadir Salary: I. D. 2. 000
Method of travel: Foot/snowshoe involving a total of 10 min. travel per measurement from Tawela.
History: General area of course selected November 1956 by Work, Moullin and assistants. Course sited by Moullin, November 1957 and installed December 1957; marked by two steel pipe markers and one steel-plate tree marker. Surveys started 1958.

Both snow surveyors live in Tawela village. Salaries shown are those for each survey of the two courses, Harnecla and Harnessi Su. Routine surveys of this course can only be maintained by a surveyor based on Tawela, due to the inaccessability of the area during most winters, particularly in years of heavy snowfall. Rest house accomodation in Tawela. Land is owned by Hamar Sala, Tawela.

HYDROLOGICAL SURVEY OF IRAQ

RECORD OF SNOW MEASUREMENTS

DESHTI TAWANISH Snow Course. 1685 Elevation, metres, GT. ZAB Drainage Basin

Water Year	Month	ROUTINE MEASUREMENTS Date	Snow *ins.*	Water *ins.*	Density	Remarks	EXTRA MEASUREMENTS Date	Snow *ins.*	Water *ins.*	Density	Remarks
	January										
	February										
	March										
	April										
	May										
1958	January										
	February			No Survey							
	March	18/2	39	12.6	33	G.N.F. Damp	23/2	34	12.3	36	G.N.F. Wet
		27/2	32	12.4	39	G.N.F. Wet					
		15/3	17	7.7	45	G.N.F. Wet	25/3	7	2.3	32	G.N.F. Wet
	April	2/4	No Snow								
	May										
1959	January										
	February	4/2	13	3.9	29	G.F.					
	March	6/3	43	10.8	25	G.F.					
		16/3	25	9.3	37	G.N.F. Damp					
	April	1/4	18	7.1	40	G.N.F. Damp					
	May										

Remarks column entries:- G.F. - Ground frozen. G.N.F. - Ground not frozen. Dry, damp or wet indicates soil conditions beneath snow.

Form 22

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HYDROLOGICAL SURVEY OF IRAQ

RECORD OF SNOW MEASUREMENTS

ZAVI SUR ..... Snow Course. 1420 ..... Elevation, metres, TIGRIS / KHABUR ..... Drainage Basin

Water Year	Month	ROUTINE MEASUREMENTS Date	Snow *ins.*	Water *ins.*	Density	Remarks	EXTRA MEASUREMENTS Date	Snow *ins.*	Water *ins.*	Density	Remarks
	January										
	February										
	March										
	April										
	May										
1958	January										
	February			No Survey			16/2	26	8.4	32	G.N.F. Damp
		17/2	27	8.5	31	G.N.F. Damp	21/2	25	8.4	33	G.N.F. Damp
	March	1/3	19	7.7	40	G.N.F. Wet					
		16/3	No Snow				26/3	No Snow			
	April	3/4	No Snow								
	May										
1959	January										
	February	5/2	6	1.6	27	G.F.					
	March	1/3	18	3.5	19	G.F.					
		15/3	17	5.4	32	G.N.F. Damp					
	April	2/4	No Snow								
	May										

Remarks column entries:- G.F. - Ground frozen. G.N.F. - Ground not frozen. Dry, damp or wet indicates soil conditions beneath snow.

Form 22

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HYDROLOGICAL SURVEY OF IRAQ

RECORD OF SNOW MEASUREMENTS

KANI BAHRI Snow Course. 1190 Elevation, metres, TIGRIS / KHABUR Drainage Basin

ROUTINE MEASUREMENTS

Water Year	Month	Date	Snow *ins.*	Water *ins.*	Density	Remarks
	January					
	February					
	March					
	April					
	May					
1958	January					
	February			No Survey		
		17/2	3	0.8	25	G.N.F. Damp
	March	1/3	No Snow			
		16/3	No Snow			
	April	3/4	No Snow			
	May					
1959	January					
	February	5/2	No Snow			
	March	1/3	5	1.2	21	G.N.F. Damp
	April	2/4	No Snow			
	May					

EXTRA MEASUREMENTS

Date	Snow *ins.*	Water *ins.*	Density	Remarks
26/3	No Snow			

Remarks column entries:- G.F. - Ground frozen. G.N.F. - Ground not frozen. Dry, damp or wet indicates soil conditions beneath snow.

Form 22

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HYDROLOGICAL SURVEY OF IRAQ

RECORD OF SNOW MEASUREMENTS

OMAR KHAYAT ..... Snow Course. 2640 ..... Elevation, metres, GT. ZAB ..... Drainage Basin

ROUTINE MEASUREMENTS

Water Year	Month	Date	Snow *ins.*	Water *ins.*	Density	Remarks
1957	January					
	February			No Survey		
		13/2	73	22.8	31	G.N.F. Damp
	March	1/3	80	26.3	33	G.N.F. Damp
		15/3	114	37.0	32	G.N.F. Damp
	April	30/3	102	40.7	40	G.N.F. Damp
		14/4	104	44.6	43	G.N.F. Damp
	May	2/5	84	40.1	49	G.N.F. Damp
1958	January					
	February	1/2	71	24.5	35	G.N.F. Damp
		13/2	63	22.5	36	G.N.F. Damp
	March	27/2	65	24.0	37	G.N.F. Damp
		13/3	67	26.2	39	G.N.F. Damp
	April	31/3	61	25.7	42	G.N.F. Wet
		15/4	42	20.7	49	G.N.F. Wet
	May	29/4	14	6.6	49	G.N.F. Wet
1959	January					
	February	30/1	35	12.4	36	G.N.F. Damp
		16/2	49	14.2	29	G.N.F. Dry
	March	28/2	55	17.8	32	G.N.F. Dry
		16/3	57	-	-	G.N.F. Dry/Damp
	April	2/4	61	22.0	36	G.N.F. Damp
		17/4	50	23.9	47	G.N.F. Damp
	May	28/4	19	8.3	44	G.N.F. Wet

EXTRA MEASUREMENTS

Date	Snow *ins.*	Water *ins.*	Density	Remarks
14/12/57	31	7.8	25	G.N.F. Damp
20/1	37	12.0	33	G.F. Dry

Remarks column entries:- G.F. - Ground frozen. G.N.F. - Ground not frozen. Dry, damp or wet indicates soil conditions beneath snow.

Form 22

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HYDROLOGICAL SURVEY OF IRAQ

RECORD OF SNOW MEASUREMENTS

KAIKASH Snow Course. 2510 Elevation, metres, GT. ZAB Drainage Basin

ROUTINE MEASUREMENTS

Water Year	Month	Date	Snow *ins.*	Water *ins.*	Density	Remarks
1957	January					
	February			No Survey		
		13/2	69	18.5	27	G.N.F. Damp
	March	1/3	70	22.3	32	G.N.F. Damp
		14/3	96	30.9	32	G.N.F. Damp
	April	30/3	88	35.4	40	G.N.F. Damp
		14/4	86	38.1	44	G.N.F. Damp
	May	2/5	61	30.5	50	G.N.F. Wet
1958	January					
	February	1/2	57	19.3	34	G.N.F. Damp
		13/2	46	16.1	35	G.N.F. Damp
	March	2/2	48	16.9	36	G.N.F. Damp
		13/3	46	17.5	38	G.N.F. Wet
	April	31/3	42	17.6	41	G.N.F. Wet
		15/4	22	10.6	48	G.N.F. Wet
	May	29/4	3	1.4	53	G.N.F. Wet
1959	January					
	February	30/1	19	7.2	37	G.N.F. Damp
		16/2	34	7.9	23	G.N.F. Dry
	March	28/2	41	10.4	25	G.N.F. Dry
		16/3	35	13.8	40	G.N.F. Damp
	April	2/4	44	17.1	39	G.N.F. Damp
		17/4	30	13.6	46	G.N.F. Damp
	May	28/4	No Snow			

EXTRA MEASUREMENTS

Date	Snow *ins.*	Water *ins.*	Density	Remarks
14/12/57	18	4.7	26	G.N.F. Damp
16/1	24	7.6	32	G.N.F. Damp
21/1	23	6.8	30	G.N.F. Dry

Remarks column entries:- G.F. - Ground frozen. G.N.F. - Ground not frozen. Dry, damp or wet indicates soil conditions beneath snow.

Form 22

312

HYDROLOGICAL SURVEY OF IRAQ

RECORD OF SNOW MEASUREMENTS

KANDASHIN Snow Course. 1980 Elevation, metres, GT. ZAB Drainage Basin

ROUTINE MEASUREMENTS

Water Year	Month	Date	Snow *ins.*	Water *ins.*	Density	Remarks
1957	January					
	February			No Survey		
		14/2	56	15.1	27	G.N.F. Damp
	March	27/2	47	16.2	35	G.N.F. Damp
		14/3	57	20.3	35	G.N.F. Wet
	April	31/3	43	17.5	40	G.N.F. Wet
		13/4	27	13.0	48	G.N.F. Wet
	May	2/5	No Snow			
1958	January					
	February	29/1	32	7.9	25	G.N.F./G.F. Damp
		14/2	42	14.5	34	G.N.F./G.F. Damp
	March	26/2	36	14.3	39	G.N.F. Damp
		12/3	20	8.8.	45	G.N.F. Wet
	April	31/3	4	2.0	48	G.N.F. Wet
		15/4	No Snow			
	May	29/4	No Snow			
1959	January					
	February	29/1	10	2.9	29	G.N.F. Damp
		16/2	22	6.3	28	G.N.F. Damp
	March	28/2	41	13.4	33	G.N.F. Damp
		15/3	34	12.1	35	G.N.F. Damp
	April	1/4	23	10.9	47	G.N.F. Wet
		16/4	No Snow			
	May	28/4	No Snow			

EXTRA MEASUREMENTS

Date	Snow *ins.*	Water *ins.*	Density	Remarks
15/1	19	6.5	34	G.N.F. Damp
19/1	11	2.4	22	G.F. Dry
21/1	15	2.7	19	G.F. Dry

Remarks column entries:- G.F. - Ground frozen. G.N.F. - Ground not frozen. Dry, damp or wet indicates soil conditions beneath snow.

Form 22

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HYDROLOGICAL SURVEY OF IRAQ

RECORD OF SNOW MEASUREMENTS

CHIKAN Snow Course. 1600 Elevation, metres, GT. ZAB Drainage Basin

ROUTINE MEASUREMENTS

Water Year	Month	Date	Snow *ins.*	Water *ins.*	Density	Remarks
1957	January					
	February			No Survey		
		15/2	40	10.9	27	G.N.F. Damp
	March	2/3	22	9.3	42	G.N.F. Wet
		16/3	16	6.3	39	G.N.F. Wet
	April	29/3	No Snow			
	May					
1958	January					
	February	2/2	28	5.8	21	G.F. Dry
		14/2	22	6.8	30	G.N.F. Damp
	March	26/2	12	5.1	42	G.N.F. Wet
		12/3	No Snow			
	April	31/3	No Snow			
	May					
1959	January					
	February	29/1	No Snow			
		16/2	No Snow			
	March	27/2	20	4.1	21	G.N.F. Damp
		15/3	17	6.6	38	G.N.F. Damp
	April	1/4	No Snow			
	May					

EXTRA MEASUREMENTS

Date	Snow *ins.*	Water *ins.*	Density	Remarks
17/1	7	1.2	17	G.N.F. Damp

Remarks column entries:- G.F. - Ground frozen. G.N.F. - Ground not frozen. Dry, damp or wet indicates soil conditions beneath snow.

Form 22

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HYDROLOGICAL SURVEY OF IRAQ

RECORD OF SNOW MEASUREMENTS

DOUR KHINIQ **Snow Course.** 2300 **Elevation, metres,** GT. ZAB **Drainage Basin**

ROUTINE MEASUREMENTS

Water Year	Month	Date	Snow *ins.*	Water *ins.*	Density	Remarks
	January					
	February					
	March					
	April					
	May					
1958	January					
	February	4/2	65	20.3	31	G.N.F. Damp
		16/2	59	20.8	35	G.N.F. Damp
	March	2/3	56	21.6	38	G.N.F. Damp
		16/3	52	21.3	41	G.N.F. Wet
	April	30/3	44	20.0	46	G.N.F. Wet
		16/4	10	4.6	46	G.N.F. Wet
	May	30/4	No Snow			
1959	January					
	February			No Survey		
		12/2	28	8.5	31	G.N.F. Damp
	March	4/3	60	17.4	29	G.N.F. Damp
		19/3	42	17.6	42	G.N.F. Damp
	April			No Survey		
		18/4	No Snow			
	May	29/4	No Snow			

EXTRA MEASUREMENTS

Date	Snow *ins.*	Water *ins.*	Density	Remarks

Remarks column entries:- G.F. - Ground frozen. G.N.F. - Ground not frozen. Dry, damp or wet indicates soil conditions beneath snow.

Form 22

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HYDROLOGICAL SURVEY OF IRAQ

RECORD OF SNOW MEASUREMENTS

SAMBAWAKAL Snow Course. 1810 Elevation, metres, GT. ZAB Drainage Basin

ROUTINE MEASUREMENTS

Water Year	Month	Date	Snow *ins.*	Water *ins.*	Density	Remarks
	January					
	February					
	March					
	April					
	May					
1958	January					
	February	3/2	43	9.5	22	G.N.F. Damp
		15/2	34	9.1	27	G.N.F. Damp
	March	1/3	24	8.8	36	G.N.F. Wet
		15/3	11	4.3	39	G.N.F. Wet
	April	30/3	No Snow			
		15/4	No Snow			
	May	30/4	No Snow			
1959	January					
	February			No Survey		
		13/2	16	3.9	25	G.N.F. Damp
	March	3/3	37	8.6	23	G.N.F. Damp
		18/3	23	7.1	32	G.N.F. Damp
	April			No Survey		
		18/4	No Snow			
	May	29/4	No Snow			

EXTRA MEASUREMENTS

Date	Snow *ins.*	Water *ins.*	Density	Remarks
15/1	13	4.3	35	G.N.F. Damp

Remarks column entries:- G.F. - Ground frozen. G.N.F. - Ground not frozen. Dry, damp or wet indicates soil conditions beneath snow.

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HYDROLOGICAL SURVEY OF IRAQ

RECORD OF SNOW MEASUREMENTS

GORA RIPNE **Snow Course.** 820 **Elevation, metres,** GT. ZAB **Drainage Basin**

ROUTINE MEASUREMENTS

Water Year	Month	Date	Snow *ins.*	Water *ins.*	Density	Remarks
1957	January					
	February	2/2	No Snow			
		16/2	No Snow			
	March	2/3	No Snow			
		18/3	No Snow			
	April	2/4	No Snow			
	May					
1958	January					
	February	4/2	3	0.8	24	G.N.F. Damp
		16/2	No Snow			
	March	2/3	No Snow			
		14/3	No Snow			
	April	30/3	No Snow			
	May					
1959	January					
	February			No Survey		
		12/2	No Snow			
	March	3/3	No Snow			
		18/3	No Snow			
	April			No Survey		
	May					

EXTRA MEASUREMENTS

Date	Snow *ins.*	Water *ins.*	Density	Remarks

Remarks column entries:- G.F. - Ground frozen. G.N.F. - Ground not frozen. Dry, damp or wet indicates soil conditions beneath snow.

Form 22

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HYDROLOGICAL SURVEY OF IRAQ

RECORD OF SNOW MEASUREMENTS

NEMAKIMIN Snow Course. 1525 Elevation, metres, GT. ZAB Drainage Basin

ROUTINE MEASUREMENTS

Water Year	Month	Date	Snow *ins.*	Water *ins.*	Density	Remarks
1957	January					
	February			No Survey		
		18/2	58	19.6	34	G.N.F. Damp
	March	3/3	41	18.5	45	G.N.F. Wet
		17/3	50	22.3	45	G.N.F. Damp
	April	2/4	27	13.2	49	G.N.F. Damp
	May					
1958	January					
	February					
		18/2	62	23.3	37	G.N.F. Damp
	March	3/3	46	20.9	45	G.N.F. Wet
		14/3	30	13.2	44	G.N.F. Wet
	April	29/3	10	4.6	47	G.N.F. Wet
	May					
1959	January					
	February	31/1	9	2.7	30	G.N.F. Wet
		14/2	12	3.5	29	G.N.F. Damp
	March			No Survey		
		12/3	58	17.8	31	G.N.F. Damp
	April	31/3	25	11.5	46	G.N.F. Wet
	May					

EXTRA MEASUREMENTS

Date	Snow *ins.*	Water *ins.*	Density	Remarks
17/4	No Snow			

Remarks column entries:- G.F. - Ground frozen. G.N.F. - Ground not frozen. Dry, damp or wet indicates soil conditions beneath snow.

Form 22

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HYDROLOGICAL SURVEY OF IRAQ

RECORD OF SNOW MEASUREMENTS

GUNDA NAWANDI **Snow Course.** 1100 **Elevation, metres,** GT. ZAB **Drainage Basin**

ROUTINE MEASUREMENTS

Water Year	Month	Date	Snow *ins.*	Water *ins.*	Density	Remarks
1957	January					
	February			No Survey		
		18/2	22	8.5	38	G.N.F. Damp
	March	3/3	No Snow			
		17/3	No Snow			
	April	2/4	No Snow			
	May					
1958	January					
	February			No Survey		
		18/2	11	3.9	36	G.N.F. Wet
	March	3/3	No Snow			
		14/3	No Snow			
	April	29/3	No Snow			
	May					
1959	January					
	February	31/1	No Snow			
		14/2	No Snow			
	March			No Survey		
		12/3	28	9.6	34	G.N.F. Wet
	April	31/3	No Snow			
	May					

EXTRA MEASUREMENTS

Date	Snow *ins.*	Water *ins.*	Density	Remarks
17/4	No Snow			

Remarks column entries:- G.F. - Ground frozen. G.N.F. - Ground not frozen. Dry, damp or wet indicates soil conditions beneath snow.

Form 22

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HYDROLOGICAL SURVEY OF IRAQ

RECORD OF SNOW MEASUREMENTS

SALARAH ..... Snow Course. 1890 ..... Elevation, metres, L.ZAB ..... Drainage Basin

ROUTINE MEASUREMENTS

Water Year	Month	Date	Snow *ins.*	Water *ins.*	Density	Remarks
1957	January					
	February	4/2	32	9.5	29	G.F. Damp
		16/2	32	10.4	32	G.N.F. Damp
	March	2/3	35	14.5	41	G.N.F. Damp
		18/3	46	19.0	39	G.N.F. Damp
	April	3/4	27	10.5	40	G.N.F. Damp
	May					
1958	January					
	February	2/2	47	15.4	33	G.N.F. Damp
		17/2	37	13.7	37	G.N.F. Damp
	March	2/3	33	14.1	42	G.N.F. Damp
		16/3	12	5.2	42	G.N.F. Damp
	April	31/3	No Snow			
	May					
1959	January					
	February	30/1	1	0.2	33	G.F. Dry
		13/2	10	2.8	29	G.F. Dry
	March	1/3	32	9.4	30	G.F. Dry
		14/3	32	12.0	38	Dry
	April	1/4	7	3.4	48	G.N.F. Wet
	May					

EXTRA MEASUREMENTS

Date	Snow *ins.*	Water *ins.*	Density	Remarks
13/1	31	6.7	22	G.F.

Remarks column entries:- G.F. - Ground frozen. G.N.F. - Ground not frozen. Dry, damp or wet indicates soil conditions beneath snow.

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HYDROLOGICAL SURVEY OF IRAQ

RECORD OF SNOW MEASUREMENTS

NURISTA ..... Snow Course. 1340 ..... Elevation, metres, L. ZAB ..... Drainage Basin

ROUTINE MEASUREMENTS

Water Year	Month	Date	Snow *ins.*	Water *ins.*	Density	Remarks
1957	January					
	February	4/2	17	3.5	20	G.N.F. Damp
		16/2	23	8.2	36	G.N.F. Damp
	March	2/3	3	0.8	24	G.N.F. Damp
		18/3	No Snow			
	April	3/4	No Snow			
	May					
1958	January					
	February	2/2	17	-	-	G.N.F. Damp
		17/2	10	2.2	23	G.N.F. Wet
	March	2/3	No Snow			
		16/3	No Snow			
	April	31/3	No Snow			
	May					
1959	January					
	February	30/1	No Snow			
		13/2	4	0.9	21	G.N.F. Damp
	March	1/3	19	5.1	27	G.N.F. Damp
		14/3	16	5.7	36	G.N.F. Wet
	April	1/4	No Snow			
	May					

EXTRA MEASUREMENTS

Date	Snow *ins.*	Water *ins.*	Density	Remarks
13/1	14	2.4	18	G.N.F. Damp

Remarks column entries:- G.F. - Ground frozen. G.N.F. - Ground not frozen. Dry, damp or wet indicates soil conditions beneath snow.

Form 22

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HYDROLOGICAL SURVEY OF IRAQ

RECORD OF SNOW MEASUREMENTS

HALSHO **Snow Course.** 1250 **Elevation, metres,** L.ZAB **Drainage Basin**

ROUTINE MEASUREMENTS

Water Year	Month	Date	Snow *ins.*	Water *ins.*	Density	Remarks
1957	January					
	February	5/2	4	-	-	G.N.F. Damp
		17/2	6	-	-	G.N.F. Damp
	March	3/3	No Snow			
		18/3	No Snow			
	April	3/4	No Snow			
	May					
1958	January					
	February	3/2	10	-	-	G.N.F. Damp
		18/2	No Snow			
	March	2/3	No Snow			
		16/3	No Snow			
	April	31/3	No Snow			
	May					
1959	January					
	February	30/1	No Snow			
		13/2	No Snow			
	March	1/3	12	3.7	31	G.N.F. Damp
		13/3	11	3.6	33	G.N.F. Wet
	April	1/4	No Snow			
	May					

EXTRA MEASUREMENTS

Date	Snow *ins.*	Water *ins.*	Density	Remarks
14/1	6	1.3	23	G.N.F. Damp

Remarks column entries:- G.F. - Ground frozen. G.N.F. - Ground not frozen. Dry, damp or wet indicates soil conditions beneath snow.

Form 22

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HYDROLOGICAL SURVEY OF IRAQ

RECORD OF SNOW MEASUREMENTS

KORA KZAW Snow Course. 1780 Elevation, metres, DIYALA Drainage Basin

ROUTINE MEASUREMENTS

Water Year	Month	Date	Snow *ins.*	Water *ins.*	Density	Remarks
1957	January					
	February	1/2	11	3.3	29	G.N.F. Damp
		16/2	16	5.6	35	G.N.F. Damp
	March	1/3	2	0.5	28	G.N.F. Wet
		16/3	No Snow			
	April			No Survey		
	May					
1958	January					
	February	29/1	12	4.9	41	G.N.F. Damp
		13/2	21	6.8	33	G.F.
	March	27/2	No Snow			
		17/3	No Snow			
	April	29/3	No Snow			
	May					
1959	January					
	February	31/1	4	1.6	37	G.N.F. Damp
		15/2	6	1.5	26	G.N.F. Damp
	March			No Survey		Inaccessible
		16/3	21	9.2	43	G.N.F. Wet
	April	3/4	No Snow			
	May					

EXTRA MEASUREMENTS

Date	Snow *ins.*	Water *ins.*	Density	Remarks

Remarks column entries:- G.F. - Ground frozen. G.N.F. - Ground not frozen. Dry, damp or wet indicates soil conditions beneath snow.

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HYDROLOGICAL SURVEY OF IRAQ

RECORD OF SNOW MEASUREMENTS

TUSTAN Snow Course. 1520 Elevation, metres, L.ZAB Drainage Basin

ROUTINE MEASUREMENTS

Water Year	Month	Date	Snow *ins.*	Water *ins.*	Density	Remarks
	January					
	February					
	March					
	April					
	May					
1958	January					
	February	29/1	14	5.6	40	G.N.F. Wet
		13/2	24	6.8	29	G.N.F. Damp
	March	27/2	10	4.5	46	G.N.F. Damp
		17/3	No Snow			
	April	29/3	No Snow			
	May					
1959	January					
	February	1/2	3	0.9	36	G.N.F. Damp
		15/2	10	2.3	23	G.N.F. Damp
	March			No Survey		Inaccessible
		16/3	27	11.1	41	G.N.F. Wet
	April		No Snow			
	May					

EXTRA MEASUREMENTS

Date	Snow *ins.*	Water *ins.*	Density	Remarks

Remarks column entries:- G.F. - Ground frozen. G.N.F. - Ground not frozen. Dry, damp or wet indicates soil conditions beneath snow.

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329

HYDROLOGICAL SURVEY OF IRAQ

RECORD OF SNOW MEASUREMENTS

DOWLI TERSCHAKEN Snow Course. 1220 Elevation, metres, L. ZAB Drainage Basin

ROUTINE MEASUREMENTS

Water Year	Month	Date	Snow *ins.*	Water *ins.*	Density	Remarks
1957	January					
	February	1/2	5	2.0	43	G.N.F. Wet
		15/2	11	4.1	37	G.N.F. Damp
	March	28/2	No Snow			
		16/3	No Snow			
	April					
	May					
1958	January					
	February	29/1	No Snow			
		14/2	2	0.6	37	G.N.F. Damp
	March	27/2	No Snow			
		17/3	No Snow			
	April	29/3	No Snow			
	May					
1959	January					
	February	31/1	No Snow			
		16/2	6	1.3	21	G.N.F. Damp
	March			No Survey		Inaccessible
		17/3	No Snow			
	April	3/4	No Snow			
	May					

EXTRA MEASUREMENTS

Date	Snow *ins.*	Water *ins.*	Density	Remarks

Remarks column entries:- G.F. - Ground frozen. G.N.F. - Ground not frozen. Dry, damp or wet indicates soil conditions beneath snow.

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HYDROLOGICAL SURVEY OF IRAQ

RECORD OF SNOW MEASUREMENTS

NIYAH MANEK Snow Course. 1690 Elevation, metres, L. ZAB Drainage Basin

ROUTINE MEASUREMENTS

Water Year	Month	Date	Snow *ins.*	Water *ins.*	Density	Remarks
	January					
	February					
	March					
	April					
	May					
1958	January					
	February	2/2	41	12.6	30	G.N.F. Damp
		15/2	41	14.2	35	G.N.F. Damp
	March	1/3	26	12.8	50	G.N.F. Wet
		16/3	No Snow			
	April	31/3	No Snow			
	May					
1959	January					
	February	1/2	9	3.9	44	Wet
		15/2	22	7	33	G.N.F. Wet
	March	1/3	57	16.1	28	G.N.F. Damp
		18/3	47 ?	30.2 ?	64 ?	G.N.F. Wet
	April	2/4	13	6.7	53	G.N.F. Wet
	May					

EXTRA MEASUREMENTS

Date	Snow *ins.*	Water *ins.*	Density	Remarks
16/1	23	6.8	30	G.N.F. Damp
15/4	No Snow			

Remarks column entries:- G.F. - Ground frozen. G.N.F. - Ground not frozen. Dry, damp or wet indicates soil conditions beneath snow.

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HYDROLOGICAL SURVEY OF IRAQ

RECORD OF SNOW MEASUREMENTS

MALAKAWA **Snow Course.** 1400 **Elevation, metres,** L. ZAB **Drainage Basin**

ROUTINE MEASUREMENTS

Water Year	Month	Date	Snow *ins.*	Water *ins.*	Density	Remarks
	January					
	February					
	March					
	April					
	May					
1958	January					
	February	2/2	34	9.0	27	G.N.F. Damp
		15/2	32	10.3	33	G.N.F. Damp
	March	1/3	No Snow			
		16/3	No Snow			
	April	31/3	No Snow			
	May					
1959	January					
	February	1/2	2	0.8	42	G.N.F. Wet
		15/2	11	2.4	22	G.N.F. Wet
	March	2/3	39	10.1	26	G.N.F. Damp
		18/3	37	19.8	54	G.N.F. Wet
	April	2/4	No Snow			
	May					

EXTRA MEASUREMENTS

Date	Snow *ins.*	Water *ins.*	Density	Remarks
16/1	No Snow			
15/4	No Snow			

Remarks column entries:- G.F. - Ground frozen. G.N.F. - Ground not frozen. Dry, damp or wet indicates soil conditions beneath snow.

Form 22

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HYDROLOGICAL SURVEY OF IRAQ

RECORD OF SNOW MEASUREMENTS

DOLASUR ..... Snow Course. 890 ..... Elevation, metres, DIYALA ..... Drainage Basin

ROUTINE MEASUREMENTS

Water Year	Month	Date	Snow *ins.*	Water *ins.*	Density	Remarks
1957	January					
	February	3/2	No Snow			
		14/2	No Snow			
	March	28/2	No Snow			
		17/3	No Snow			
	April			No Survey		
	May					
1958	January					
	February	2/2	No Snow			
		14/2	No Snow			
	March	2/3	No Snow			
		16/3	No Snow			
	April	31/3	No Snow			
	May					
1959	January					
	February	1/2	No Snow			
		16/2	No Snow			
	March	4/3	22	5.8	27	G.N.F. Damp
		17/3	No Snow			
	April	3/4	No Snow			
	May					

EXTRA MEASUREMENTS

Date	Snow *ins.*	Water *ins.*	Density	Remarks
15/1	No Snow			
29/1	No Snow			

Remarks column entries:- G.F. - Ground frozen. G.N.F. - Ground not frozen. Dry, damp or wet indicates soil conditions beneath snow.

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HYDROLOGICAL SURVEY OF IRAQ

RECORD OF SNOW MEASUREMENTS

HARNECLA **Snow Course.** 1620 **Elevation, metres,** DIYALA R. **Drainage Basin**

ROUTINE MEASUREMENTS

Water Year	Month	Date	Snow *ins.*	Water *ins.*	Density	Remarks
	January					
	February					
	March					
	April					
	May					
1958	January					
	February			No Survey		
		15/2	17	4.9	29	G.F.
	March	28/2	No Snow			
		15/3	No Snow			
	April	30/3	No Snow			
	May					
	January					
	February	29/1	No Snow			
		14/2	10	2.1	21	G.N.F. Damp
	March	28/2	37	8.3	23	G.N.F. Damp
		14/3	43	16.6	38	G.N.F. Damp
	April	30/3	9	4.3	47	G.N.F. Wet
	May					

EXTRA MEASUREMENTS

Date	Snow *ins.*	Water *ins.*	Density	Remarks
17/1	No Snow			

Remarks column entries:- G.F. - Ground frozen. G.N.F. - Ground not frozen. Dry, damp or wet indicates soil conditions beneath snow.

Form 22

329

HYDROLOGICAL SURVEY OF IRAQ

RECORD OF SNOW MEASUREMENTS

HARIRESSI SU **Snow Course.** 1480 **Elevation, metres,** DIYALA R. **Drainage Basin**

ROUTINE MEASUREMENTS

Water Year	Month	Date	Snow *ins.*	Water *ins.*	Density	Remarks
	January					
	February					
	March					
	April					
	May					
1958	January					
	February			No Survey		
		15/2	6	2.2	40	G.N.F. Damp
	March	28/2	No Snow			
		15/3	No Snow			
		30/3	No Snow			
	April					
	May					
1959	January					
	February	29/1	No Snow			
		14/2	5	1.2	24	G.N.F. Damp
	March	28/2	22	10.2	46	G.N.F. Wet
		14/3	18	6.0	34	G.N.F. Wet
		30/3	No Snow			
	April					
	May					

EXTRA MEASUREMENTS

Date	Snow *ins.*	Water *ins.*	Density	Remarks
17/1	No Snow			

Remarks column entries:- G.F. - Ground frozen. G.N.F. - Ground not frozen. Dry, damp or wet indicates soil conditions beneath snow.

Form 22

330

ANNEX A-5

DESCRIPTIONS OF RECORDING RAIN-GAGE STATIONS

(As of April 1959)

ADHAIM

Latitude: 34°33' N. Longitude: 44°30' E. Elevation: 90 m.
Site: Instrument enclosure at Adhaim Narrows discharge station
Installed: 27 January 1958
Drainage basin: Adhaim River
Non-recording gage: H. S. I. 8", local manufacture

AMADIA

Latitude: 37°07' N. Longitude: 43°30' E. Elevation: 1210 m.
Site: Primary school
Drainage basin: Greater Zab River
Non-recording gage: H. S. I. 8", local manufacture

DIANA

Latitude: 36°40' N. Longitude: 44°33' E. Elevation: 700 m.
Site: Instrument enclosure at Diana H. S. I. field office
Installed: 23 September 1957; (N-R gage) 26 December 1956
Drainage basin: Balikian, Ruwanduz, and Greater Zab rivers
Non-recording gage: H. S. I. 8", local manufacture

DIWANIYAH

Latitude: 31°59' N., Longitude: 44°59' E. Elevation: 20 m.
Site: Meteorological office garden
Installed: 5 January 1958
Drainage basin: Euphrates River
Non-recording gage: British Meteorological Office 8"

DOKAN

Latitude: 35°57' N. Longitude: 44°58' E. Elevation: 535 m.
Site: Instrument enclosure near athletic field in permanent housing area
Installed: 23 October 1957
Drainage basin: Lesser Zab River
Non-recording gage: H. S. I. 8", local manufacture

K-2 PUMPING STATION

Latitude: 34°58' N. Longitude: 43°20' E. Elevation 150 m.
Site: Beside K-2 head office
Installed: 1 December 1957
Drainage basin: Tigris River
Non-recording gage: Johnson and Mercer 8"

KHANAQIN

Latitude: 34°18' N. Longitude: 45°26' E. Elevation: 201 m.
Site: Khanaqin Oil Refinery garden
Installed: 4 December 1957
Drainage basin: Alwand and Diyala rivers
Non-recording gage: British Meteorological Office 8"

KIRKUK H. S. I.

Latitude: 35°28' N. Longitude: 44°24' E. Elevation: 320 m.
Site: Irrigation Department garden
Installed: 1 January 1957
Drainage basin: Khasa Su, Adhaim River
Non-recording gage: H. S. I. 8", local manufacture

KIRKUK MET

Latitude: 35°28' N. Longitude: 44°24' E. Elevation: 331 m.
Site: Kirkuk Iraqi Air Force Airfield
Drainage basin: Khasa Su, Adhaim River
Non-recording gage: British Meteorological Office 8"

MOSUL

Latitude: 36°19' N. Longitude: 43°09' E. Elevation: 223 m.
Site: Meteorological Station, Mosul Airport
Installed: 26 November 1957
Drainage basin: Tigris River
Non-recording gage: British Meteorological Office 8"

RUTBA

Latitude: 33°02' N. Longitude: 40°17' E. Elevation: 640 m.
Site: Opposite police station
Installed: 1 January 1958
Drainage basin: Wadi Hawran, Euphrates River
Non-recording gage: British Meteorological Office 5"

SHAQLAWA

Latitude: 36°24' N. Longitude: 44°20' E. Elevation: 970 m.
Site: Primary school
Installed: 23 November 1957
Drainage area: Darabirush Chai, Greater Zab River
Non-recording gage: H. S. I. 8", local manufacture

SULAIMANIA

Latitude: 35°33' N. Longitude: 45°27' E. Elevation: 890 m.
Site: Forestry Department grounds
Installed: 24 November 1957
Drainage basin: Tanjero and Diyala rivers
Non-recording gage: Casella 5"

T-1 PUMPING STATION

Latitude: 34°12' N. Longitude: 41°20' E. Elevation: 300 m.
Site: Near office buildings
Installed: 29 December 1957
Drainage basin: Wadi el Idhana, Euphrates River
Non-recording gage: British Meteorological Office 8"

TUSAN

Latitude: 37°00' N. Longitude: 42°28' E. Elevation: 380 m.
Site: H. S. I. discharge camp
Installed: 25 November 1957
Drainage basin: Tigris River
Non-recording gage: H. S. I. 8", local manufacture

ANNEX A-6

DESCRIPTIONS OF NON-RECORDING RAIN-GAGE STATIONS

(As of April 1959)

AIN SIFNI

Latitude: 36°41' N. Longitude: 43°21' E. Elevation: 520 m.
Site: Yard of police station
Installed: 20 January 1957
Drainage basin: Khazir and Greater Zab rivers

BARSINJA

Latitude: 35°32' N. Longitude: 45°42' E. Elevation: 1300 m.
Site: Schoolyard
Drainage basin: Lesser Zab River
Installed: 16 February 1957

BILLE (ZIBAR)

Latitude: 36°52' N. Longitude: 44°04' E. Elevation: 480 m.
Site: Primary school
Installed: 18 December 1956
Drainage basin: Greater Zab River

FATHA

Latitude: 35°03' N. Longitude: 43°34' E. Elevation: 120 m.
Site: Near H. S. I. discharge camp
Installed: 1 February 1957
Drainage basin: Tigris River

GALALA

Latitude: 36°37' N. Longitude: 44°49' E. Elevation: 1100 m.
Site: Primary school
Installed: December 1956
Drainage basin: Ruwanduz and Greater Zab rivers

HALABJA

Latitude: 35°10' N. Longitude: 46°00' E. Elevation: 730 m.
Site: Schoolyard
Installed: 1 February 1957
Drainage basin: Diyala River

IFRAZ

Latitude: 36°23' N. Longitude: 43°48' E. Elevation: 285 m.
Site: H. S. I. discharge camp
Installed: 12 January 1957
Drainage basin: Greater Zab River

KANI SPIKA

Latitude: 35°31' N. Longitude: 45°53' E. Elevation: 1080 m.
Site: Grounds of police post
Installed: 2 February 1957
Drainage basin: Diyala River

KIFRI

Latitude: 34°42' N. Longitude: 44°58' E. Elevation: 210 m.
Site: Yard of government buildings
Installed: 18 January 1957
Drainage basin: Narin Chai, Diyala River

KOI SANJAK

Latitude: 36°05' N. Longitude: 44°38' E. Elevation: 610 m.
Site: Yard of government buildings
Installed: 22 January 1957
Drainage basin: Lesser Zab River

MAKHMOUR

Latitude: 35°46' N. Longitude: 45°35' E. Elevation: 270 m.
Site: Yard of police station
Installed: 28 January 1957
Drainage basin: Tigris River

MERGA SOR

Latitude: 36°50' N. Longitude: 44°19' E. Elevation: 1170 m.
Site: School grounds, on snow tower
Installed: 20 November 1957
Drainage basin: Balikian, Ruwanduz, and Greater Zab rivers

QADIR KARAM

Latitude: 35°11' N. Longitude: 44°53' E. Elevation: 380 m.
Site: Police station
Installed: 14 January 1957
Drainage basin: Tauq Chai, Adhaim River

QARA DAGH

Latitude: 35°18' N. Longitude: 45°23'E. Elevation: 830 m.
Site: School roof
Installed: 27 January 1957
Drainage basin: Diyala River

RAML

Latitude: 34°57' N. Longitude: 44°01' E. Elevation: 200 m.
Site: Near rest house
Installed: 1 February 1957
Drainage basin: Adhaim River

SIDEKAN

Latitude: 36°47' N. Longitude: 44°40' E. Elevation: 1000 m.
Site: Outside school, on snow tower
Installed: 1 November 1957
Drainage basin: Balikian, Ruwanduz, and Greater Zab rivers

TAQ TAQ

Latitude: 35°53' N. Longitude: 44°35' E. Elevation: 370 m.
Site: Yard of government buildings
Installed: 8 January 1957
Drainage basin: Lesser Zab River

ANNEX A-7

DESCRIPTION OF THERMOGRAPH STATION

(As of April 1959)

HAJJI UMRAN

Latitude: 36°39' N. Longitude: 45°02' E. Elevation: 1970 m.
Site: Near I. P. C. ski huts, 40 minuites' walk from village
Installed: 2April 1958
Drainage basin: Ruwanduz, Greater Zab rivers
Instrument: Bendix Aviation Corporation thermograph, eight-day clock, temperature in degrees centigrade. Installed in standard Stevenson screen, the height of which can be varied to suit depth of snow cover.

ANNEX A-8

DESCRIPTION OF EVAPORATION STATIONS

(As of April 1959)

DIANA

General. Latitude: 36°40' Longitude: 44°33' Liwa: Erbil
Ht. above M. S. L. 700 m. (1:20,000 map No. 84/620 Provisional)
Sited in front of H. S. I. office, Diana
Drainage basin: Greater Zab River - Balikian River
Authority: Hydrological Survey of Iraq

Instrumentation. The following notes are intended to assist in the evaluation of past records: (N. B. only rainfall observations were made at the nearby first Diana station. Exposure of the two sites is very similar.)

1. Non-recording rain gage: Readings since 23 December 1956. U. S. Weather Bureau type 8" gage, made locally. Moved to new site 6 June 1957. Readings up to 1 February 1957 sometimes doubtful; thereafter of a good standard. Daily readings at 0900 hours.

2. Recording rain gage: Readings since 23 September 1957. Bendix No. 2982. Reliable record.

3. Maximum, minimum, and current air temperatures: Readings since 7 June 1957. Observations on dial-type thermometers. Installed in temporary instrument screen until 5 May 1958, when replaced by standard Stevenson screen (large). Daily readings at 0900 hours; air temperatures also at 1500 hours daily.

4. Wet- and dry-bulb temperatures: Readings since 16 November 1957. Observed on non-ventilated thermometers installed in instrument screen until 19 January 1958, when replaced by a sling pyschrometer. Daily readings at 0900 hours and 1500 hours.

5. Pan evaporation: Readings since 7 June 1957. Class A type pan (made locally), 4 ft. diameter, 10" high, on standard timber grillage. Cup measurements using hook gage in stilling well. Water level adjusted at 0900 hours daily. Water depth maintained at 7 1/2".

6. Pan surface water temperatures: Readings since 7 June 1957. Observed at 0900 hours and 1500 hours daily with normal mercury bulb thermometer.

7. Thermograph: Readings since 15 November 1957. Installed in temporary instrument screen until 5 May 1958, when placed in standard Stevenson screen (large). Make: Bendix Aviation Corporation; No. 3276.

8. Pyrheliometer: Readings since 21 September 1957. Installed on one-meter-high concrete pillar on roof of permanent H.S.I. office. Orientated E-W.

9. Anemometer: Readings since 8 January 1958. Total mileage type. Make: Instruments Corporation. Installed on NW corner of evaporation pan grillage; cup axis 6" above pan rim. Read daily at 0900 hours and 1500 hours.

Miscellaneous. Daily 0900-hours river-water temperatures observed on Ruwanduz River since 20 January 1958; Balikian River since 25 January 1958 and also when discharge measurements are made.

The air-temperature readings were observed by a temporary man between June and August 1957, over which period errors may have occurred in the writing down of the observations (wrong day, etc.), but the actual readings themselves are probably fairly reliable. Thereafter the two observers (the permanent Diana clerk and office messenger/day watchman) have been closely watched and trained. They do the work well and very conscientiously, though occasional errors may be found. The general standard of the observations from this station is now high, and they should be considered correct unless there is good evidence to the contrary.

Copies of all non-recording instrument records are held in the Diana office.

DOKAN OLD STATION

General. Latitude: 35°57' Longitude: 44°58' Liwa: Sulaimania
Ht. above M.S.L. 550 m. (various damsite maps)
Sited in the office area of the Dokan Dam construction camp.
Drainage basin: Lesser Zab River
Authority: Resident Engineer
Station moved to new site October 1957

Instrumentation. The following notes are intended to assist in the evaluation of past records:

1. Non-recording rain gage: Readings since 22 November 1954. Homemade pattern with turned brass rim of 8 7/8" diameter. Mounted on post, rim height 65". Measurements by calibrated glass flask.

2. Maximum and minimum temperatures: Readings since 1 March 1952. U-tube thermometer with magnet. These readings were started by the Irrigation Department, when the instrument was near the observer's home in Dokan village (approximate elevation 440 meters). Moved from this site apparently on 2 September 1954.

3. Wet- and dry-bulb temperatures: Readings since 26 May 1955. Negretti and Zambra unventilated thermometers.

4. Instrument screen: Homemade screen. Instrument height 33". (Standard height 4'6")

Miscellaneous. River-water temperatures observed near the ferry since 1 March 1952: Readings once weekly until 2 September 1954; thereafter daily.

The site is near the crest of a long, bare, and steep slope facing south to southwest. As the major direction of storms is from the southwest, the site is badly overexposed, and the rainfall measurements will probably be appreciably low. The catch in strong winds would be further reduced by the excessive height of the instrument above the ground.

The early thermometer site might have given slightly higher air temperatures than this one.

DOKAN NEW STATION

General. Latitude: 35°57' Longitude: 44°58' Liwa: Sulaimania
Ht. above M. S. L. 535 m. (Damsite maps)
Sited in the permanent housing area of the Dokan Dam.
Drainage basin: Lesser Zab River
Station moved here from old site in October 1957.

Instrumentation. New meteorological enclosure installed October 1957 as follows:

1. Non-recording rain gage: H. S. I., 8" type.

2. Recording rain gage: Reading since 31 October 1957. Bendix eight-day recorder.

3. Instrument screen: Homemade type until 13 April 1958; standard instrument height. Replaced by standard Meteorological Office Stevenson screen (large).

4. Maximum, minimum, and current air temperatures: Dial type installed 31 October 1957, replacing previous U-tube thermometer. Read daily at 0900 hours.

5. Wet- and dry-bulb temperatures: Sling pyschrometer replaced previous instrument 20 January 1958. Read daily at 0900 hours.

