UNITED STATES AGENCY FOR INTERNATIONAL DEVELOPMENT

ISLAMABAD, PAKISTAN

IRRIGATION SYSTEMS MANAGEMENT PROJECT

PHASE II

Project Number 391-0467

ASSESSMENT OF HYDRAULIC MONITORING EQUIPMENT NEEDS OF PROVINCIAL IRRIGATION DEPARTMENTS

AUGUST 1991

HARZA ENGINEERING COMPANY

DEVELOPMENT ALTERNATIVES, INC.

ASSOCIATED CONSULTING ENGINEERS-ACE (PVT) LTD

CONTRACT NUMBER 391-0467-C-00-9830-00

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Executive Summary

The Irrigation Systems Management, (ISM) Project, Phase-II is designed to increase agricultural production of Pakistan by improving the reliability of water delivery and the equity of water distribution throughout the four provinces. Technical assistance for the project is divided into six major components:

- Rehabilitation/Civil Works
- Operation and Maintenance
- Equipment Management and Utilization
- Monitoring and Evaluation
- Computerization
- Training

Under "Monitoring and Evaluation" and "Training" components, the Technical Assistance team is to help the provincial irrigation departments develop the capabilities of monitoring the operation and performance of their canal systems, collecting hydraulic/sediment data for future revision to hydraulic design criteria for the canals, and cataloguing, computerizing and storing the data for future use.

This report provides an assessment of the hydraulic/sediment monitoring needs of the provincial irrigation departments to effectively monitor the operation and performance of their canals and collect pertinent hydraulic and sediment data for future use. Institutional approaches for data collection and training requirements of the irrigation departments also are discussed.

Type of Equipment

The recommended equipment is suitable for measuring canals and drains, but not the rivers. It includes hydraulic equipment for discharge and stage measurements of canals, sediment sampling equipment for suspended and bed material sampling, and laboratory equipment for particle size distribution analysis of suspended and bed material samples and total suspended sediment concentration analysis.

The types and specifications of the equipment were selected based on the hydraulic parameters of canals and sediment characteristics required for design of alluvial or lined channels, and for monitoring the operation and performance of the canals. The design requirements for hydraulic data were discussed with Mr. Gene Thompson, Chief Design Engineer, Harza and Mr. W.R. Stoneman Provincial Advisor of the Technical Assistance Team, Karachi.

The recommended equipment does not include vehicles, computers and other office assessories.

Activities of ISM/R Project

Under the Irrigation System Management Research (ISM/R) Project, also funded by the United State Agency for International Development, central research units have been recommended in each province. These units are placed under the Chief Engineer, Irrigation Research Institute in the Punjab Province; Director, Design and Hydrology in the Northwest Frontier Province; Director, Hydrology and Research in the Sindh Province and the Chief Engineer in Balochistan Province. The responsibilities of these units are not confined to the monitoring of the canal systems but also include general assessment of water resources both surface water and groundwater and climatology.

The Government of Punjab and NWFP have already submitted the PC-I proformas for these units. However, the quantity of hydraulic and sediment equipment proposed in all four provinces is not sufficient to routinely monitor the operation and performance of the canal systems. Therefore, no credit is given to this equipment in assessing the equipment needs defined in this report.

Institutional Approach

An institutional arrangement for monitoring should be consistent with the objective of a continuing monitoring effort after the termination of the project. Based on discussions with the provincial advisors, provincial coordinators and on the writer's experience, there is consensus that a central unit generally deteriorates over a period. The best approach is to make those engineers responsible for data collection who will be using the data in future.

The data collection efforts include:

- Routine Hydraulic Survey - to check operation and performance of canals for reliability and equity of water distribution
- Detailed Hydraulic Survey - to collect data for future revision of design criteria
- Laboratory and Office Analyses, including computerization and storing of data for future use.

A most feasible institutional arrangement will be to perform the routine survey at divisional levels, and detailed survey and office analyses at circle levels. This will avoid too much need of vehicles and will need only limited additional staff. The additional staff required at a circle level will be one junior research officer, three research assistants, two hydrographers, two field assistants and one driver. The number of circles and divisions responsible for maintenance of canals are 21 and 62 in

Punjab, 16 and 39 in Sindh, 3 and 11 in Balochistan and 4 and 12 in NWFP, respectively.

Equipment Cost

The equipment cost is estimated for three levels of possible funding, and also for a reduced monitoring designated as a "pilot project."

Minimum Operation

Equipment provided at circle levels, the divisions will borrow equipment from the circles for routine survey.

Adequate Operation

Divisions are equipped for routine survey and circles are provided with equipment to perform detailed survey.

Full Operation

Equipment at same levels as for adequate operation, with some additional equipment such as sonic sounders, velocity counters, mechanical sieve shakers, etc.