6. Anemometer: Readings since 23 February 1957. Total mileage type. Installed on NW corner of evaporation pan grillage; cup axis 6" above pan rim. Read daily at 0900 hours.

7. Pan evaporation: Readings since 1 November 1957. Class A type pan (made locally). Four feet diameter and ten inches high on standard timber grillage. Cup measurements using hook gage in stilling well. Water level adjusted daily at 0900 hours. Water depth maintained at 7 1/2 inches.

8. Pan surface water temperatures: Readings since 14 April 1958. Observed daily at 0900 hours with normal mercury bulb thermometer.

9. Pyrheliometer: Readings since 27 January 1958. Installed in enclosure on masonry stand 70 centimeters high.

Miscellaneous. Daily river-water temperatures continue to be observed. Copies of all non-recording instrument observations made at the two sites are held at the office of the Resident Engineer.

The new site is a good one. The observer has not changed since the readings first began. He is a good man, and his work is dependable. General supervision over this station was maintained by members of the Resident Engineer's staff.

TUSAN

General. Latitude: 37°00' Longitude: 42°28' Liwa: Mosul
Ht. above M. S. L. 380 m. (1/4 inch map No. J-38s)
Sited in front of the H. S. I. camp, Tusan
Drainage basin: Tigris River
Authority: Hydrological Survey of Iraq

Instrumentation.

1. Non-recording rain gage: Readings since 25 November 1957. U. S. Weather Bureau type 8" gage; made locally. Read daily at 0900 hours.

2. Recording rain gage: Readings since 26 November 1957. Bendix No. 2953. Reliable record.

3. Pan evaporation: Readings since 11 December 1957. Class A type pan (made locally). Four feet diameter by ten inches high on standard timber grillage. Cup measurements using hook gage in stilling well. Water level adjusted daily at 0900 hours. Water depth maintained at 7 1/2 inches.

4. Pan surface water temperatures: Readings since 10 December 1957. Observed daily at 0900 hours with normal mercury-bulb thermometer.

5. Anemometer: Readings since 8 May 1958. Total mileage type. Installed on NW corner of evaporation pan grillage; cup axis 8" above pan rim. Read daily at 0900 hours.

6. Maximum, minimum, and current air temperatures: Readings since 9 May 1958. Observations daily at 0900 hours on dial-type thermometers. Installed in standard Stevenson screen (small).

7. Wet- and dry-bulb temperatures: Readings since 8 May 1958, with sling psychrometer. Read daily at 0900 hours.

Miscellaneous. Up to May 1958 various discharge observers made the readings. Thereafter the local cableway winchman was also the meteorological observer, at an increased rate of pay.

ANNEX A-9

DAILY PRECIPITATION RECORDS

(Stations arranged alphabetically)

ADHAIM

Latitude 34°33' N. Longitude 44°30' E. Elevation 90 m.

H. S. I. 8-inch-diameter non-automatic gage
Bendix 8-inch-diameter automatic weighing gage
Daily precipitation in millimeters, water year 1957-1958

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1							-	-	-	-	-	-
2							-	5.0	-	-	1.0	-
3							-	-	-	-	-	-
4							-	-	-	-	-	-
5							-	-	-	-	-	-
6							-	-	-	-	-	-
7							-	-	-	-	-	-
8							-	7.4	-	-	-	-
9							-	-	-	-	-	-
10							-	-	-	-	-	-
11							-	-	-	-	-	-
12							-	-	-	-	-	-
13							-	-	-	-	-	-
14							-	-	-	-	-	-
15							-	-	-	-	-	-
16							-	-	-	-	-	-
17							-	-	-	-	-	-
18							-	-	-	-	-	-
19							-	-	-	-	-	-
20							-	-	-	-	-	-
21							4.0	-	1.0	-	-	-
22							-	-	-	-	-	-
23							-	-	-	-	-	-
24							-	-	-	-	-	-
25							-	-	-	-	-	-
26							-	-	-	-	-	-
27							-	-	-	-	-	-
28						-	-	-	-	4.0	-	-
29						-		-	-	-	-	-
30						1.4		-	-	-	-	-
31						2.0		-		1.0		-
Total							4.0	12.4	1.0	5.0	1.0	0.0

ADHAIM

Latitude 34°33' N. Longitude 44°30' E. Elevation 90 m.

H. S. I. 8-inch-diameter non-automatic gage
Bendix 8-inch-diameter automatic weighing gage
Daily precipitation in millimeters, water year 1958-1959

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1	-	-	-	-	-	-						
2	-	-	-	-	-	-						
3	-	-	-	1.0	-	-						
4	-	-	-	4.0	-	-						
5	-	-	-	10.0	-	-						
6	-	-	-	3.0	1.3	1.5						
7	-	-	-	-	7.0	1.5						
8	-	-	-	-	10.0	-						
9	-	-	-	-	-	-						
10	-	-	-	-	-	-						
11	-	-	-	-	-	-						
12	-	-	-	-	-	-						
13	-	-	-	-	8.0	-						
14	-	-	-	-	3.5	-						
15	-	-	-	-	-	-						
16	-	-	-	-	-	-						
17	-	-	-	-	-	-						
18	-	-	-	-	-	-						
19	-	-	-	-	-	1.0						
20	-	-	-	-	-	-						
21	-	-	-	-	-	-						
22	-	-	-	-	-	-						
23	-	-	-	-	-	-						
24	-	-	-	-	-	-						
25	-	-	-	-	-	-						
26	-	-	-	-	-	-						
27	-	-	-	-	-	-						
28	-	-	-	-	-	-						
29	-	-	-	-	-	3.0						
30	-	-	-	-	-	2.0						
31	-		-		-	-						
Total	0.0	0.0	0.0	18.0	29.8	9.0						

AIN SIFNI

Latitude 36°41' N. Longitude 43°21' E. Elevation 520 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1956-1957

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1							16.5	-	-	-		
2							17.4	5.0	3.0	3.0		
3							-	18.3	3.2	-		
4							3.0	10.0	-	-		
5							-	3.5	-	-		
6							-	-	-	-		
7							-	4.3	-	-		
8							-	3.2	-	4.0		
9							2.3	-	3.0	8.0		
10							-	-	14.0	5.0		
11							2.5	4.0	-	-		
12							14.3	-	-	-		
13							1.2	3.5	-	-		
14							-	3.5	-	3.0		
15							-	-	-	-		
16							-	-	-	-		
17							-	8.7	-	-		
18							-	2.3	-	4.0		
19							-	-	8.5	-		
20							-	-	2.0	-		
21						-	-	-	8.5	3.0		
22						-	-	-	-	-		
23						-	10.2	13.0	-	-		
24						-	8.3	7.0	3.0	-		
25						-	7.0	10.0	-	8.0		
26						-	8.3	2.0	-	-		
27						-	4.5	-	4.0	-		
28						-	-	-	-	-		
29						8.0		-	28.0	-		
30						18.7		2.0	-	-		
31						14.2		-		-		
Total							95.5	100.3	77.2	38.0		

AIN SIFNI

Latitude 36°41' N. Longitude 43°21' E. Elevation 520 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1957-1958

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1									-	-	-	
2									-	-	-	
3									-	-	-	
4									-	-	-	
5									-	-	-	
6									-	-	-	
7									-	-	-	
8									-	-	-	
9									-	-	-	
10									-	-	-	
11									-	-	-	
12									-	-	-	
13									-	-	-	
14									-	-	-	
15						4.0			-	-	-	
16						-			14.0	-	-	
17						-			-	-	-	
18						10.0			T	-	-	
19						-			1.0	-	-	
20						-			-	-	-	
21						8.0			-	-	-	
22						18.5			-	-	-	
23						-			-	-	-	
24						-			-	-	-	
25						-			-	-	-	
26						-			-	-	-	
27						-			-	-	-	
28						8.0			-	-	-	
29						25.0			-	-	-	
30						-			-	0.5	-	
31						6.5				-		
Total									15.0	0.5	0.0	

AIN SIFNI

Latitude 36°41' N. Longitude 43°21' E. Elevation 520 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1958-1959

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1	-	-	-	-	-	-						
2	-	-	-	T	-	-						
3	-	-	-	2.0	22.0	-						
4	-	-	-	10.0	-	-						
5	-	-	-	28.0	-	-						
6	-	-	-	-	23.5	32.0						
7	-	-	-	-	9.0	18.0						
8	-	-	-	-	26.0	-						
9	-	-	-	-	7.0	-						
10	-	-	-	-	-	-						
11	-	-	-	-	-	-						
12	-	-	-	-	-	-						
13	-	-	T	-	7.0	-						
14	-	-	-	-	8.0	-						
15	-	-	-	-	-	-						
16	-	-	-	-	-	-						
17	-	-	-	-	-	-						
18	-	-	-	-	-	3.5						
19	-	-	-	-	-	29.0						
20	-	-	-	-	-	3.0						
21	-	-	-	-	-	-						
22	-	-	-	-	-	-						
23	-	-	-	-	-	-						
24	-	-	-	-	-	-						
25	T	-	-	-	-	-						
26	-	-	-	-	-	-						
27	-	-	-	-	-	-						
28	-	-	-	-	-	-						
29	-	-	-	-	-	-						
30	-	-	-	-	-	-						
31	-		-		-	1.5						
Total	T	0.0	T	40.0	102.5	87.0						

BARZINJA

Latitude 35°32' N. Longitude 45°42' E. Elevation 1300 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1956-1957

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1								-	17.2	10.5	-	
2								-	10.9	0.4	-	
3								0.8	9.5	0.6	-	
4								9.9	-	-	-	
5								27.2	-	12.5	2.0	
6								25.8	-	6.0	1.7	
7								19.4	5.3	10.6	-	
8								0.9	6.5	29.2	-	
9								-	16.9	4.2	-	
10								14.8	2.0	-	-	
11								33.5	-	-	-	
12								14.6	-	-	-	
13								14.7	-	-	0.5	
14								33.4	-	-	-	
15								8.2	-	8.9	-	
16							-	-	-	-	-	
17							-	3.7	-	-	-	
18							-	25.3	-	5.9	-	
19							-	-	25.2	28.7	-	
20							-	-	-	-	-	
21							-	-	5.7	-	-	
22							-	-	-	-	-	
23							-	11.5	15.9	-	-	
24							-	8.5	2.2	21.7	-	
25							27.4	13.0	-	20.8	-	
26							32.7	5.2	3.9	-	-	
27							3.0	-	19.7	-	-	
28							6.7	7.5	-	-	-	
29								-	29.1	-	-	
30								51.9	12.4	-	-	
31								7.7		-	-	
Total								337.5	182.4	160.0	4.2	

BARZINJA

Latitude 35°32' N. Longitude 45°42' E. Elevation 1300 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1957-1958

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1				-	7.5	-	-	-				
2				-	-	5.2	-	-				
3				-	-	25.5	-	5.5				
4				-	-	20.0	-	-				
5				-	30.0	20.0	14.0	-				
6				-	-	14.0	-	-				
7				-	25.6	-	-	-				
8				-	3.5	-	-	24.0				
9				-	5.5	-	-	-				
10				-	9.0	21.4	-	-				
11				-	-	-	-	-				
12				-	-	-	-	-				
13				-	-	-	-	-				
14				-	-	-	-	-				
15				14.0	-	-	-	-				
16				-	-	-	-	-				
17				-	-	14.0	-	-				
18				-	-	-	-	-				
19				-	-	15.6	-	-				
20				-	15.0	28.0	-	-				
21				20.0	23.0	-	-	-				
22				3.0	-	-	-	-				
23				31.0	-	-	28.0	17.5				
24				18.0	-	-	-	-				
25				-	-	-	-	-				
26				-	-	-	-	-				
27				-	-	-	-	-				
28				-	-	-	-	-				
29				-	-	21.0		9.0				
30				-	-	25.0		-				
31					-	26.0		-				
Total				86.0	119.1	235.7	42.0	56.0				

BAWANUR

Latitude 34°49' N. Longitude 45°30' E. Elevation 240 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1958-1959

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1					-	-						
2					-	-						
3					-	-						
4					-	-						
5					1.5	-						
6					22.5	-						
7					-	-*						
8					11.0	-						
9					19.0	-						
10					-	-						
11					-	-						
12					-	-						
13					-	-						
14					6.5	-						
15					12.0	-						
16				-	-	-						
17				-	-	-						
18				-	-	-						
19				-	-	-						
20				-	-	-						
21				-	-	-						
22				-	-	16.0						
23				-	-	-						
24				-	-	-						
25				-	-	-						
26				-	-	-						
27				-	-	-						
28				-	-	-						
29				24.0	-	-						
30				24.0	-	18.0						
31					-	-						
Total					72.5	34.0						

* Rain at surrounding stations this day

BILLE-ZEBAR

Latitude 35°52' N. Longitude 44°04' E. Elevation 480 m.

H.S.I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1956-1957

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1						3.0	12.0	-	7.2	2.5		
2						10.0	8.0	-	-	1.8		
3						2.0	-	37.2	-	2.0		
4						20.9	-	27.5	-	2.1		
5						24.4	-	52.5	-	7.5		
6						22.0	-	47.2	-	21.3		
7						-	-	18.0	-	9.1		
8						-	-	16.0	10.1	52.2		
9						-	-	-	T	6.7		
10						-	-	22.0	-	5.4		
11						-	-	26.2	-	1.5		
12						-	7.0	14.7	-	-		
13						7.9	1.0	17.5	-	46.8		
14						-	22.0	12.0	-	7.3		
15						-	4.0	-	-	-		
16						-	-	-	-	-		
17						12.0	-	7.0	-	1.6		
18					-	43.8	-	2.4	-	33.9		
19					-	10.5	-	-	17.0	2.0		
20					6.0	1.8	-	-	2.0	T		
21					34.0	-	-	-	2.8	-		
22					T	-	-	-	5.2	-		
23					-	-	-	24.7	4.3	-		
24					-	-	7.6	19.1	T	-		
25					-	-	5.5	-	2.5	-		
26					-	-	56.0	11.2	7.6	12.0		
27					-	-	18.7	-	T	-		
28					22.0	-	12.4	-	3.5	-		
29					5.0	14.5		-	13.2	-		
30					-	36.0		5.8	7.6	-		
31					-	28.0		14.5		-		
Total						236.8	154.2	375.5	83.0	215.7		

BILLE-ZEBAR

Latitude 35°52' N. Longitude 44°04' E. Elevation 480 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1957-1958

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1								-	-	-	T	-
2								8.0	-	-	T	-
3								-	-	-	T	-
4								-	-	-	-	-
5								-	-	-	T	-
6								-	-	-	-	-
7								-	-	-	-	-
8								52.0	-	-	-	-
9								2.0	-	-	-	-
10								-	-	-	T	-
11								-	-	-	-	-
12								-	-	-	-	-
13								-	-	-	-	-
14								-	-	-	-	-
15								-	-	-	-	-
16								-	-	T	-	-
17								-	14.0	-	-	-
18								-	12.0	-	-	-
19								-	-	-	-	-
20								-	-	-	-	-
21								4.0	8.0	-	-	-
22							11.0	5.0	-	-	-	-
23							15.0	28.0	-	-	-	-
24							1.0	10.0	-	-	-	-
25							-	-	-	T	-	-
26							-	-	-	-	-	-
27							-	-	-	-	T	-
28							-	-	-	-	-	-
29								-	-	T	-	-
30								9.0	-	T	-	-
31								-		T		-
Total								118.0	34.0	T	T	0.0

BILLE-ZEBAR

Latitude 35°52' N. Longitude 44°04' E. Elevation 480 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1958-1959

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1	-	-	-	-	1.5	-						
2	-	-	-	-	-	-						
3	-	-	-	-	-	-						
4	-	-	-	5.0	20.4	-						
5	-	-	-	8.0	8.3	-						
6	-	-	-	15.0	-	-						
7	-	-	-	7.0	53.0	-						
8	-	-	-	-	56.4	50.0						
9	-	-	-	-	53.8	-						
10	-	-	-	-	10.2	-						
11	-	-	-	-	-	-						
12	-	-	-	-	-	-						
13	-	-	-	-	-	-						
14	-	-	-	-	-	-						
15	-	-	-	-	10.4	-						
16	-	-	-	-	-	-						
17	-	-	-	-	-	-						
18	-	-	-	-	-	-						
19	-	-	-	-	-	11.0						
20	-	-	-	-	-	52.2						
21	-	-	-	-	-	-						
22	-	-	-	-	-	-						
23	-	-	-	-	-	-						
24	-	-	-	-	-	-						
25	-	-	-	-	-	-						
26	-	-	-	-	-	-						
27	-	-	-	-	-	-						
28	-	-	-	-	-	-						
29	-	-	-	-	-	-						
30	-	-	-	-	-	3.4						
31	-		-		-	19.6						
Total	0.0	0.0	0.0	35.0	214.0	136.2						

DIANA

Latitude 36°40' N. Longitude 44°33' E. Elevation 700 m.

H. S. I. 8-inch-diameter non-automatic gage
Bendix 8-inch-diameter automatic weighing gage
Daily precipitation in millimeters, water year 1956-1957

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1						5.2	2.0	-	10.2	-	-	-
2						5.0	17.3	-	2.0	3.0	-	-
3						-	-	12.0	8.0	1.0	-	-
4						3.9	1.0	41.5	-	15.0	-	-
5						4.5	-	32.0	-	0.5	-	-
6						2.5	-	23.5	-	10.5	0.3	-
7						-	-	10.0	-	10.0	-	-
8						-	-	5.0	11.0	17.0	-	-
9						-	-	-	8.0	5.1	-	-
10						-	9.5	10.0	-	2.0	-	-
11						-	8.6	6.0	1.0	0.5	-	-
12						-	1.0	10.0	-	-	0.5	-
13						4.3	18.7	24.0	-	13.6	-	-
14						4.5	-	8.0	-	0.5	3.5	-
15						-	0.2	2.0	-	-	-	-
16						-	-	-	-	4.3	-	-
17						2.3	-	5.0	-	4.9	-	-
18						2.2	-	5.0	-	22.3	-	-
19						4.5	-	-	8.0	0.2	-	-
20						-	-	-	2.0	-	-	-
21						-	-	-	5.2	0.3	-	-
22						-	-	7.0	4.0	-	-	-
23						-	0.5	11.0	2.1	-	-	-
24						-	-	29.0	3.0	T	-	-
25						-	18.7	3.0	-	T	-	-
26						-	23.6	11.0	5.0	9.6	-	-
27					T	-	0.9	-	7.0	0.8	-	-
28					8.5	-	0.5	-	2.0	-	-	-
29					-	4.5		-	15.0	-	-	-
30					-	2.3		14.0	2.0	-	-	-
31					-	2.3		4.0		-		-
Total						48.0	102.5	273.0	95.5	121.1	4.3	0.0

DIANA

Latitude 36°40'' N. Longitude 44°33' E. Elevation 700 m.

H. S. I. 8-inch-diameter non-automatic gage
Bendix 8-inch-diameter automatic weighing gage
Daily precipitation in millimeters, water year 1957-1958

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1	-	-	1.0	1.5	-	-	-	-	-	-	18.5	-
2	-	-	-	2.5	1.0	12.2	-	19.3	2.1	2.0	-	-
3	-	-	-	3.2	-	11.5	-	3.6	-	-	-	-
4	-	-	-	-	17.5	4.3	-	-	-	-	4.7	-
5	-	-	-	6.5	3.3	3.5	8.5	-	6.0	-	-	-
6	-	-	-	35.0	11.0	7.6	-	-	-	-	-	-
7	-	-	-	-	3.3	3.7	-	-	-	-	-	-
8	-	-	-	-	26.4	-	-	24.0	-	-	-	-
9	-	-	T	-	1.5	-	-	2.2	-	-	-	-
10	-	-	-	-	-	8.7	-	-	-	-	-	-
11	-	-	-	-	T	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-
13	3.0	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	11.5	-	3.5	-	-	-	-	-	-
15	-	-	0.5	8.2	-	0.5	-	-	-	1.0	-	-
16	-	-	9.0	0.7	-	7.5	-	-	8.3	-	-	-
17	-	-	4.4	-	-	7.5	1.0	-	10.1	-	-	-
18	-	-	-	-	-	4.0	-	-	-	-	-	-
19	-	-	-	-	2.1	-	-	-	2.7	-	-	-
20	-	-	-	-	3.4	7.5	-	-	2.5	-	-	-
21	-	-	-	-	-	5.3	13.7	4.4	1.6	-	-	-
22	-	-	2.5	-	-	1.5	17.1	-	-	-	-	-
23	-	-	7.4	-	-	-	2.5	18.3	-	-	-	-
24	-	-	-	-	-	-	-	1.0	-	-	-	-
25	-	-	-	-	1.0	-	-	-	-	-	-	-
26	-	-	-	-	-	-	-	-	-	-	-	-
27	-	-	-	-	-	4.3	-	1.1	-	-	-	-
28	-	-	0.4	-	-	16.6	-	0.7	-	-	-	-
29	-	4.0	-	0.1	-	61.3		7.1	T	7.0	-	-
30	-	-	-	T	-	36.6		0.3	-	-	-	-
31	-		-		-	2.9		-		-		-
Total	3.0	4.0	25.2	69.2	70.5	210.5	42.8	82.0	33.3	10.0	23.2	0.0

DIANA

Latitude 36°40' N. Longitude 44°33' E. Elevation 700 m.

H. S. I. 8-inch-diameter non-automatic gage
Bendix 8-inch-diameter automatic weighing gage
Daily precipitation in millimeters, water year 1958-1959

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1	-	-	-	-	-	-						
2	-	-	-	-	-	-						
3	-	-	-	4.3	12.5	-						
4	-	-	-	6.2	1.4	-						
5	-	-	-	23.0	1.4	-						
6	-	-	-	2.5	35.3	-						
7	-	-	-	-	22.0	19.5						
8	-	-	-	-	48.0	1.0						
9	-	-	-	-	28.3	-						
10	-	-	1.0	-	-	-						
11	-	-	-	-	-	-						
12	-	-	-	-	-	-						
13	-	-	-	-	1.5	-						
14	-	-	-	-	10.5	1.5						
15	-	-	-	-	2.0	-						
16	-	-	-	-	-	-						
17	-	-	-	-	-	-						
18	-	-	-	-	-	-						
19	-	-	-	-	-	23.0						
20	-	-	-	-	-	-						
21	-	-	-	-	-	-						
22	-	5.5	-	-	-	-						
23	-	-	-	-	-	-						
24	-	-	-	-	-	-						
25	-	-	-	-	-	-						
26	-	-	-	-	-	-						
27	-	-	-	-	-	-						
28	-	-	-	-	-	-						
29	-	-	-	7.5	-	3.3						
30	-	-	-	1.0	-	1.5						
31	-		-		-	0.5						
Total	0.0	5.5	1.0	44.5	162.9	50.3						

DIWANIYA

Latitude 31°51' N. Longitude 44°51' E. Elevation 20 m.

Bendix 8-inch-diameter automatic weighing gage
Daily precipitation in millimeters, water year 1957-1958

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1							-	-	-	-	-	
2							-	-	-	-	-	
3							-	-	-	-	-	
4							-	-	4.0	-	-	
5							-	-	-	-	-	
6						-	-	-	-		-	
7						T	-	-	-		-	
8						-	-	1.0	-		-	
9						-	-	-	-		-	
10						-	-	-	-		-	
11						-	-	-	-		-	
12						-	-	-	-	-	-	
13						-	-	-	-	-	-	
14						-	-	-	-	-	-	
15						-	-	-	-	-	-	
16						-	-	-	-	-		
17						-	-	-	-	-		
18						T	-	-	-	-		
19						-	T	-	-	-		
20						9.0	-	-	-	-		
21						T	-	-	-	-		
22						-	-	-	-	-		
23						-	-	-	-	-		
24						-	-	-	-	-		
25						-	-	-	-	-		
26						-	-	-	-	-		
27						-	-	-	-	-		
28						T	-	-	-	-		
29						14.0		-	-	-		
30						-		-	-	-		
31						-		-		4.0		
Total							T	1.0	4.0			

DIWANIYA

Latitude 31°51' N. Longitude 44°51' E. Elevation 20 m.

Bendix 8-inch-diameter automatic weighing gage
Daily precipitation in millimeters, water year 1958-1959

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1				-	-	-						
2				-	-	-						
3				-	-	-						
4				11.0	-	-						
5				2.0	17.0	-						
6				-	22.0	-						
7				-	5.0	-						
8				-	3.0	-						
9				-	-	-						
10				-	-	-						
11				-	-	-						
12				-	-	-						
13			-	-	-	-						
14			-	-	4.0	-						
15			-	-	-	2.0						
16			-	-	-							
17			-	-	-							
18			-	-	-							
19			-	-	-							
20			-	-	-							
21			-	-	-							
22			-	-	-							
23			-	-	-							
24			-	-	-							
25			-	-	-							
26			-	-	-							
27			-	-	-							
28			-	-	-							
29			-	-	-							
30			-	-	-							
31			-		-							
Total				13.0	51.0							

DOKAN

Latitude 35°57' N. Longitude 44°58' E. Elevation 535

H.S.I. 8-inch-diameter non-automatic gage
Bendix 8-inch-diameter automatic weighing gage
Daily precipitation in millimeters, water year 1956-1957

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1								-	23.5	5.0	-	
2								-	2.0	0.5	-	
3								5.0	13.0	2.0	-	
4								36.0	-	T	1.5	
5								54.0	-	1.0	11.5	
6								28.0	2.0	6.0	-	
7								23.0	-	16.5	-	
8								3.0	7.0	39.0	-	
9								-	17.5	3.0	-	
10							22.5	13.0	-	-	-	
11							8.0	8.0	-	1.0	T	
12							11.0	18.0	-	-	-	
13							20.0	60.0	-	27.0	T	
14							-	34.0	-	1.0	2.0	
15							-	21.0	-	-	-	
16							-	-	-	-	-	
17							-	6.0	-	1.0	-	
18							-	16.0	-	10.0	-	
19							-	-	14.0	0.5	-	
20							-	-	11.0	-	-	
21							-	-	7.5	-	-	
22							-	0.5	-	-	-	
23							-	6.0	6.0	-	-	
24							4.5	14.0	5.0	T	-	
25							53.5	11.0	2.0	7.5	-	
26							41.0	1.0	4.0	1.5	-	
27							42.0	-	38.5	-	-	
28							6.0	5.5	2.5	-	-	
29								-	7.0	-	-	
30								10.0	3.0	-	-	
31								5.0		-		
Total								378.0	165.5	122.5	15.0	

DOKAN

Latitude 35°57' N. Longitude 44°58' E. Elevation 535 m.

H. S. I. 8-inch-diameter non-automatic gage
Bendix 8-inch-diameter automatic weighing gage
Daily precipitation in millimeters, water year 1957-1958

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1	-		T	-	0.3	-	-	-	-	-	15.0	
2	-		-	2.5	0.3	13.0	-	7.5	3.5	-	-	
3	-		-	7.0	-	14.0	-	2.5	-	-	-	
4	-		-	-	14.0	29.5	-	-	-	-	-	
5	-		-	1.0	2.0	29.0	8.0	T	8.0	-	-	
6	-		-	33.5	11.0	29.5	-	-	-	-	-	
7	-		-	-	1.0	4.0	-	-	T	-	-	
8	-		-	0.5	11.0	-	-	19.5	-	-	-	
9	-		-	-	1.0	-	-	4.0	-	-	-	
10	-		T	-	-	33.5	-	-	-	-		
11	-		-	-	-	1.0	-	-	-	-		
12	-		-	-	-	-	-	-	-	T		
13	T		-	-	-	-	-	-	-	-		
14	-		-	12.0	-	3.0	-	-	5.5	-		
15	-		1.0	12.0	-	-	-	-	-	-		
16	-		-	1.0	-	0.5	-	-	2.5	-		
17	T		5.0	9.0	-	6.5	-	-	1.0	-		
18	-		2.0	-	-	6.5	-	-	-	-		
19	-		-	-	1.0	-	-	-	1.0	-		
20	-		-	-	2.0	6.0	-	-	-	-		
21	-		-	-	-	19.0	18.0	4.0	1.0	-		
22	-		T	-	-	0.5	12.5	-	-	-		
23	-	-	3.5	-	-	-	2.0	13.0	-	-		
24	-	-	-	-	-	-	-	-	-	0.5		
25	-	-	-	-	2.5	-	-	-	-	-		
26	-	-	-	-	-	-	-	-	-	-		
27	-	-	-	-	-	1.5	-	-	-	-		
28	-	-	-	-	-	1.0	-	T	-	3.0		
29	-	3.0	-	T	-	10.0		T	-	9.0		
30	-	-	-	0.5	-	18.0		T	-	-		
31	-		-		-	6.0		-	-	-		
Total	T		11.5	79.0	46.1	232.0	40.5	50.5	22.5	12.5		

DOKAN

Latitude 35°57' N. Longitude 44°58' E. Elevation 535 m.

H. S. I. 8-inch-diameter non-automatic gage
Bendix 8-inch-diameter automatic weighing gage
Daily precipitation in millimeters, water year 1958-1959

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1			-	-	-	-						
2			-	0.5	-	-						
3			-	4.5	5.5	-						
4			-	2.0	18.0	-						
5			-	18.5	3.5	-						
6			-	3.0	21.5	-						
7			-	-	24.5	11.5						
8			-	-	54.0	3.0						
9			-	-	23.0	-						
10			T	-	-	-						
11			T	-	-	-						
12			-	-	-	-						
13			-	-	2.0	-						
14			-	-	15.0	-						
15			-	-	1.0	-						
16			-	-	-	-						
17			-	-	-	-						
18			-	-	-	T						
19			-	-	-	18.0						
20			-	-	-	5.0						
21			-	-	-	-						
22			-	-	-	-						
23			-	-	-	-						
24			-	-	-	-						
25			-	-	-	-						
26			-	-	-	-						
27			T	-	-	-						
28			-	T	-	-						
29			-	4.0	-	1.0						
30			-	4.0	-	7.5						
31			-		-	1.0						
Total			T	36.5	168.0	47.0						

FATHA

Latitude 35°03' N. Longitude 43°34' E. Elevation 120 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1956-1957

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1							3.0	-	12.0	-	-	-
2							-	1.5	3.5	-	-	-
3							-	3.6	-	-	-	-
4							-	25.2	-	-	1.6	-
5							-	17.3	-	-	T	-
6							-	1.7	-	T	-	-
7							-	3.8	2.6	2.0	-	-
8							-	-	-	26.5	-	-
9							-	-	8.0	1.8	-	-
10							19.4	T	-	-	-	-
11							T	6.5	-	-	-	-
12							3.5	-	-	-	-	-
13							-	4.5	-	20.5	1.0	-
14							-	T	-	-	-	-
15							-	13.5	-	-	-	-
16							-	-	-	-	-	-
17							-	-	-	-	-	-
18							-	-	-	-	-	-
19							-	-	15.0	-	-	-
20							-	-	-	-	-	-
21							-	-	31.8	-	-	-
22							-	-	-	-	-	-
23							-	T	-	-	-	-
24							-	28.7	-	1.5	-	-
25							12.5	1.0	T	7.7	-	-
26							13.5	1.5	10.0	T	-	-
27							-	-	12.0	-	-	-
28							-	-	-	-	-	-
29								1.5	13.2	-	-	-
30								-	1.8	-	-	-
31								-		-		-
Total							51.9	110.3	109.9	60.0	2.6	0.0

FATHA

Latitude 35°03' N. Longitude 43°34' E. Elevation 120 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1957-1958

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1			-		-	-	-	-	-	-	-	-
2			-		3.0	7.0	-	2.8	-	-	-	-
3			-		-	T	-	-	-	-	-	-
4			-		7.0	1.0	-	-	-	1.8	-	-
5			-		-	5.0	-	-	-	-	-	-
6			-		6.0	-	-	-	-	-	-	-
7			-		-	-	-	-	T	-	-	-
8			-		-	-	-	4.5	-	-	-	-
9			-		-	-	-	-	-	-	-	-
10			-		-	2.0	-	-	-	-	-	-
11			-		-	-	-	-	-	-	-	-
12			-		-	-	-	-	-	-	-	-
13			-		-	-	-	-	-	-	-	-
14			T		-	-	-	-	-	-	-	-
15			-		-	-	-	-	-	-	-	-
16			2.0		-	T	-	-	-	-	-	-
17			-		-	2.0	-	-	-	-	-	-
18			-		-	-	-	-	-	-	-	-
19			-		-	-	-	-	-	-	-	-
20			-		-	-	-	-	-	-	-	-
21			-		-	14.0	2.5	-	-	-	-	-
22			T		-	-	1.0	-	-	-	-	-
23			-		-	-	-	1.0	-	-	-	-
24			-		3.0	-	-	-	-	-	-	-
25			-		-	-	-	-	-	-	-	-
26			-		-	-	-	-	-	-	-	-
27			-		-	T	-	-	-	T	-	-
28			-		-	5.0	-	-	-	-	-	-
29			-		-	T		-	-	2.0	-	-
30			-		-	7.0		-	-	-	-	-
31			-		-	1.0		-		T		-
Total			2.0		19.0	44.0	3.5	8.3	T	3.8	0.0	0.0

FATHA

Latitude 35°03' N. Longitude 43°34' E. Elevation 120 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1958-1959

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1	-	-	-	-	-							
2	-	-	-	T	-							
3	-	-	-	T	T							
4	-	-	-	6.2	-							
5	-	-	-	8.5	-							
6	-	-	-	-	9.8							
7	-	-	-	-	5.0							
8	-	-	-	-	2.8							
9	-	-	-	-	T							
10	-	-	-	-	-							
11	-	-	-	-	-							
12	-	-	-	-	-							
13	-	-	-	-	3.7							
14	-	-	-	-	1.7							
15	-	-	-	-	-							
16	-	-	-	-	-							
17	-	-	-	-	-							
18	-	-	-	-	-							
19	-	-	-	-	-							
20	-	-	-	-	-							
21	-	-	-	-	-							
22	-	-	-	-	-							
23	-	-	-	-	-							
24	-	-	-	-	-							
25	-	-	-	-	-							
26	-	-	-	-	-							
27	-	-	-	-	-							
28	-	-	-	-	-							
29	-	-	-	T	-							
30	-	-	-	1.5	T							
31	-		-		-							
Total	0.0	0.0	0.0	16.2	23.0							

GALALA

Latitude 36°37' N. Longitude 44°49' E. Elevation 1100 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1956-1957

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1						-	-	-	8.5			
2						-	23.0	-	-			
3						-	-	21.0	-			
4						-	-	56.7	-			
5						2.0	-	45.0	-			
6						8.0	-	12.0	-			
7						-	-	9.5	-			
8						-	-	-	-			
9						-	22.0	-	14.5			
10						-	20.0	-	-			
11						-	-	14.0	-			
12						-	15.0	10.5	-			
13						-	-	28.8	-			
14						-	-	14.7	-			
15						-	-	2.5	-			
16						-	-	-	-			
17						-	-	8.0	-			
18						-	-	5.0	-			
19						29.0	-	-	-			
20						-	-	-	11.0			
21					17.5	-	-	-	-			
22					-	-	-	3.0	3.0			
23					-	-	-	14.0	6.0			
24					-	-	-	34.0	-			
25					-	-	9.0	12.0	-			
26					-	-	28.0	-	-			
27					-	-	27.0	-	48.0			
28					-	-	-	-	2.0			
29					8.5	-		-	-			
30					8.0	-		28.5	-			
31					-	-		-				
Total						39.0	144.0	319.2	93.0			

GALALA

Latitude 36°37' N. Longitude 44°49' E. Elevation 1100 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1957-1958

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1					25.0	-	-	-	-			
2					10.0	10.0	-	9.5	-			
3					-	10.0	-	-	4.5			
4					-	6.0	-	-	-			
5					-	5.0	26.0	-	-			
6				52.0	-	6.0	-	-	-			
7				-	28.0	5.5	-	-	-			
8				-	26.0	-	-	18.0	-			
9				-	22.5	-	-	-	-			
10				-	-	18.5	-	-	-			
11				-	-	-	-	-	-			
12				-	-	-	-	-	-			
13				-	-	-	-	-	-			
14				-	-	-	-	-	-			
15				28.0	-	3.0	-	-	-			
16				3.0	-	-	-	-	-			
17				4.0	-	10.0	-	-	-			
18				-	-	3.0	-	-	27.0			
19				-	8.0	-	-	-	29.0			
20				-	7.5	7.5	-	-	29.0			
21				-	-	-	-	-	-			
22				-	-	11.0	27.0	-	-			
23				-	-	-	16.0	28.0	-			
24				-	-	-	-	-	-			
25				-	-	-	-	-	-			
26				-	-	-	-	-	-			
27				-	-	-	-	-	-			
28				-	-	-	-	-	-			
29				-	-	23.5		12.0	-			
30				15.0	-	22.0		3.0	-			
31					-	20.0		-				
Total					127.0	161.0	69.0	70.5	89.5			

GALALA

Latitude 36°37' N. Longitude 44°49' E. Elevation 1100 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1958-1959

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1					-							
2					-							
3					-							
4					-							
5					-							
6					-							
7					-							
8					27.0							
9					48.0							
10					45.0							
11					-							
12					-							
13					-							
14					27.0							
15					-							
16					-							
17					-							
18					-							
19					-							
20					-							
21					-							
22					-							
23					-							
24					-							
25					-							
26					-							
27					-							
28					-							
29					-							
30					-							
31					-							
Total					147.0							

HALABJA

Latitude 35°10' N. Longitude 46°00' E. Elevation 730 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1956-1957

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1							-	-	17.5			
2							-	-	12.0			
3							-	-	8.0			
4							-	-	10.0			
5							-	-	-			
6							-	42.0	-			
7							-	48.5	-			
8							-	25.0	-			
9							-	3.0	2.0			
10							-	-	33.0			
11							9.0	13.5	-			
12							-	12.5	-			
13							-	16.5	4.0			
14							14.5	20.5	-			
15							-	30.0	-			
16							-	5.0	-			
17							-	-	-			
18							-	-	-			
19							-	9.0	-			
20							-	-	6.0			
21							-	-	-			
22							-	-	19.5			
23							-	-	-			
24							-	2.5	14.0			
25							4.0	7.0	-			
26							16.5	5.0	-			
27							35.0	2.0	-			
28							-	-	22.5			
29								6.0	14.5			
30								-	-			
31								56.5				
Total							79.0	304.5	163.0			

HALABJA

Latitude 35°10' N. Longitude 46°00' E. Elevation 730 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1957-1958

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1				-	10.3	-	-	-	-			
2				-	-	-		7.5	-			
3				-	-	4.1		-	26.0			
4				-	-	60.6		-	-			
5				-	28.6	4.2		-	-			
6				-	22.0	17.4	-	9.5	-			
7				-	-	-	-	-	-			
8				-	-	-	-	37.0	-			
9				-	-	-	-	-	-			
10				-	8.6	14.2	-	-	-			
11				-	-	-	-	-	-			
12				-	-	-	-	-	-			
13				-	-	-	-	-	-			
14				-	-	-	-	-	-			
15				-	-	-	-	-	-			
16				16.5	-	-	-	-	-			
17				3.5	-	4.3	-	-	-			
18				38.0	-	5.1	-	-	-			
19				-	-	-	-	-	-			
20				-	-	9.2	-	-	-			
21				-	33.7	7.0	-	5.0	30.0			
22				-	-	10.0	-	-	-			
23				-	-	-	20.2	-	-			
24				-	-	-	-	9.0	-			
25				-	-	-	-	-	-			
26				-	-	1.0	-	-	-			
27				-	-	-	-	-	-			
28				-	-	-	-	-	-			
29				-	-	26.5		10.5	-			
30				12.0	-	45.0		-	-			
31					-	-		-				
Total				70.0	103.2	208.6		78.5	56.0			

HALABJA

Latitude 35°10' N. Longitude 46°00' Elevation 730 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1958-1959

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1				-	-							
2				-	-							
3				-	-							
4				-	-							
5				-	-							
6				-	5.0							
7				-	20.0							
8				-	18.5							
9				-	50.5							
10				-	21.0							
11				-	-							
12				-	-							
13				-	-							
14				-	3.0							
15				-	5.2							
16				-	-							
17				-	-							
18				-	-							
19				-	-							
20				-	-							
21				-	-							
22				-	-							
23				-	-							
24				-	-							
25				-	-							
26				-	-							
27				-	-							
28				-	-							
29				-	-							
30				26.0	-							
31					-							
Total				26.0	123.2							

IFRAZ

Latitude 36°23' N. Longitude 43°48' E. Elevation 285 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1956-1957

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1							-	-	7.2	0.4	-	-
2							14.0	0.1	3.1	2.4	-	-
3							-	T	8.2	-	-	-
4							1.1	17.8	-	-	-	-
5							-	25.4	-	-	10.2	-
6							-	24.8	1.8	9.0	-	-
7							-	40.2	0.2	-	-	-
8							-	7.8	3.8	0.5	-	-
9							-	T	1.5	4.0	-	-
10							6.8	-	-	-	-	-
11							6.6	3.2	-	-	-	-
12							2.0	-	-	-	-	-
13						0.6	11.9	3.7	-	33.2	8.4	-
14						-	0.2	11.0	-	-	2.3	-
15						-	-	14.5	-	-	-	-
16						-	-	4.0	-	-	-	-
17						0.5	-	T	-	-	-	-
18						14.6	-	9.9	-	1.3	-	-
19						3.7	-	2.0	9.5	0.1	-	-
20						1.0	-	-	0.9	-	-	-
21						-	-	-	12.4	-	-	-
22						-	-	-	-	-	-	-
23						-	-	T	-	-	-	-
24						-	-	4.6	-	-	-	-
25						-	5.5	8.3	7.6	-	-	-
26						-	15.9	13.0	7.5	1.0	-	-
27						-	1.9	T	7.7	3.0	0.3	-
28						-	-	-	7.6	-	-	-
29						9.0		-	8.5	-	-	-
30						5.1		-	3.7	-	-	-
31						6.1		2.3		-		-
Total							65.9	192.6	91.2	54.9	21.2	0.0

IFRAZ

Latitude 36°23' N. Longitude 43°48' E. Elevation 285 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1957-1958

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1	-	-	-	-	0.5	-	-	-	-	-	-	-
2	-	-	-	0.4	-	-	-	7.7	-	-	-	-
3	-	-	-	-	1.4	10.3	-	-	0.3	-	-	-
4	-	-	-	1.3	-	1.3	-	-	-	-	-	-
5	-	-	-	-	20.9	3.6	5.5	-	-	-	-	-
6	-	-	-	-	0.4	4.0	-	-	-	-	-	-
7	-	-	-	27.5	15.3	10.4	-	-	-	-	-	-
8	-	-	-	-	5.4	-	-	7.5	-	-	-	-
9	-	-	-	1.5	16.5	-	-	-	-	-	-	-
10	-	-	-	-	1.6	12.3	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-
13	1.4	-	-	-	-	-	-	-	-	-	-	-
14	0.3	-	-	-	-	2.9	-	-	-	-	-	-
15	1.5	-	-	4.6	-	-	-	-	-	-	-	-
16	-	-	-	1.2	-	1.4	-	-	5.4	-	-	-
17	-	-	11.3	-	-	1.5	-	-	-	-	-	-
18	-	-	-	27.8	-	3.3	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	0.4	-	-	-
20	-	-	-	-	3.0	4.2	-	-	-	-	-	-
21	-	-	-	-	-	11.2	5.1	1.4	-	-	-	-
22	-	-	1.4	-	-	-	2.3	-	-	-	-	-
23	-	-	-	-	-	-	-	4.0	-	-	-	-
24	-	-	-	-	-	-	1.2	-	-	-	-	-
25	-	-	-	-	-	-	-	-	-	1.3	-	-
26	-	-	-	-	1.6	-	-	-	-	-	-	-
27	-	-	-	-	-	1.1	-	-	-	-	-	-
28	-	-	-	-	-	11.9	-	-	-	-	-	-
29	-	-	-	-	-	3.3		1.7	-	-	-	-
30	-	-	-	-	-	17.8		-	-	-	-	-
31	-		-		-	5.0		-		-		-
Total	3.2	0.0	12.7	64.3	66.6	105.5	14.1	22.3	6.1	1.3	0.0	0.0

IFRAZ

Latitude 36°23' N. Longitude 43°48' E. Elevation 285 m.

H.S.I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1958-1959

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1		-	-	-	-	-						
2		-	-	-	-	-						
3		-	-	0.3	-	-						
4		-	-	2.7	12.3	-						
5		-	-	12.3	0.2	-						
6		-	-	26.4	38.7	-						
7		-	-	9.2	4.2	0.4						
8		-	-	-	17.4	15.7						
9		-	-	-	12.5	-						
10		-	-	-	0.3	-						
11		-	-	-	-	-						
12		-	-	0.3	-	-						
13		-	-	-	-	-						
14		-	-	-	12.3	-						
15		-	-	-	1.2	-						
16		-	-	-	-	-						
17		-	-	-	-	-						
18		-	-	-	-	-						
19		-	-	-	-	0.3						
20		-	-	-	-	6.1						
21		-	-	-	-	-						
22		-	-	-	-	-						
23		-	-	-	-	-						
24		-	-	-	-	-						
25		-	-	-	-	-						
26		-	-	-	-	-						
27		-	-	-	-	-						
28		-	-	-	-	-						
29		-	-	-	-	-						
30		-	-	1.3	-	3.7						
31			-		-	-						
Total		0.0	0.0	52.5	99.1	26.2						

K-2

Latitude 34°58' N. Longitude 43°20' E. Elevation 150 m.

Bendix 8-inch-diameter automatic weighing gage
Daily precipitation in millimeters, water year 1957-1958

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1					-	-	-	-	-	-	-	-
2					2.0	7.0	-	2.0	-	-	-	-
3					T	1.0	-	-	-	2.0	-	-
4					11.0	4.0	-	-	-	-	-	-
5					-	-	-	-	-	-	-	-
6					5.0	-	-	-	-	-	-	-
7					-	-	-	-	2.0	-	-	-
8					-	-	-	12.0	-	-	-	-
9					-	-	-	-	-	-	-	-
10					-	T	-	-	-	-	-	-
11					-	-	-	-	-	-	-	-
12					-	-	-	-	-	-	-	-
13					-	-	-	-	-	-	-	-
14					-	-	-	-	-	-	-	-
15					-	-	-	-	-	-	-	-
16					-	T	-	-	-	-	-	-
17					-	-	-	-	-	-	-	-
18					-	-	-	-	-	-	-	-
19					-	-	-	-	-	-	-	-
20					-	8.0	-	-	-	-	-	-
21					-	-	-	-	-	-	-	-
22					-	-	-	-	-	-	-	-
23					-	-	-	2.0	-	-	-	-
24					5.0	-	-	-	-	-	-	-
25					-	-	-	-	-	-	-	-
26					-	-	-	-	-	-	-	-
27					-	T	-	-	-	-	-	-
28					-	3.0	-	-	-	-	-	-
29					-	10.0		-	-	-	-	-
30					-	5.0		-	-	-	-	-
31					-	-		-		-		-
Total					23.0	38.0	0.0	16.0	2.0	2.0	0.0	0.0

K-2

Latitude 34°58' N. Longitude 43°20' E. Elevation 150 m.

Bendix 8-inch-diameter automatic weighing gage
Daily precipitation in millimeters, water year 1958-1959

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1	-	-	-	-	-							
2	-	-	-	-	-							
3	-	-	-	-	1.0							
4	-	-	-	T	-							
5	-	-	-	11.2	-							
6	-	-	-	1.6	15.2							
7	-	-	-	-	1.8							
8	-	-	-	-	3.3							
9	-	-	-	-	-							
10	-	-	-	-	-							
11	-	-	-	-	-							
12	-	-	-	-	-							
13	-	-	-	-	3.0							
14	-	-	-	-	0.8							
15	-	-	-	-	-							
16	-	-	-	-	-							
17	-	-	-	-	-							
18	-	-	-	-	-							
19	-	-	-	-	-							
20	-	-	-	-	-							
21	-	-	-	-	-							
22	-	-	-	-	-							
23	-	-	-	-	-							
24	-	-	-	-	-							
25	-	-	-	-	-							
26	-	-	-	-	-							
27	-	-	-	-	-							
28	-	-	-	-	-							
29	-	-	-	2.4	T							
30	-	-	-	0.3	-							
31	-		-		-							
Total	0.0	0.0	0.0	15.5	25.1							

KANI SPIKA

Latitude 35°31' N. Longitude 45°53' E. Elevation 1080 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1956-1957

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1								-	31.0	3.0		
2								-	17.0	7.0		
3							-	-	40.0	2.0		
4							-	8.0	-	-		
5							-	30.0	-	14.0		
6							-	22.0	-	7.0		
7							-	31.0	-	9.0		
8							-	-	-	33.0		
9							-	-	19.0	4.0		
10							11.0	17.0	-	-		
11							13.0	27.0	-	-		
12							2.0	21.0	-	-		
13							13.0	12.0	-	45.0		
14							-	42.0	-	-		
15							-	11.0	-	-		
16							-	-	-	-		
17							-	6.0	-	4.0		
18							-	21.0	-	3.0		
19							-	-	15.0	5.0		
20							-	-	-	-		
21							-	-	32.0	-		
22							-	-	-	-		
23							-	-	22.0	-		
24							6.0	-	-	11.0		
25							22.0	18.0	4.0	19.0		
26							45.0	9.0	-	-		
27							3.0	4.0	17.0	-		
28							5.0	-	3.0	-		
29								11.0	20.0	-		
30								-	22.0	-		
31								-		-		
Total								290.0	242.0	166.0		

KANI SPIKA

Latitude 35°31' N. Longitude 45°53' E. Elevation 1080 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1957-1958

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1				-	10.0	-	-	-	-	-	6.9	-
2				-	-	-	-	-	-	-	1.2	-
3				-	-	21.0	-	9.0	10.0	-	-	-
4				11.7	-	49.0	-	-	-	-	-	-
5				4.0	35.0	8.0	-	-	-	-	-	-
6				10.0	11.0	19.0	-	-	-	-	-	-
7				2.0	29.0	-	-	-	-	-	T	-
8				3.0	4.0	-	-	25.0	-	T	2.0	-
9				-	7.0	-	-	2.0	-	-	-	-
10				-	-	28.0	-	-	-	-	2.1	-
11				-	-	-	-	-	-	-	0.2	-
12				-	-	-	-	-	-	-	-	-
13				-	-	-	-	-	-	-	-	-
14				12.0	-	-	-	-	-	-	-	-
15				23.0	-	-	-	-	-	-	-	-
16				8.0	-	7.0	-	-	-	-	-	-
17				38.0	-	-	-	-	-	-	-	-
18				-	-	8.0	-	-	T	-	-	-
19				-	17.0	-	-	-	-	-	-	-
20				6.0	39.0	19.0	-	-	-	-	-	-
21				-	-	23.0	-	-	-	-	-	-
22				-	-	18.0	30.0	2.0	-	-	-	-
23				-	-	-	-	5.0	-	-	-	-
24				-	-	-	-	12.0	-	-	-	-
25				-	-	-	-	-	-	-	-	-
26				-	-	-	-	-	-	-	-	-
27				-	-	-	-	-	-	-	-	-
28				-	-	-	-	-	-	T	-	-
29				-	-	38.0		7.0	-	-	-	-
30				21.0	-	32.0		-	-	T	-	-
31					-	-		-		-		-
Total				138.7	152.0	270.0	30.0	62.0	10.0	T	12.4	0.0

KANI SPIKA

Latitude 35°31' N. Longitude 45°53' E. Elevation 1080 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1958-1959

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1	-	-	-	-	-	-						
2	-	-	-	-	-	-						
3	-	-	-	-	-	-						
4	-	-	-	5.4	11.2	-						
5	-	-	-	11.8	5.1	-						
6	-	-	-	23.4	7.5	-						
7	-	-	-	-	3.5	-						
8	-	-	-	-	11.6	-						
9	-	-	-	-	3.2	-						
10	-	-	-	-	7.1	-						
11	-	-	-	-	-	-						
12	-	-	-	-	-	-						
13	-	-	-	-	5.4	-						
14	-	-	-	-	3.2	-						
15	-	-	-	-	-	-						
16	-	-	-	-	-	-						
17	-	-	-	-	-	-						
18	-	-	-	-	-	-						
19	-	-	-	-	-	45.0						
20	-	-	-	-	-	-						
21	-	-	-	-	-	-						
22	-	-	-	-	-	-						
23	-	-	-	-	-	-						
24	-	-	-	-	-	-						
25	-	-	-	-	-	-						
26	-	-	-	-	-	-						
27	T	-	-	-	-	-						
28	-	-	-	-	-	-						
29	-	-	-	3.7	-	-						
30	-	-	-	26.5	-	3.0						
31	-		-		-	7.0						
Total	T	0.0	0.0	70.8	57.8	55.0						

KHANAQIN

Latitude 34°18' N. Longitude 45°26' E. Elevation 201 m.

Bendix 8-inch-diameter automatic weighing gage
Daily precipitation in millimeters, water year 1957-1958

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1						-	-	-	-			
2						6.0	-	3.0	-			
3						2.0	-	-	-			
4						118.0	-	-	T			
5					-	-	-	-	-			
6					10.5	1.0	-	3.0	-			
7					-	-	-	-	-			
8					-	-	-	15.0	-			
9					-	-	-	-	-			
10					-	11.0	-	-	-			
11					-	-	-	-	-			
12					-	-	-	-	-			
13					-	-	-	-	-			
14					-	-	-	-	-			
15					-	-	-	-	-			
16					-	-	-	-	-			
17					-	-	-	-	-			
18					-	2.0	-	-	-			
19					2.0	-	-	-	-			
20					3.0	10.0	-	-	-			
21					-	19.0	-	5.0	-			
22					-	2.0	5.0	-	-			
23					-	-	-	-	-			
24					-	-	-	-	-			
25					-	-	-	-	-			
26					-	-	-	-	-			
27					-	-	-	-	-			
28					-	-	-	-				
29					-	5.0		-				
30					-	9.0		-				
31					-	-		-				
Total						185.0	5.0	26.0				

KHANAQIN

Latitude 34°18' N. Longitude 45°26' E. Elevation 201 m.

Bendix 8-inch-diameter automatic weighing gage
Daily precipitation in millimeters, water year 1958-1959

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1				-	-							
2				-	-							
3				-	-							
4				-	-							
5				22.0	-							
6				-	23.0							
7				-	1.0							
8				-	14.0							
9				-	-							
10				-	-							
11				-	-							
12				-	-							
13				-	9.0							
14				-	7.0							
15				-	-							
16				-	-							
17				-	-							
18				-	-							
19				-	-							
20				-	-							
21				-	-							
22				-	-							
23				-	-							
24				-	-							
25				-	-							
26				-	-							
27				-	-							
28				-	-							
29				-	-							
30				15.0	-							
31				-	-							
Total				27.0	54.0							

KIFRI

Latitude 34°42' N. Longitude 44°58' E. Elevation 210 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1956-1957

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1							12.5	-	-	-	-	
2							-	-	2.8	5.5	-	
3							-	-	16.3	-	-	
4							-	-	11.5	2.3	-	
5							1.2	6.0	-	6.2	-	
6							1.6	5.1	1.0	-	-	
7							-	29.5	-	13.5	-	
8							-	-	3.2	2.3	-	
9							-	-	-	5.5	-	
10							-	-	-	-	-	
11							27.3	8.5	-	-	-	
12							1.2	19.8	-	-	-	
13							-	4.0	-	19.0	-	
14							1.5	33.9	-	-	-	
15							-	-	-	-	-	
16							-	14.5	-	-	-	
17							-	-	-	-	-	
18							-	-	-	-	-	
19						11.2	-	-	-	-	-	
20						T	-	-	9.5	-	-	
21						-	-	-	-	-	-	
22						-	-	-	31.8	-	-	
23						-	-	-	-	-	-	
24						-	3.0	-	1.5	-	-	
25						-	-	12.5	-	4.5	-	
26						-	26.0	15.0	-	T	-	
27						-	15.5	-	-	-	-	
28						-	-	-	7.1	-	-	
29						-		-	10.5	-	-	
30						3.8		-	14.7	-	-	
31						-		7.0		-		
Total							89.8	155.8	109.9	58.8	0.0	

KIFRI

Latitude 34°42' N. Longitude 44°58' E. Elevation 210 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1957-1958

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1					-	-	-	-	-	-	3.0	-
2					-	-	-	0.6	-	-	-	-
3					-	6.0	-	-	-	-	-	-
4					-	54.0	-	-	-	-	-	-
5					34.0	-	-	-	-	4.0	-	-
6					-	8.0	-	-	-	-	-	-
7					15.0	-	-	-	-	-	-	-
8					-	-	-	2.1	-	-	-	-
9					-	-	-	-	-	-	-	-
10					3.0	7.0	-	-	-	-	-	-
11					-	-	-	-	-	-	-	-
12					-	-	-	-	-	-	-	-
13					-	-	-	-	-	-	-	-
14					-	-	-	-	-	-	-	-
15					-	-	-	-	-	-	-	-
16					-	-	-	-	-	-	-	-
17					-	4.0	-	-	-	-	-	-
18					-	-	-	-	-	-	-	-
19					-	-	-	-	-	-	-	-
20					-	24.0	-	-	-	-	-	-
21					-	29.0	-	-	-	-	-	-
22					3.0	-	14.0	-	-	-	-	-
23					-	-	-	-	-	-	-	-
24					-	-	-	-	-	-	-	-
25					-	-	-	-	-	-	-	-
26					-	-	-	-	-	-	-	-
27					-	-	-	-	-	-	-	-
28					-	-	-	-	-	-	-	-
29					-	3.0		-	-	-	-	-
30					-	16.0		-	-	-	-	-
31					-	-		-		-		-
Total					55.0	151.0	14.0	2.7	0.0	4.0	3.0	0.0

KIFRI

Latitude 34°42' N. Longitude 44°58' E. Elevation 210 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1958-1959

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1		-	-	-	-	-						
2		-	-	-	-	-						
3		-	-	-	-	-						
4		-	-	-	-	-						
5		-	-	-	-	-						
6		-	-	4.3	-	-						
7		-	-	-	12.0	-						
8		-	-	-	5.5	-						
9		-	-	-	7.5	-						
10		-	-	-	-	-						
11		-	-	-	-	-						
12		-	-	-	14.2	-						
13		-	-	-	11.1	-						
14		-	-	-	-	-						
15		-	-	-	-	-						
16		-	-	-	-	-						
17		-	-	-	-	-						
18		-	-	-	-	-						
19		-	-	-	-	-						
20		-	-	-	-	3.2						
21		-	-	-	-	-						
22		-	-	-	-	-						
23		-	-	-	-	-						
24		-	-	-	-	-						
25		-	-	-	-	-						
26		-	-	-	-	-						
27		-	-	-	-	-						
28		-	-	-	-	-						
29		-	-	-	-	-						
30		-	-	-	-	-						
31			-		-	-						
Total		0.0	0.0	4.3	50.3	3.2						

KIRKUK - H. S. I.

Latitude 35°28' N. Longitude 44°24' E. Elevation 320 m.

H. S. I. 8-inch-diameter non-automatic gage
Bendix 8-inch-diameter automatic weighing gage
Daily precipitation in millimeters, water year 1956-1957

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1						-		-		-	-	
2						-		-		23.0	-	
3						-		-		0.5	-	
4						4.4		28.0		-	-	
5						11.7		22.0		-	-	
6						4.3		4.0		0.6	-	
7						-		5.3		T	-	
8						-		-		42.2	-	
9						-		-		T	-	
10						-		-		T	-	
11						-		2.5		3.0	-	
12						-		7.2		-	1.5	
13						-		-		8.0	T	
14						-		15.0		1.5	-	
15						-		16.5		-	-	
16						-		12.8		-	-	
17						-				-	-	
18						15.0				4.0	-	
19						0.7				-	-	
20						0.4				-	-	
21						-			24.5	-	-	
22						-			T	-	-	
23						-			-	-	-	
24						-			-	-	-	
25						-			-	8.4	-	
26						-	31.0		-	-	-	
27						-	13.0		17.5	-	-	
28						-	-		-	-	-	
29						4.0			12.0	-	-	
30						12.1			-	-	-	
31						T				-		
Total						52.6				91.2	1.5	

KIRKUK - H. S. I.

Latitude 35°28' N. Longitude 44°24' E. Elevation 320 m.

H. S. I. 8-inch-diameter non-automatic gage
Bendix 8-inch-diameter automatic weighing gage
Daily precipitation in millimeters, water year 1957-1958

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1					-	-	-	-	-	-	-	-
2					1.0	10.0	-	3.7	T	-	0.6	-
3					1.0	-	-	-	-	-	T	-
4					3.0	24.9	-	-	-	T	-	-
5					-	0.6	-	-	-	-	-	-
6					10.0	9.4	-	-	-	-	-	-
7					-	-	-	-	-	-	-	-
8					-	-	-	13.0	-	-	-	-
9				-	T	-	-	-	-	-	-	-
10				T	-	15.0	-	-	-	-	-	-
11				-	-	-	-	-	-	-	-	-
12				-	-	-	-	-	-	-	-	-
13				-	-	-	-	-	-	-	-	-
14				11.0	-	-	-	-	T	-	-	-
15				-	-	-	-	-	-	-	-	-
16				-	-	0.9	-	-	T	-	-	-
17				8.0	-	0.4	-	-	-	-	-	-
18				-	-	-	-	-	T	-	-	-
19				-	-	-	-	-	-	-	-	-
20				-	-	5.8	-	-	-	-	-	-
21				-	-	18.2	0.4	-	-	-	-	-
22				-	-	-	11.4	-	-	-	-	-
23				-	-	-	-	1.6	-	-	-	-
24				-	6.0	-	-	-	-	T	-	-
25				T	-	-	-	-	-	-	-	-
26				-	0.5	-	-	-	-	-	-	-
27				-	-	-	-	-	-	1.0	-	-
28				-	-	-	-	-	-	-	-	-
29				6.0	-	1.2		-	-	2.0	-	-
30				-	-	15.0		0.3	-	-	-	-
31					-	-		-		0.1		-
Total					21.5	101.4	11.8	18.6	T	3.1	0.6	0.0

KIRKUK - H. S. I.

Latitude 35°28' N. Longitude 44°24' E. Elevation 320 m.

H. S. I. 8-inch-diameter non-automatic gage
Bendix 8-inch-diameter automatic weighing gage
Daily precipitation in millimeters, water year 1958-1959

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1	-	-	-	-	-	-						
2	-	-	-	-	-	-						
3	-	-	-	T	3.0	-						
4	-	-	-	9.0	2.0	-						
5	-	-	-	36.5	-	-						
6	-	-	-	2.6	13.5	-						
7	-	-	-	-	28.5	5.8						
8	-	-	-	-	11.0	-						
9	-	-	-	-	-	-						
10	-	-	-	-	-	-						
11	-	-	-	-	-	-						
12	-	-	-	-	-	-						
13	-	-	-	-	3.0	-						
14	-	-	-	-	4.1	-						
15	-	-	-	-	-	-						
16	-	-	-	-	-	-						
17	-	-	-	-	-	-						
18	-	-	-	-	-	-						
19	-	-	-	-	-	2.8						
20	-	-	-	-	-	-						
21	-	-	-	-	-	T						
22	-	-	-	-	-	-						
23	-	-	-	-	-	-						
24	-	-	-	-	-	-						
25	-	-	-	-	-	-						
26	-	-	-	-	-	-						
27	-	-	-	-	-	-						
28	-	-	-	-	-	-						
29	-	-	-	-	-	-						
30	-	-	-	2.2	T	-						
31	-		-		-	-						
Total	0.0	0.0	0.0	50.3	65.1	8.6						

KOI SANJAK

Latitude 36°05' N. Longitude 44°48' E. Elevation 610 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1956-1957

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1							5.4	4.0	10.0	-	-	
2							51.0	-	14.0	3.0	-	
3							-	-	18.0	4.0	-	
4							-	12.3	-	7.0	3.0	
5							5.0	29.5	-	-	4.0	
6							-	50.0	-	2.0	-	
7							-	20.0	-	9.0	-	
8							-	16.0	7.0	3.0	-	
9							-	-	9.0	7.0	-	
10							12.0	-	-	12.0	-	
11							13.0	4.0	-	-	-	
12							3.0	6.0	-	4.0	-	
13							5.0	35.0	-	2.0	3.0	
14							7.0	25.0	-	48.0	-	
15							-	40.0	-	3.0	-	
16							-	3.0	-	-	-	
17							-	-	-	-	-	
18							-	12.0	-	25.0	-	
19							-	20.0	8.0	-	-	
20							-	-	12.0	-	-	
21							-	-	5.0	-	-	
22							-	-	4.0	-	-	
23						-	-	25.0	7.0	-	-	
24						-	-	22.0	3.0	-	-	
25						-	22.0	20.0	5.0	-	4.0	
26						-	30.0	20.5	2.0	8.0	-	
27						-	18.0	10.0	14.0	1.0	-	
28						-	14.0	12.0	16.0	-	-	
29						11.1		-	-	-	-	
30						7.8		15.0	13.0	-	-	
31						5.2		13.0		-		
Total							185.4	414.3	147.0	138.0	14.0	

KOI SANJAK

Latitude 36°05' N. Longitude 44°48' E. Elevation 610 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1957-1958

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1				-	8.0	-	6.8	-	-	-		
2				7.0	5.0	16.0	-	6.0	-	-		
3				-	3.0	22.0	-	-	-	-		
4				5.0	3.0	38.0	-	-	11.0	-		
5				-	5.0	-	-	-	-	-		
6				25.0	19.0	-	-	-	-	-		
7				3.0	18.0	-	-	-	8.0	-		
8				-	9.0	-	-	11.0	-	-		
9				4.0	6.0	-	-	8.0	-	-		
10				-	2.0	40.0	-	9.0	-	-		
11				-	-	-	-	-	-	-		
12				-	-	-	-	-	-	-		
13				-	-	-	-	-	7.0	-		
14				-	-	8.0	-	-	-	-		
15				20.0	-	-	-	13.0	-	-		
16				-	-	10.0	-	-	13.0	-		
17				-	-	6.0	-	-	-	15.0		
18				30.0	-	-	-	-	-	-		
19				10.0	7.0	-	-	-	-	17.0		
20				-	3.0	8.0	-	-	-	-		
21				-	-	9.0	7.0	7.0	-	-		
22				12.0	-	7.0	45.0	-	-	-		
23				5.0	-	-	-	-	-	-		
24				-	-	-	-	-	-	-		
25				-	-	-	-	-	-	-		
26				-	-	-	-	-	-	-		
27				14.0	-	3.0	-	-	-	-		
28				-	-	2.0		-	-	-		
29				5.0	-	32.0		-	-	-		
30				-	-	48.0		-	-	8.0		
31					-	-		-		-		
Total				140.0	88.0	249.0	58.8	54.0	39.0	40.0		

KOI SANJAK

Latitude 36°05' N. Longitude 44°48' E. Elevation 610 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1958-1959

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1			-	-	-	-						
2			-	13.0	-	-						
3			-	17.0	60.0	-						
4			-	41.0	32.0	-						
5			-	9.0	-	-						
6			-	-	-	-						
7			-	-	6.0	9.0						
8			-	-	12.0	8.0						
9			-	-	-	-						
10			-	-	-	-						
11			-	-	-	-						
12			-	-	-	-						
13			-	-	-	-						
14			12.0	-	-	-						
15			-	-	-	-						
16			-	-	-	-						
17			-	-	-	-						
18			-	-	-	-						
19			-	-	-	-						
20			-	-	-	-						
21			-	-	-	-						
22			-	-	-	-						
23			-	-	-	-						
24			-	-	-	-						
25			-	-	-	-						
26			-	-	-	-						
27			-	-	-	-						
28			-	-	-	-						
29			-	-	-	-						
30			-	-	9.0	4.0						
31			-		-	2.0						
Total			12.0	80.0	119.0	23.0						

MAKHMUR

Latitude 35°46' N. Longitude 45°35' E. Elevation 270 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1956-1957

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1							2.3	-	6.0	9.0		
2							-	-	-	4.0		
3							-	6.0	3.0	-		
4							-	23.0	-	-		
5							-	26.0	-	-		
6							-	26.0	-	-		
7							-	31.5	-	-		
8							-	7.0	-	8.0		
9							-	6.0	-	5.0		
10							7.5	-	-	-		
11							-	-	-	-		
12							-	2.0	-	-		
13							6.0	12.0	-	38.0		
14							-	17.0	-	-		
15							-	6.0	-	-		
16							-	31.5	-	-		
17							-	-	-	-		
18							-	-	-	-		
19							-	-	31.0	-		
20							-	-	-	-		
21							-	-	30.0	-		
22							-	1.0	1.0	-		
23							-	0.5	-	-		
24							-	5.0	-	10.0		
25							3.5	16.0	-	-		
26							12.0	6.0	-	12.0		
27							-	-	-	-		
28							-	6.0	-	-		
29						3.0		3.0	29.0	-		
30						3.4		-	10.0	-		
31						-		-		-		
Total							31.3	231.5	110.0	86.0		

MAKHMUR

Latitude 35°46' N. Longitude 45°35' E. Elevation 270 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1957-1958

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1				-	-	-	-	-	-	-	-	-
2				-	1.0	-	-	6.0	-	-	-	-
3				-	-	7.0	-	-	-	-	-	-
4				-	-	-	-	-	-	-	-	-
5				-	7.0	1.0	1.0	-	-	-	-	-
6				-	-	7.0	-	-	-	-	-	-
7				-	6.0	20.0	-	-	-	-	-	-
8				-	-	-	-	13.0	-	-	-	-
9				-	-	-	-	-	-	-	-	-
10				-	-	-	-	-	-	-	-	-
11				-	-	6.0	-	-	-	-	-	-
12				-	-	-	-	-	-	-	-	-
13				-	-	-	-	-	-	-	-	-
14				-	-	-	-	-	4.0	-	-	-
15				-	-	-	-	-		-	-	-
16				-	-	-	-	-	-	-	-	-
17				-	-	-	-	-		-	-	-
18				-	-	-	-	-		-	-	-
19				-	-	-	-	-		-	-	-
20				-	-	-	-	-		-	-	-
21				50.0	-	7.0	4.0	-		-	-	-
22				-	-	5.0	-	-		-	-	-
23				-	-	-	-	3.0		-	-	-
24				-	-	-	-	-		-	-	-
25				-	-	-	-	-		-	-	-
26				-	-	-	-	-		-	-	-
27				-	-	-	-	-		-	-	-
28				-	-	-	-	-		-	-	-
29				3.0	-	8.0		-		-	-	-
30				-	-	49.0		-		-	-	-
31					-	9.0		-		-		-
Total				53.0	14.0	119.0	5.0	22.0		0.0	0.0	0.0

MAKHMUR

Latitude 35°46' N. Longitude 45°35' E. Elevation 270 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1958-1959

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1				-	-							
2				-	1.3							
3				-	-							
4				-	-							
5				-	-							
6				-	1.0							
7				-	3.0							
8				-	-							
9				-	-							
10				-	-							
11				-	-							
12				-	1.0							
13				-	-							
14				-	7.0							
15				-	-							
16				-	-							
17				-	-							
18				-	-							
19				-	-							
20				-	-							
21				-	-							
22				-	-							
23				-	-							
24				-	-							
25				-	-							
26				-	-							
27				-	-							
28				-	-							
29				-	-							
30				-	-							
31					-							
Total				0.0	13.3							

MERGA SOOR

Latitude 36°50' N. Longitude 44°19' E. Elevation 1170 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1957-1958

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1					-	-	-	-	5.0	-		
2					-	-	-	21.0	-	-		
3					-	-	-	-	-	-		
4					26.0	8.2	-	-	-	-		
5					6.0	11.1	-	-	-	-		
6					20.0	18.0	-	-	-	-		
7					52.0	4.3	-	-	-	-		
8					-	-	-	44.0	-	-		
9					-	-	-	10.0	-	-		
10					-	-	-	-	-	-		
11					-	-	-	-	-	-		
12					-	-	-	-	-	-		
13					-	-	-	-	-	-		
14					-	-	-	-	-	-		
15					-	8.0	-	-	-	-		
16					-	3.0	-	-	-	-		
17					-	11.5	-	-	13.0	-		
18					-	8.5	-	-	16.0	-		
19					39.0	T	-	-	-	-		
20					5.0	T	-	-	5.0	-		
21				-	-	-	-	-	6.0	-		
22				-	-	-	-	5.5	-	-		
23				-	-	-	40.0	7.0	-	-		
24				26.0	-	-	-	36.0	-	-		
25				6.0	-	-	-	9.0	-	-		
26				20.0	-	-	-	-	-	-		
27				-	-	30.0	-	-	-	T		
28				-	-	-	-	-	-	T		
29				5.0	-	-		-	-	T		
30					-	-		15.0	-	-		
31					-	-		-		-		
Total					148.0	102.6	40.0	147.5	45.0	T		

MERGA SOOR

Latitude 36°50' N. Longitude 44°19' E. Elevation 1170 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1958-1959

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1				-	-	-						
2				-	2.5	-						
3				11.0	-	-						
4				14.0	-	-						
5				17.0	-	-						
6				4.0	20.0	-						
7				-	32.0	40.0						
8				-	80.0	12.0						
9				-	45.0	-						
10				-	-	-						
11				-	-	-						
12				-	-	-						
13				-	8.0	-						
14				-	11.0	-						
15				-	-	-						
16				-	-	-						
17				-	-	-						
18				-	-	-						
19				-	-	6.0						
20				-	-	-						
21				-	-	-						
22				-	-	-						
23				-	-	-						
24				-	-	-						
25				-	-	-						
26				-	-	-						
27				-	-	-						
28				-	-	-						
29				-	-	-						
30				4.0	-	50.0						
31					-	10.0						
Total				50.0	198.5	118.0						

MOSUL

Latitude 36°19'N. Longitude 43°09' E. Elevation 223 m.

Bendix 8-inch-diameter automatic weighing gage
Daily precipitation in millimeters, water year 1957-1958

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1					-	-	-	-	-	-		
2					-	11.0	-	7.0	-	1.0		
3					-	-	-	-	-	-		
4					-	T	-	-	-	-		
5					-	3.8	2.0	-	-	-		
6					2.0	12.7	-	-	-	-		
7					6.5	T	-	-	-	-		
8					1.0	-	-	24.0	-	-		
9					-	-	-	-	-	-		
10					-	7.0	-	-	-	-		
11					-	T	-	-	-	-		
12					-	-	-	-	-	-		
13					-	-	-	-	-	-		
14					-	6.4	-	-	-	-		
15					-	T	-	-	-	-		
16					-	-	-	-	4.0	-		
17					-	-	-	-	-	-		
18					-	2.0	-	-	-	-		
19					-	-	-	-	-	-		
20					-	7.0	-	-	-	-		
21					-	4.5	3.0	-	-	-		
22					-	-	-	-	-	-		
23					-	-	-	5.0	-	-		
24					-	-	-	-	-	-		
25					-	-	-	-	-	-		
26				-	-	-	-	-	-	-		
27				-	-	2.0	-	-	-			
28				-	-	14.0	-	-	-			
29				2.0	-	-		1.0	-			
30				-	-	2.0		1.0	-			
31					-	-		-				
Total					9.5	72.4	5.0	38.0	4.0			

MOSUL

Latitude 36°19' N. Longitude 43°09' E. Elevation 223 m.

Bendix 8-inch-diameter automatic weighing gage
Daily precipitation in millimeters, water year 1958-1959

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1				-	-	-						
2				-	-	-						
3				1.0	14.0	-						
4				-	-	-						
5				8.0	-	-						
6				-	21.0	-						
7				-	3.0	16.0						
8				1.0	7.0	-						
9				1.0	1.0	-						
10				-	-	-						
11				-	-	-						
12				-	-							
13				-	-							
14				-	1.0							
15				-	-							
16				-	-							
17				-	-							
18				-	-							
19				-	-							
20				-	-							
21				-	-							
22				-	-							
23				-	-							
24				-	-							
25				-	-							
26				-	-							
27				-	-							
28				-	-							
29				-	-							
30				-	-							
31					-							
Total				11.0	47.0							

QADIR KARAM

Latitude 35°11' N. Longitude 44°53' E. Elevation 380 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1956-1957

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1							-	16.4	21.5	T	-	
2							14.3	-	12.0	9.7	-	
3							-	-	9.0	2.8	-	
4							-	17.6	-	-	T	
5							-	8.6	-	5.3	T	
6							1.6	14.3	-	-	-	
7							-	9.1	3.1	8.2	-	
8							-	-	T	24.7	-	
9							-	-	0.8	4.4	-	
10							-	1.2	-	-	-	
11							30.2	21.2	-	-	-	
12							1.5	-	-	-	T	
13							-	10.7	-	15.4	T	
14							3.1	28.4	-	-	-	
15						-	0.4	6.6	-	-	-	
16						1.1	-	-	-	-	-	
17						-	-	-	-	-	-	
18						11.2	-	-	-	0.5	-	
19						2.0	-	-	4.8	6.2	-	
20						-	-	-	7.6	-	-	
21						-	-	-	22.2	-	-	
22						-	-	-	-	-	-	
23						-	-	-	3.0	-	-	
24						-	-	5.5	-	T	-	
25						-	T	2.6	-	14.2	-	
26						-	39.2	-	-	-	-	
27						-	11.7	-	2.5	-	-	
28						-	20.5	-	1.8	-	T	
29						7.0		-	11.0	-	-	
30						7.8		93.0	5.6	-	-	
31						1.2		2.5		-		
Total							122.5	237.7	104.9	91.4	T	

QADIR KARAM

Latitude 35°11' N. Longitude 44°53' E. Elevation 380 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1957-1958

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1				-	-	-	-	-	-	-		
2				-	-	-	-	-	-	-		
3				-	-	8.5	-	-	-	-		
4				-	16.2	44.6	-	-	-	-		
5				-	-	-	-	4.0	-	-		
6				10.2	8.0	-	-	-	-	-		
7				-	-	-	-	-	-	-		
8				-	-	-	-	25.5	-	-		
9				-	-	-	-	-	-	-		
10				-	-	14.5	-	-	-	-		
11				-	-	-	-	-	-	-		
12				-	-	-	-	-	-	-		
13				-	-	-	-	-	-	-		
14				10.6	-	-	-	-	-	-		
15				1.2	-	-	-	-	-	-		
16				17.0	-	-	-	-	-	-		
17				-	-	-	-	-	-	-		
18				-	-	-	-	-	-	-		
19				-	-	-	-	-	-	-		
20				-	10.0	12.0	-	-	-	-		
21				-	-	22.0	-	-	-	-		
22				-	-	6.0	-	-	-	-		
23				-	-	-	-	-	-	-		
24				-	-	-	-	-	-	-		
25				-	-	-	-	-	-	-		
26				-	-	-	-	-	-	-		
27				-	-	-	-	-	-	-		
28				-	-	-	-	-	-	-		
29				24.0	-	-		-	-	4.5		
30				-	-	15.0		-	-	-		
31					-	4.6		-		-		
Total				63.0	34.2	127.2	0.0	29.5	0.0	4.5		

QADIR KARAM

Latitude 35°11' N. Longitude 44°53' E. Elevation 380 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1958-1959

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1	-	-	-	-	-	-						
2	-	-	-	-	-	-						
3	-	-	-	38.0	-	-						
4	-	-	-	12.0	2.8	-						
5	-	-	-	121.0	15.2	-						
6	-	-	-	66.0	22.6	-						
7	-	-	-	-	2.3	34.0						
8	-	-	-	-	14.0	-						
9	-	-	-	-	3.6	-						
10	-	-	-	-	-	-						
11	-	-	-	-	-	-						
12	-	-	-	-	-	-						
13	-	-	-	- -	22.8	-						
14	-	-	-	-	8.4	-						
15	-	-	-	-	3.6	-						
16	-	-	-	-	-	-						
17	-	-	-	-	-	-						
18	-	-	-	-	-	-						
19	-	-	-	-	-	36.0						
20	-	-	-	-	-	-						
21	-	-	-	-	-	-						
22	-	-	-	-	-	-						
23	-	-	-	-	-	-						
24	-	-	-	-	-	-						
25	-	-	-	-	-	-						
26	-	-	-	-	-	-						
27	-	-	-	-	-	-						
28	-	-	-	-	-	-						
29	-	-	-	68.0	-	-						
30	-	-	-	15.0	-	40.0						
31	-		-		-	-						
Total	0.0	0.0	0.0	320.0	95.3	110.0						

QARA DAGH

Latitude 35°18' N. Longitude 45°23' E. Elevation 830 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1957-1958

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1							-		-	-		
2							-		-	-		
3							-		-	-		
4							-		-	-		
5							-		-	-		
6							-		-	-		
7							-		-	-		
8							-		-	-		
9							-		-	-		
10							-		-	-		
11							-		-	-		
12							-		-	-		
13							-		-	-		
14							-		-	-		
15							-		-	-		
16							-		2.5	-		
17							-		-	-		
18							-		T	-		
19							-		-	-		
20							-		-	-		
21							-		-	-		
22							17.0		-	-		
23							18.5		-	-		
24							-		-	-		
25							-		-	-		
26							-		-	15.0		
27							-		-	-		
28							-		-	T		
29						-			-	61.0		
30						19.5			-	T		
31						12.5				-		
Total							35.5		2.5	76.0		

QARA DAGH

Latitude 35°18' N. Longitude 45°23' E. Elevation 830 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1958-1959

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1					-	-						
2					-	-						
3					-	-						
4					-	-						
5					-	-						
6					41.0	-						
7					33.0	-						
8					77.0	12.5						
9					9.0	4.5						
10					-	-						
11					-	-						
12					-	-						
13					-	-						
14					8.0	-						
15					25.5	-						
16					-	-						
17					-	-						
18					-	-						
19					-	-						
20					-	35.5						
21					-	T						
22					-	-						
23					-	-						
24					-	-						
25					-	-						
26					-	-						
27					-	-						
28					-	-						
29					-	-						
30					-	-						
31					-	28.5						
Total					193.5	81.0						

RAML

Latitude 34°57' N. Longitude 44°01' E. Elevation 200 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1956-1957

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1							-	-	11.0	7.0	-	-
2							-	-	12.0	-	-	-
3							-	-	T	-	-	-
4							-	22.0	3.0	-	-	-
5							-	15.0	-	-	-	-
6							-	-	-	T	-	-
7							-	-	-	-	-	-
8							-	-	-	-	T	-
9							-	-	T	5.0	-	-
10							-	2.0	-	2.0	-	-
11							21.0	10.0	-	-	-	-
12							T	-	-	-	-	-
13							T	12.0	-	53.0	-	-
14							4.0	32.0	-	-	-	-
15							-	15.0	-	-	-	-
16							-	-	-	-	-	-
17							-	-	-	-	-	-
18							-	-	T	-	-	-
19							-	-	-	-	-	-
20							-	-	-	T	-	-
21							-	-	21.0	T	-	-
22							-	1.0	-	T	-	-
23							-	-	-	-	-	-
24							-	49.0	-	-	-	-
25							4.0	31.0	T	-	-	-
26							25.0	15.0	-	2.0	-	-
27							5.0	-	11.0	-	-	-
28							-	-	3.0	-	-	-
29								-	5.0	-	-	-
30								-	6.0	-	-	-
31								-		-		-
Total							59.0	204.0	72.0	69.0	T	0.0

RAML

Latitude 34°57' N. Longitude 44°01' E. Elevation 200 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1957-1958

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1	-	-	-	-	-	-	-	-	-	-	-	-
2	-	-	-	-	-	7.0	-	-	2.0	-	1.0	-
3	-	-	-	-	-	-	-	-	-	-	-	-
4	-	-	-	-	-	8.0	-	5.0	-	-	-	-
5	-	-	-	-	-	-	-	T	-	3.0	-	-
6	-	-	-	-	7.0	-	-	-	-	T	-	-
7	-	-	-	1.0	-	-	-	-	-	-	-	-
8	-	-	-	-	-	-	-	12.0	-	-	-	-
9	-	-	-	-	9.0	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-	-	-	-	-
12	-	-	-	-	-	-	-	-	-	-	-	-
13	-	-	-	-	-	-	-	-	-	-	-	-
14	-	-	-	-	-	-	-	-	-	-	-	-
15	-	-	-	-	-	T	-	-	-	-	-	-
16	-	-	-	1.2	-	-	-	-	-	-	-	-
17	-	-	-	-	-	3.0	-	-	-	-	-	-
18	-	-	-	2.0	-	T	-	-	-	-	-	-
19	-	-	-	-	-	-	-	-	-	-	-	-
20	-	-	-	-	-	-	-	-	-	-	-	-
21	-	-	-	-	-	12.0	-	-	-	-	-	-
22	-	-	-	-	-	-	6.0	-	-	-	-	-
23	-	-	-	-	-	-	T	-	6.0	-	-	-
24	-	-	-	-	-	-	-	-	-	-	-	-
25	-	-	-	-	-	-	-	-	-	-	-	-
26	-	-	-	-	-	-	-	-	-	-	-	-
27	-	-	-	-	-	-	-	-	-	-	-	-
28	-	-	-	-	-	-	-	-	-	2.0	-	-
29	-	-	-	-	-	16.0		-	-	T	-	-
30	-	-	-	-	-	6.0		T	-	-	-	-
31	-		-		-	-		-		-		-
Total	0.0	0.0	0.0	4.2	16.0	52.0	6.0	17.0	8.0	5.0	1.0	0.0

RAML

Latitude 34°57' N. Longitude 44°01' E. Elevation 200 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1958-1959

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1	-	-	-	-	-							
2	-	-	-	-	-							
3	-	-	-	-	-							
4	-	-	-	-	-							
5	-	-	-	-	-							
6	-	-	-	12.0	-							
7	-	-	-	14.0	-							
8	-	-	-	7.0	12.0							
9	-	-	-	-	-							
10	-	-	-	-	-							
11	-	-	-	-	-							
12	-	-	-	-	5.0							
13	-	-	-	-	14.0							
14	-	-	-	-	-							
15	-	-	-	-	-							
16	-	-	-	-	-							
17	-	-	-	-	-							
18	-	-	-	-	-							
19	-	-	-	-	-							
20	-	-	-	-	-							
21	-	-	-	-	-							
22	-	-	-	-	-							
23	-	-	-	-	-							
24	-	-	-	-	-							
25	-	-	-	-	-							
26	-	-	-	-	-							
27	-	-	-	-	-							
28	-	-	-	-	-							
29	-	-	-	-	-							
30	-	-	-	-	-							
31	-		-		-							
Total	0.0	0.0	0.0	33.0	31.0							

RUTBA

Latitude 33°02' N. Longitude 40°17' E. Elevation 640 m.

Bendix 8-inch-diameter automatic weighing gage
Daily precipitation in millimeters, water year 1957-1958

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1						-	-	-	-	-	-	
2						10.0	-	1.0	-	-		
3						-	-	-	-	-		
4						-	-	-	-	-		
5						2.0	-	-	-	-		
6						6.0	T	-	-	-		
7						-	-	-	-	-		
8						-	-	1.0	-	-		
9						-	-	-	-	-		
10						-	-	-	-	T		
11						-	-	-	-	-		
12						-	-	-	-	-		
13						-	-	-	-	-		
14						-	-	-	-	3.0		
15						-	-	-	-	-		
16						-	-	-	4.0	-		
17						-	-	-	-	-		
18						-	-	-	-	-		
19						-	1.0	-	-	-		
20						2.0	-	-	-	T		
21						-	4.0	-	-	-		
22						-	-	-	-	-		
23						-	-	-	-	-		
24						-	-	-	-	1.0		
25						-	-	-	-	-		
26						2.0	-	-	-	-		
27						-	-	-	-	-		
28						-	-	-	-	-		
29						-		-	-	-		
30						2.0		-	-	-		
31						-		-		-		
Total						24.0	5.0	2.0	4.0	4.0		

RUTBA

Latitude 33°02' N. Longitude 40°17' E. Elevation 640 m.

Bendix 8-inch-diameter automatic weighing gage
Daily precipitation in millimeters, water year 1958-1959

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1				-	-	-						
2				-	-	-						
3				-	-	-						
4				3.0	-	-						
5				-	-	-						
6				-	-	-						
7				-	-	-						
8				-	-	-						
9				-	-	-						
10				6.0	-	-						
11				-	-	-						
12				-	-	-						
13				-	-	-						
14				-	-	-						
15				-	-	4.0						
16				-	-	-						
17				-	-	-						
18				-	-	-						
19				-	-	-						
20				-	-							
21				-	-							
22				-	-							
23			-	-	-							
24			-	-	-							
25			-	-	-							
26			-	-	-							
27			-	-	-							
28			-	-	-							
29			-	-	-							
30			-	-	-							
31			-		-							
Total				9.0	0.0							

RUWANDUZ

Latitude 36°37' N. Longitude 44°32' E. Elevation 690 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1956-1957

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1									6.0	-		
2									1.0	10.0		
3									7.0	1.5		
4									-	10.0		
5									-	-		
6									-	11.5		
7								13.5	-	11.5		
8								4.0	6.5	23.5		
9								-	11.5	8.0		
10								12.0	-	-		
11								-	-	-		
12								12.0	-	-		
13								28.5	-	11.0		
14								8.0	-	7.0		
15								-	-	-		
16								-	-	1.5		
17								5.0	-	6.0		
18								9.0	-	23.0		
19								-	7.0	-		
20								-	-	5.5		
21								-	6.5	-		
22								7.0	-	-		
23								11.5	3.5	-		
24								25.5	-	-		
25								6.5	-	-		
26								18.0	4.5	11.5		
27								-	3.5	0.5		
28								-	-	-		
29								-	10.0	-		
30								11.0	-	-		
31								3.0		-		
Total									67.0	142.0		

RUWANDUZ

Latitude 36°37' N. Longitude 44°32' E. Elevation 690 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1958-1959

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1				-	-							
2				-	-							
3				-	14.5							
4				10.0	-							
5				18.0	2.5							
6				3.0	34.0							
7				-	24.0							
8				-	65.0							
9				-	27.0							
10				-	-							
11				-	-							
12				-	-							
13				-	-							
14				-	13.0							
15				-	-							
16				-	-							
17				-	-							
18				-	-							
19				-	-							
20				-	-							
21				-	-							
22				-	-							
23				-	-							
24				-	-							
25				-	-							
26				-	-							
27				-	-							
28				-	-							
29				5.5	-							
30				-	-							
31					-							
Total				36.5	180.0							

SHAQLAWA

Latitude 36°24' N. Longitude 44°20' E. Elevation 970 m.

H. S. I. 8-inch-diameter non-automatic gage
Bendix 8-inch-diameter automatic weighing gage
Daily precipitation in millimeters, water year 1957-1958

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1					-	-	-	-	-	-	5.0	-
2					-	20.0	-	8.0	2.0	T	-	-
3					-	4.5	-	-	-	-	-	-
4					32.6	11.0	-	-	-	-	8.0	-
5					10.0	6.5	-	-	2.0	-	-	-
6					9.0	16.0	-	-	-	-	-	-
7					35.0	-	-	-	-	-	-	-
8					33.0	-	-	18.0	-	-	-	-
9					-	-	-	8.0	-	-	-	-
10					-	25.0	-	-	-	-	-	-
11					-	-	-	-	-	-	-	-
12					-	-	-	-	-	-	-	-
13					-	-	-	-	-	-	-	-
14					-	11.0	-	-	-	-	-	-
15					-	5.4	-	-	-	6.0	-	-
16					-	9.4	-	-	13.0	-	-	-
17					T	4.0	-	-	2.0	-	-	-
18					-	-	-	-	-	-	-	-
19					6.0	-	-	-	2.0	-	-	-
20					-	11.0	-	-	-	2.0	-	-
21					-	18.5	17.0	-	3.0	-	-	-
22					-	-	11.0	-	-	-	-	-
23				-	-	-	5.0	20.0	-	-	-	-
24				-	2.0	-	-	-	-	1.0	-	-
25				-	T	-	-	-	-	-	-	-
26				-	-	-	-	-	-	-	-	-
27				-	-	5.5	-	-	-	-	-	-
28				-	-	31.0	-	-	-	-	-	-
29				-	-	100.0		10.0	-	6.0	-	-
30				7.0	-	39.0		-	-	-	-	-
31					-	4.0		-		-		-
Total					127.6	321.8	33.0	64.0	24.0	15.0	13.0	0.0

412

SHAGLAWA

Latitude 36°24' N. Longitude 44°20' E. Elevation 970 m.

H. S. I. 8-inch-diameter non-automatic gage
Bendix 8-inch-diameter automatic weighing gage
Daily precipitation in millimeters, water year 1958-1959

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1			-	-	-	-						
2			-	-	-	-						
3			-	2.0	12.0	-						
4			-	7.0	1.0	-						
5			-	19.0	1.0	4.0						
6			-	4.0	30.0	-						
7			-	-	21.0	-						
8			-	-	29.0	42.0						
9			-	-	18.0	-						
10			-	-	7.0	-						
11			-	-	3.0	-						
12			-	-	7.0	4.0						
13			-	-	-							
14			-	-	3.0							
15			-	-								
16			-	-								
17			-	-								
18			-	-								
19			-	-								
20			-	-								
21			-	-								
22			-	-								
23			-	-								
24			-	-								
25			-	-								
26			-	-								
27			-	-								
28			-	-								
29			-	-	-							
30			-	-	-							
31			-	-	-							
Total			0.0	32.0								

SIDEKAN

Latitude 36°47' N. Longitude 44°40' E. Elevation 1000 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1957-1958

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1				-	-	-	-	-	-			
2				-	-	-	-	14.0	4.0			
3				-	-	-	-	-	-			
4				-	33.0	8.5	-	-	-			
5				-	2.2	10.4	15.0	-	-			
6				-	4.7	-	-	-	-			
7				-	7.6	3.2	-	-	-			
8				-	22.7	6.9	-	34.0	-			
9				-	-	-	-	-	-			
10				-	-	7.3	-	-	-			
11				-	-	-	-	-	-			
12				-	-	-	-	-	-			
13				-	-	-	-	-	-			
14				-	-	3.2	-	-	-			
15				-	-	-	-	-	-			
16				-	-	19.7	-	-	14.0			
17				-	-	5.5	-	-	19.0			
18				-	-	-	-	-	7.0			
19				-	20.0	-	-	-	4.0			
20				-	1.5	-	-	-	-			
21				-	-	5.0	-	4.0	-			
22				-	-	-	16.0	-	-			
23				-	-	-	2.0	28.0	-			
24				-	-	-	-	-	-			
25				-	-	-	-	-	-			
26				-	-	-	-	-	-			
27				-	-	-	-	-	-			
28				-	-	13.0	-	-	-			
29				-	-	10.0		3.0	3.0			
30				5.4	-	-		6.0	-			
31					-	11.5		-				
Total				5.4	91.7	104.2	33.0	89.0	51.0			

SIDEKAN

Latitude 36°47' N. Longitude 44°40' E. Elevation 1000 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1958-1959

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1				-	-							
2				-	-							
3				-	5.1							
4				13.0	2.0							
5				13.5	-							
6				-	31.5							
7				-	19.4							
8				-	52.7							
9				-	29.5							
10				-	-							
11				-	-							
12				-	-							
13				-	-							
14				-	-							
15				-	-							
16				-	-							
17				-	-							
18				-	-							
19				-	-							
20				-	-							
21				-	-							
22				-	-							
23				-	-							
24				-	-							
25				-	-							
26				-	-							
27				-	-							
28				-	-							
29				8.2	-							
30				1.3	-							
31					-							
Total				36.0	140.2							

SULAIMANIYA

Latitude 35°33' N. Longitude 45°27' E. Elevation 890 m.

Bendix 8-inch-diameter automatic weighing gage
Daily precipitation in millimeters, water year 1957-1958

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1					-	-	-	-	-	-	-	-
2					-	4.0	-	3.0	2.0	-	-	-
3					-	8.0	-	-	-	-	-	-
4					33.0	57.0	-	-	-	-	-	-
5					-	11.0	-	4.0	-	-	-	-
6					14.0	13.0	-	-	-	-	-	-
7					-	4.0	-	-	-	-	-	-
8					-	-	-	16.0	-	-	-	-
9					-	-	-	-	-	-	-	-
10					-	28.0	-	-	-	-	-	-
11					-	-	-	-	-	-	-	-
12					-	-	-	-	-	-	-	-
13					-	-	-	-	-	-	-	-
14					-	-	-	-	-	-	-	-
15					-	-	-	-	-	-	-	-
16					-	-	-	-	-	-	-	-
17					-	1.0	-	-	-	-	-	-
18					-	4.0	-	-	-	-	-	-
19					1.0	-	-	-	-	-	-	-
20					26.0	5.0	-	-	-	-	-	-
21					1.0	45.0	-	-	-	-	-	-
22					-	6.0	15.0	-	-	-	-	-
23					-	1.0	-	3.0	-	-	-	-
24					-	-	-	-	-	-	-	-
25				-	-	-	-	-	-	-	-	-
26				-	-	-	-	-	-	-	-	-
27				-	-	-	-	-	-	-	-	-
28				-	-	-	-	-	-	2.0	-	-
29				14.0	-	16.0		-	-	1.0	-	-
30				-	-	12.0		-	-	2.0	-	-
31					-	7.0		-		-		-
Total					75.0	222.0	15.0	26.0	2.0	5.0	0.0	0.0

T-1

Latitude 34°12' N. Longitude 41°20' E. Elevation 300 m.

Bendix 8-inch-diameter automatic weighing gage
Daily precipitation in millimeters, water year 1957-1958

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1						1.0	-	-	-	-	-	-
2						8.0	-	7.0	-	-	-	-
3						-	-	-	-	4.0	-	-
4						3.0	-	-	-	-	-	-
5						T	-	-	-	-	-	-
6						-	-	-	-	-	-	-
7						-	-	-	-	-	-	-
8						-	-	-	-	-	-	-
9						-	-	-	-	-	-	-
10						-	-	-	-	-	-	-
11						1.0	-	-	-	-	-	-
12						-	-	-	-	-	-	-
13						T	-	-	-	2.0	-	-
14						1.0	-	-	-	-	-	-
15						1.0	-	-	-	-	-	-
16						-	-	-	-	-	-	-
17						-	-	-	-	-	-	-
18						-	-	-	-	-	-	-
19						-	-	-	-	-	-	-
20						-	-	-	-	-	-	-
21						-	-	-	-	-	-	-
22						-	-	-	-	-	-	-
23						T	-	-	-	-	-	-
24						-	-	-	-	-	-	-
25						-	-	-	-	-	-	-
26						1.0	-	-	-	-	-	-
27						-	-	-	-	-	-	-
28						-	-	-	-	-	-	-
29						-		-	-	-	-	-
30					-	-		-	-	-	-	-
31					-	-		-		1.0		-
Total						16.0	0.0	7.0	0.0	7.0	0.0	0.0

T-1

Latitude 34°12' N. Longitude 41°20' E. Elevation 300 m.

Bendix 8-inch-diameter automatic weighing gage
Daily precipitation in millimeters, water year 1958-1959

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1			-	-	-	-						
2			-	-	-	-						
3			-	-	-	-						
4			-	-	-	-						
5			-	-	-	-						
6			-	-	-	-						
7			-	-	4.0	-						
8			-	-	-	-						
9			-	-	-	-						
10			-	4.0	-	-						
11			-	-	-	-						
12			-	-	-	-						
13			-	-	4.0	-						
14			-	-	-	-						
15			-	-	-	-						
16			-	-		-						
17			-	-		-						
18			-	-		-						
19			-	-								
20			-	-								
21			-	-								
22			-	-								
23			-	-								
24			-	-	-							
25			-	-	-							
26			-	-	-							
27			-	-	-							
28			-	-	-							
29			-	-	-							
30			-	-	-							
31			-		-							
Total			0.0	4.0								

TAQ TAQ

Latitude 35°53' N. Longitude 44°35' E. Elevation 370 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1956-1957

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1							18.0	-	12.0	-	-	-
2							-	-	8.0	-	-	-
3							-	4.0	7.0	-	-	-
4							6.0	40.0	8.0	T	-	-
5							-	28.0	-	-	1.0	-
6							-	5.0	-	10.0	T	-
7							-	17.0	2.0	15.0	-	-
8							-	-	-	8.0	-	-
9						-	-	-	T	-	-	-
10						-	21.0	5.0	12.0	-	-	-
11						-	6.0	10.0	-	-	T	-
12						T	3.0	30.0	-	-	1.5	-
13						-	14.0	30.0	-	16.0	2.0	-
14						-	-	14.5	-	18.0	-	-
15						-	-	5.0	-	-	-	-
16						T	-	-	-	-	-	-
17						-	-	-	-	-	-	-
18						24.0	-	-	-	8.0	-	-
19						1.0	-	-	-	-	-	-
20						T	-	-	10.0	-	-	-
21						-	-	-	30.0	-	-	-
22						-	-	-	15.0	-	-	-
23						-	-	9.5	-	-	-	-
24						-	4.0	23.0	7.0	17.0	-	-
25						-	46.0	6.0	-	5.0	-	-
26						-	11.0	-	6.0	-	-	-
27						-	18.0	6.0	8.0	-	-	-
28						-	11.0	-	5.0	-	-	-
29						11.0		4.0	-	-	-	-
30						5.0		12.0	7.0	-	-	-
31						T		-		-		-
Total							158.0	249.0	137.0	97.0	4.5	0.0

TAQ TAQ

Latitude 35°53' N. Longitude 44°35' E. Elevation 370 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1957-1958

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1	-	-	-		1.0	-	-	-	-	-	4.0	-
2	-	-	T		-	8.5	-	8.0	3.0	-	-	-
3	-	-	-		-	6.0	-	-	-	-	2.0	-
4	-	-	-		-	38.0	-	-	-	-	-	-
5	-	T	-		9.0	39.0	2.0	-	-	-	-	-
6	-	-	-		20.0	28.0	-	-	-	-	-	-
7	-	-	-		1.0	-	-	-	-	-	-	-
8	-	-	-		1.0	-	-	28.0	T	-	-	-
9	-	-	-		-	-	-	T	-	-	-	-
10	-	-	T		-	30.0	-	-	-	-	-	-
11	-	-	-		-	-	-	-	-	-	-	-
12	-	-	-		-	-	-	-	-	-	-	-
13	T	-	-		-	-	-	-	-	-	-	-
14	-	-	-		-	3.0	-	-	7.0	-	-	-
15	T	-	T		-	T	-	-	-	-	-	-
16	-	-	2.0		-	2.0	-	-	-	-	-	-
17	T	-	T		-	1.0	-	-	T	-	-	-
18	-	-	T		-	3.0	-	-	T	-	-	-
19	-	-	-		T	-	-	-	-	-	-	-
20	-	-	-		7.0	7.5	-	-	2.0	-	-	-
21	-	-	-		2.0	9.0	2.0	3.0	-	-	-	-
22	-	-	1.0		-	T	5.0	-	-	-	-	-
23	-	-	-		-	-	-	7.0	-	-	-	-
24	-	-	-		T	-	-	-	-	T	-	-
25	-	-	-		-	-	T	-	-	-	-	-
26	-	-	-		-	-	-	-	-	-	-	-
27	-	-	-		-	T	-	-	-	-	-	-
28	-	-	-		-	T	-	-	-	4.0	-	-
29	-	-	-		-	12.0		-	T	12.0	-	-
30	-	-	-		-	15.0		T	-	T	-	-
31	-		-		-	3.0		-		-		-
Total	T	T	3.0		41.0	205.0	9.0	46.0	12.0	16.0	6.0	0.0

TAQ TAQ

Latitude 35°53' N. Longitude 44°35' E. Elevation 370 m.

H. S. I. 8-inch-diameter non-automatic gage
Daily precipitation in millimeters, water year 1958-1959

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1	-	-	-	-	-							
2	-	-	-	-	-							
3	-	-	-	2.0	7.5							
4	-	-	-	3.0	0.4							
5	-	-	-	-	2.0							
6	-	-	-	17.0	16.4							
7	-	-	-	T	46.3							
8	-	-	-	-	55.0							
9	-	-	-	-	11.0							
10	-	-	T	-	-							
11	-	-	-	-	-							
12	-	-	-	-	-							
13	-	-	-	-	3.2							
14	-	-	-	-	7.0							
15	-	-	-	-	1.0							
16	-	-	-	-	-							
17	-	-	-	-	-							
18	-	-	-	T	-							
19	-	-	-	-	-							
20	-	-	-	-	-							
21	-	-	-	-	-							
22	-	-	-	-	-							
23	-	-	-	-	-							
24	-	-	-	-	-							
25	-	-	-	-	-							
26	-	-	-	-	-							
27	-	-	-	-	-							
28	-	-	-	-	-							
29	-	-	-	T	-							
30	-	-	-	2.0	2.0							
31	-		-		-							
Total	0.0	0.0	T	24.0	151.8							

TUSAN

Latitude 37°00' N. Longitude 42°28' E. Elevation 380 m.

H. S. I. 8-inch-diameter non-automatic gage
Bendix 8-inch-diameter automatic weighing gage
Daily precipitation in millimeters, water year 1957-1958

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1					-	-	-	-	-	-	0.7	-
2					T	18.2	-	11.1	-	1.0	-	-
3					31.0	7.9	-	-	-	-	1.9	-
4					2.0	11.2	T	3.7	-	-	-	-
5					3.0	7.3	5.0	-	-	-	-	-
6						10.2	6.0	-	-	-	-	-
7						-	-	-	-	-	-	-
8						-	-	13.0	-	-	-	-
9					-	5.4	-	-	-	-	-	-
10					-	32.5	-	-	-	-	-	-
11					T	-	-	-	-	-	-	-
12					1.2	-	-	-	-	-	-	-
13					-	-	-	-	-	-	-	-
14					-	3.5	-	-	-	-	-	-
15					-	0.6	-	-	-	1.6	-	-
16					-	4.5	-	-	10.5	-	-	-
17					-	0.7	-	-	8.0	-	-	-
18					-	-	-	-	1.0	-	-	-
19					-	-	-	-	3.0	-	-	-
20					-	5.5	-	-	0.7	-	-	-
21					3.3	6.0	1.0	-	1.9	-	-	-
22					-	2.4	2.0	-	-	-	-	-
23					-	-	-	3.0	-	-	-	-
24					-	-	-	-	-	1.2	-	-
25					-	-	-	0.5	-	-	-	-
26				-	-	12.0	-	-	-	-	-	-
27				-	-	33.0	-	-	-	-	-	-
28				-	-	14.3	-	-	-	0.3	-	-
29				2.0	-	10.9		0.7	-	-	-	-
30				-	-	9.2		-	-	0.3	-	-
31					-	-		-		-		-
Total						195.3	14.0	32.0	25.1	4.4	2.6	0.0

TUSAN

Latitude 37°00' N. Longitude 42°28' E. Elevation 380 m.

H. S. I. 8-inch-diameter non-automatic gage
Bendix 8-inch-diameter automatic weighing gage
Daily precipitation in millimeters, water year 1958-1959

Day	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July
1	-	-	-	-	-	-						
2	-	-	-	-	-	-						
3	-	-	-	1.1	25.8	-						
4	-	-	-	10.2	-	-						
5	-	-	-	10.8	0.7	0.4						
6	-	-	-	1.1	13.0	4.2						
7	-	-	-	-	17.4	14.2						
8	-	-	-	T	36.7	-						
9	-	-	-	-	6.0	-						
10	-	-	-	-	-	-						
11	-	-	-	-	-	-						
12	-	-	1.5	-	-	-						
13	-	-	-	-	2.2	-						
14	-	-	-	-	6.2	0.2						
15	-	-	-	-	-	2.7						
16	-	-	-	-	-	-						
17	-	-	-	-	-	-						
18	-	-	-	-	-	5.2						
19	-	-	-	T	-	21.5						
20	-	-	-	-	-	-						
21	-	-	-	-	-	-						
22	-	-	-	-	-	-						
23	-	-	-	-	-	-						
24	-	-	-	-	-	-						
25	-	-	-	-	-	-						
26	-	-	-	-	-	-						
27	-	-	-	-	-	-						
28	-	-	-	-	-	-						
29	-	-	-	-	0.8	1.1						
30	-	-	-	-	-	0.5						
31	-		-		-	T						
Total	0.0	0.0	1.5	23.2	108.8	50.0						

ANNEX A-10

TEMPERATURE DATA

TWO-HOURLY TEMPERATURE AT DIANA

November 1957

Temperature in degrees centigrade

	Forenoon						Afternoon					
Day	2	4	6	8	10	12	2	4	6	8	10	12
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
11												
12												
13												
14												
15								13	12	12	12	10
16	9	9	9	10	14	14	17	15	12	11	10	10
17	9	8	8	8	9	9	10	10	9	9	10	9
18	9	8	8	10	13	14	14	12	10	9	10	9
19	8	7	5	7	13	16	18	14	12	11	9	8
20	6	5	4	5	10	14	12	10	9	9	8	7
21	5	5	4	7	10	13	12	10	7	5	4	3
22	3	2	0	4	8	11	12	8	5	4	2	1
23	1	-1	0	3	9	12	13	10	7	5	4	2
24	1	0	-2	2	7	12	14	10	8	6	4	3
25	1	0	-1	2	5	11	15	15	12	10	8	6
26	5	4	3	2	6	12	17	16	10	8	6	4
27	3	2	2	1	6	12	15	16	10	9	7	5
28	4	3	2	2	5	9	10	11	9	9	8	6
29	5	3	2	3	8	12	15	13	12	11	10	9
30	9	9	9	8	9	12	13	12	11	11	10	10

TWO-HOURLY TEMPERATURE AT DIANA

December 1957

Temperature in degrees centigrade

	Forenoon						Afternoon					
Day	2	4	6	8	10	12	2	4	6	8	10	12
1	9	9	9	9	12	16	16	15	12	12	9	8
2	7	7	5	6	8	9	12	12	11	11	10	10
3	9	9	9	9	9	12	15	17	13	11	10	9
4	8	7	7	5	7	8	9	9	8	8	8	8
5	8	7	7	7	8	10	11	11	10	9	8	8
6	8	8	7	7	10	11	12	12	10	7	6	5
7	5	5	5	5	6	8	9	8	7	6	6	6
8	7	6	8	7	6	10	11	8	7	7	5	7
9	6	3	2	2	3	3	4	4	3	3	3	3
10	3	2	2	2	3	5	6	7	3	2	1	0
11	-1	-2	-3	-2	0	3	4	4	4	3	3	2
12	0	1	0	-1	4	7	11	10	7	5	4	3
13	2	2	2	2	6	10	12	12	9	7	6	4
14	3	2	1	1	5	10	14	13	8	6	5	3
15	2	1	0	1	5	10	13	12	8	7	5	4
16	2	2	1	0	3	7	10	10	6	5	4	2
17	2	-1	-1	-2	4	8	12	12	8	6	3	2
18	2	0	-1	1	6	10	13	10	9	7	6	5
19	4	4	3	3	5	5	6	6	5	4	4	4
20	8	8	6	7	8	10	8	8	4	4	3	2
21	1	1	0	1	3	8	8	7	5	4	2	1
22	1	0	-2	-1	3	7	8	8	3	1	0	-1
23	-3	-3	-5	-5	2	6	9	5	3	1	0	-2
24	-2	-4	-4	-3	1	6	8	5	3	1	1	-1
25	-2	-3	-3	0	1	0	1	1	0	0	-1	-1
26	-2	-2	-2	-2	-2	-1	-1	-2	-2	-3	-3	-3
27	-4	-4	-5	-4	-4	-1	2	-1	-2	-3	-4	-5
28	-6	-6	-7	-5	0	5	7	2	1	-1	-3	-4
29	-5	-6	-6	-4	1	5	8	3	1	0	-3	-4
30	-4	-6	-8	-4	-1	3	8	6	3	2	0	0
31	-1	-2	-3	-2	3	6	9	7	5	3	2	0

Maximum temperature of 17°C. occurred 3 December at 1600 hours.
Minimum temperature of -8°C. occurred 30 December at 0600 hours.

TWO-HOURLY TEMPERATURE AT DIANA

January 1958

Temperature in degrees centigrade

	Forenoon						Afternoon					
Day	2	4	6	8	10	12	2	4	6	8	10	12
1	-2	-2	-4	-3	3	7	8	6	6	4	3	3
2	2	1	0	-1	3	4	5	5	4	5	5	4
3	5	2	2	0	-1	-1	-1	-1	-1	-1	0	-1
4	0	0	0	1	3	4	4	3	3	3	3	3
5	3	3	2	3	4	5	5	5	5	4	4	4
6	3	3	3	4	4	5	5	5	3	2	2	2
7	2	2	2	2	4	6	8	5	3	2	1	1
8	1	2	2	2	2	4	6	6	4	3	3	1
9	0	0	-1	0	3	5	6	6	5	3	2	2
10	1	1	0	0	3	6	7	10	6	2	2	2
11	1	1	1	2	4	6	8	6	6	5	5	3
12	2	0	-1	1	3	5	8	6	5	3	3	2
13	2	1	1	2	3	7	11	10	7	5	3	2
14	1	0	-1	0	6	8	10	10	8	7	6	7
15	6	5	5	6	7	8	9	8	7	6	6	6
16	5	4	5	5	8	10	11	10	9	7	6	6
17	5	5	4	4	5	5	8	5	5	4	4	4
18	3	3	3	2	4	2	5	4	3	2	1	0
19	-1	0	0	1	2	5	6	4	3	2	1	0
20	0	0	0	1	2	3	4	4	3	3	3	2
21	0	0	0	0	1	2	3	3	2	2	2	2
22	2	2	2	3	4	5	6	6	5	4	3	2
23	2	2	1	2	3	4	8	8	5	3	2	1
24	0	-1	-2	-1	2	5	7	7	6	5	3	2
25	1	0	-1	1	5	10	12	10	7	5	3	3
26	2	1	0	1	6	8	11	9	8	5	4	3
27	3	3	2	3	4	6	6	5	4	3	3	2
28	1	0	1	0	1	2	3	2	2	1	1	1
29	1	0	-1	-2	-5	-4	-4	-5	-4	-4	-4	-4
30	-5	-4	-4	-3	0	1	1	-1	0	0	0	0
31	0	-2	-3	-4	-4	-2	-2	-6	-7	-9	-8	-10

Maximum temperature of 12°C. occurred 25 January at 1400 hours.
Minimum temperature of -10°C. occurred 31 January at 2400 hours.

TWO-HOURLY TEMPERATURE AT DIANA

February 1958

Temperature in degrees centigrade

	Forenoon						Afternoon					
Day	2	4	6	8	10	12	2	4	6	8	10	12
1	-10	-11	-10	-9	-7	-3	-4	-6	-8	-10	-11	-13
2	-13	-14	-14	-12	-9	-7	-4	-6	-9	-11	-12	-14
3	-15	-15	-15	-13	-7	-4	-2	-2	-6	-7	-7	-7
4	-8	-9	-9	-7	-3	-1	1	-2	-5	-6	-8	-9
5	-10	-11	-13	-9	-6	-2	0	-2	-3	-4	-4	-4
6	-5	-4	-4	-2	-1	1	0	-3	-4	-5	-5	-6
7	-6	-7	-8	-7	-4	-3	-4	-7	-9	-10	-10	-11
8	-11	-12	-12	-9	-5	-1	0	-5	-6	-7	-9	-9
9	-10	-10	-10	-7	1	5	6	0	-1	-2	-4	-7
10	-7	-7	-8	-6	-1	3	7	8	3	2	-1	-2
11	-4	-5	-6	-5	1	7	10	11	6	4	3	1
12	-1	-1	-3	-1	5	9	11	14	9	6	4	3
13	2	1	-1	2	7	13	16	13	10	7	6	4
14	2	0	-1	3	8	12	15	14	9	7	5	3
15	2	0	-1	3	8	13	15	12	9	8	6	4
16	3	2	0	4	10	14	14	12	10	8	6	4
17	3	2	2	3	4	6	7	5	4	3	3	2
18	1	1	-2	1	6	10	14	15	10	7	5	3
19	2	0	-1	4	10	14	15	15	11	9	7	6
20	5	4	3	7	12	17	20	19	13	11	8	7
21	6	4	3	9	12	16	16	14	13	11	10	10
22	9	8	8	7	8	9	10	10	9	10	9	8
23	7	6	6	8	10	11	14	9	8	7	5	4
24	4	4	3	4	5	7	11	11	8	7	7	6
25	4	4	3	5	11	12	11	13	9	8	7	5
26	4	3	2	5	10	14	18	18	13	11	8	6
27	6	4	4	7	12	16	20	20	14	12	10	7
28	6	5	4	8	14	19	22	20	14	13	10	8

Maximum temperature of 22°C. occurred 28 February at 1400 hours.
Minimum temperature of -15°C. occurred 3 February at 0200, 0400, and 0600 hours.

TWO-HOURLY TEMPERATURE AT DIANA

March 1958

Temperature in degrees centigrade

	Forenoon						Afternoon					
Day	2	4	6	8	10	12	2	4	6	8	10	12
1	7	5	5	8	14	19	22	20	15	13	11	9
2	7	5	5	9	13	14	14	12	10	9	9	9
3	8	8	7	9	8	11	10	12	11	10	8	5
4	5	3	2	4	10	14	15	17	12	11	9	7
5	7	7	6	9	12	14	16	15	13	11	9	9
6	7	7	6	8	12	16	20	10	7	6	3	1
7	0	-1	-2	2	10	14	17	17	13	10	8	5
8	4	4	2	6	13	17	17	17	14	13	14	13
9	10	11	11	9	10	12	12	12	11	11	9	8
10	7	6	3	6	7	11	13	12	9	7	5	4
11	2	1	1	4	9	13	14	16	13	12	12	9
12	7	6	5	8	14	17	18	18	14	12	10	9
13	7	6	4	9	13	17	20	19	15	15	14	19
14	19	16	11	14	13	14	13	10	9	8	6	5
15	3	2	0	7	11	13	13	14	10	8	6	4
16	2	1	1	4	10	14	17	18	13	11	8	7
17	6	5	3	8	10	15	17	15	12	10	9	7
18	8	7	6	9	14	19	18	18	15	13	11	9
19	8	6	6	10	17	18	18	17	15	14	11	10
20	9	8	8	12	15	19	21	19	17	15	13	11
21	11	9	9	15	20	25	26	25	20	17	14	13
22	11	14	14	16	22	23	22	21	17	15	13	11
23	9	9	11	14	16	17	18	17	16	13	13	13
24	10	8	5	6	9	10	10	13	10	8	6	5
25	4	5	5	10	13	15	16	15	12	11	10	9
26	9	9	9	11	12	12	15	14	13	11	10	9
27	8	5	6	12	16	19	20	19	16	15	13	13
28	12	12	11	11	12	14	16	19	17	17	15	13
29	10	10	10	14	17	18	19	18	14	12	11	10
30	9	10	10	13	16	17	16	16	14	13	12	11
31	10	10	11	15	13	17	19	18	16	14	12	10

Maximum temperature of 26°C. occurred 21 March at 1400 hours.
Minimum temperature of -3°C. occurred 7 March at 0500 hours.

TWO-HOURLY TEMPERATURE AT DIANA

April 1958

Temperature in degrees centigrade

	Forenoon						Afternoon					
Day	2	4	6	8	10	12	2	4	6	8	10	12
1	10	9	8	10	16	20	24	25	20	16	15	13
2	12	11	11	13	18	20	21	23	22	19	15	13
3	11	10	9	12	17	20	23	22	18	16	13	11
4	9	7	7	13	18	20	18	18	15	13	10	8
5	7	6	5	12	18	16	15	9	8	6	5	4
6	3	2	1	9	14	18	20	20	15	12	9	8
7	7	7	7	11	15	20	22	22	19	17	13	12
8	11	10	10	12	14	20	24	25	21	18	14	13
9	12	10	12	15	19	22	22	20	19	17	15	12
10	12	10	11	12	14	17	20	20	17	22	19	18
11	17	16	16	15	15	19	17	17	15	13	10	8
12	5	4	3	8	16	18	18	18	14	10	9	7
13	5	4	4	11	17	19	20	19	16	14	11	7
14	7	6	5	10	15	20	20	19	16	15	15	15
15	13	10	9	15	20	22	22	20	18	17	16	13
16	12	11	12	17	20	23	25	23	21	20	15	13
17	12	12	13	14	14	13	13	13	12	12	12	11
18	11	11	11	16	20	21	22	22	18	14	13	10
19	10	9	10	11	13	11	11	11	10	10	19	13
20	11	9	10	11	12	16	18	15	14	12	14	10
21	10	9	10	12	14	15	16	15	14	12	10	8
22	7	6	6	9	14	17	19	19	15	11	10	8
23	6	5	5	12	17	20	22	23	19	15	12	10
24	8	7	6	14	19	23	26	25	20	22	15	12
25	10	8	9	16	22	26	29	30	23	19	15	13
26	12	9	11	17	23	27	30	30	23	19	16	15
27	13	11	13	19	25	30	33	32	25	21	18	16
28	14	12	14	20	22	27	30	30	25	22	20	18
29	16	16	15	16	21	24	24	21	22	19	16	14
30	12	10	9	15	22	24	25	24	20	16	14	10

Maximum temperature of 33°C. occurred 27 April at 1500 hours.
Minimum temperature of 1°C. occurred 6 April at 0600 hours.

TWO-HOURLY TEMPERATURE AT DIANA

May 1958

Temperature in degrees centigrade

	Forenoon						Afternoon					
Day	2	4	6	8	10	12	2	4	6	8	10	12
1	9	8	7	15	20	24	25	25	21	19	18	17
2	12	9	10	17	22	24	25	23	19	18	15	14
3	13	11	10	12	15	18	20	20	17	14	12	11
4	8	7	7	14	20	21	22	20	19	15	14	13
5	10	9	9					21	18	16	13	11
6	7	7	6	12	18	21	23	22	19	16	14	11
7	10	8	8	14	20	24	24	24	20	16	14	11
8	10	7	9	15	22	24	25	24	21	16	14	11
9	9	7	9	15	21	25	26	25	21	17	14	12
10	10	8	10	17	22	26	28	27	23	19	16	14
11	11	11	10	18	25	30	31	29	25	23	21	19
12	18	16	16	20	21	26	29	30	30	26	21	19
13	17	14	13	15	20	28	33	35	33	27	24	19
14	17	16	13	16	24	30	33	34	30	27	23	21
15	18	17	17	18	25	31	35	35	24	22	20	19
16	18	18	17	20	25	31	36	35	33	28	27	22
17	18	16	14	18	25	31	34	35	32	27	23	20
18	18	17	14	18	25	32	35	35	33	29	22	20
19	17	16	14	15	29	33	34	34	30	26	24	21
20	21	21	20	24	27	31	32	32	28	28	23	22
21	23	20	20	26	29	32	32	31	29	25	23	23
22	21	20	20	26	29	30	32	31	28	24	23	20
23	19	18	20	27	30	32	34	33	31	26	24	21
24	19	17	18	21	27	32	30	32	28	24	22	23
25	21	19	21	26	34	36	35	33	30	27	25	21
26	20	16	17	23	27	28	30	30	28	25	21	19
27	17	16	16	21	26	30	26	25	23	22	19	18
28	17	15	16	18	26	30	23	20	23	23	21	20
29	19	18	18	23	30	35	34	32	27	24	20	18
30	20	19	20	23	26	30	31	29	27	24	21	18
31	16	15	15	21	27	29	29	30	28	24	23	21

Maximum temperature of 36°C. occurred 16 May at 1400 hours and 25 May at 1200 hours.

Minimum temperature of 6°C. occurred 6 May at 0600 hours.

TWO-HOURLY TEMPERATURE AT DIANA

June 1958

Temperature in degrees centigrade

	Forenoon						Afternoon					
Day	2	4	6	8	10	12	2	4	6	8	10	12
1	20	17	19	24	28	32	19	22	21	20	18	16
2	15	13	13	16	21	26	28	27	27	24	22	20
3	18	16	19	23	28	33	34	33	30	26	24	21
4	18	18	19	25	32	33	34	28	22	21	18	17
5	15	14	16	21	27	32	33	32	29	26	23	20
6	18	17	18	25	30	33	34	33	30	26	23	20
7	19	18	20	25	32	34	35	33	31	29	28	22
8	23	20	21	27	29	30	30	30	27	25	24	21
9	19	18	18	20	26	31	31	29	25	23	25	23
10	21	16	17	24	28	30	31	30	27	24	22	20
11	18	17	17	25	29	30	30	29	26	24	22	19
12	17	15	18	23	28	30	32	31	28	25	23	22
13	20	18	22	27	31	33	32	31	28	25	24	23
14	22	22	25	28	31	33	33	32	29	26	25	24
15	22	22	26	29	32	35	36	36	31	28	27	24
16	22	21	21	24	31	35	37	37	35	31	27	24
17	21	20	20	25	32	38	36	38	35	32	30	27
18	24	23	22	28	31	32	31	30	28	26	25	22
19	20	17	18	23	28	30	31	31	28	26	22	20
20	18	15	19	25	27	29	29	27	25	22	20	16
21	14	12	14	20	25	29	31	31	28	24	20	19
22	17	15	17	25	30	32	34	34	32	28	25	23
23	20	18	18	21	30	33	35	36	34	29	26	23
24	20	19	19	24	31	35	36	37	35	32	28	26
25	24	22	23	31	35	37	37	37	35	31	30	27
26	24	23	23	29	34	38	40	39	35	34	30	27
27	27	24	25	30	35	39	39	38	34	33	30	29
28	27	25	26	32	35	38	39	37	34	31	30	27
29	26	23	22	27	33							
30					35	38	39	38	35	33	31	27

Maximum temperature of 40°C. occurred 26 June at 1400 hours.
Minimum temperature of 12°C. occurred 21 June at 0400 hours.

TWO-HOURLY TEMPERATURE AT DIANA

July 1958

Temperature in degrees centigrade

	Forenoon						Afternoon					
Day	2	4	6	8	10	12	2	4	6	8	10	12
1	23	22	23	29	35	37	38	37	34	30	27	23
2	21	19	21	28	34	37	38	37	34	31	31	29
3	26	24	25	30	34	36	35	34	30	28	26	23
4	21	20	22	30	33	35	36	35	32	29	26	24
5	24	23	27	31	36	36	37	37	34	30	27	25
6	24	22	23	30	35	38	40	40	36	32	29	25
7	24	21	19	23	33	38	39	38	36	34	30	26
8	24	23	22	27	34	35	35	34	32	29	28	27
9	23	23	24	28	31	33	33	32	30	27	27	25
10	22	21	21	26	30	31	31	30	28	26	25	23
11	22	22	23	26	27	28	28	27	25	23	22	19
12	16	16	15	20	26	28	30	30	30	26	23	23
13	21	21	22	26	29	31	34	34	31	28	26	26
14	24	23	22	24	30	33	35	35	33	30	28	26
15	26	23	23	29	33	37	40	40	37	33	31	29
16	26	24	25	29	35	40	42	42	39	35	32	30
17	28	25	24	32	38	42	43	41	39	37	35	34
18	31	27	26	32	38	40	40	39	36	34	32	30
19	26	23	24	30	36	38	40	40	37	35	30	29
20	26	24	22	28	35	40	41	40	38	35	34	30
21	27	24	25	25	34	40	39	37	36	34	31	28
22	26	23	23	27	34	37	38	37	35	32	30	28
23	24	21	22	26	32	37	37	37	34	33	29	26
24	23	22	22	30	34	37	38	38	36	33	30	29
25	26	24	25	30	36	39	40	40	36	34	32	29
26	27	25	25	30	37	39	41	40	37	34	31	28
27	26	24	24	29	31	41	43	42	39	37	33	31
28	27	26	24	26	33	38	39	40	37	35	32	28
29	26	23	22	25	33	38	39	39	36	35	30	28
30	25	22	21	25	33	37	38	38	35	31	28	25
31	21	20	18	23	31	37	38	38	35	32	31	25

Maximum temperature of 43°C. occurred 17 and 27 July at 1400 hours.
Minimum temperature of 15°C. occurred 12 July at 0600 hours.

TWO-HOURLY TEMPERATURE AT DIANA

August 1958

Temperature in degrees centigrade

	Forenoon						Afternoon					
Day	2	4	6	8	10	12	2	4	6	8	10	12
1	23	21	21	26	34	37	39	40	36	34	32	31
2	28	28	28	31	34	36	38	38	35	31	29	29
3	28	26	27	29	32	35	36	37	33	30	29	27
4	26	24	24	22	31	35	38	38	35	32	30	28
5	26	24	23	27	32	35	38	39	37	33	30	28
6	25	24	22	25	34	38	40	40	38	34	30	27
7	26	23	21	26	35	39	40	41	37	34	31	27
8	25	24	22	27	35	39	39	38	35	32	30	27
9	25	23	22	25	32	36	38	37	35	32	29	26
10	24	23	20	25	32	37	39	39	36	34	31	27
11	25	22	20	23	31	36	37	37	34	31	29	29
12	23	22	21	26	33	37	37	37	33	32	28	25
13	22	18	19	25	32	37	39	38	34	32	28	25
14	23	20	22	29	35	39	40	39	36	34	30	25
15	23	21	20	26	35	38	39	37	34	31	28	24
16	22	20	20	26	33	35	36	36	32	29	28	24
17	22	21	19	24	31	35	37	37	33	31	29	28
18	26	24	24	24	33	36	36	36	34	32	29	28
19	26	25	25	30	35	37	38	38	34	32	29	26
20	24	22	23	28	35	39	39	39	34	31	27	25
21	24	21	21	28	36	38	39	37	34	31	28	24
22	23	22	20	26	35	39	40	38	35	31	28	25
23	22	21	21	26	29	40	41	42	37	34	32	28
24	27	28	29	34	39	41	42	41	37	33	33	32
25	31	29	27	26	34	39	40	40	38	34	32	31
26	30	29	29	32	37	38	40	40	31	30	29	27
27	25	24	22	27	35	39	41	40	37	34	31	29
28	27	25	24	27	34	40	42	41	37	35	33	32
29	26	23	22	26	34	38	39	38	35	33	28	25
30	23	22	19	24	30	37	38	37	34	32	28	24
31	22	20	18	23	30	37	38	38	34	31	30	27

Maximum temperature of 42°C. occurred 23 August at 1600 hours and 24 and 28 August at 1400 hours.

Minimum temperature of 18°C. occurred 13 August at 0400 hours and 31 August at 0600 hours.

TWO-HOURLY TEMPERATURE AT DIANA

September 1958

Temperature in degrees centigrade

	Forenoon						Afternoon					
Day	2	4	6	8	10	12	2	4	6	8	10	12
1	24	23	21	21	32	37	37	36	33	30	30	25
2	23	20	19	23	30	32	35	34	31	29	27	26
3	23	21	19	25	31	34	36	35	31	31	29	25
4	23	21	20	25	32	35	36	35	32	30	27	24
5	22	21	19	24	31	35	36	36	33	30	29	26
6	24	23	21	24	30	36	38	38	34	32	31	30
7	24	22	20	21	29	36	37	37	35	32	29	26
8	25	22	19	20	28	33	34	33	29	26	25	21
9	19	17	15	20	28	32	34	33	29	28	26	21
10	18	18	16	21	28	32	32	31	28	26	25	24
11	18	20	21	24	27	30	31	30	27	25	22	19
12	17	16	15	20	22	33	35	34	30	28	24	21
13	20	17	16	20	27	33	36	36	32	28	26	23
14	20	18	17	17	27	34	38	38	34	30	28	27
15	25	25	25	24	31	35	38	38	33	30	25	23
16	21	20	18	20	28	35	35	34	30	28	27	25
17	24	22	21	22	28	32	33	31	28	26	25	24
18	20	17	16	20	27	30	32	31	27	26	24	21
19	20	19	17	22	29	31	32	32	29	28	25	23
20	21	19	18	22	28	33	33	32	28	26	24	20
21	19	18	16	20	27	33	33	32	28	27	22	20
22	17	17	13	15	22	30	33	32	28	26	23	20
23	19	17	16	19	26	30	23	20	20	18	18	15
24	16	14	14	18	24	28	30	30	27	24	21	18
25	17	14	14	18	25	30	33	33	28	25	21	19
26	17	16	14	18	25	32	34	33	29	26	23	21
27	18	16	13	19	26	32	35	34	31	28	23	22
28	20	18	16	19	26	32	36	34	30	28	25	21
29	19	17	15	16	25	33	34	34	30	26	23	20
30	19	18	18	20	31	32	32	30	27	24	23	21

Maximum temperature of 38°C. occurred 6 and 14 September at 1400 and 1600 hours.
Minimum temperature of 13°C. occurred 22 September at 0600 hours.

TWO-HOURLY TEMPERATURE AT DIANA

October 1958

Temperature in degrees centigrade

	Forenoon						Afternoon					
Day	2	4	6	8	10	12	2	4	6	8	10	12
1	19	16	14	19	26	30	32	31	27	25	20	19
2	17	16	14	18	26	30	31	30	26	25	20	18
3	15	13	12	16	23	30	31	30	27	26	21	19
4	17	14	13	17	25	31	31	30	25	23	20	19
5	16	15	13	17	25	30	32	31	26	23	20	18
6	16	15	14	17	22	32	33	31	27	25	23	20
7	19	17	15	17	24	30	32	31	28	26	22	19
8	18	17	15	18	25	30	31	30	27	23	21	20
9	18	16	16	18	25	29	30	29	26	25	22	20
10	19	17	16	18	24	28	29	28	25	22	20	19
11	17	17	15	17	23	25	23	24	21	20	20	21
12	18	18	19	22	25	27	28	25	23	22	21	20
13	18	18	16	17	21	23	26	24	22	19	18	17
14	16	15	12	16	21	25	27	26	23	20	18	16
15	14	12	11	14	20	25	26	25	23	22	18	16
16	14	14	13	15	22	25	26	25	22	19	17	16
17	15	15	22	24	25	26	25	23	21	20	18	15
18	13	11	11	15	22	26	27	25	22	19	18	14
19	13	11	10	14	21	26	30	27	24	20	18	16
20	13	13	10	14	21	27	32	30	25	22	19	17
21	14	13	11	15	22	29	33	30	27	23	20	18
22	18	15	15	19	26	31	34	31	27	24	20	20
23	19	16	14	20	26	32	33	30	28	25	22	19
24	17	15	14	19	27	29	29	25	24	21	19	16
25	14	13	11	17	23	28	27	24	22	19	17	14
26	12	12	10	15	21	27	27	24	21	20	17	18
27	16	15	14	15	17	21	23	23	20	19	17	17
28	13	11	10	11	18	22	23	21	17	16	13	11
29	8	7	5	9	15	20	21	19	16	15	11	9
30	7	5	3	7	14	18	20	17	15	13	10	8
31	8	6	5	10	16	19	20	19	15	12	11	9

Maximum temperature of 34°C. occurred 22 October at 1400 hours.
Minimum temperature of 3°C. occurred 30 October at 0600 hours.

TWO-HOURLY TEMPERATURE AT DIANA

November 1958

Temperature in degrees centigrade

	Forenoon						Afternoon					
Day	2	4	6	8	10	12	2	4	6	8	10	12
1	7	6	5	8	15	19	21	19	16	13	11	10
2	9	7	6	9	15	20	21	20	18	17	15	14
3	13	12	12	13	18	21	21	21	19	18	16	15
4	15	15	13	12	15	17	17	16	14	13	14	13
5	13	12	13	13	14	14	15	12	12	12	12	12
6	12	11	11	12	13	14	15	15	13	13	13	12
7	12	11	11	13	16	19	20	16	15	14	13	12
8	14	13	12	15	16	17	18	15	12	11	10	9
9	7	6	5	8	13	22	24	15	12	11	10	8
10	6	5	4	7	13	18	21	19	15	13	11	10
11	9	8	8	8	11	15	17	16	16	15	14	14
12	13	12	11	14	19	22	24	20	18	16	14	12
13	11	9	9	12	18	22	23	19	17	15	14	13
14	11	10	9	13	20	24	25	21	18	17	15	12
15	11	10	8	14	19	24	23	19	16	14	12	11
16	8	7	6	11	18	20	21	18	14	13	12	8
17	7	7	5	8	12	18	21	19	14	11	9	7
18	6	4	1	4	11	16	19	17	13	12	11	11
19	10	10	9	12	16	15	15	14	11	10	8	8
20	6	5	4	6	11	17	17	13	12	10	8	6
21	5	4	3	7	9	9	8	7	5	6	5	5
22	5	5	3	8	9	10	10	9	8	5	3	1
23	-1	-3	-2	0	9	12	15	9	7	4	3	1
24	0	-2	-2	-1	5	11	16	13	8	5	5	4
25	3	1	0	3	8	14	17	14	11	9	7	6
26	4	1	0	4	10	15	17	12	10	8	5	4
27	2	0	-1	3	8	15	17	13	12	10	10	9
28	8	7	8	9	10	13	13	11	9	8	6	6
29	6	5	4	5	6	7	9	8	7	7	6	6
30	6	5	6	7	7	8	9	9	8	8	7	6

Maximum temperature of 25°C. occurred 14 November at 1400 hours.
Minimum temperature of -3°C. occurred 23 November at 0400 hours.

TWO-HOURLY TEMPERATURE AT DIANA

December 1958

Temperature in degrees centigrade

	Forenoon						Afternoon					
Day	2	4	6	8	10	12	2	4	6	8	10	12
1	3	2	4	5	9	10	11	9	7	6	3	2
2	0	0	-1	-1	3	8	10	9	6	4	3	0
3	-1	0	0	2	4	7	11	8	6	6	5	4
4	4	3	2	2	2	3	4	4	4	4	4	4
5	4	4	3	4	6	8	9	8	8	7	7	6
6	5	5	5	6	8	9	8	8	8	8	8	8
7	8	9	9	9	11	12	13	12	11	11	11	11
8	10	10	15	14	12	13	15	13	14	13	14	11
9	10	10	10	9	10	9	7	6	6	6	5	5
10	5	5	5	6	9	11	12	10	8	7	5	4
11	3	3	2	4	7	10	12	10	7	5	4	3
12	1	0	0	1	4	9	11	8	6	4	3	1
13	0	-1	-1	0	3	5	5	5	5	4	4	4
14	4	4	4	4	5	5	5	5	5	5	5	5
15	5	5	5	5	5	7	8	7	5	4	4	3
16	1	1	2	2	4	5	7	5	4	4	2	1
17	0	-1	-1	0	4	8	10	8	6	4	3	2
18	-1	-1	-1	2	6	10	12	8	7	5	3	2
19	1	1	0	3	8	12	14	10	8	6	5	3
20	2	1	0	4	8	13	15	11	9	7	5	5
21	4	2	2	4	7	10	11	8	8	6	6	5
22	4	3	2	3	4	5	7	9	6	5	4	4
23	2	1	-1	0	4	9	12	12	8	5	5	3
24	2	0	0	0	5	10	13	10	7	5	4	2
25	1	0	-2	1	5	10	13	10	7	6	5	3
26	2	1	0	1	6	10	13	9	8	6	5	4
27	3	3	1	4	8	10	13	10	8	6	8	6
28	5	7	6	9	11	13	14	10	9	7	6	5
29	5	3	3	4	6	9	12	11	9	9	8	7
30	6	5	4	4	7	11	13	11	8	6	5	3
31	3	1	0	1	5	11	13	10	9	7	5	4

Maximum temperature of 15°C. occurred 8 December at 0600 and 1400 hours; 20 December at 1400 hours.

Minimum temperature of -2°C. occurred 25 December at 0600 hours.

TWO-HOURLY TEMPERATURE AT DIANA

January 1959

Temperature in degrees centigrade

	Forenoon						Afternoon					
Day	2	4	6	8	10	12	2	4	6	8	10	12
1	2	2	1	2	6	11	13	10	8	4	4	2
2	1	-2	-1	-1	6	11	13	9	6	3	1	-1
3	-1	-3	-3	-2	3	7	8	6	5	4	2	1
4	1	0	-1	0	6	12	13	10	8	6	4	3
5	1	0	-2	-	3	9	12	13	9	8	4	4
6	3	4	4	5	6	7	8	9	8	7	7	7
7	7	9	8	8	11	12	11	10	9	10	9	9
8	9	8	9	11	14	17	17	13	11	10	8	7
9	6	5	3	4	8	12	15	12	10	8	6	5
10	4	3	2	3	6	11	14	14	9	7	6	4
11	3	2	1	2	7	10	13	11	9	8	7	6
12	5	5	3	4	5	9	13	13	8	7	5	2
13	2	1	-2	0	6	10	14	13	9	6	4	3
14	2	0	1	1	6	10	14	10	8	7	5	4
15	3	3	3	4	9	10	11	10	9	8	7	6
16	4	2	0	4	9	13	15	12	10	7	6	4
17	2	2	1	4	8	13	15	12	10	8	6	4
18	3	1	1	4	8	11	14	12	10	8	7	8
19	7	7	7	8	8	6	4	3	3	3	2	2
20	3	2	2	2	7	9	11	10	8	8	6	6
21	5	5	4	5	9	12	11	8	7	5	3	2
22	1	0	0	1	5	10	10	7	6	5	3	4
23	3	2	3	4	10	13	13	12	8	5	3	2
24	1	-1	-2	0	4	10	13	11	7	4	3	2
25	0	-1	-2	0	5	8	11	13	7	6	4	2
26	0	-1	-2	-2	3	8	13	12	6	5	3	1
27	-1	-2	-4	-1	4	10	13	12	7	6	4	1
28	1	-1	-3	-1	5	10	15	14	8	6	4	2
29	2	-1	-2	2	7	11	13	11	11	7	7	6
30	6	5	5	6	9	13	11	11	10	9	8	14
31	13	12	9	8	10	11	12	9	8	6	5	4

Maximum temperature of 17°C. occurred on 8 January at 1200 and 1400 hours.
Minimum temperature of -4°C. occurred on 27 January at 0600 hours.

TWO-HOURLY TEMPERATURE AT DIANA

February 1959

Temperature in degrees centigrade

	Forenoon						Afternoon					
Day	2	4	6	8	10	12	2	4	6	8	10	12
1	3	3	3	4	8	9	8	6	4	4	3	3
2	2	1	1	2	5	10	12	11	9	7	5	4
3	3	2	1	2	5	11	12	12	9	7	5	2
4	2	1	1	3	6	9	7	6	6	5	5	2
5	1	0	0	2	2	2	3	3	3	2	1	1
6	-1	0	-1	1	4	7	10	8	6	4	3	2
7	1	2	2	4	7	8	7	6	4	4	4	2
8	2	1	1	1	6	9	9	7	5	4	3	2
9	2	0	-1	2	3	7	8	9	5	3	2	0
10	-2	-1	-3	-2	3	7	9	9	4	3	2	0
11	-2	-4	-4	-3	3	6	9	8	3	2	0	-1
12	-3	-2	-2	0	4	8	10	8	5	3	2	-1
13	-2	-3	-3	-1	5	10	12	9	8	7	7	6
14	2	1	1	3	5	8	8	7	6	5	3	2
15	0	1	0	2	6	6	6	5	5	4	4	4
16	3	1	1	2	4	6	7	5	4	3	1	0
17	-1	-2	-3	-2	2	6	8	7	3	2	2	1
18	1	1	0	2	7	4	5	3	2	2	2	2
19	0	-1	-1	0	3	4	4	2	1	-1	-1	-2
20	-3	-4	-7	-3	-1	1	2	0	-2	-4	-5	-6
21	-6	-6	-6	-6	-2	1	0	0	-2	-4	-5	-7
22	-7	-8	-9	-5	-2	1	4	1	-1	-1	-2	-2
23	-2	-2	-2	-2	2	4	7	8	5	2	0	-1
24	-2	-1	-1	-1	3	6	7	2	0	0	0	0
25	0	1	0	1	3	3	4	1	1	-1	-1	-2
26	-2	-2	-2	-1	1	1	1	0	0	0	-1	-2
27	-2	-2	-3	-1	1	4	6	5	3	2	1	-1
28	-1	-3	-4	-1	4	7	8	7	3	1	0	-2

Maximum temperature of 12°C. occurred on 2 February at 1400 hours, 3 February at 1400 hours and 1600 hours, and 13 February at 1400 hours.

Minimum temperature of -9°C. occurred on 22 February at 0600 hours.

TWO-HOURLY TEMPERATURE AT HAJJI UMRAN

April 1958

Temperature in degrees centigrade

	Forenoon						Afternoon					
Day	2	4	6	8	10	12	2	4	6	8	10	12
1												
2								9	11	9	8	4
3	6	7	8	9	11	12	12	11	9	8	7	6
4	5	5	8	9	10	10	9	8	6	4	3	2
5	2	2	2	4	7	5	4	1	-2	0	0	0
6	0	-1	-1	1	5	8	8	7	5	3	3	3
7	3	4	5	5	8	10	10	9	7	6	5	6
8	6	6	8	9	9	11	13	12	10	9	10	9
9	9	9	10	10	12	11	11	11	10	9	9	9
10	8	8	10	10	13	14	12	14	14	14	12	9
11	8	8	7	6	2	5	6	6	5	3	2	1
12	0	0	0	3	4	5	1	4	2	0	0	0
13	1	0	1	3	4	6	7	6	5	3	2	1
14	1	2	3	5	6	8			5	5	5	3
15	3	2	5	8	10	10	10	8	7	6	6	5
16	5	6	9	10	11	10	10	9	10	5	4	2
17	6	8	9	5	6	8	10	9	9	8	7	7
18	7	6	7	8	8	8	6	3	3	4	3	3
19	3	3	3	3	5	8	15	13	12	5	0	0
20	1	3	2	3	3	3	3	4	4	3	3	3
21	3	4	4	5	5	7	7	6	5	4	3	0
22	-1	0	0	1	3	3	4	5	3	2	1	1
23	1	1	1	2	4	6	7	8	6	5	5	5
24	4	4	5	6	9	10	12	12	10	8	8	6
25	7	8	10	11	13	15	18	18	13	10	10	10
26	11	11	12	16	18	20	20	19	15	12	13	12
27	12	12	15	15								

ANNEX A-11

MONTHLY VALUES OF TOTAL EVAPORATION

Total evaporation in millimeters

Year and Month	DOKAN Pan	DOKAN Reservoir	TUSAN Pan	TUSAN Reservoir	DIANA Pan	DIANA Reservoir
1957						
June					272	(26) 190
July					394	276
August					378	265
September					273	191
October					157	110
November	64	45			62	43
December	18	13	*20	(21) 14	27	19
1958						
January	*	*	*59	(29) 41	32	(30) 22
February	*6	(6) 4	*52	(21) 36	*16	(8) 11
March	80	56	114	80	97	68
April	121	85	180	126	140	98
May	254	178	301	211	280	196
June	331	232	353	247	339	237
July	400	280	444	311	397	278
August	383	268	421	295	381	267
September	291	204	313	219	263	184
October	192	134	216	151	206	144
November	78	55	89	62	76	53
December	* 2	(3) 1	49	34	34	24
1959						
January	*	*	58	41	43	30
February	*	*	56	39	42	29
March	*	*	105	74	53	37

Notes:
1. Reservoir evaporation computed by multiplying pan evaporation by 0.7.
2. * denotes pan out of use because of ice for all or part of month.
3. The total number of days of record for incomplete months is given in brackets.

APPENDIX A

EXHIBITS

Exhibit A- 1 Expansion Program, Stream Gaging and Sediment Sampling
A- 2 Sketches of Stream-Gaging Installations
A- 3 Hydrological Forms
A- 4 Completion of Discharge Measurement Forms
A- 5 Stages in Computation of Daily Discharge
A- 6 Form 12, Field Observation of Suspended Sediment
A- 7 Snow Survey Program
A- 8 Snow Survey Field Forms
A- 9 Deshti Tawanish Snow Course
A-10 Zavi Sur Snow Course
A-11 Kani Bahri Snow Course
A-12 Omar Khayat Snow Course
A-13 Kalkash Snow Course
A-14 Kandashin Snow Course
A-15 Chikan Snow Course
A-16 Dour Khiniq Snow Course
A-17 Sambawakal Snow Course
A-18 Gora Ripne Snow Course
A-19 Newakhwin Snow Course
A-20 Gunda Nawandi Snow Course
A-21 Salarah Snow Course
A-22 Nurista Snow Course
A-23 Halsho Snow Course
A-24 Kora Kzaw Snow Course
A-25 Tustan Snow Course
A-26 Dowli Terschakan Snow Course
A-27 Miyan Mamek Snow Course
A-28 Malakawa Snow Course
A-29 Dowlasur Snow Course
A-30 Harnercla Snow Course
A-31 Harnessi Su Snow Course
A-32 Expansion Program, Meteorological Network
A-33 Sample Field Data for Meteorological Stations
A-34 Standard Non-Recording Rain Gage

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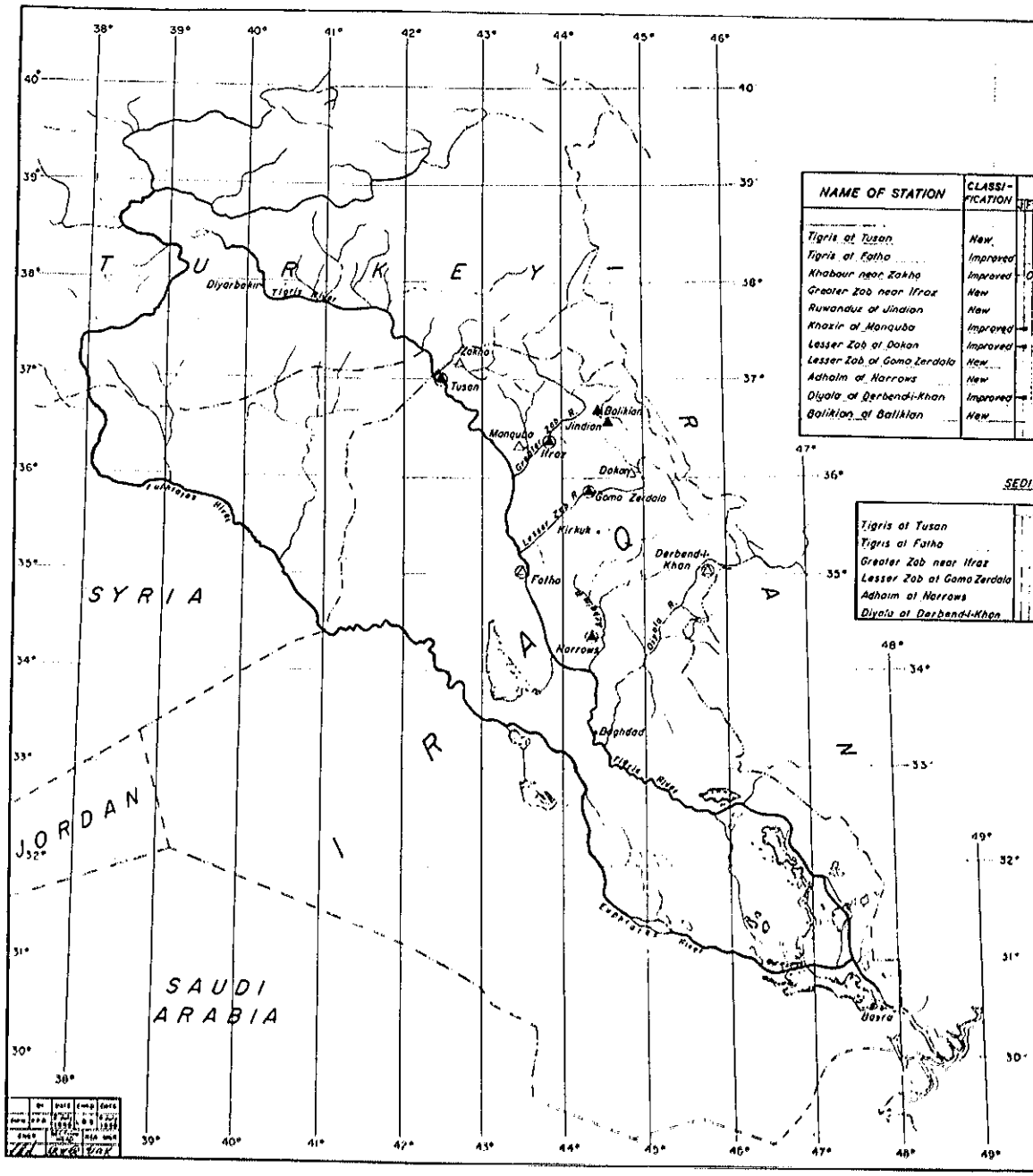
EXHIBIT A-1



STREAM GAGING STATIONS

NAME OF STATION	CLASSIFICATION	1956	1957	1958	1959	MAJOR WORK
Tigris at Tusan	New					Class I cableway, gage well
Tigris at Fatha	Improved					Gage well
Khabour near Zakho	Improved	Operation by D.G.I.				Class II cableway, gage well
Greater Zab near Ifraz	New					Class I cableway, gage well
Ruwanduz at Jindian	New					Class II cableway, gage well
Khazir at Manquba	Improved	Operation by D.G.I.				Class II cableway, gage well
Lesser Zab at Dokan	Improved		Operation by D.G.I.			Reconstruct Class II cableway, gage well
Lesser Zab at Gama Zerdala	New					Class II cableway, gage well
Adhaim at Narrows	New					Class I cableway, gage well
Diyala at Derbendi-Khan	Improved		Operation by D.G.I.			Reconstruct Class II cableway, gage well
Baliklan at Baliklan	New					Class II cableway, gage well

J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D J F M A

SEDIMENT SAMPLING STATIONS

Tigris at Tusan	
Tigris at Fatha	
Greater Zab near Ifraz	
Lesser Zab at Gama Zerdala	
Adhaim at Narrows	
Diyala at Derbend-i-Khan	

NOTE:

Above tabulation includes only those stations constructed or operated under direction of H.S.I. Stations operated by D.G.I. are not included except where construction work under direction of H.S.I. is indicated. Gage well at Derbend-i-Khan will be constructed later under direction of Resident Engineer.

LEGEND

- Construction period
- Operation by H.S.I.
- △ Improved or re-established station
- ▲ New station
- ○ Sediment sampling station
- D.G.I. Director General of Irrigation

Scale: 0 50 100 150 200 km

GOVERNMENT OF IRAQ
MINISTRY OF AGRICULTURE
HYDROLOGICAL SURVEY OF IRAQ

EXPANSION PROGRAM STREAM GAGING AND SEDIMENT SAMPLING

HARZA ENGINEERING CO. CHICAGO — DUNNIE, DEACON & COURLEY LONDON — IN ASSOCIATION

BAGHDAD, IRAQ — DATE 8 July 1959 — DWG NO 610-14

REV NO	DATE	REVISIONS	BY	CHKD	APPD
1	13 JUL 59	Completion of Bar Charts	DJK	DJK	VAF

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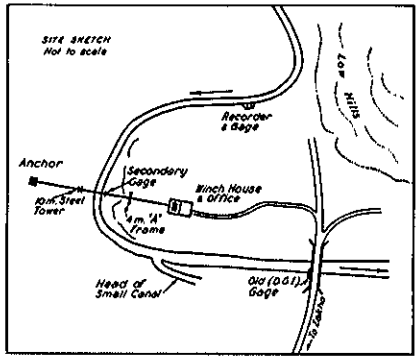
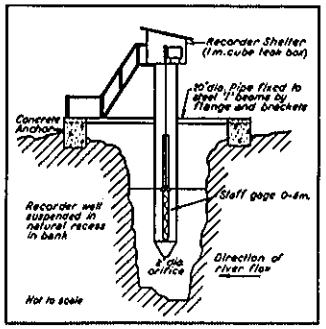
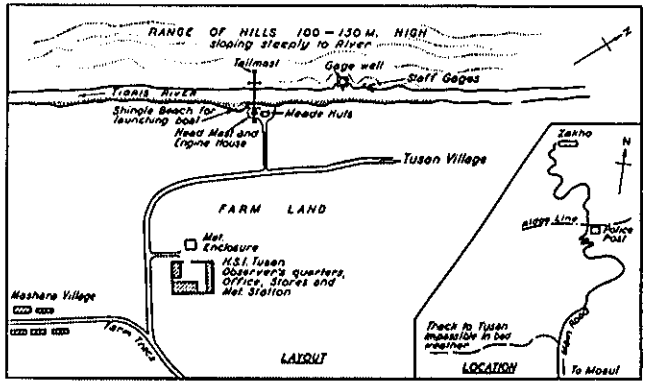
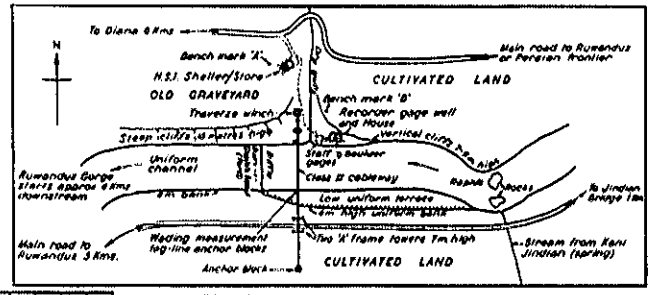




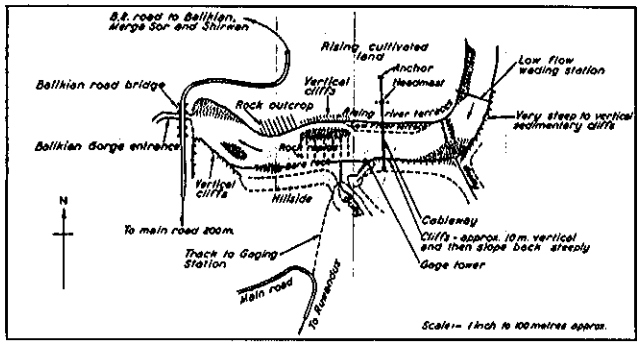
(a) KHABOUR RIVER AT ZAKHO



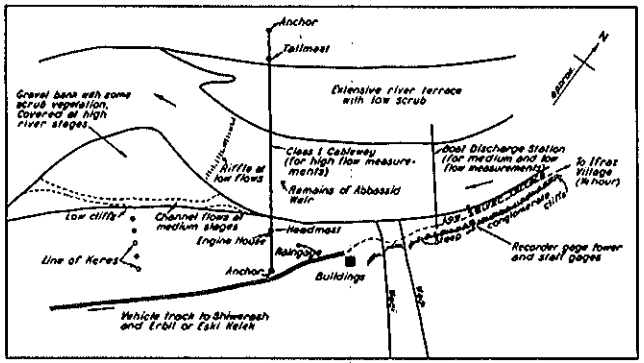
(b) TIGRIS RIVER AT TUSAN



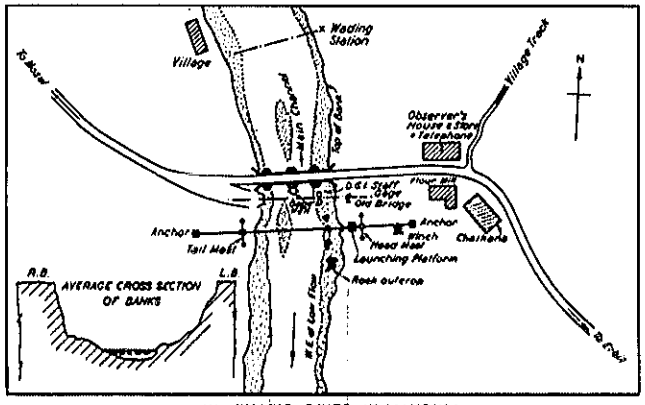
(c) RUWANDUZ RIVER AT JINDIAN



(d) BALIKIAN RIVER NEAR BALIKIAN



(e) GREATER ZAB RIVER AT IFRAZ



(f) KHAZIR RIVER AT MANQUBA

DRWG	BY	DATE	CHKD	DATE	
	K.R.		J.C.R.		
			DATE		

REV. NO.	DATE	NATURE OF REVISION	BY	CHKD	APPR.

GOVERNMENT OF IRAQ
MINISTRY OF AGRICULTURE

HYDROLOGICAL SURVEY OF IRAQ

SKETCHES OF STREAM-GAGING INSTALLATIONS

HAZZA ENGINEERING CO. CHICAGO — IN ASSOCIATION — DINNIE, DEACON & GOURLEY LONDON

BAGHDAD, IRAQ — DATE 25 AUG. 1959 — DWG. NO. 610-20

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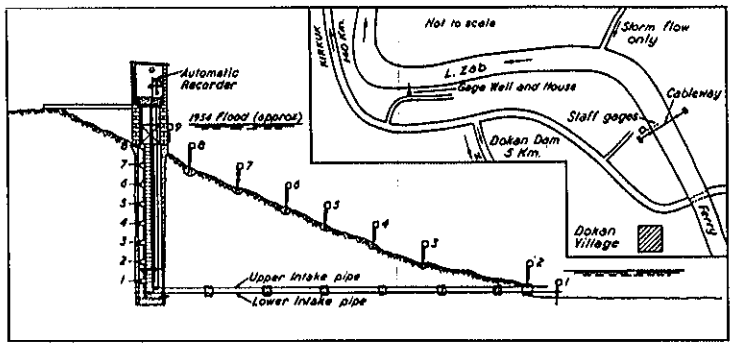
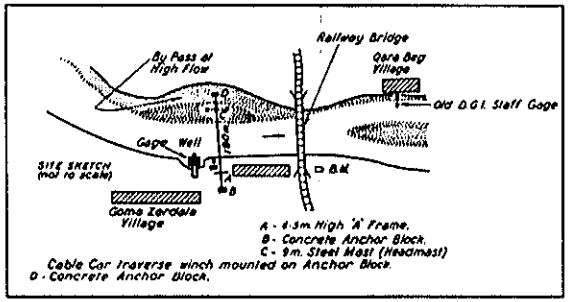
EXHIBIT A-2

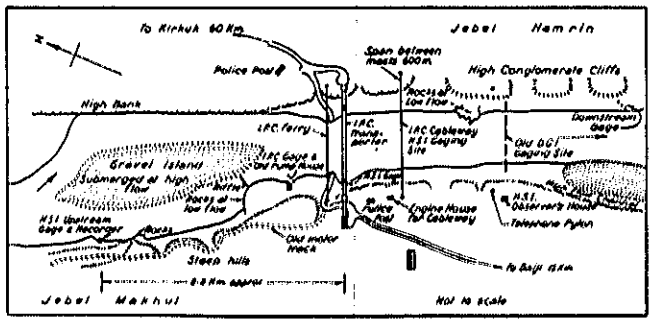
Sheet 2 of 2



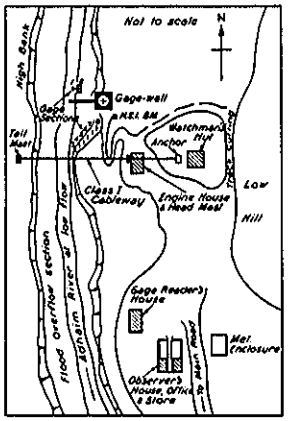
(g) LESSER ZAB RIVER AT DOKAN FERRY



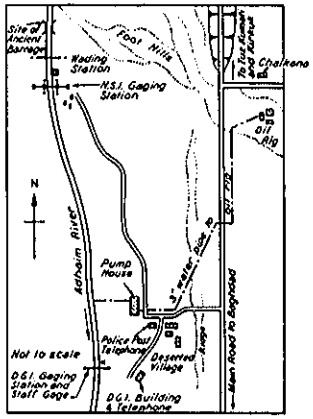
(h) LESSER ZAB RIVER AT GOMA ZERDALA



(i) TIGRIS RIVER AT FATHA

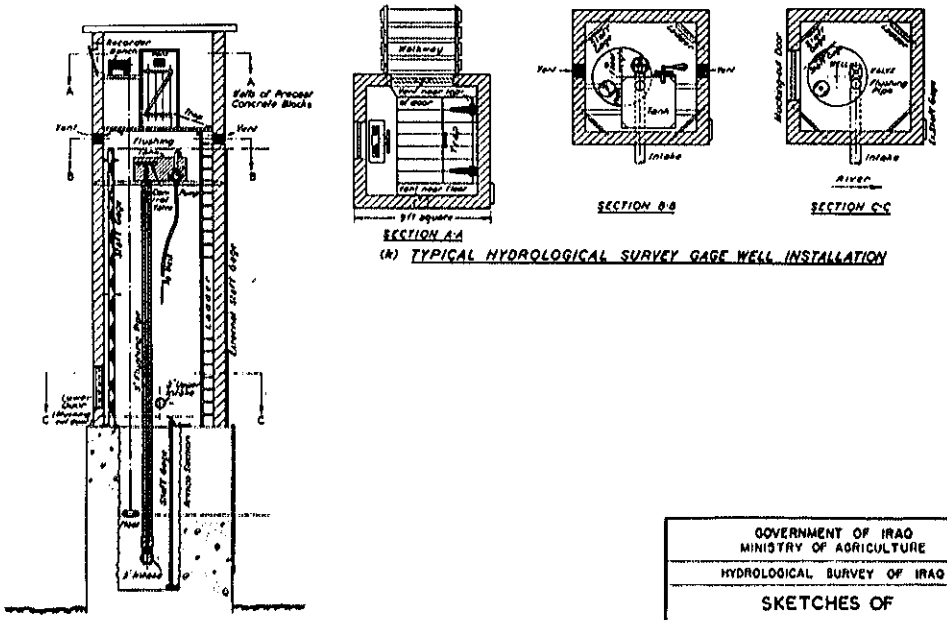


LAYOUT



LOCATION

(j) ADHAIM RIVER AT NARROWS



(k) TYPICAL HYDROLOGICAL SURVEY GAGE WELL INSTALLATION

GOVERNMENT OF IRAQ
MINISTRY OF AGRICULTURE

HYDROLOGICAL SURVEY OF IRAQ

SKETCHES OF
STREAM-GAGING INSTALLATIONS

HARZA ENGINEERING CO. CHICAGO — GINNIE, DEACON & GOURLEY LONDON — IN ASSOCIATION

BAGHDAD, IRAQ — DATE 25 AUG. 1958 — DWG NO. 610-21

	BY	DATE	CHKD	DATE	
DWN	R.B.	8/25/58	D.J.H.	8/25/58	
CHKD		DESIGNED		INS. UNDR	
APPD		H.W.R.			

DWG NO	DATE	NATURE OF REVISION	BY	CHKD	APPD

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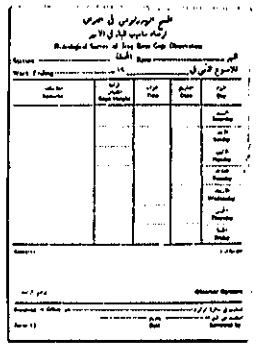
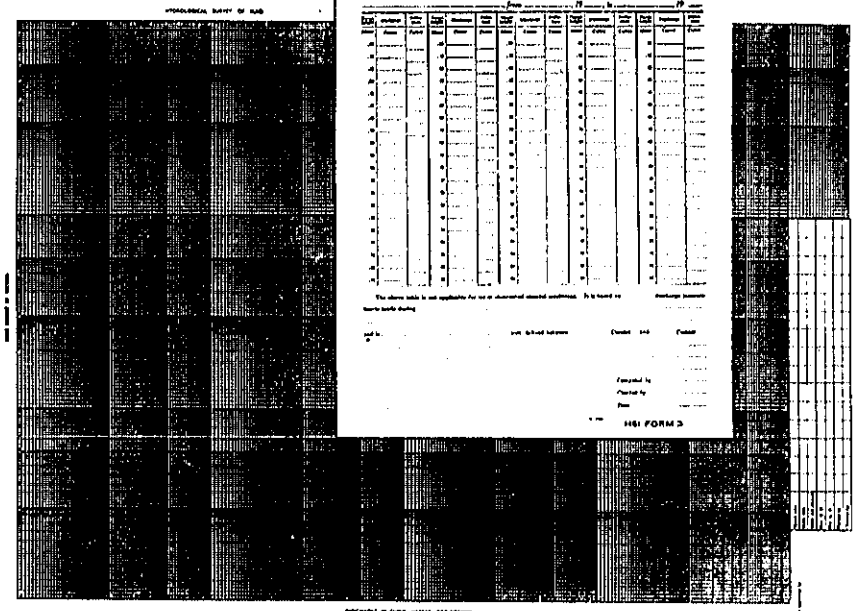
FORM 3, RATING TABLE

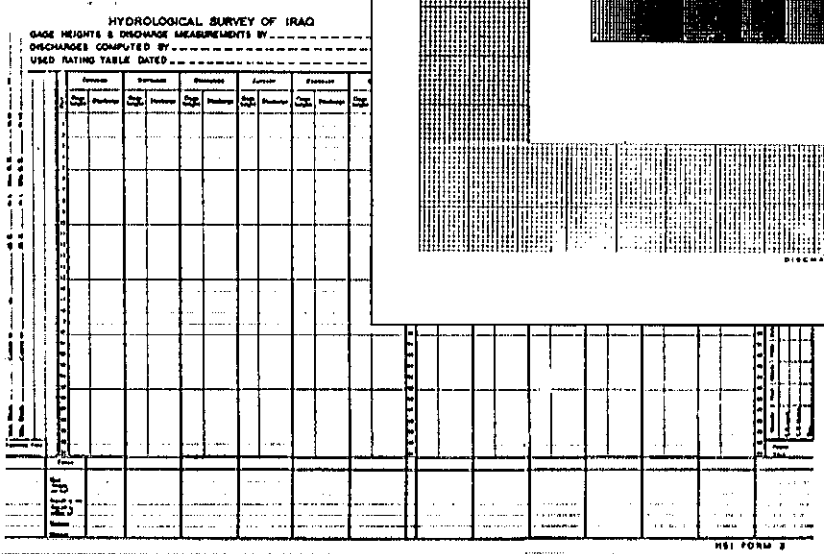
FORM 6, RATING CURVE (LOGARITHMIC)



FORM 13, RIVER GAGE OBSERVATION



FORM 5, RATING CURVE (ARITHMETIC)



FORM 2, DETERMINATION OF DAILY DISCHARGE

DATE	NO	DISTRIBUTION
PRINTS		
	BY	DATE / CHKD / DATE
DESIGN		
CIVIL		
DEPT	GROUP LEADER	HEAD / DEPT HEAD
CIVIL		
MECH.		
ELECT.		
PLAN.		HEAD / CHIEF
STAFF		CHECKER

REV NO	DATE	NATURE OF REVISION	BY	CHKD	APPD

GOVERNMENT OF IRAQ
MINISTRY OF AGRICULTURE

HYDROLOGICAL SURVEY OF IRAQ

HYDROLOGICAL FORMS

HARZA ENGINEERING CO. CHICAGO — IN ASSOCIATION — BINNIE, DEACON & GOURLEY LONDON

BAGHDAD, IRAQ — DATE 24 June 1963 — DWG NO. 680-31

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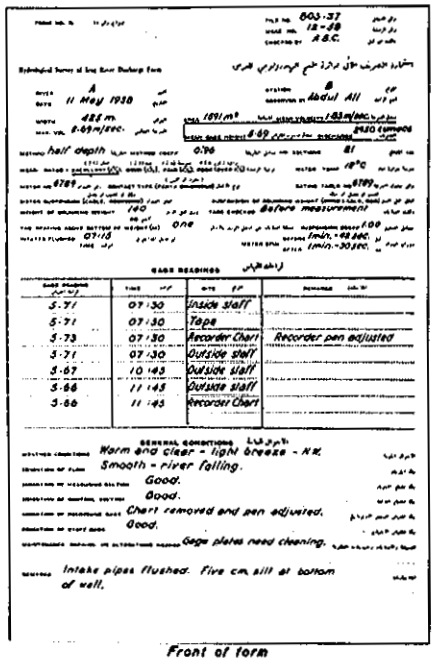
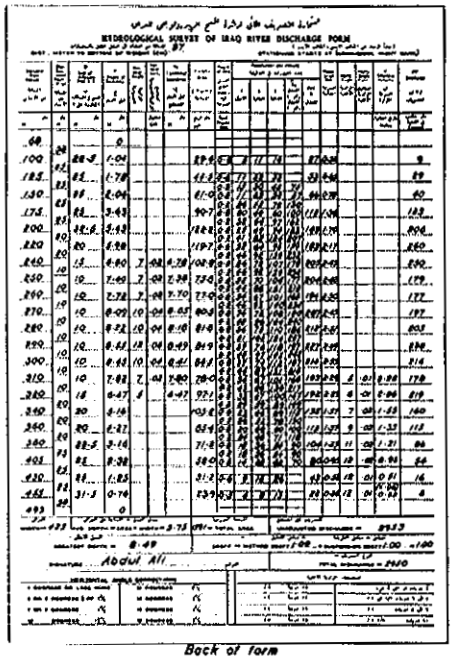
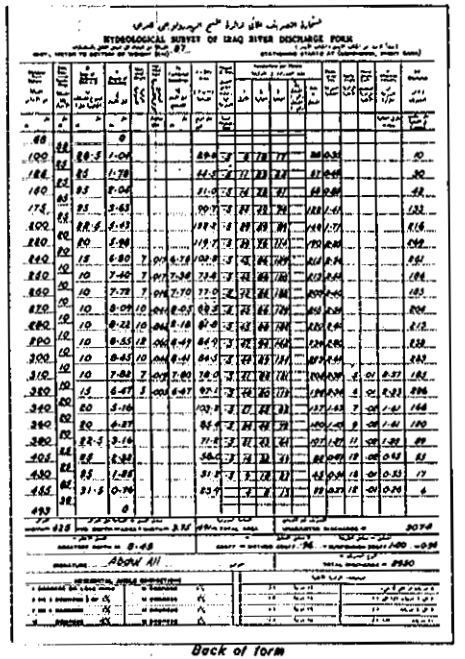


Front of form
Summary of data

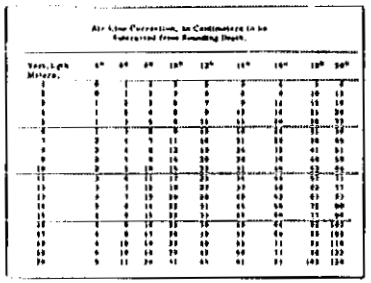


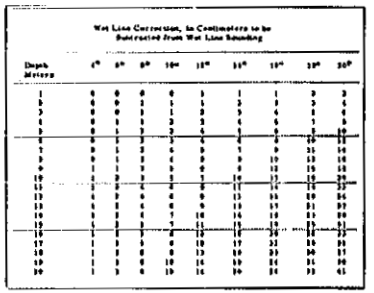
Back of form
0.2 and 0.8 depth method of measurement



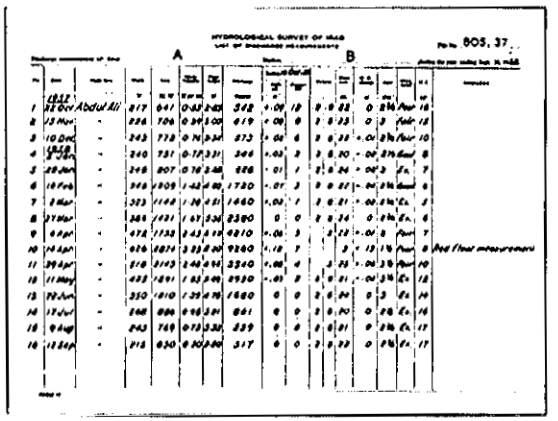
Back of form
Half depth method of measurement

(b) DISCHARGE MEASUREMENT FIELD DATA SHEET — FORM IS





(a) SOUNDING CORRECTION TABLES



(c) SUMMARY OF DISCHARGE MEASUREMENTS

	BY	DATE	CHKD	DATE
DWN	J C R		J C R	
ENGR				

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GOVERNMENT OF IRAQ
MINISTRY OF AGRICULTURE

HYDROLOGICAL SURVEY OF IRAQ

COMPLETION OF
DISCHARGE MEASUREMENT FORMS

DARZA ENGINEERING CO. CHICAGO — IN ASSOCIATION — BINNIE, DEACON & GOURLEY LONDON

BAGHDAD, IRAQ — DATE 27 AUG 1959 — DWG NO 610-25

REV NO	DATE	NATURE OF REVISION	BY	CHKD	APPR

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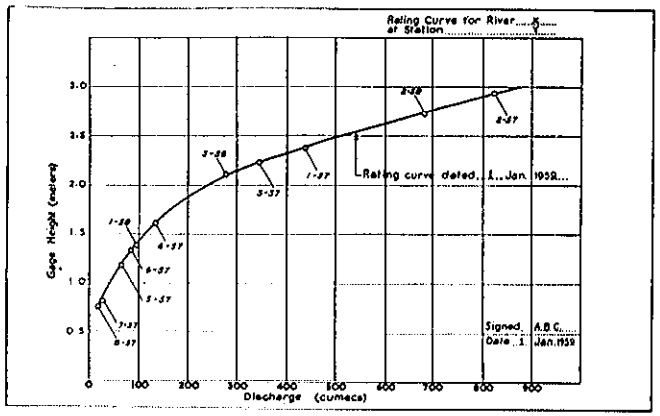

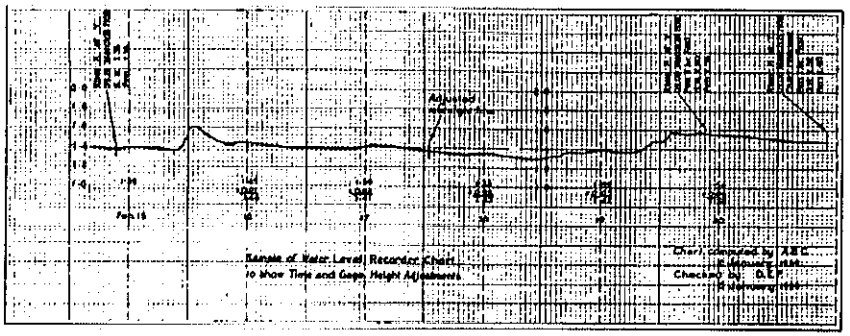

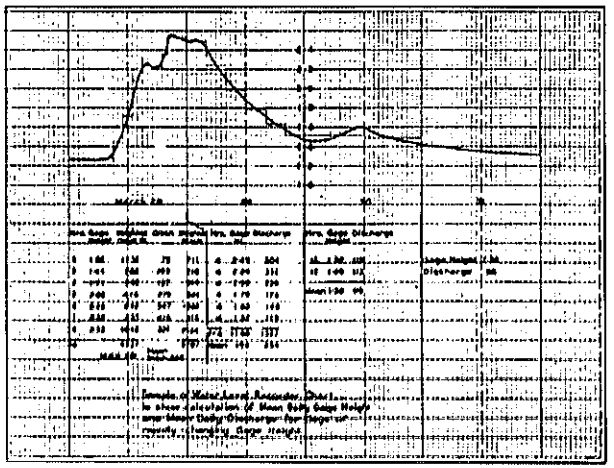

HYDROLOGICAL SURVEY OF IRAQ

Rating table for X River at Y — Dated 1 January 1958

from 1 October 1956 to 30 September 1957 inclusive

Gage Height (Meters)	m	m	m	m	m	m	m	m	m	m	m	Discharge (Cumecs)
0.0												
.1												
.2												
.3												
.4												
.5												
.6												
.7												
.8												
.9												
1.0						80	81	82	84	88		
.1	33	34	35	36	36	37	38	39	39	40		8
.2	31	32	33	34	35	36	37	38	39	40		12
.3	41	42	43	44	45	47	48	49	51	52		16
.4	53	54	56	57	59	60	61	63	64	66		20
.5	67	68	70	72	73	74	76	78	79	80		24
.6	82	84	85	87	88	90	92	93	95	96		28
.7	98	100	101	103	105	106	108	110	112	113		32
.8	115	117	119	121	123	124	126	128	130	132		36
.9	134	136	138	140	142	144	147	149	151	153		40
2.0	155	157	160	162	164	166	169	171	173	175		44
.1	178	181	183	186	189	191	194	197	200	202		48
.2	205	208	211	214	217	220	224	227	230	233		52
.3	240	244	248	252	256	260	264	268	272	276		56
.4	280	285	290	295	300	305	310	315	320	325		60
.5	330	336	341	347	352	358	364	369	375	380		64
.6	386	392	398	404	410	416	421	427	433	439		68
.7	445	452	458	464	471	478	484	490	497	504		72
.8	510	517	524	531	538	545	553	559	566	573		76
.9	580	587	594	601	609	616	623	632	636	643		80
3.0	650	658	666	673	680	688	695	703	710	718		84
.1	725	733	740	748	756	763	770	778	785	793		88
.2	800	808	816	824	832	840	848	856	864	872		92
.3	880											

Computed by A.B.C. 1:1 with Checked by D.E.F. 1:1 with

This rating is well defined throughout the range shown.

HSI FORM 4

DAILY GAGE HEIGHT, IN METERS, AND DISCHARGE, IN CUMECS, OF X RIVER AT Y FOR YEAR ENDING SEPT. 30, 1958.

Day	February Gage height	February Discharge	March Gage height	March Discharge
1	1.18	86	1.82	78
2	1.13	82	1.90	74
3	1.13	82	1.18	67
4	1.13	82	1.68*	116
5	1.73*	198*	1.72*	192
6	1.49*	112*	1.76	146
7	1.25	90	2.01*	244
8	1.06	78	2.65*	606*
9	1.08	79	2.61*	598*
10	1.04	73	2.19	304
11	1.04	73	2.47	490
12	1.02	168	2.41	317
13	1.04	168	2.43	378
14	1.29	190	2.29	237
15	1.29	190	2.20	284
16	1.46	112	2.33	414
17	1.91	195	2.31	392
18	1.33	93	2.23	288
19	1.02	115	2.07	274
20	1.08	114	1.93	232
21	1.00	115	1.73	192
22	1.07	113	1.58	130
23	1.03	110	1.60	98
24	1.04	112	1.38	84
25	1.02	93	1.38	79
26	1.09	95	1.64	73
27	1.02	93	1.63	72
28	1.00	90	1.61*	228*
29			1.94*	334*
30			1.20*	116*
31			1.36	98
Total		2848		7377
Mean		98.0		237
Maximum		198		606
Minimum		86		67

(Portion of one year form)

NOTES:

1. This exhibit illustrates the important stages in the computation of daily discharge records for a hypothetical station. Data are made as simple as possible for clarity of illustration. The computations are based on field data assumed to have been obtained during the water years 1957 and 1958.
2. A detailed description of the computation of daily discharge is given in the "Manual for Preparation of Records of Daily Discharge." (in Appendix A).

BY	DATE	CHKD	DATE		
DRN	ENGR				
ENGR					

REV NO	DATE	NATURE OF REVISION	BY	CHKD	APPD

GOVERNMENT OF IRAQ
MINISTRY OF AGRICULTURE

HYDROLOGICAL SURVEY OF IRAQ

STAGES IN COMPUTATION OF DAILY DISCHARGE

HAMZA ENGINEERING CO. CHICAGO — BINNIE, DEACON & GOURLEY LONDON — IN ASSOCIATION

BAGHDAD, IRAQ — DATE 23-6-59 — DWG NO 610-22

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FORM 12

المسح الهيدرولوجي في العراق

ارصاد الطمي العالق بمياه الانهر

HYDROLOGICAL SURVEY OF IRAQ

FIELD OBSERVATION OF SUSPENDED SEDIMENT

River TIGRIS النهر

Date 11 NOV. 1958 التاريخ

Beginning time 10.05 وقت الابتداء

Ending time 11.50 وقت الانتهاء

Water temperature 15°C درجة حرارة الماء

Measured discharge 337.9 التصريف المرصود

Type of Sampler used نوع الجهاز المستعمل

~~D.G.I. Bottle Sampler~~ جهاز مديرية الري

U.S. Depth Integrater الجهاز الاميركي للرصد على طول العمق

~~U.S. Point Sampler~~ الجهاز الاميركي للرصد عند نقطة واحدة

Station FATHA المحطة

Made by X X X X رصد بواسطة

Gage reading 0.90 Time 10.05 الوقت قراءة المقياس

Gage reading 0.90 Time 11.50 الوقت قراءة المقياس

Mean gage 0.90 معدل المقياس

Size of Nozzle قطر فتحة الجهاز الاميركي

$\frac{1}{8}$ inch X $\frac{1}{8}$ انج

$\frac{3}{16}$ inch $\frac{3}{16}$ انج

$\frac{1}{4}$ inch $\frac{1}{4}$ انج

رقم الموقع العمودي Vertical Number	البعد عن نقطة الأساس (متر) Distance from Reference Point (M)	عمق الماء (متر) Depth of water (M)	عمق النموذج (متر) Depth of Sample (M)	REMARKS الملاحظات
(1)	(2)	(3)	(4)	(5)
I	220	2.85	(A) (أ)	
			(B) (ب)	TIME FOR
			(C) (ج)	
II	260	4.60	(A) (أ)	BOTTLE TO FILL
			(B) (ب)	
			(C) (ج)	TO 3/4 FULL
III	320	4.15	(A) (أ)	
			(B) (ب)	APPROX. 45 SECONDS
			(C) (ج)	

Sample Locations-Unless Otherwise Instructed

Vertical I is at $\frac{1}{4}$ of distance across river

Vertical II is at middle of river

Vertical III is at $\frac{3}{4}$ of distance across river

Depth (A) is half metre from surface

Depth (B) is at mid-depth

Depth (C) is half metre from bottom

If depth is between 2 and 3 metres, take sample (A) & (C) only.

If depth is less than 2 metres take sample (B) only.

موقع النموذج- مالم تعطى تعليمات اخرى :

الموقع العمودي رقم I عند $\frac{1}{4}$ عرض النهر

« « II عند منتصف عرض النهر

« « III عند $\frac{3}{4}$ عرض النهر

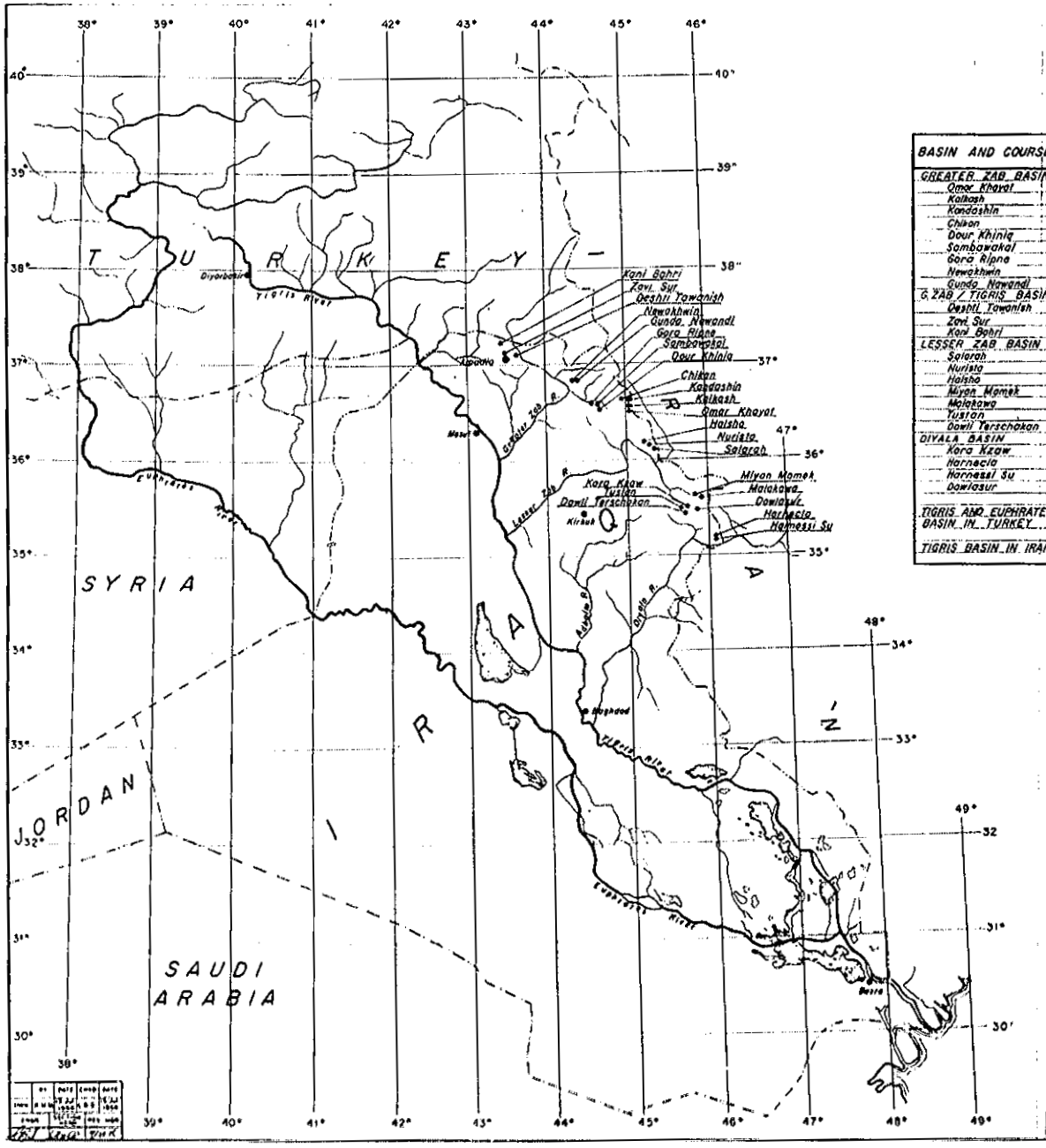
عمق (ا) على بعد نصف متر من سطح الماء

عمق (ب) عند منتصف العمق

عمق (ج) على بعد نصف متر من قاع البحر

اذا كان عمق الماء بين ٢ و ٣ أمتار فيرصد النموذجين (ا)،(ج) فقط

اذا كان عمق الماء اقل من مترين فيرصد النموذج (ب) فقط.



PROGRESS ON SNOW SURVEYS

BASIN AND COURSE	Elevation Metres	1956	1957	1958	1959
		J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J J A S O N D	J F M A M J
GREATER ZAB BASIN					
Qour Khayat	2440				
Kalkash	2510				
Kandashin	1980				
Chikan	1600				
Dour Khinig	2300				
Sambawakal	1810				
Gara Rijne	820				
Newakhwin	1525				
Gunda Nawandi	1100				
G. ZAB / TIGRIS BASIN					
Deshti Tawanish	1885				
Zavi Sur	1420				
Kani Bahri	1190				
LESSER ZAB BASIN					
Saiarah	1890				
Nurista	1340				
Halsha	1250				
Miyan Mamek	1690				
Malakawa	1400				
Tustan	1320				
Dawli Terschakan	1220				
DIYALA BASIN					
Kara Kaow	1780				
Harnecia	1620				
Harnessi Su	1480				
Dowlasur	890				
TIGRIS AND EUPHRATES BASIN IN TURKEY		20-25 Courses proposed			
TIGRIS BASIN IN IRAN		8-10 Courses proposed			

NOTES:

1. Courses are surveyed on the first and fifteenth of each month beginning on February 1 and ending on April 1 or May 1 inclusive.
2. Many courses are on basin divides and should prove to be of use for forecasting flows in basins other than those under which they are shown.

LEGEND

Installation of courses

Snow surveys observed

Scale 0 50 100 150 200 km

GOVERNMENT OF IRAQ
MINISTRY OF AGRICULTURE
HYDROLOGICAL SURVEY OF IRAQ

SNOW SURVEY PROGRAM

HARZA ENGINEERING CO (CHICAGO) — BIRNIE, DEACON & COURTLEY (LONDON)
IN ASSOCIATION
BAGHDAD - IRAQ — DATE (1st July 1958) — DRAWING NO 626-4

450

BEST AVAILABLE COPY

HYDROLOGICAL SURVEY OF IRAQ

المسح الهيدرولوجي في العراق

COPY OF FIELD SNOW SURVEY NOTES

استمارة ملاحظات الحقل لمسح الجليد

Country, Liwa Iraq ; Mosul الواء Drainage basin Gt Zab R/Tigris R. حوض

Snow course Deshti Tawanish (5560 ft) خط قياس الجليد

Party Zaia ; Adem (Yord. M.W.M) الفرقة Date 18-2-58 التاريخ

DESCRIPTION OF SURVEY OF COURSE* وصف أو عدد خطوط قياس الجليد	SAMPLE NO. رقم العينة	DEPTH OF SNOW (INCHES) عمق الجليد بالبوصات	LENGTH OF CORE (INCHES) طول العمود بالبوصات	WEIGHT OF SAMPLE (LBS) وزن العينة بالرطل	WATER CONTENT OF SNOW (INCHES) وزن الماء في الجليد بالبوصات	WATER CONTENT PERCENT نسبة الماء المئوية	REMARKS (SEE REVERSE SIDE) الملاحظات (انظر ظهر الورقة)
A line	1	38½	33	2½	33½	12	31	Ground Damp
	2	40	36	2½	35	13½	34	"
	3	36	33	2½	32½	11	31	"
	4	39	33½	2½	34½	13	33	"
	5	39	32	2½	34	12½	32	"
B line	1	38½	31½	2½	34	12½	33	"
	2	39	31	2½	33	11½	30	"
	3	39	36	2½	34	12½	32	"
	4	38½	34½	2½	34½	13	34	"
	5	38	35½	2½	34	12½	33	"
C line	1	38	31½	2½	33½	12	32	"
	2	39	32½	2½	34	12½	32	"
	3	39	36	2½	35	13½	35	"
	4	38	34	2½	34	12½	32	"
	5	43	37	2½	36	14½	36	"
Totals		582½				169		
Means		39				12.6	32.5	

*Show number or description as given on sketch map, i.e., "Course No. 1," or "Major Course," or "N.S.E." etc.

†Always start measurements for sampling from the *lateral* point as shown by the sketch map of the course and follow the spacing for samples as indicated. Particular care should be taken to note any irregular spacing between samples.

No. 1 of 1 sheets. Comp. by Zaia Yelda Checked by M.W.M.

Form 8

Front of form

NOTE:-Please fill while in the field.

Time of Survey Began 12.40 p.m. Ended 1.50 p.m.

Sampling Conditions (Please check items descriptive of present conditions)

Weather at time of sampling

✓ Clear
Partly cloudy
Overcast
Raining
Snowing
Blowing
Freezing
✓ Thawing

Snow conditions at snow course

Snow samples obtained easily
✓ *Snow samples obtained with moderate difficulty
*Snow samples obtained with extreme difficulty
Ice layer on ground. How thick? ..... inches
Ground frozen under snow
✓ Ground not frozen under snow
Ground dry under snow
✓ Ground damp under snow
Ground wet (saturated) under snow

*Explain fully under remarks.

General Snow Conditions

1. What elevation is snow line generally? 5,000 feet approx.
2. Is snow melting on north and east slopes? No
3. Is snow melting on south and west slopes? Little
4. How many inches of new snow at snow course? 2-3 inches
5. Is there evidence of snow slides? No

General Streamflow Conditions

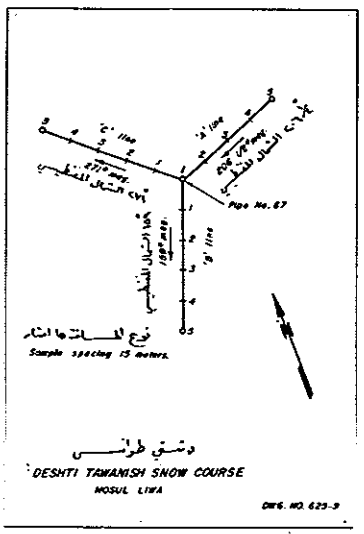
1. Are very small streams running? Yes..... No ✓
2. Are small streams bridged over by snow? Yes ✓ No.....
3. Are streams clear or muddy? (Check one) Clear ✓ Muddy.....

REMARKS:

1. Snowline N slopes approx 6000 ft
S slopes approx 5,500-6,000 ft
2. Very hot sun temperatures makes sampling difficult
3. Training survey under supervision

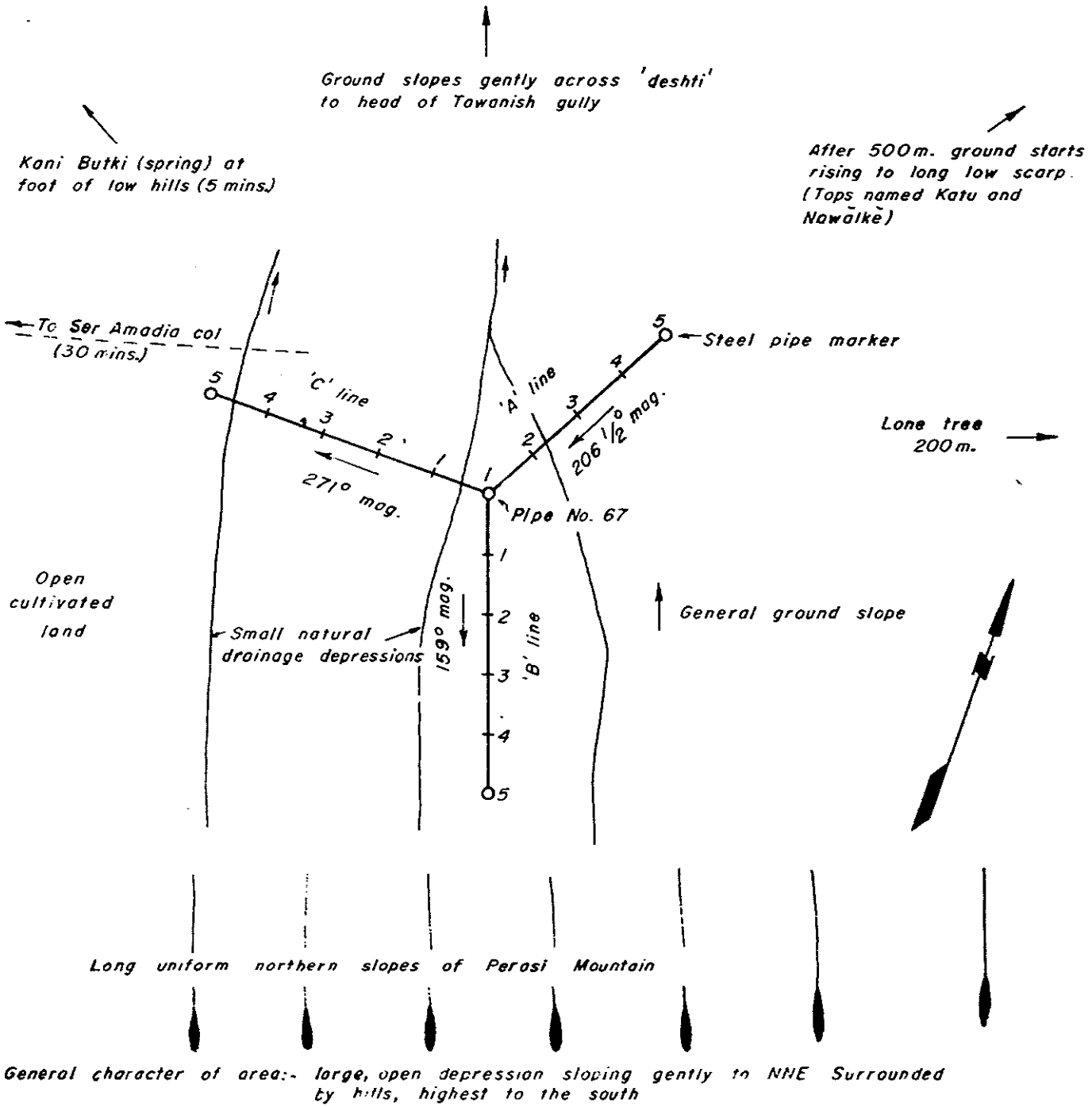
Back of form

(a) COPY OF FIELD SNOW SURVEY NOTES — FORM 8



(b) SURVEYOR'S FIELD COPY OF SNOW COURSE LAYOUT

GOVERNMENT OF IRAQ MINISTRY OF AGRICULTURE		
HYDROLOGICAL SURVEY OF IRAQ		
SNOW SURVEY FIELD FORMS		
HARZA ENGINEERING CO. CHICAGO	IN ASSOCIATION	BINNIE, DEACON & GOURLEY LONDON
BAGHDAD, IRAQ	DATE 17 SEP 1959	DWG. NO. 625-29



General character of area:- large, open depression sloping gently to NNE Surrounded by hills, highest to the south

DESHTI TAWANISH SNOW COURSE

Established Sept. 57 by Moullin, Clarke, M. Shamoon and assistants.

Lat: 37° 08' 25" N. Long: 43° 29' 42" E.

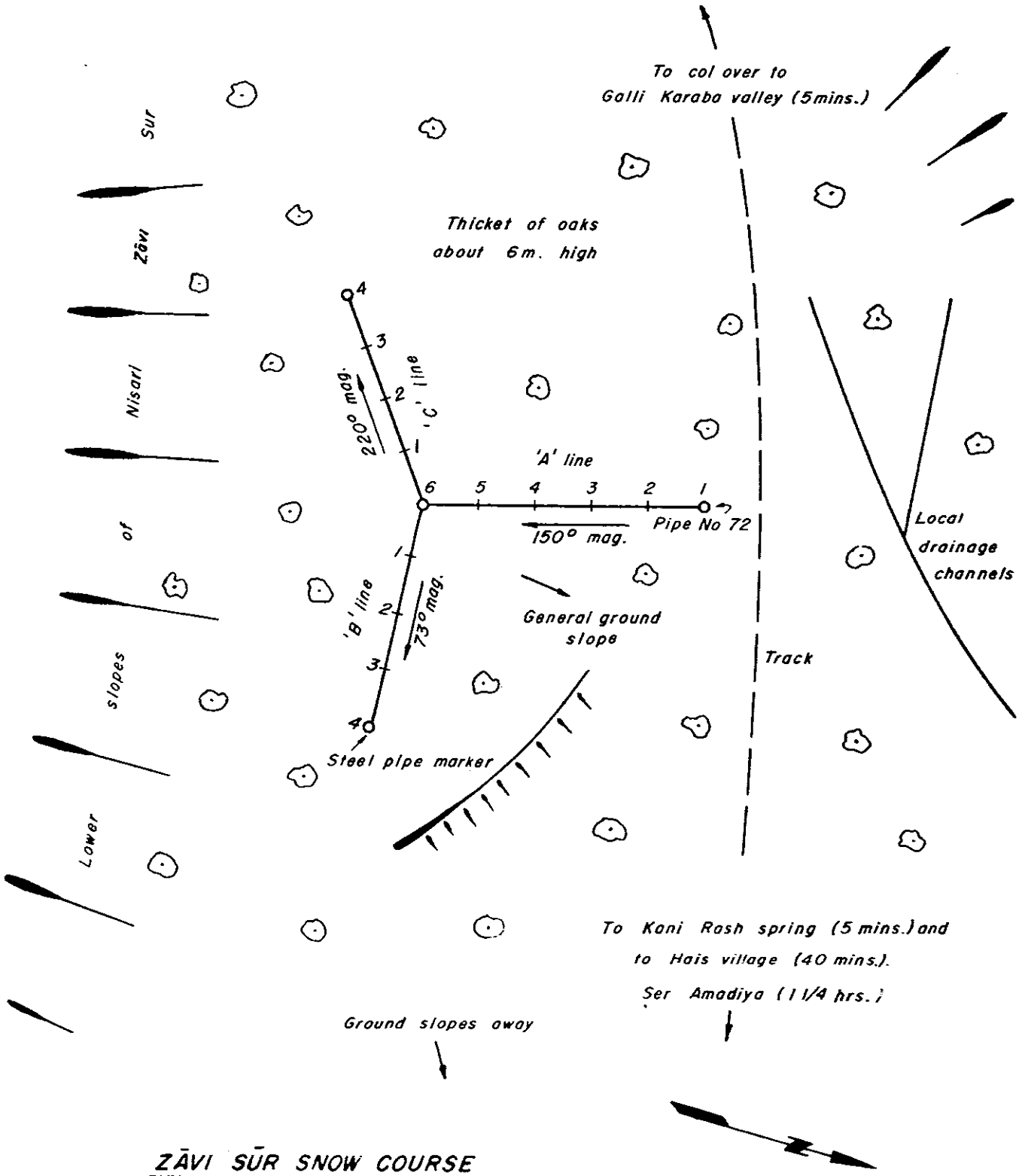
Elevation:- 1685m. (5530 ft.) from 1:20,000 map (90/530).

Sample spacing - 15 meters. Number of samples - 15.

Course marked by four 5 meter steel pipe markers.

Bearings measured from magnetic north.

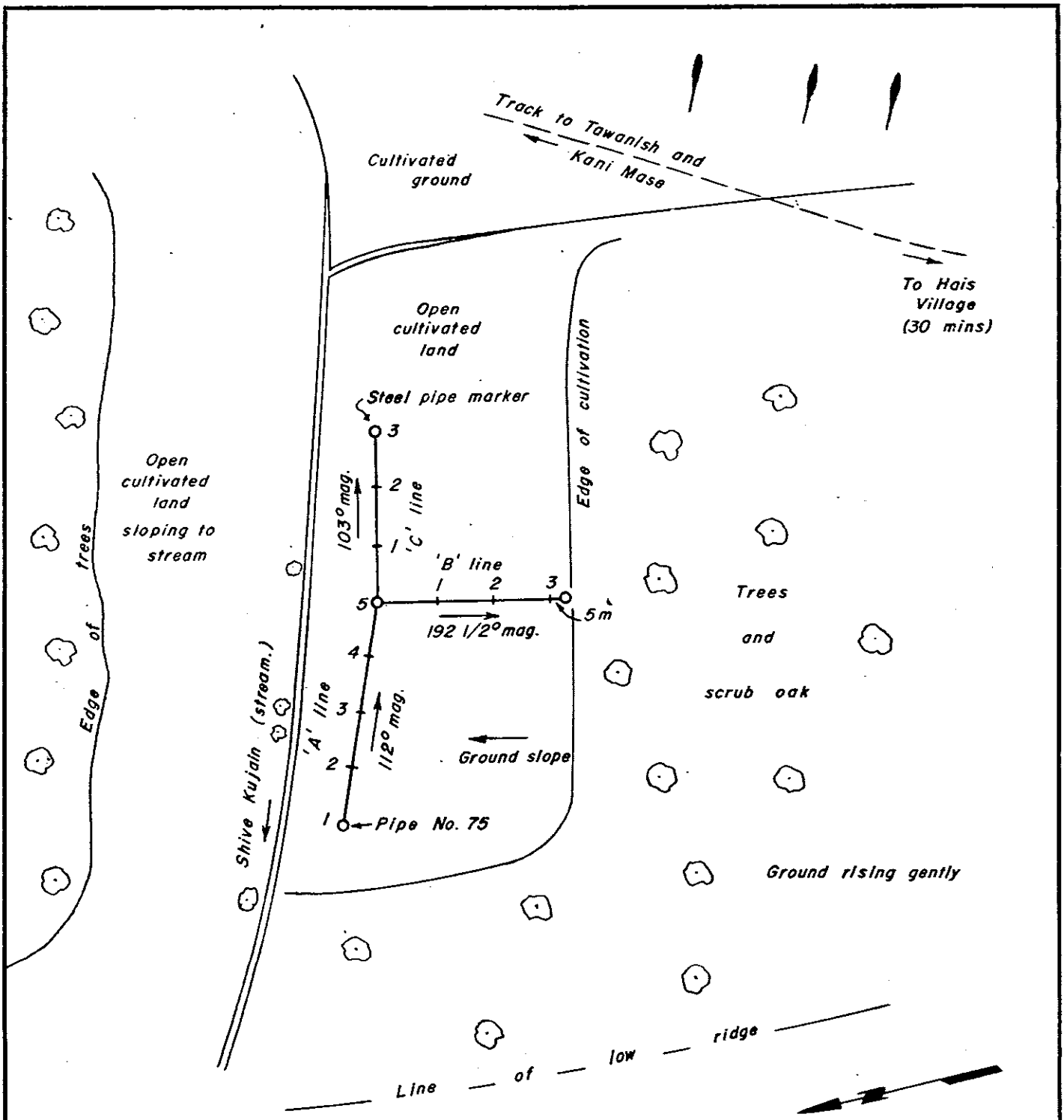
GOVERMENT OF IRAQ MINISTRY OF AGRICUTURE	
HYDROLOGICAL SURVEY OF IRAQ	
DESHTI TAWANISH SNOW COURSE MOSUL LIWA	
HARZA ENGINEERING CO CHICAGO IN ASSOCIATION	BINNIE, DEACON & GOURLEY LONDON
BAGHDAD, IRAQ	DATE 19 Mar 59 / DWG NO 625 - 9



ZĀVI SŪR SNOW COURSE

Established Sept. 57 by Moullin, Clarke and Yord.
Lat: 37° 08' 35" N. Long: 43° 26' 01" E.
Elevation:- 1420m. (4660 ft.) from 1: 20,000 map (90/520).
Sample spacing - 10 meters, Number of samples - 14.
Course marked by one 5 meter and three 4 meter steel pipe markers.
Bearings measured from magnetic north.

GOVERMENT OF IRAQ MINISTRY OF AGRICULTURE		
HYDROLOGICAL SURVEY OF IRAQ		
ZAVI SUR SNOW COURSE MOSUL LIWA		
HARZA ENGINEERING CO CHICAGO IN ASSOCIATION	SINNIE, DEACON & GOURLEY LONDON	
BAGHDAD, IRAQ	DATE 19 Mar 59	DWG. NO 625 - 8



KANI BAHRI SNOW COURSE

Established Sept. 57 by Moullin, Clarke and assistants.

Lat: 37° 10' 18" N. Long: 43° 26' 34" E.

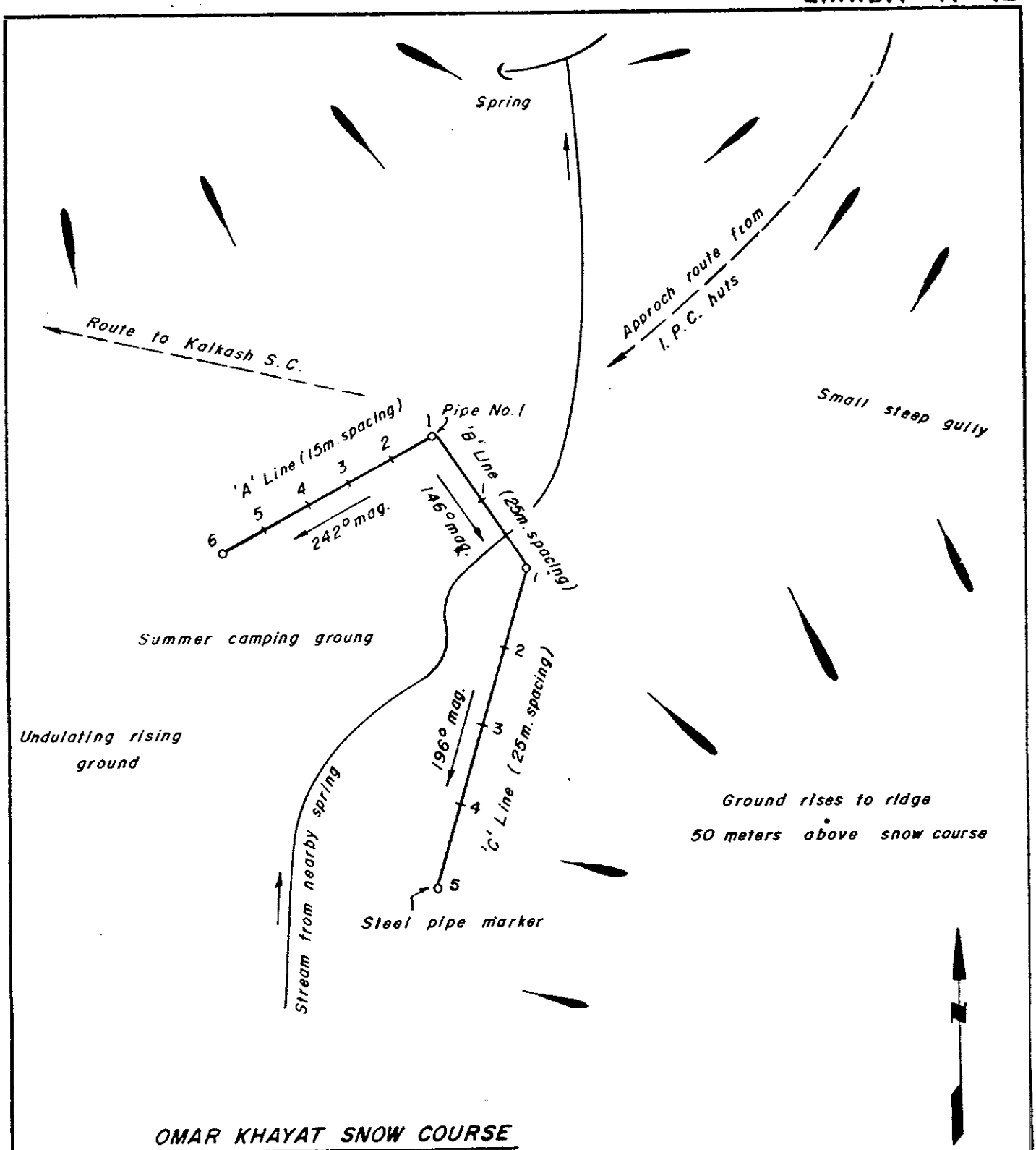
Elevation:- 1190 m. (3900 ft.) from 1:20,000 map (90/520).

Sample spacing - 15 meters. Number of samples - 11.

Course marked by four 4 meter steel pipe markers.

Bearings measured from magnetic north.

GOVERMENT OF IRAQ MINISTRY OF AGRICULTURE		
HYDROLOGICAL SURVEY OF IRAQ		
KANI BAHRI SNOW COURSE MOSUL LIWA		
HARZA ENGINEERING CO. CHICAGO IN ASSOCIATION	BINNIE, DEACON & GOURLEY LONDON	
BAGHDAD, IRAQ	DATE 18 Mar. 59	DWG. NO. 625 - 7



OMAR KHAYAT SNOW COURSE

Established Dec. 56 by Moullin and assistants.

Lat: 36° 37' 09" N. Long: 45° 00' 59" E.

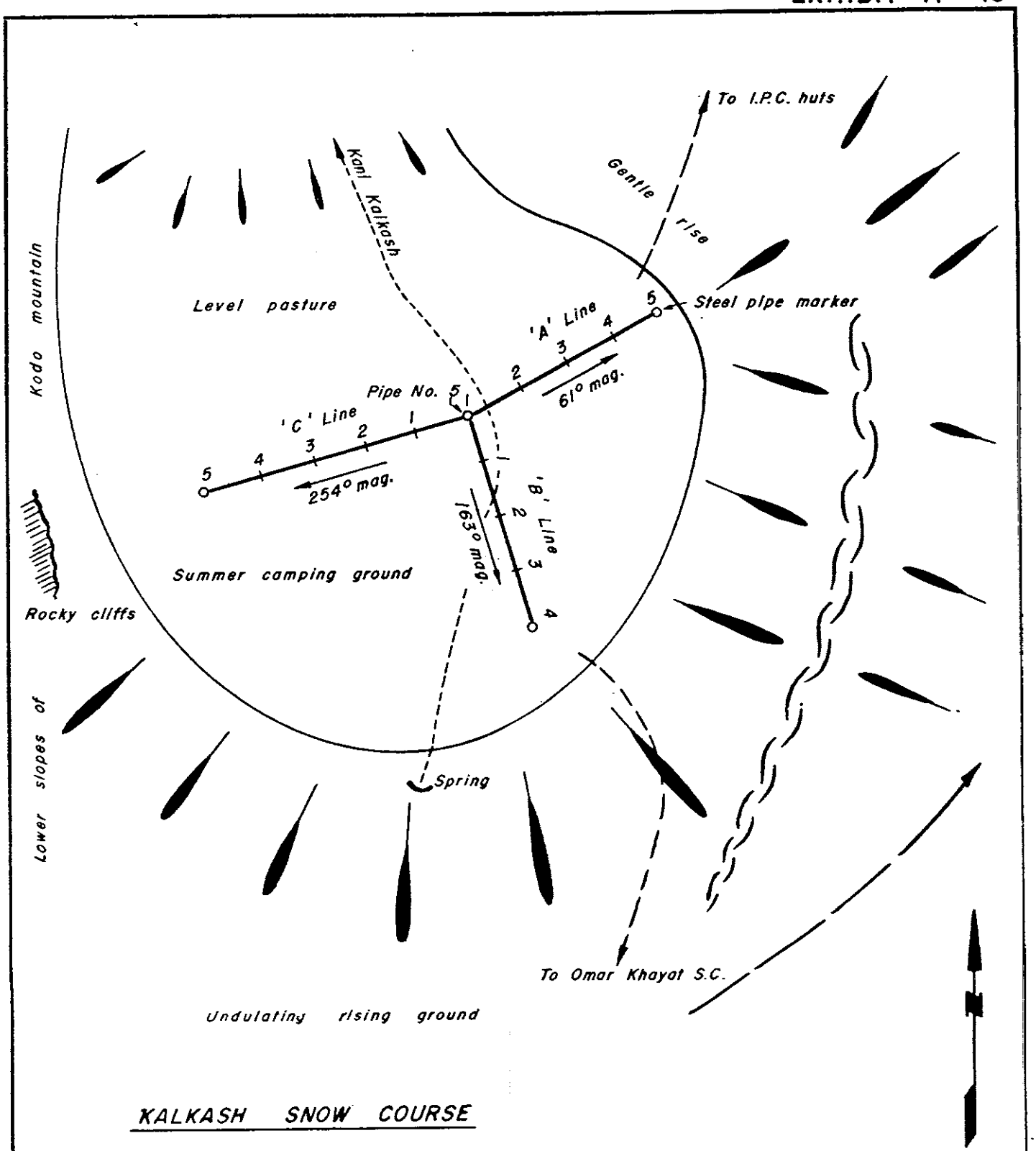
Elevation:- 2640m. (8650 ft.) from 1:20,000 map (84/660).

Sample spacing – 15 and 25 meters. No. of samples – 12

Course marked by four 7 meter steel pipe markers.

Bearings measured from magnetic north.

GOVERMENT OF IRAQ MINISTRY OF AGRICULTURE	
HYDROLOGICAL SURVEY OF IRAQ	
OMAR KHAYAT SNOW COURSE ERBIL LIWA	
HARZA ENGINEERING CO CHICAGO	BINNIE, DEACON & GOURLEY LONDON
IN ASSOCIATION	
BAGHDAD, IRAQ	DATE 7 May 59 / DWG NO 625 - 23



KALKASH SNOW COURSE

Established Oct. 56 by Work, Moullin, Brown and assistants.

Lat: 36° 37′ 49″ N. Long: 45° 00′ 46″ E.

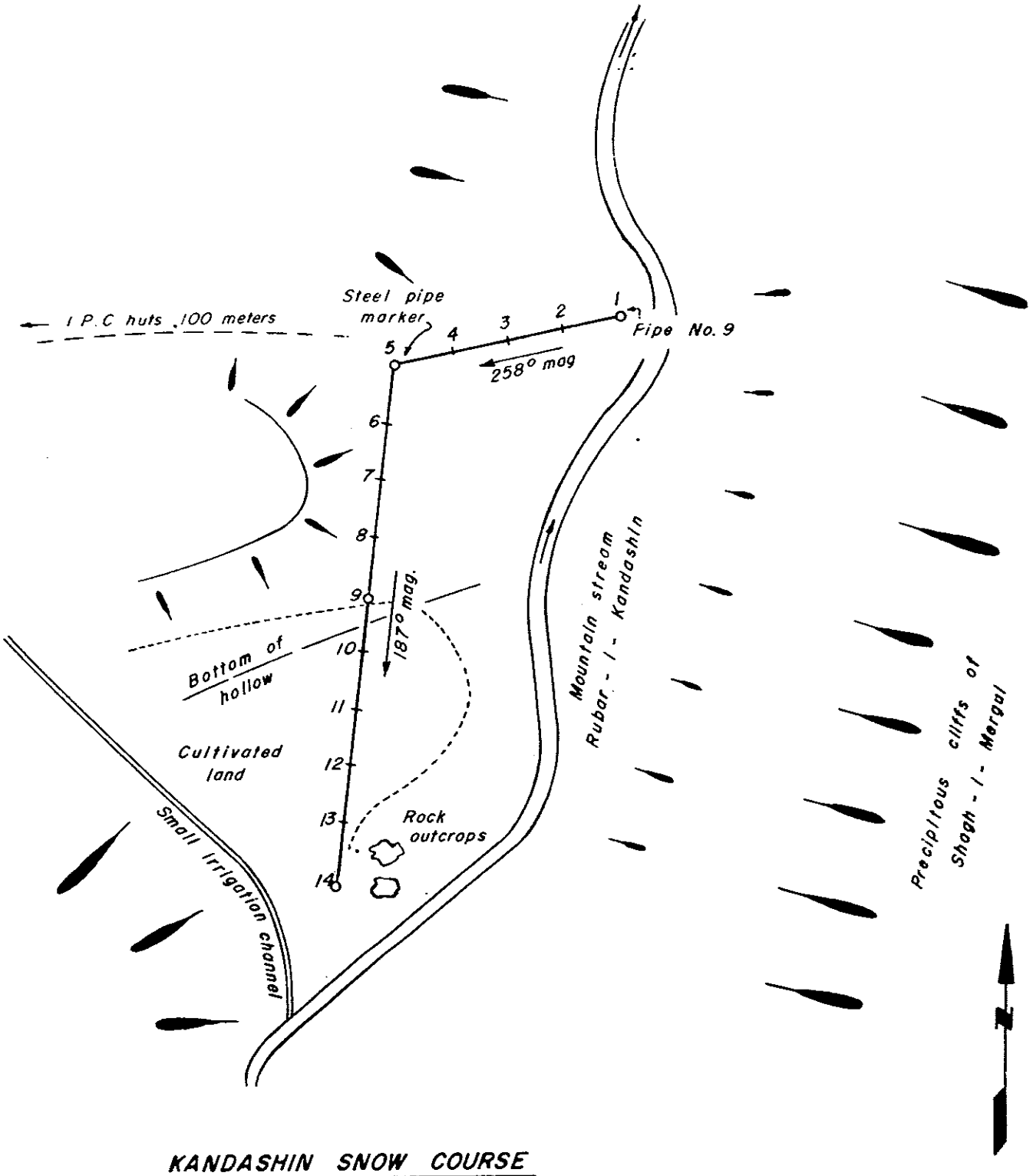
Elevation:- 2510 m. (8250 ft.) from 1:20,000 map (84/660).

Sample spacing - 15 meters. Number of samples - 14.

Course marked by four 5 meter steel pipe markers.

Bearings measured from magnetic north.

GOVERMENT OF IRAQ MINISTRY OF AGRICULTURE		
HYDROLOGICAL SURVEY OF IRAQ		
KALKASH SNOW COURSE ERBIL LIWA		
HARZA ENGINEERING CO CHICAGO - IN ASSOCIATION BINNIE, DEACON & GOURLEY LONDON		
BAGHDAD, IRAQ	DATE 9 May 59	DWG. NO. 625 - 24



KANDASHIN SNOW COURSE

Established Oct. 56 by Work, Moullin, Brown and assistants.

Lat: 36° 39' 06" N Long: 45° 01' 56" E.

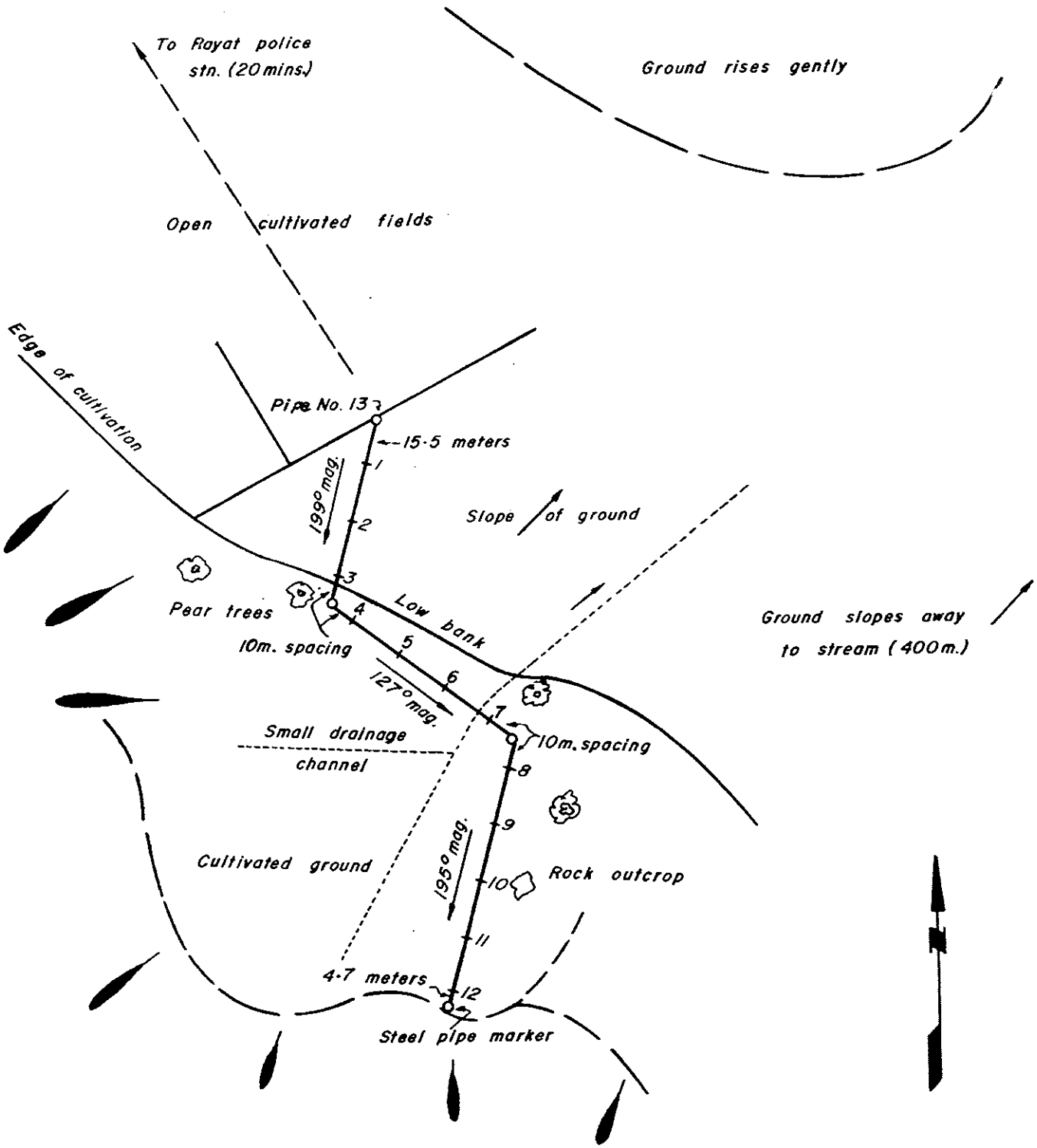
Elevation :- 1980 m. (6500 ft) from 1:20,000 map (84/660).

Sample spacing — 10 meters. Number of samples — 14

Course marked by one 5 meter and three 4 meter steel pipe markers.

Bearings measured from magnetic north.

GOVERMENT OF IRAQ MINISTRY OF AGRICUTURE		
HYDROLOGICAL SURVEY OF IRAQ		
KANDASHIN SNOW COURSE ERBIL LIWA		
HARZA ENGINEERING CO. CHICAGO IN ASSOCIATION	BINNIE, DEACON & GOURLEY LONDON	
BAGHDAD, IRAQ	DATE 10 May 59	DWG. NO. 625 - 25



CHIKAN SNOW COURSE

Established Oct. 56 by Work, Moullin, Brown and assistants.

Lat: 39° 40' 07" N. Long: 44° 58' 36" E.

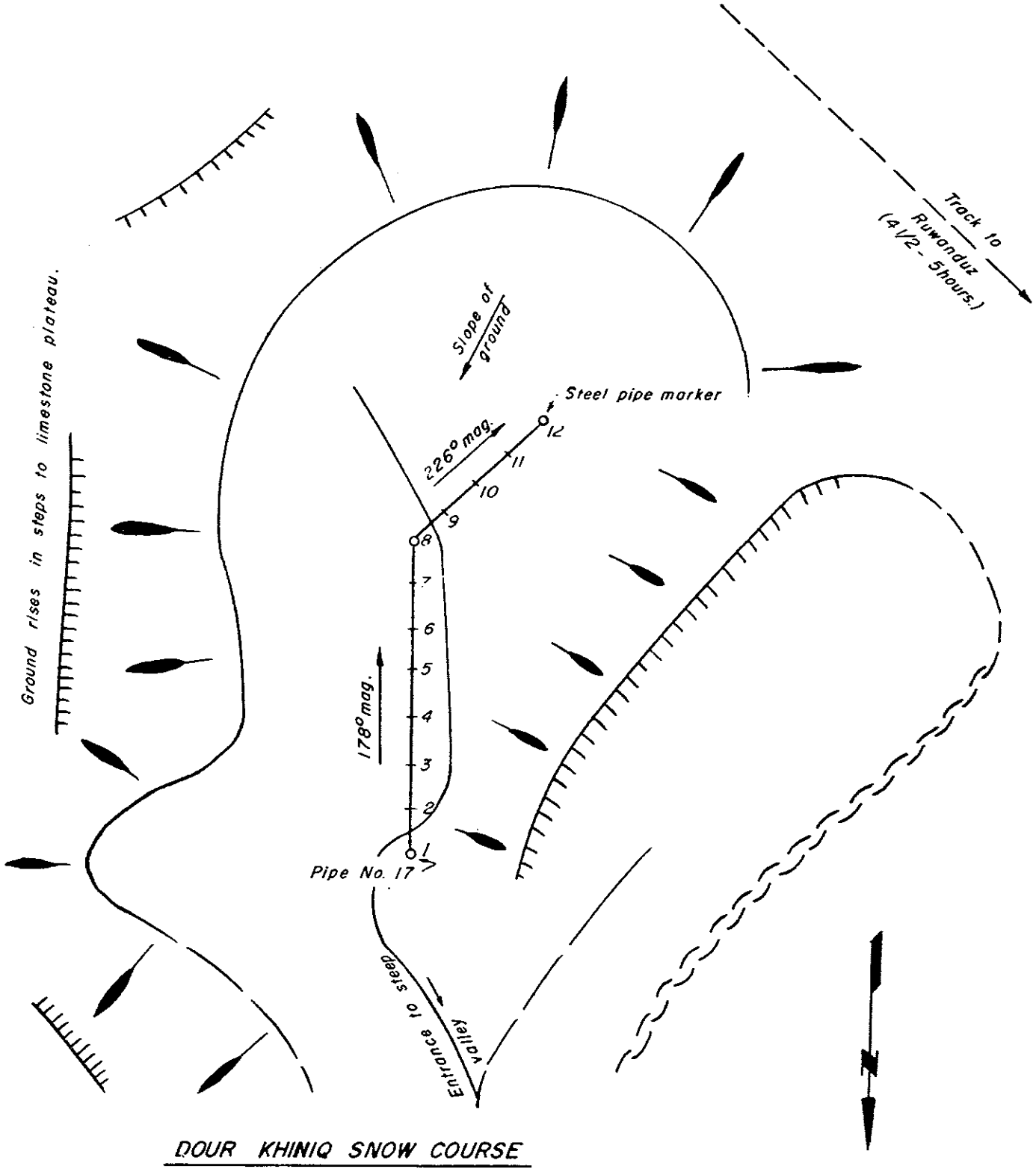
Elevation:-1600m. (5250 ft.) from 1:20,000 map (84/660).

Sample spacing - 20 meters. Number of samples - 12.

Course marked by one 5 meter and three 4 meter steel pipe markers.

Bearings measured from magnetic north.

GOVERMENT OF IRAQ MINISTRY OF AGRICULTURE		
HYDROLOGICAL SURVEY OF IRAQ		
CHIKAN SNOW COURSE MOSUL LIWA		
HARZA ENGINEERING CO. CHICAGO IN ASSOCIATION	BINNIE, DEACON & GOURLEY LONDON	
BAGHDAD, IRAQ	DATE 11 May 59	DWG. NO 625 - 26



DOUR KHINIQ SNOW COURSE

Established Oct. 56 by Work, Moullin, Brown and assistants.

Lat: 36° 34' 16" N. Long: 44° 36' 56" E.

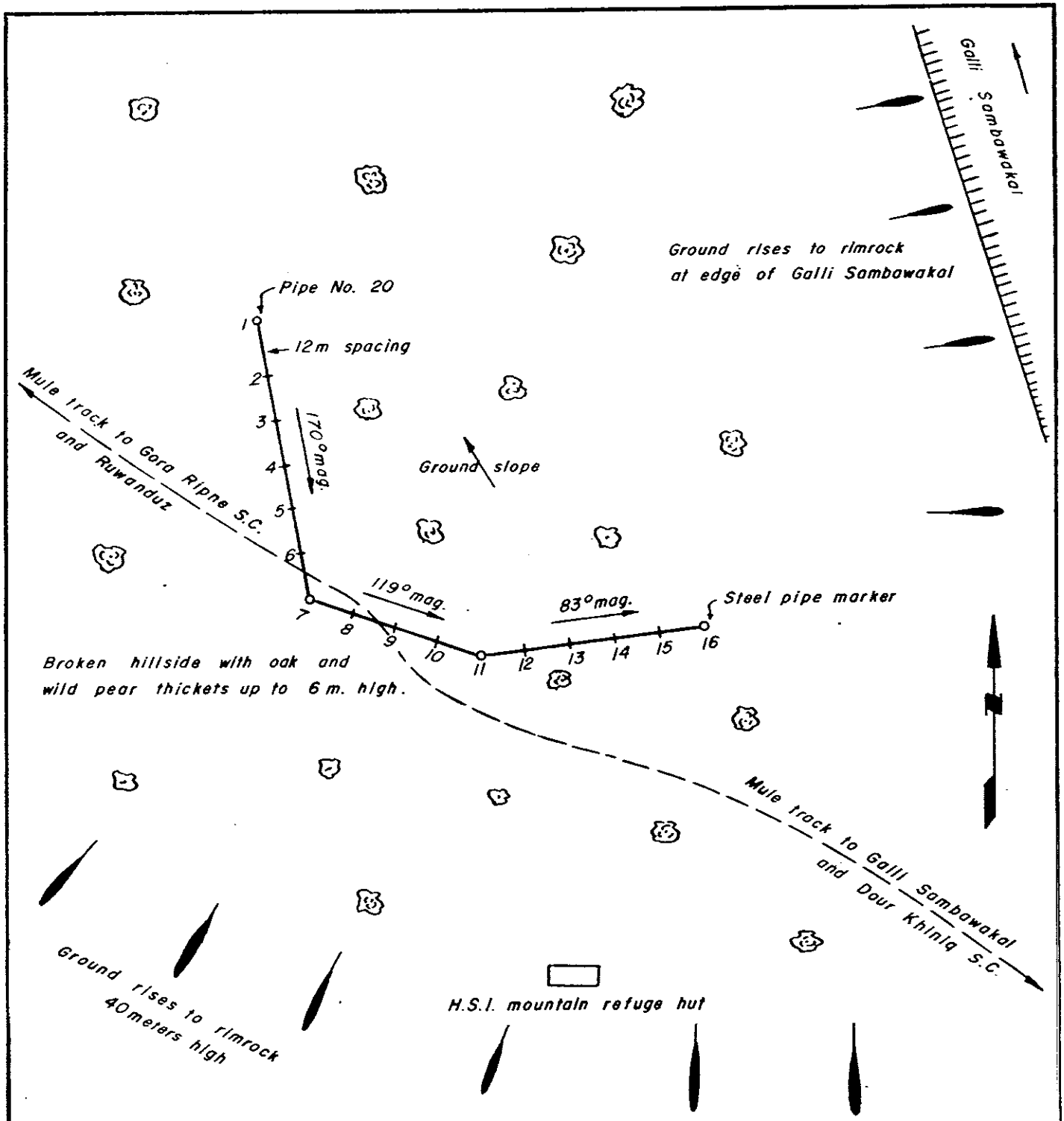
Elevation:- 2300 m. (7550 ft.) from 1: 20,000 map (83/630).

Sample spacing – 10 meters. Number of samples – 12.

Course marked by one 5 meter and two 4 meter steel pipe markers.

Bearings measured from magnetic north.

GOVERMENT OF IRAQ MINISTRY OF AGRICULTURE		
HYDROLOGICAL SURVEY OF IRAQ		
DOUR KHINIQ SNOW COURSE ERBIL LIWA		
HARZA ENGINEERING CO CHICAGO	IN ASSOCIATION	BINNIE, DEACON & GOURLEY LONDON
BAGHDAD, IRAQ	DATE 18 April 59	DWG NO 625 - 13



SAMBAWAKAL SNOW COURSE

Established Oct. 56 by Work, Moullin, Brown and assistants.

Lat: 36° 35' 23" N. Long: 44° 35' 33" E.

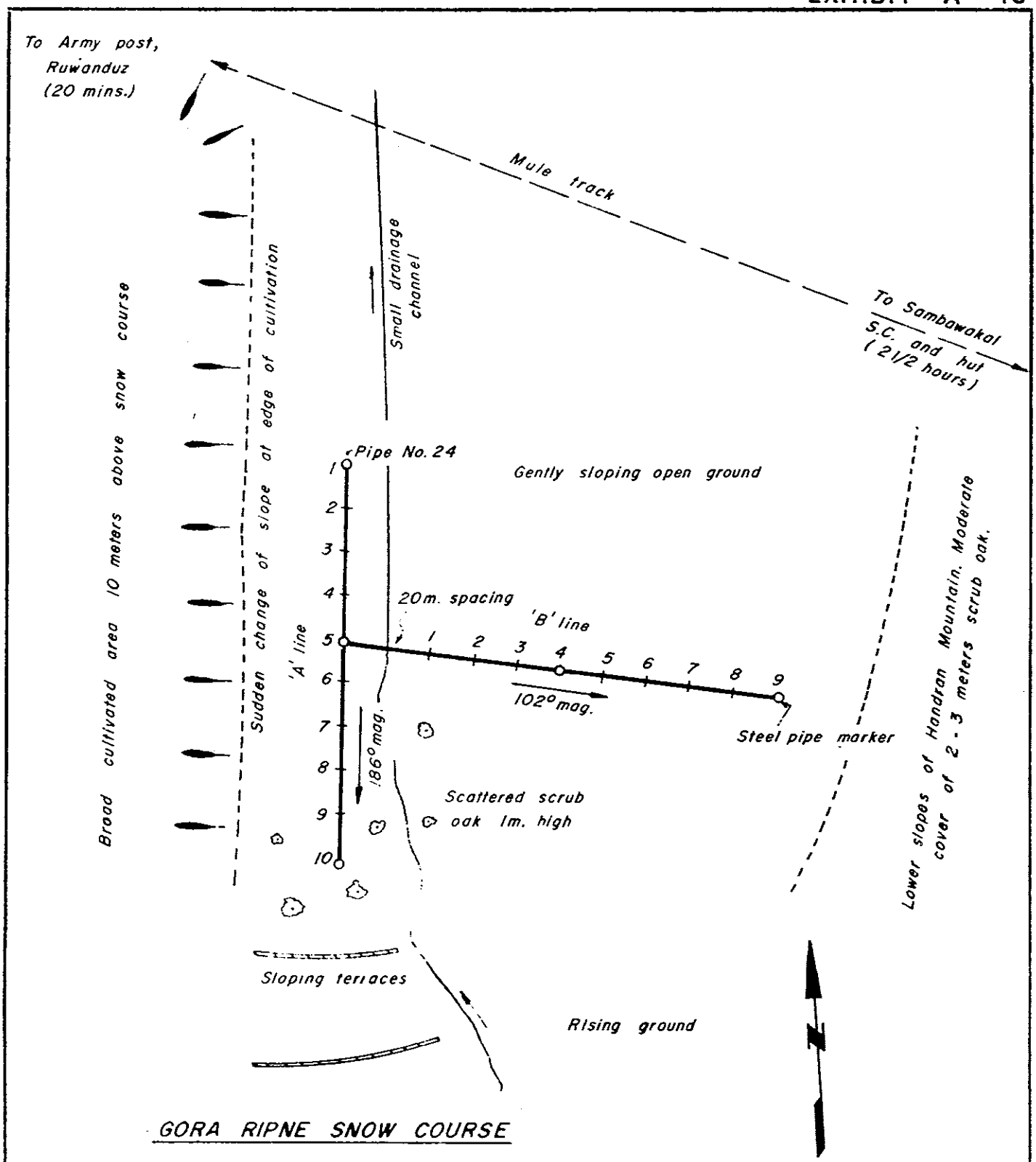
Elevation: - 1810 m. (5950 ft.) from 1:20,000 map (83/620).

Sample spacing - 10 meters. Number of samples - 16

Course marked by one 5meter and three 4 meter steel pipe markers.

Bearings measured from magnetic north.

GOVERMENT OF IRAQ MINISTRY OF AGRICULTURE		
HYDROLOGICAL SURVEY OF IRAQ		
SAMBAWAKAL SNOW COURSE ERBIL LIWA		
HARZA ENGINEERING CO CHICAGO IN ASSOCIATION	BINNIE, DEACON & GOURLEY LONDON	
BAGHDAD, IRAQ	DATE 13 May 59	DWG NO 625 - 28



GORA RIPNE SNOW COURSE

Established Oct. 56 by Work, Moullin, Brown and assistants.

Lat: 36° 36' 43"N. Long: 44° 33 10" E.

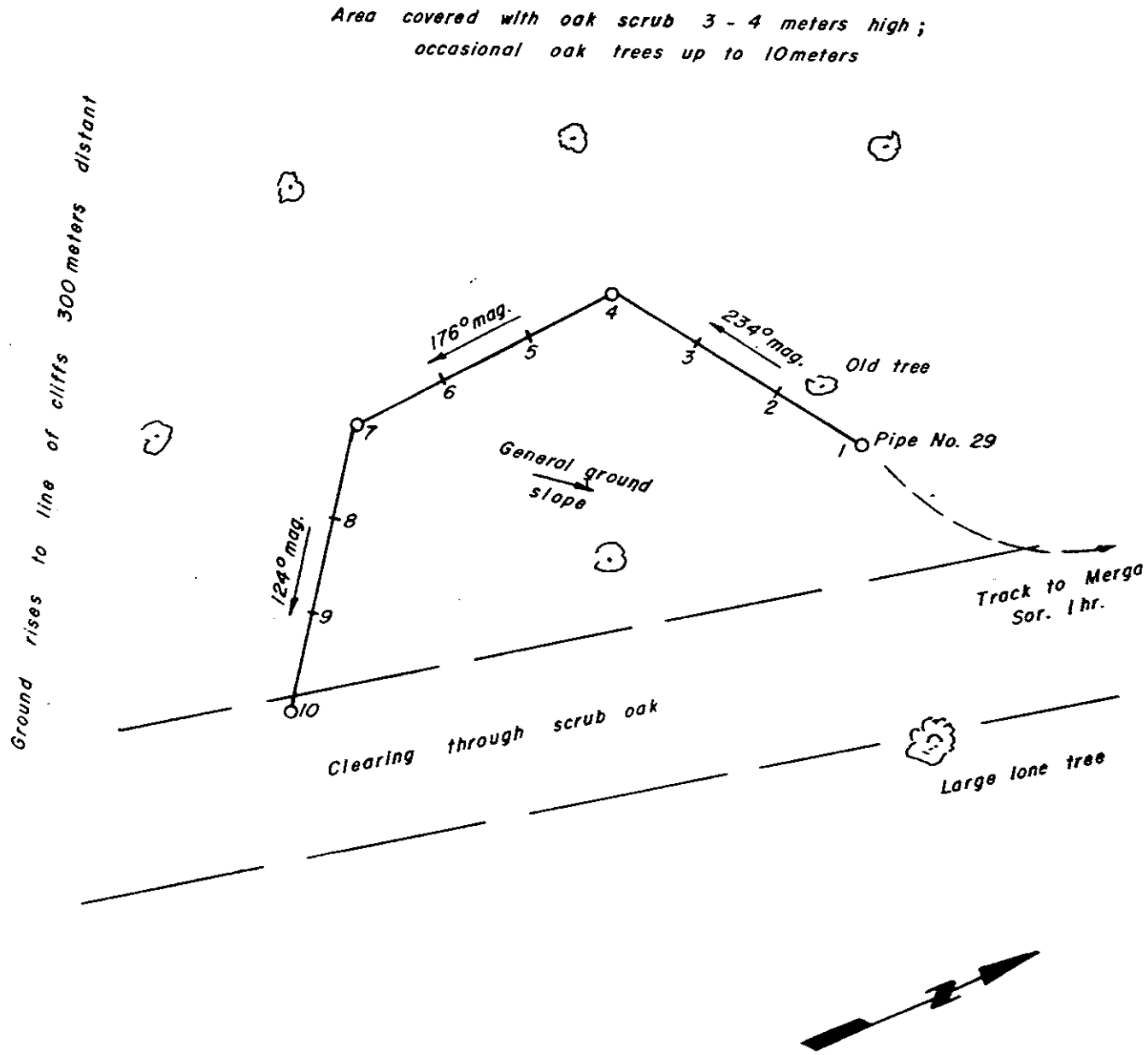
Elevation :- 820m. (2700 ft) from 1:20,000 map (84/620).

Sample spacing – 10 meters. Number of samples – 19.

Course marked by five 4 meter steel pipe markers.

Bearings measured from magnetic north.

GOVERMENT OF IRAQ MINISTRY OF AGRICULTURE	
HYDROLOGICAL SURVEY OF IRAQ	
GORA RIPNE SNOW COURSE ERBIL LIWA	
HARZA ENGINEERING CO CHICAGO IN ASSOCIATION	BINNIE, DEACON & GOURLEY LONDON
BAGHDAD, IRAQ	DATE 20 April 59 / DWG NO 625 - 15



NEWAKHWIN SNOW COURSE

Established Oct. 56 by Work, Moullin, Parko and assistants.

Lat: 36° 49′ 30″N. Long: 44° 17′ 36″ E.

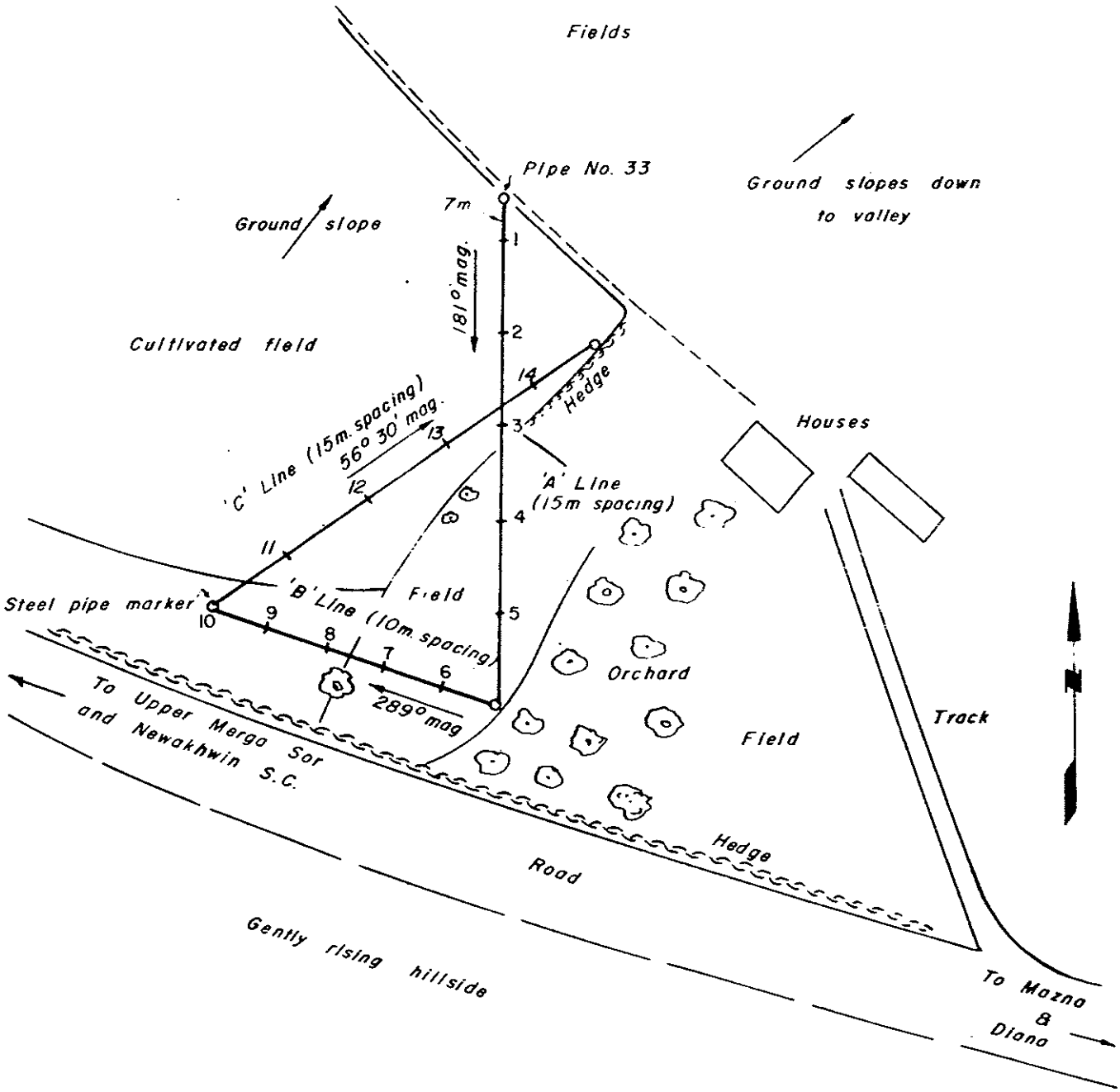
Elevation: 1525 m. (5000 ft.) from 1:20,000 map (86/600).

Sample spacing – 10 meters. No of samples – 10 .

Course marked by one 5 meter and three 4 meter steel pipe markers.

Bearings measured from magnetic north .

GOVERMENT OF IRAQ MINISTRY OF AGRICULTURE		
HYDROLOGICAL SURVEY OF IRAQ		
NEWAKHWIN SNOW COURSE ERBIL LIWA		
HARZA ENGINEERING CO CHICAGO IN ASSOCIATION	BINNIE, DEACON & GOURLEY LONDON	
BAGHDAD, IRAQ	DATE 19 April 59	DWG NO 625 - 14



GUNDA NAWANDI SNOW COURSE

Established Dec. 56 by Moullin and assistants.

Lat: 36° 50' 08" N. Long: 44° 18' 26" E.

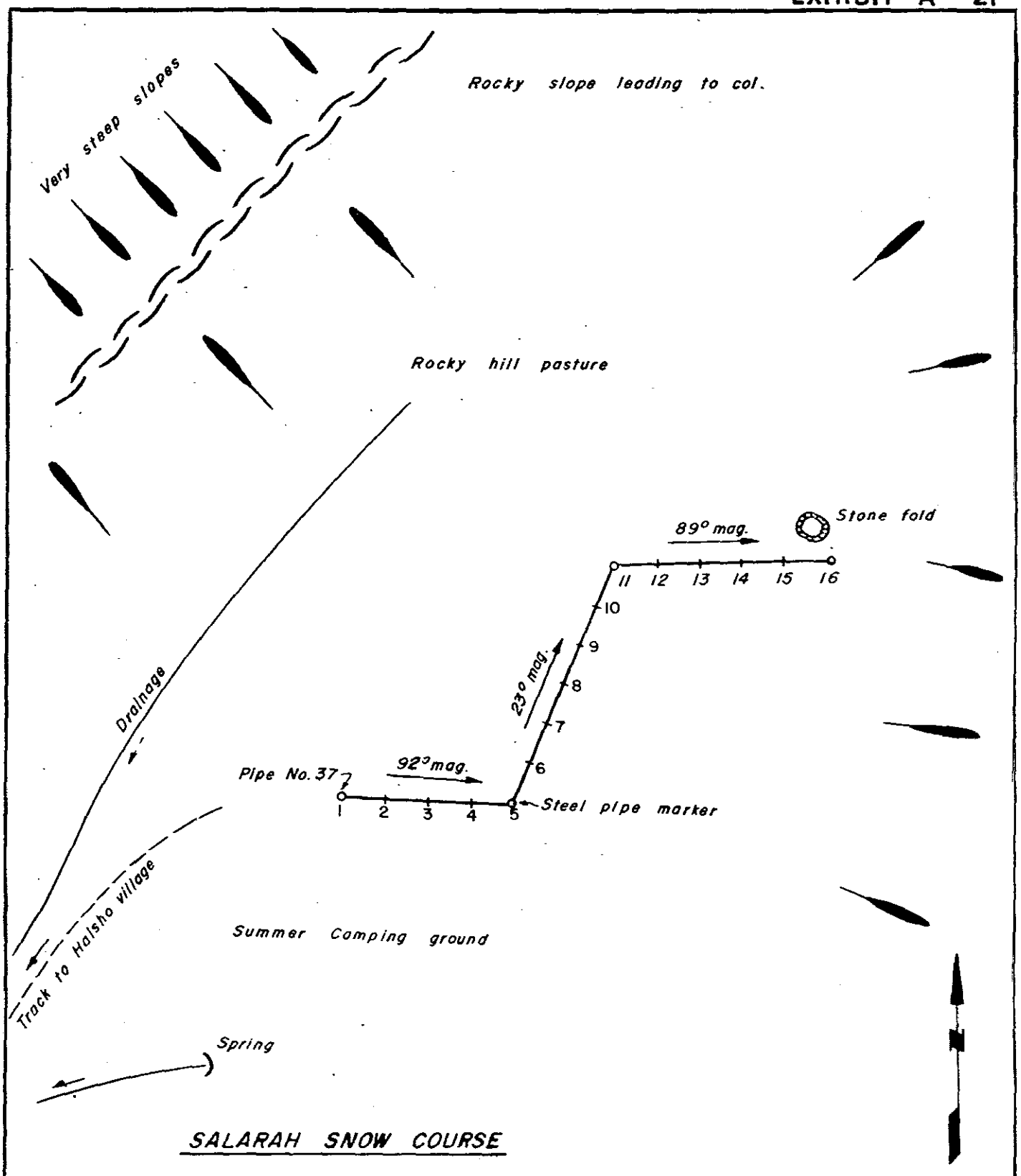
Elevation:- 1100 m. (3600 ft.) from 1:20,000 map (86/600).

Sample spacing:- 10, 15 meters. Number of samples - 14

Course marked by four 4 meter steel marker pipes set at the edges of the fields.

Bearings measured from magnetic north.

GOVERMENT OF IRAQ MINISTRY OF AGRICULTURE		
HYDROLOGICAL SURVEY OF IRAQ		
GUNDA NAWANDI SNOW COURSE ERBIL LIWA		
HARZA ENGINEERING CO CHICAGO IN ASSOCIATION	BINNIE, DEACON & GOURLEY LONDON	
BAGHDAD, IRAQ	DATE 12 May 59	DWG. NO 625-27



SALARAH SNOW COURSE

Established Oct. 56 by Work, Moullin, Brown and assistants.

Lat: 36° 11' 20" N. Long: 45° 17' 41" E.

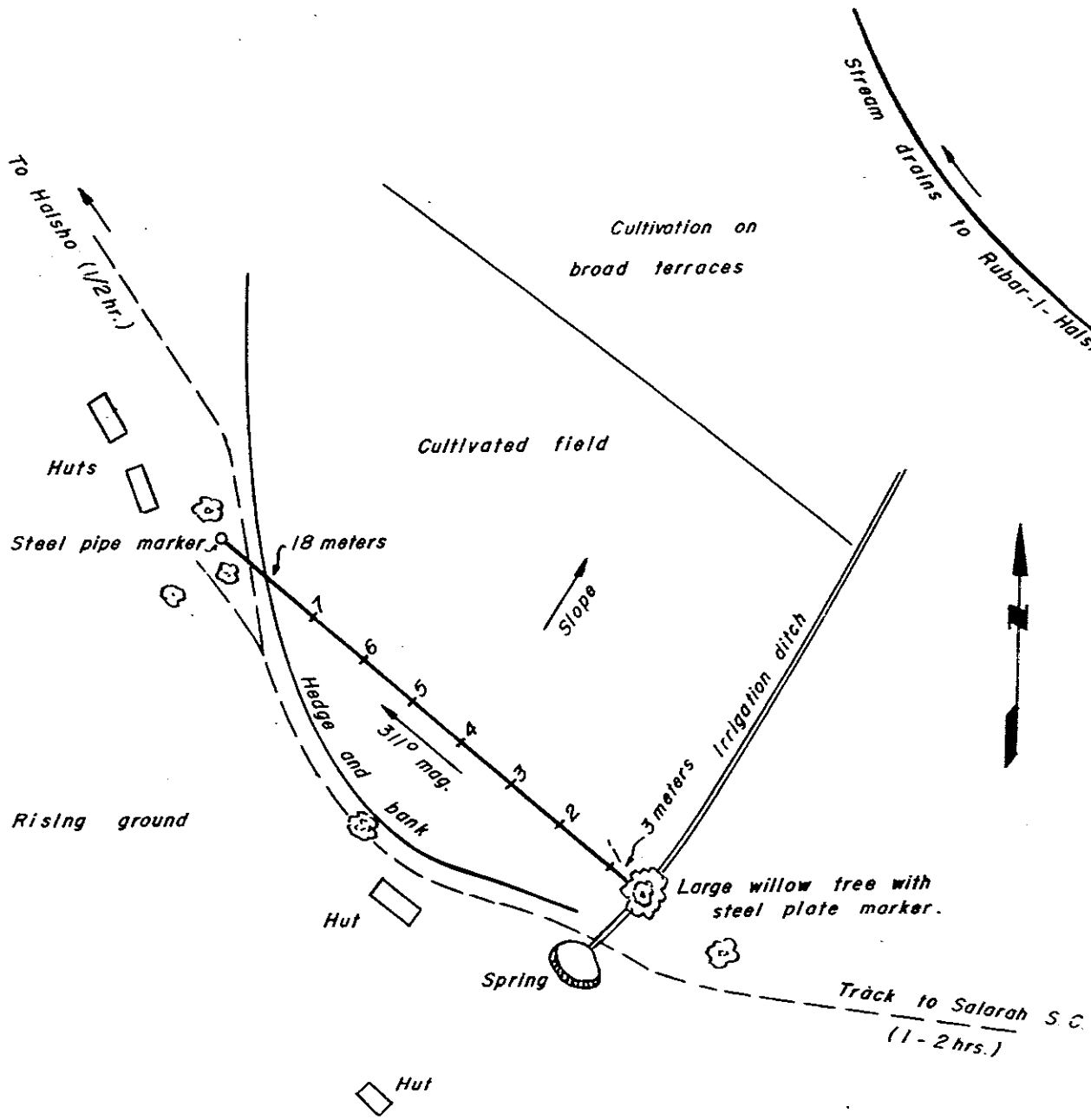
Elevation:- 1890 m. (6200 ft.) from 1:20,000 map (79/690).

Sample spacing – 15 meters. Number of samples – 16.

Course marked by four 5 meter steel pipe markers.

Bearings measured from magnetic north.

GOVERMENT OF IRAQ MINISTRY OF AGRICULTURE		
HYDROLOGICAL SURVEY OF IRAQ		
SALARAH SNOW COURSE SULAIMANIA LIWA		
HARZA ENGINEERING CO CHICAGO IN ASSOCIATION	BINNIE, DEACON & GOURLEY LONDON	
BAGHDAD, IRAQ	DATE 22 April 59	DWG NO 625-17



NURISTA SNOW COURSE

Established Oct. 56 by Work, Moullin, Brown and assistants.

Lat: 36° 11' 50" N. Long: 45° 15' 59" E.

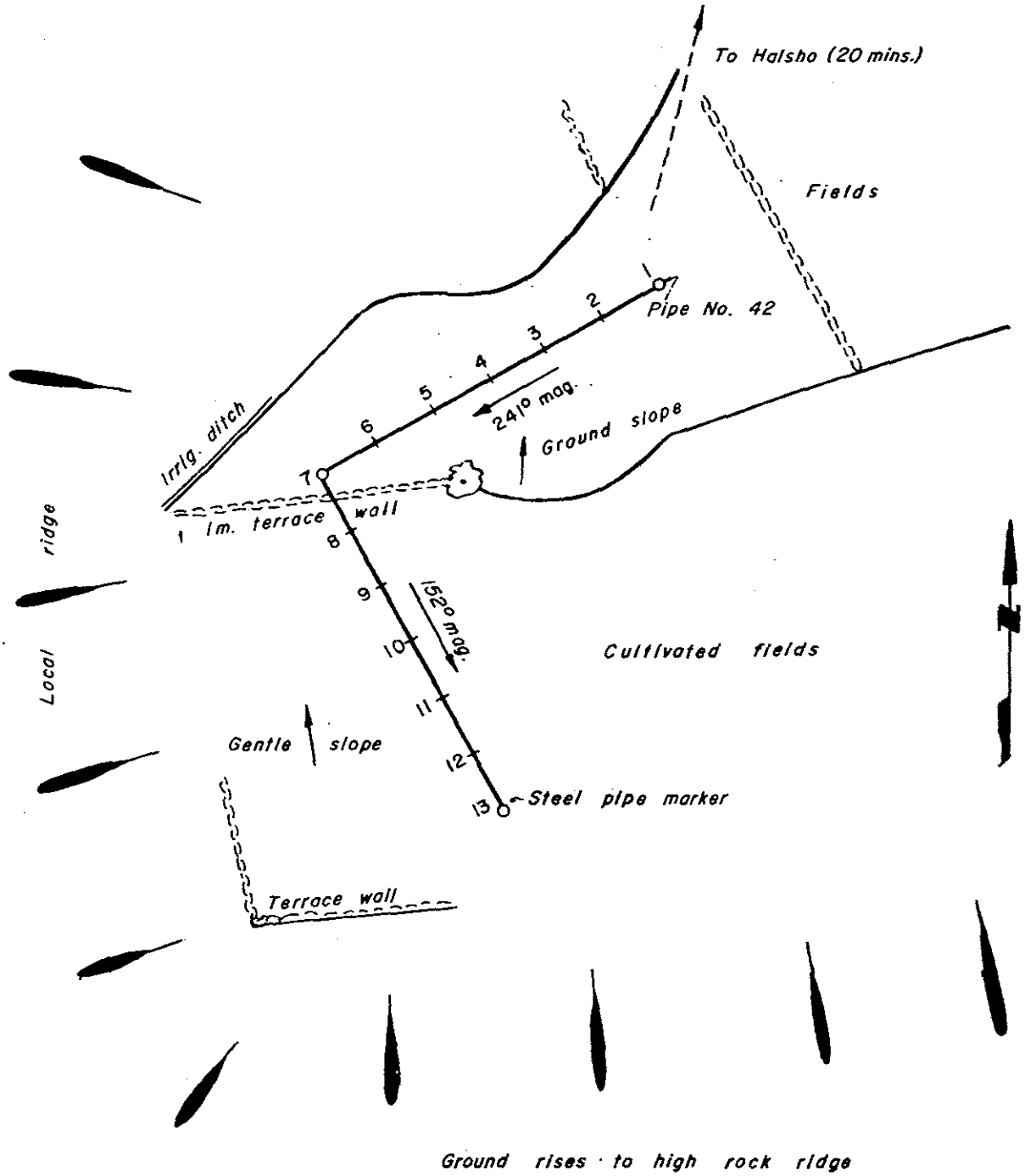
Elevation :- 1340 m. (4400 ft.) from 1:20,000 map (79/680).

Sample spacing - 10 meters. Number of samples - 7

Course marked by one 4 meter steel pipe marker and one steel plate tree marker, 3 meters above ground level.

Bearings measured from magnetic north.

GOVERMENT OF IRAQ MINISTRY OF AGRICULTURE	
HYDROLOGICAL SURVEY OF IRAQ	
NURISTA SNOW COURSE SULAIMANIA LIWA	
HARZA ENGINEERING CO. CHICAGO IN ASSOCIATION	BINNIE, DEACON & GOURLEY LONDON
BAGHDAD, IRAQ	DATE 23April59 DWG NO 625 - 18



HALSHO SNOW COURSE

Established Oct. 56 by Work, Moullin, Brown and assistants.

Lat: 36° 12' 06" N. Long: 45° 15' 12" E.

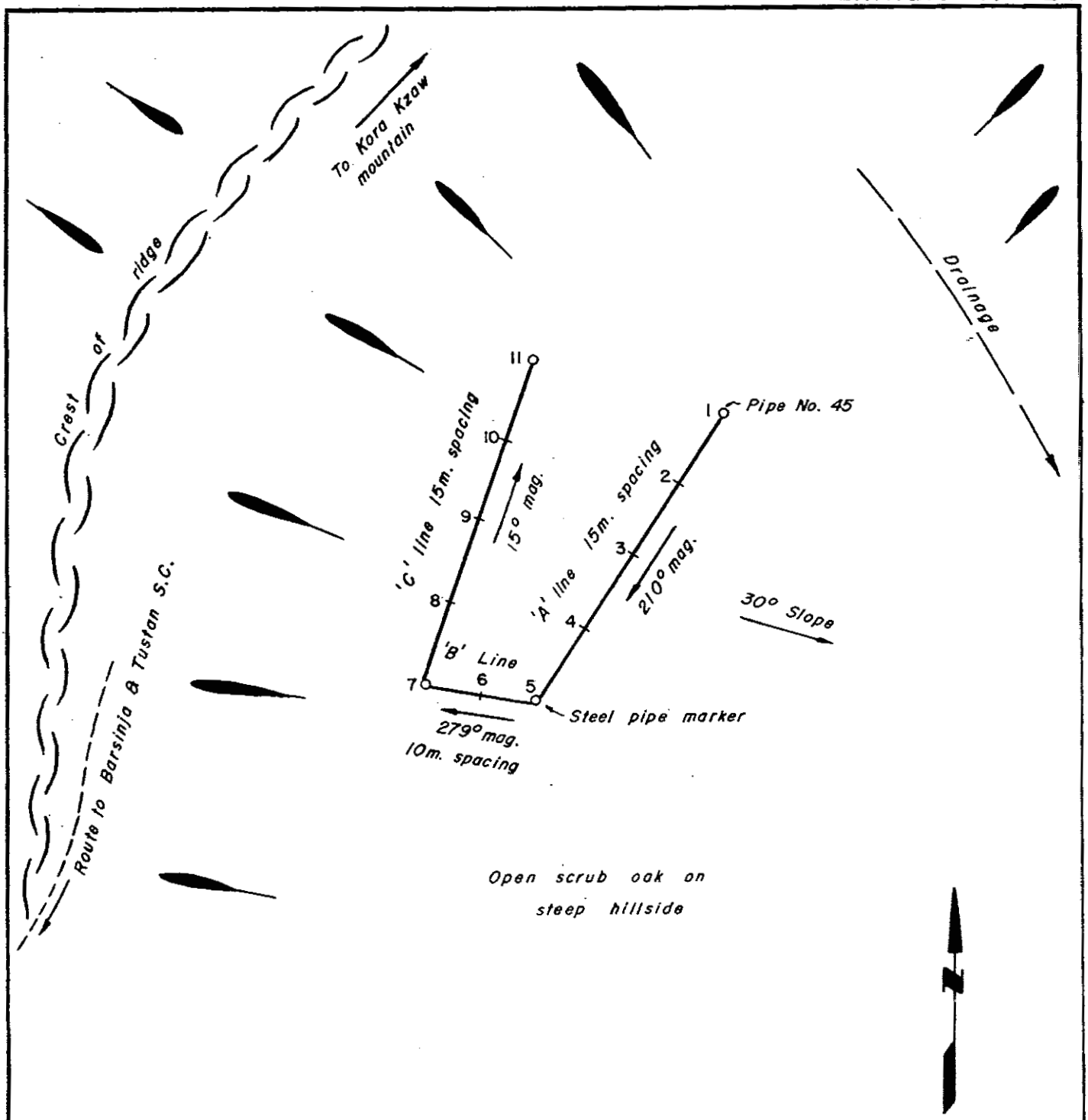
Elevation:- 1250 m. (4100 ft.) from 1:20,000 map (79/680).

Sample spacing - 15 meters. Number of samples - 13.

Course marked by one 5 meter and two 4 meter steel pipe markers.

Bearings measured from magnetic north.

GOVERMENT OF IRAQ MINISTRY OF AGRICULTURE		
HYDROLOGICAL SURVEY OF IRAQ		
HALSHO SNOW COURSE SULAIMANIA LIWA		
HARZA ENGINEERING CO CHICAGO IN ASSOCIATION	BINNIE, DEACON & GOURLEY LONDON	
BAGHDAD, IRAQ	DATE 25 April 59	DWG. NO. 625-19



KORA KZAW SNOW COURSE

Established Oct. 56 by Work, Moullin and assistants.

Lat: 35° 34' 33" N. Long. 45° 42' 02" E.

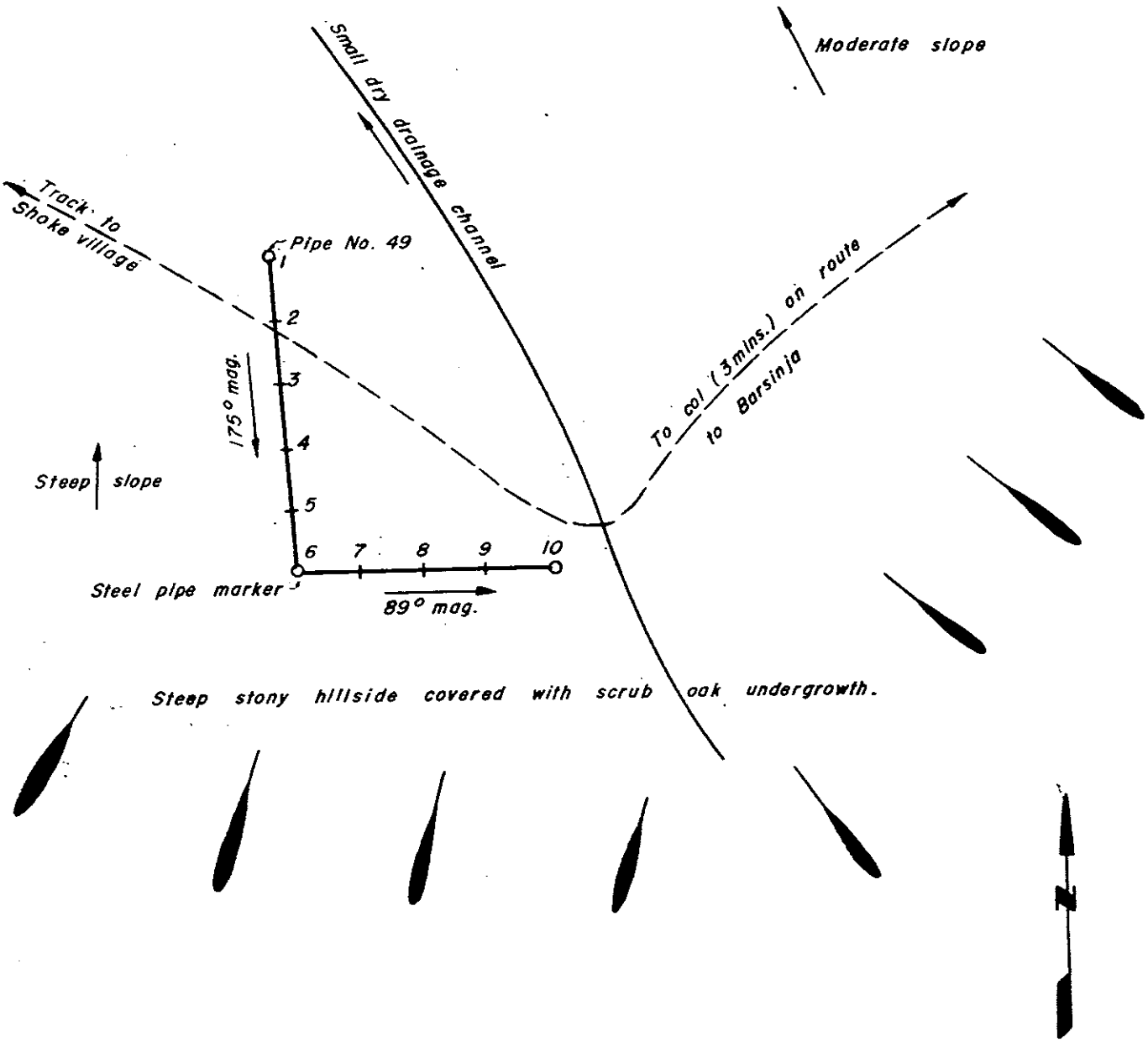
Elevation - 1780 m. (5850 ft.) from 1: 20,000 map (72/720)

Sample spacing - 10 and 15 meters. No. of samples - 11.

Course marked by four 5 meter steel pipe markers.

Bearings measured from magnetic north.

GOVERMENT OF IRAQ MINISTRY OF AGRICULTURE	
HYDROLOGICAL SURVEY OF IRAQ	
KORA KZAW SNOW COURSE SULAIMANIA LIWA	
HARZA ENGINEERING CO CHICAGO	BINNIE, DEACON & GOURLEY LONDON IN ASSOCIATION
BAGHDAD, IRAQ	DATE 26 April 1959 / DWG NO 625 - 20



TUSTAN SNOW COURSE

Established Oct. 57 by Moullin and assistants.

Lat: 35° 33' 38" N. Long: 45° 40' 26" E.

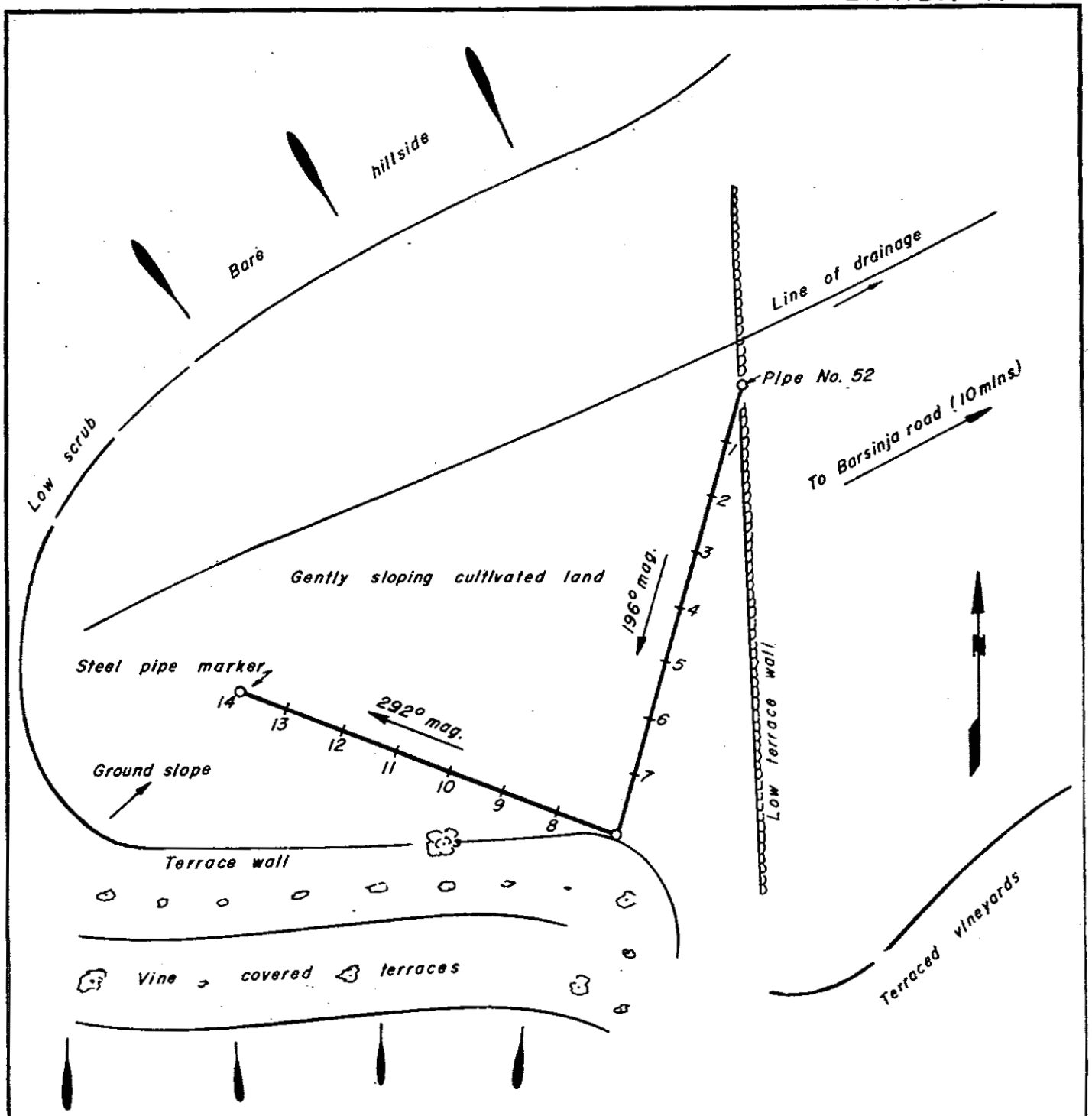
Elevation :- 1520m. (5000 ft.) from 1:20,000 map (72/720).

Sample spacing - 9 meters. Number of samples - 10.

Course marked by three 4 meter steel pipe markers.

Bearings measured from magnetic north.

GOVERMENT OF IRAQ MINISTRY OF AGRICULTURE	
HYDROLOGICAL SURVEY OF IRAQ	
TUSTAN SNOW COURSE SULAIMANIA LIWA	
HARZA ENGINEERING CO. CHICAGO IN ASSOCIATION	BINNIE, DEACON & GOURLEY LONDON
BAGHDAD, IRAQ	DATE 27 April 59 / DWG. NO. 625 - 21



DOWLI TERSCHAKAN SNOW COURSE

Established Nov. 56 by Work, Moullin and assistants.

Lat: 35° 27' 29" N. Long: 45° 41' 38" E.

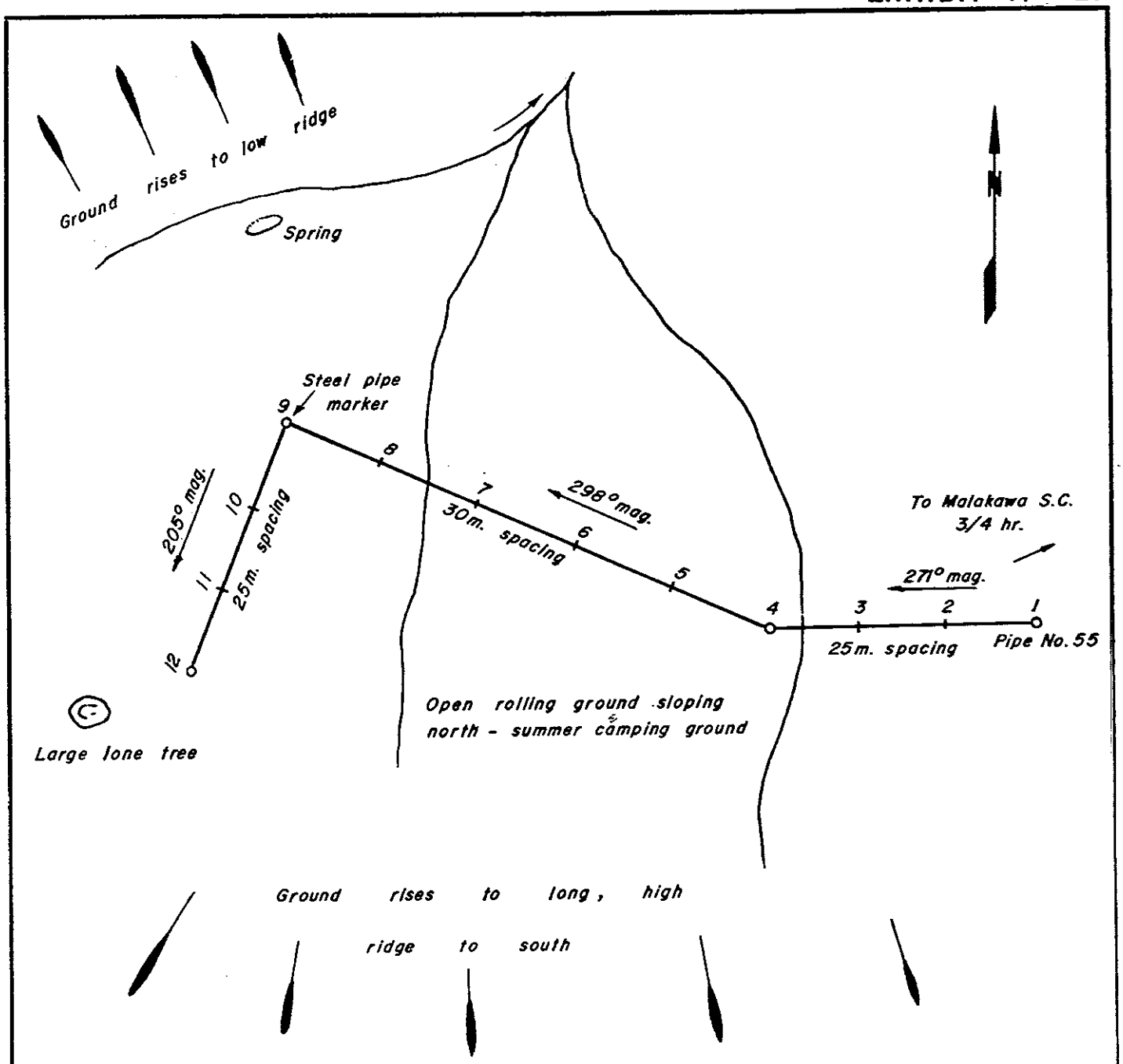
Elevation :- 1220 m. (4000 ft.) from 1:20,000 map (71/720).

Sample spacing - 10 meters. Number of samples - 14.

Course marked by three 4 meter steel pipe markers.

Bearings measured from magnetic north.

GOVERMENT OF IRAQ MINISTRY OF AGRICULTURE		
HYDROLOGICAL SURVEY OF IRAQ		
DOWLI TERSCHAKAN SNOW COURSE SULAIMANIA LIWA		
HARZA ENGINEERING CO CHICAGO	IN ASSOCIATION	BINNIE, DEACON & GOURLEY LONDON
BAGHDAD, IRAQ	DATE 28 April 59	DWG. NO 625 - 22



MIYAN MAMEK SNOW COURSE

Established: Nov. 56 by Work, Moullin and assistants.

Lat: 35° 36' 45" N. Long: 45" 52' 55" E.

Elevation:-1690 m. (5550 ft.) from 1:20,000 map (73/740).

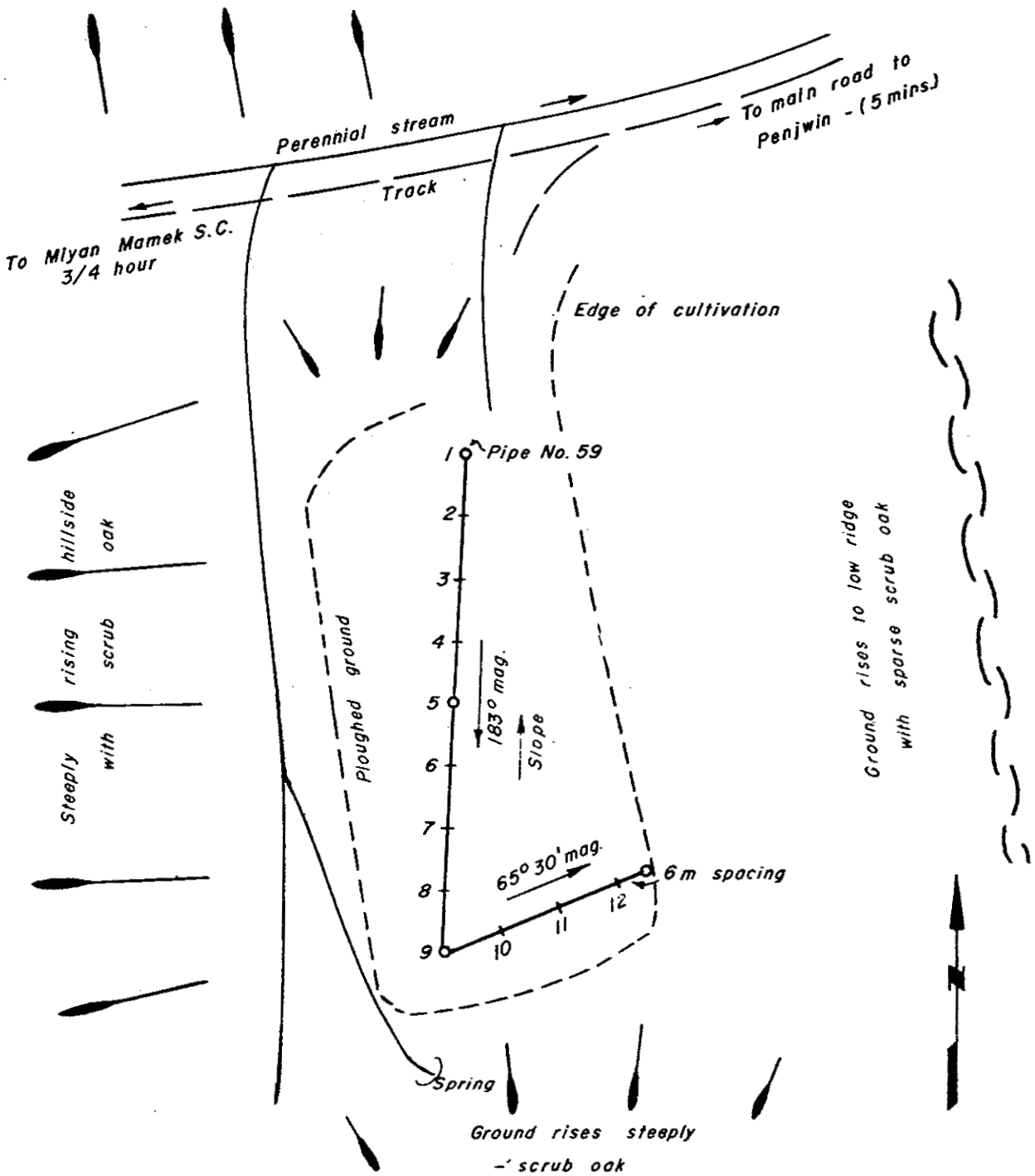
Sample spacing - 25 and 30 meters. Number of samples-12.

Course marked by four 5 meter steel marker pipes.

Bearings measured from magnetic north.

GOVERMENT OF IRAQ MINISTRY OF AGRICULTURE		
HYDROLOGICAL SURVEY OF IRAQ		
MIYAN MAMEK SNOW COURSE SULAIMANIA LIWA		
HARZA ENGINEERING CO. CHICAGO	IN ASSOCIATION	BINNIE, DEACON & GOURLEY LONDON
BAGHDAD, IRAQ	DATE 17 Mar. 59	DWG. NO. 625 - 6

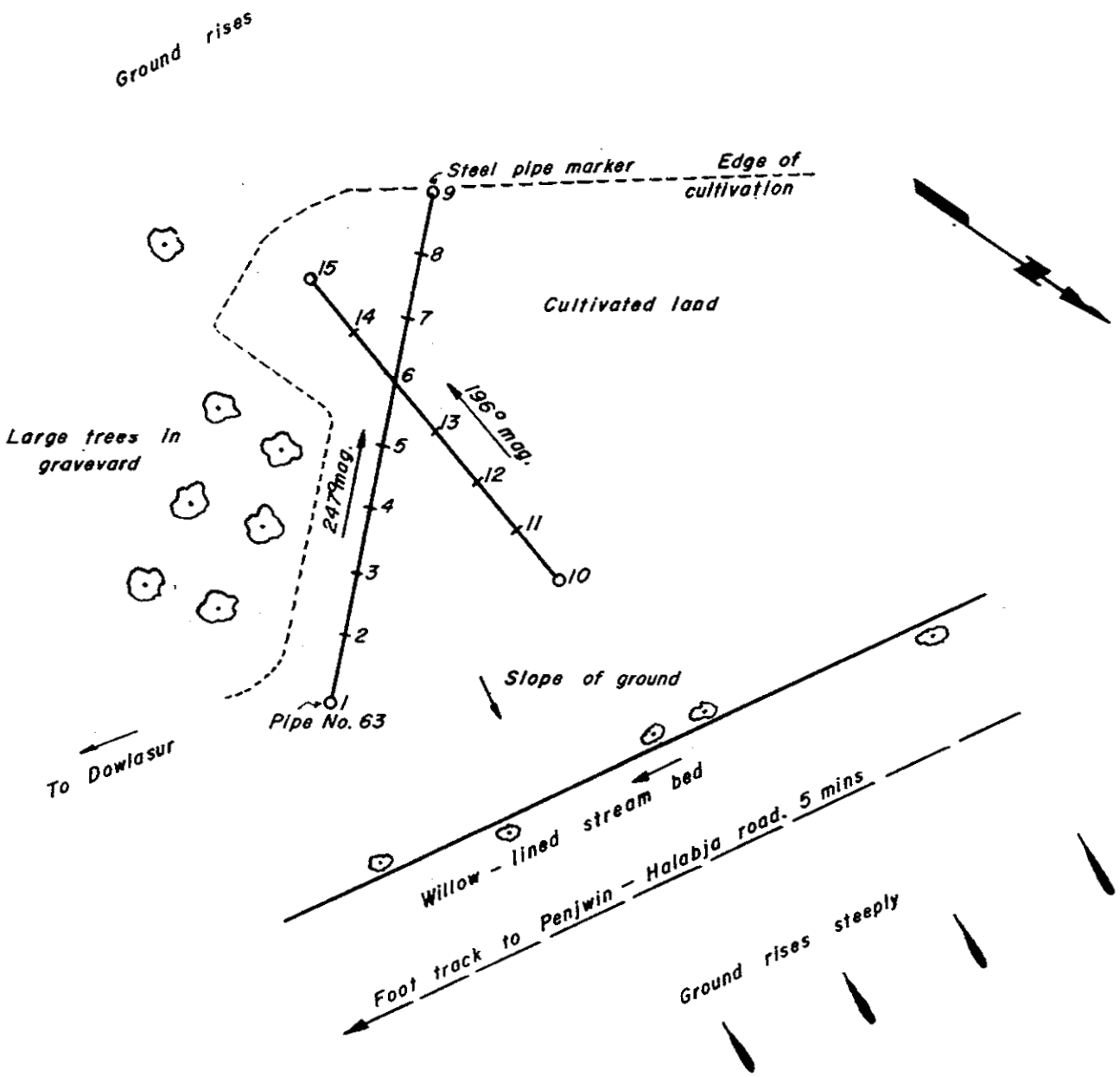
470



MALAKAWA SNOW COURSE

Established Nov. 56 by Work, Moullin and Parko
Lat: 35° 36' 51" N. Long: 45° 54' 18" E.
Elevation:- 1400 m. (4600 ft) from 1:20,000 map (73/740).
Sample spacing - 12 meters. Number of samples - 12.
Course marked by four 4meter steel marker pipes
Bearings measured from magnetic north.

GOVERMENT OF IRAQ MINISTRY OF AGRICULTURE	
HYDROLOGICAL SURVEY OF IRAQ	
MALAKAWA SNOW COURSE SULAIMANIA LIWA	
HARZA ENGINEERING CO CHICAGO	BINNIE, DEACON & GOURLEY LONDON
IN ASSOCIATION	
BAGHDAD, IRAQ	DATE 22 Mar 59 / DWG. NO 625 - 10



General character of area: Course lines in floor of small sheltered E-W side valley

DOWLASUR SNOW COURSE

Established Nov 56 by Work, Moullin and Parko.

Lat: 35° 31' 32" N. Long: 45° 51' 28" E.

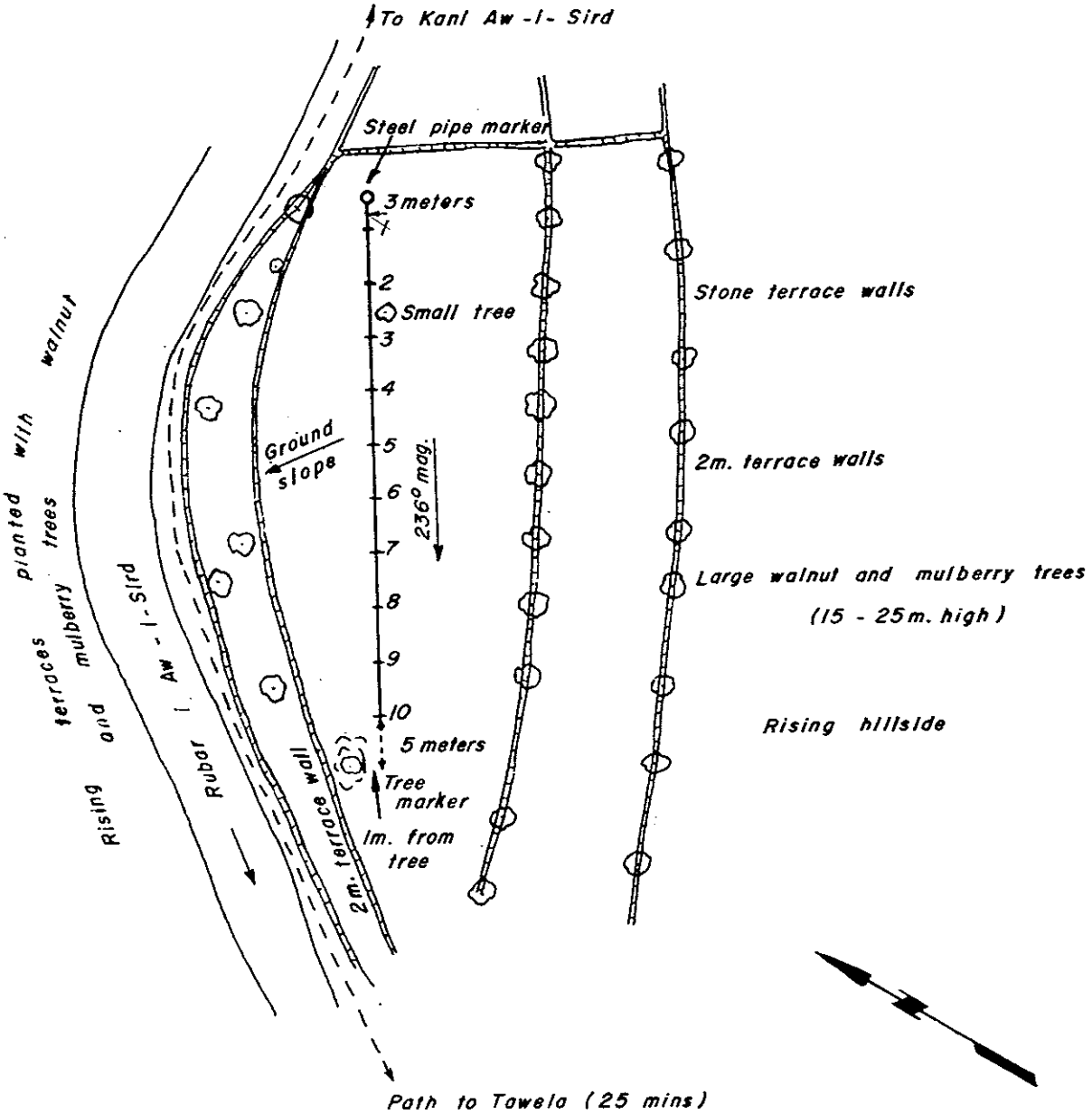
Elevation:- 890 m. (2900 ft.) from 1:20,000 map (72/740).

Sample spacing – 10 meters. Number of samples – 15.

Course marked by four 4 meter steel pipe markers.

Bearings measured from magnetic north.

GOVERMENT OF IRAQ MINISTRY OF AGRICULTURE		
HYDROLOGICAL SURVEY OF IRAQ		
DOWLASUR SNOW COURSE SULAIMANIYA LIWA		
HARZA ENGINEERING CO. CHICAGO IN ASSOCIATION	BINNIE, DEACON & GOURLEY LONDON.	
BAGHDAD, IRAQ	DATE 21 April 59	DWG. NO 625 - 16



General character of area:- Tilled, tree-planted terraces on lower slopes of steep-sided valley

HARNERCLA SNOW COURSE

Established Nov. 57 by Moullin, Gilpin and assistants.

Lat: 35° 12' 40" N. Long: 46° 11' 07" E.

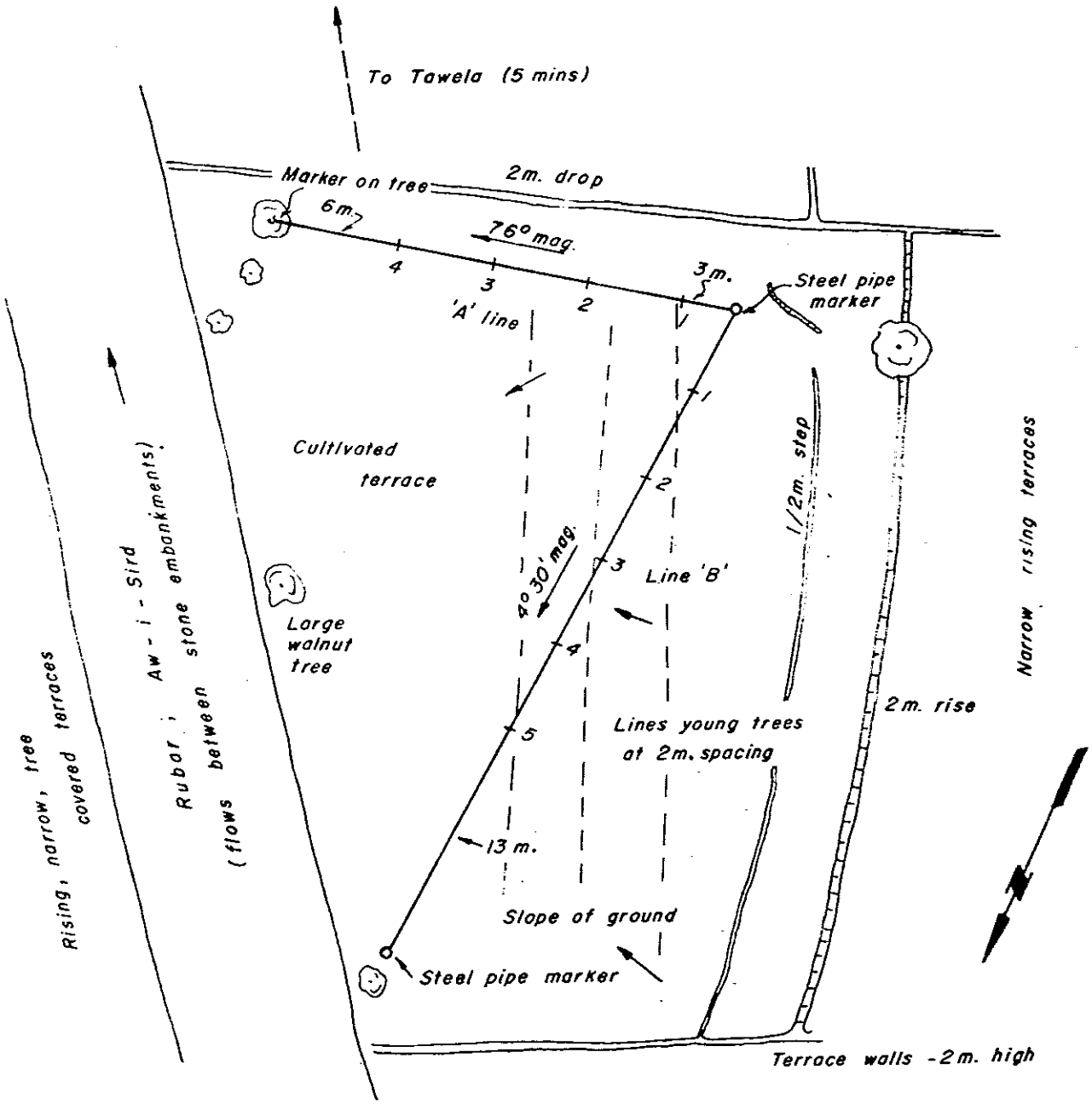
Elevation:- 1620 m. (5300 ft.) from 1:20,000 map (68/770).

Sample spacing - 5 meters. Number of samples - 10

Course marked by one 4 meter steel pipe marker and one steel plate tree marker.

Bearings measured from magnetic north.

GOVERMENT OF IRAQ MINISTRY OF AGRICULTURE	
HYDROLOGICAL SURVEY OF IRAQ	
HARNERCLA SNOW COURSE SULAIMANIA LIWA	
HARZA ENGINEERING CO. CHICAGO IN ASSOCIATION	SINNIE, DEACON & GOURLEY LONDON
BAGHDAD, IRAQ	DATE 24 Mar 59 / DWG NO 625-12



HARNESSI SU SNOW COURSE

Established Nov. 57 by Moullin, Gilpen and assistants.

Lat: 35° 12' 04" N. Long: 46° 10' 54" E.

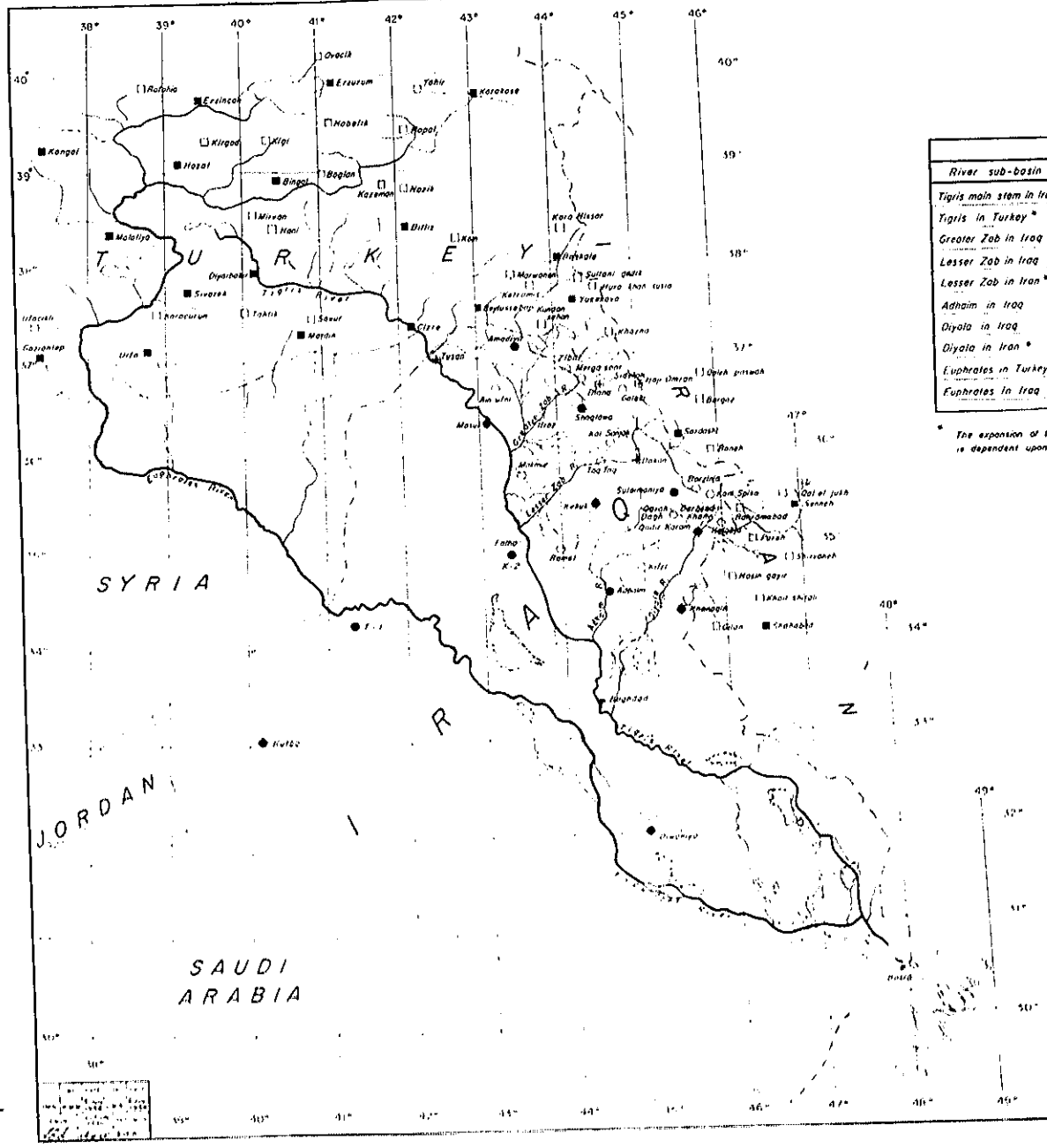
Elevation:- 1480 m. (4850 ft.) from 1:20,000 map (68/770).

Sample spacing - 5 meters. Number of samples - 9

Course marked by two 4 meter steel pipe markers and one steel plate tree marker.

Bearings measured from magnetic north

GOVERMENT OF IRAQ MINISTRY OF AGRICULTURE		
HYDROLOGICAL SURVEY OF IRAQ		
HARNESSI SU SNOW COURSE SULAIMANIA LIWA		
HARZA ENGINEERING CO CHICAGO	IN ASSOCIATION	BINNIE, DEACON & GOURLEY LONDON
BAGHDAD, IRAQ	DATE 23 Mar 59	DWG. NO 625-11



PROGRESS ON METEOROLOGICAL NETWORK EXPANSION

River sub-basin	No. of installations: Non Rec precip	Rec precip	Evap	1956	1957	1958	1959
Tigris main stem in Iraq	2	3	1				
Tigris in Turkey *	11	6	0				
Greater Zab in Iraq	6	3	1				
Lesser Zab in Iraq	4	1	1				
Lesser Zab in Iran *	3	1	0				
Adhaim in Iraq	2	2	0				
Diyala in Iraq	3	3	0				
Diyala in Iran *	7	2	0				
Euphrates in Turkey *	12	11	0				
Euphrates in Iraq	0	3	0				

* The expansion of the meteorological network into Turkey and Iran is dependent upon final international negotiations

LEGEND

- Actual or scheduled installation
- Actual operation
- Proposed nonrecording precipitation gage
- Proposed recording precipitation gage
- Nonrecording precipitation gage installed by H.S.I.
- Recording precipitation gage installed by H.S.I.
- Thermograph installed by H.S.I.
- Recording precipitation gage with temperature installed by H.S.I.
- Evaporation station installed by H.S.I. (includes recording precipitation gage and temperature)

NOTE.

Map shows only the stations installed or proposed by H.S.I. Stations previously installed by meteorological services of Iraq and other countries are not shown.

GOVERNMENT OF IRAQ
Ministry of Agriculture
METEOROLOGICAL SURVEY OF IRAQ

EXPANSION PROGRAM
METEOROLOGICAL NETWORK

620-7

1/75

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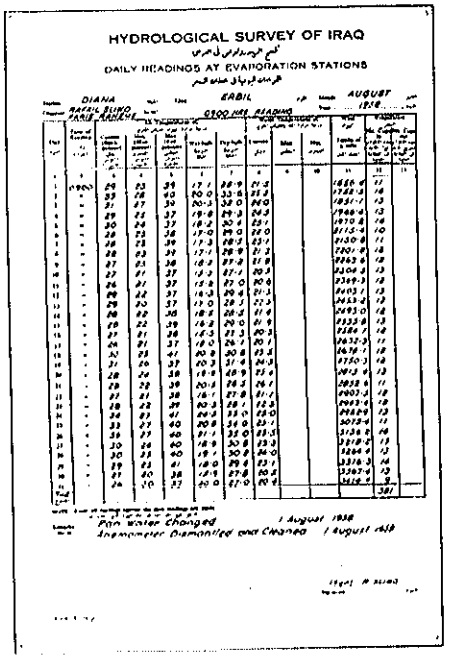
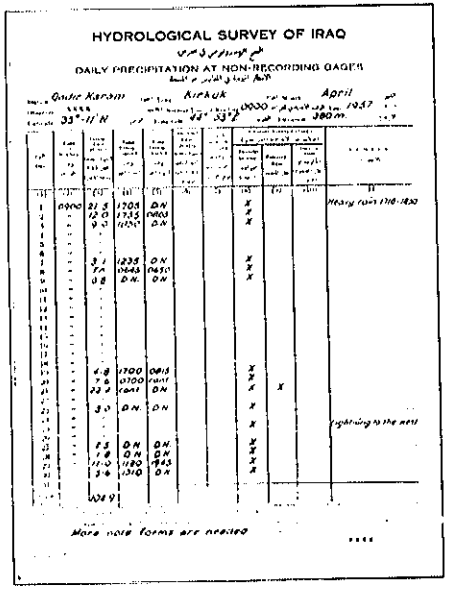
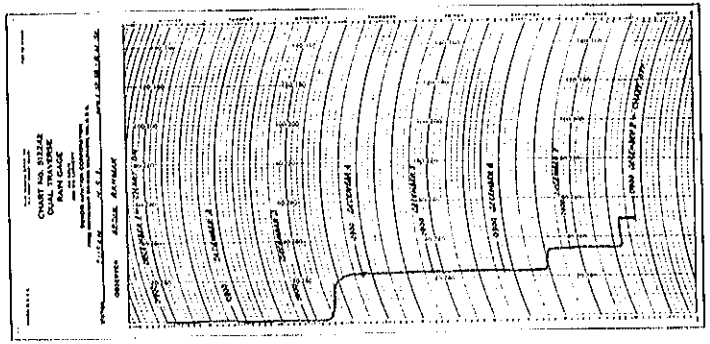


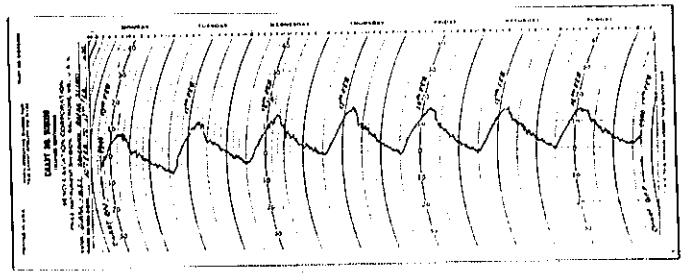
(a) EVAPORATION STATION



(b) NON-RECORDING RAIN GAGE



(c) RECORDING RAIN GAGE CHART



(d) THERMOGRAPH (TEMPERATURE RECORDER) CHART

GOVERNMENT OF IRAQ
MINISTRY OF AGRICULTURE
HYDROLOGICAL SURVEY OF IRAQ

SAMPLE FIELD DATA FOR METEOROLOGICAL STATIONS

HALZA ENGINEERING CO CHICAGO
IN ASSOCIATION
BURNIE, DUNCAN & GOURLEY LONDON
BAGHDAD, IRAQ
DATE 28 AUG 1959
DWG NO 620-21

1/76

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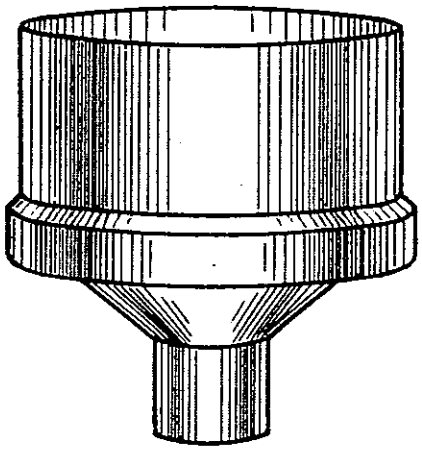

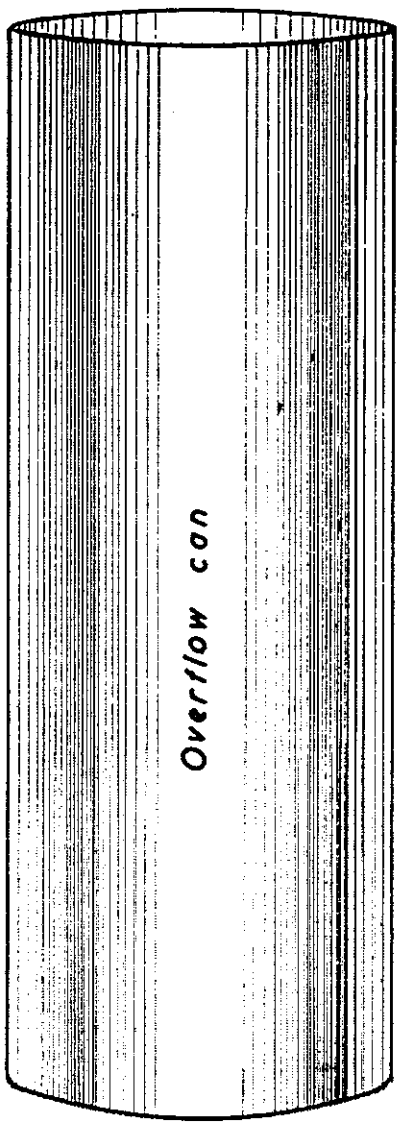

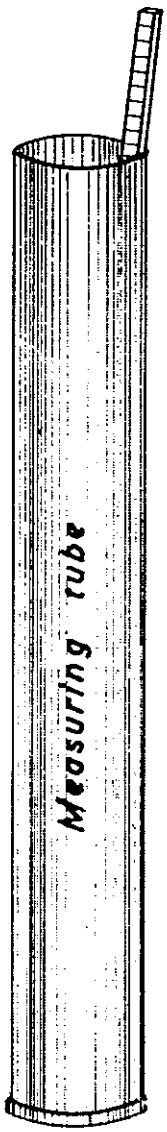

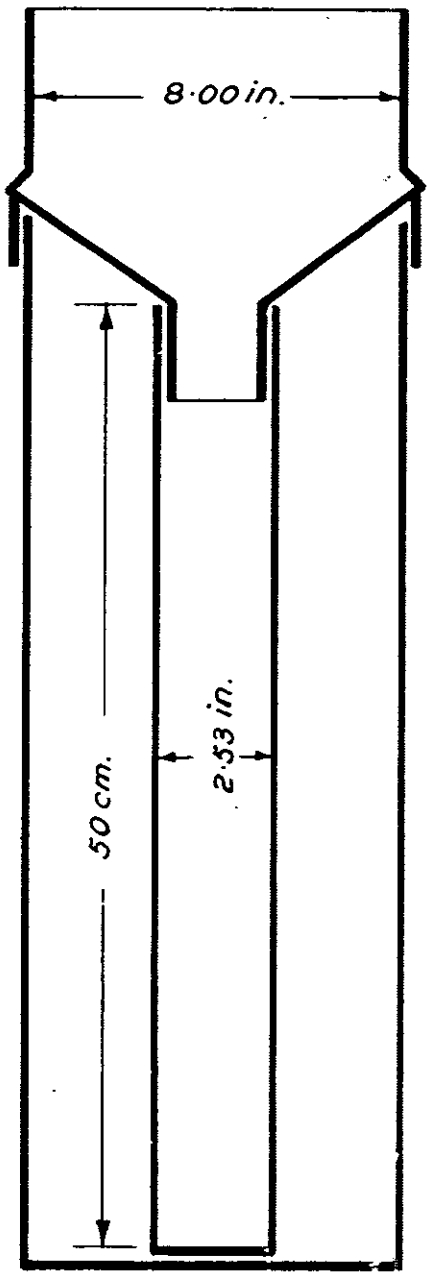

Cross section

GOVERMENT OF IRAQ
MINISTRY OF AGRICULTURE

HYDROLOGICAL SURVEY OF IRAQ

STANDARD NON-RECORDING RAIN GAGE

HARZA ENGINEERING CO. CHICAGO — BINNIE, DEACON & GOURLEY LONDON
IN ASSOCIATION

BAGHDAD, IRAQ | DATE 28 Aug 59 | DWG. NO. 620-20