Pilot Project

A pilot project approach is recommended as an alternate to the above three operations. This is a viable approach because this will provide an opportunity to judge the response and willingness of irrigation engineers and sub-engineers to perform the monitoring efforts. Also initial cost of providing the equipment will be reduced. The pilot project should be started in five circles in Punjab, four in Sindh and two each in NWFP and Balochistan. The monitoring activities should be limited to routine hydraulic survey and limited sediment data collection. The additional staff required at circle level will be two research assistants and one office assistant.

Equipment requirements are estimated based on providing one piece of each item of equipment for a division/circle, except two pieces of the equipment that will be subjected to frequent wear and tear. Spares are provided for about two years of operation.

Minimum Operation

	Local Cost (Rs.) (Million)	Foreign Cost (US$) (Million)
Punjab	2.25	0.521
Sindh	1.66	0.397
Balochistan	0.30	0.071
NWFP	0.38	0.095
Total	4.59	1.084

Adequate Operation

	Local Cost (Rs.) (Million)	Foreign Cost (US$) (Million)
Punjab	5.07	1.142
Sindh	3.24	0.776
Balochistan	0.62	0.167
NWFP	0.73	0.199
Total	9.66	2.284

Full Operation

	Local Cost (Rs.) (Million)	Foreign Cost (US$) (Million)
Punjab	5.12	1.649
Sindh	3.27	1.123
Balochistan	0.62	0.228
NWFP	0.73	0.275
Total	9.74	3.275

Pilot Project

	Local Cost (Rs.) (Million)	Foreign Cost (US$) (Million)
Punjab	0.30	0.229
Sindh	0.97	0.174
Balochistan	0.43	0.095
NWFP	0.39	0.081
Total	3.09	0.579

The above cost does not include the cost for vehicles, computers and office facilities. However, the cost of survey levels and levelling staffs is included in the local cost component.

Training

As part of its agreement with the Federal Coordination Cell, the Alluvial Channels Observation Project is providing limited training to the sub-engineers (overseers), assistant engineers (sub-divisional officers), and executive engineers. The field training is well organized. However, the training documents given to the trainees are not designed to provide step-by-step instructions to conduct routine and detailed surveys, and to interpret, evaluate and analyse the data for checking the operation and performance of the canals and for future design. Also the irrigation staff cannot utilize this training now because of non-availability of equipment. Between today and the procurement of equipment, they may forget whatever was learned.

At the time of delivery of the equipment to circles/divisions, a new training program will have to be planned and implemented under the supervision of a hydraulic/sediment monitoring specialist. The training documents should be rewritten by the specialist.

The new field and office training program should be confined to the procedures suitable for monitoring the operation and performance of the canals, and for collection of hydraulic parameters and sediment characteristics for possible revision of the hydraulic design criteria in future. The program may include, but not be limited to, the following.

Field Methods

1. Canal Stage Measurement
   - Daily Observations
   - During Routine and Detailed Surveys

2. Canal Discharge Measurement
   - Wading Method
   - Boat Method
   - Calibrated Control Structures

3. Canal Sediment Sampling
   - Suspended Sediment
   - Bed Material

4. Watercourse Measurement
   - Wading Method
   - Portable flumes
   - Outlet Geometry

5. Precautions and Potential Errors in Measurements

6. Laboratory Procedures for Sediment Analyses

Training Documents

1. Purpose of Canal Surveys
2. Methods of Stage and Discharge Measurements
3. Development of Stage - Discharge Relationships
4. Sediment Sampling and Analyses
5. Data Interpretation, Evaluation, Reduction and Compilation
6. Evaluation of Reliability of Water Delivery and Equity of Water Distribution.

Introduction

This report was prepared by Khalid Jawed, Senior Hydrologist from Harza Engineering Company, Chicago, during his assignment in Pakistan as Hydraulic/Sediment Equipment Specialist on Irrigation Systems Management (ISM) Project, Phase II, from December 7, 1990 through January 14, 1991 and August 05 to 16, 1991. The information provided and the opinions expressed in the report are based on:

- Information/data available from various reports prepared by Alluvial Channels Observation Project (ACOP) on Irrigation Systems and Rehabilitation and Management Project, Phase-II;
- Various reports and correspondence on ISMP-II provided by Mr. Mehboob Karim, Monitoring and Evaluation (M&E) Specialist, and Mr. Adil Hasni, Training Specialist, Harza Engineering Company, Islamabad;
- Meetings held with Provincial Advisors of Technical Assistance (TA) team of Harza Engineering Company and Provincial Coordinators from Provincial Irrigation Departments (PIDs) of Punjab, Northwest Frontier (NWFP), Sindh, and Balochistan.

Background

The ISM project is intended to directly support the activities of the PIDs in the construction, operation, and maintenance of irrigation and drainage systems. Each department has extensive field organisations and a provincial secretariat with officers responsible for design, planning, equipment management, hydraulic and sediment monitoring, and research. However, the capabilities of each department vary widely in successfully performing their responsibilities.

Irrigation systems of Pakistan are quite old and were designed based on the accepted design criteria at that time. Over the period, the water supply sources to the canal systems have changed due to the construction of storage reservoirs and development of ground water. The canal systems are generally run at discharges higher than the design capacities to meet the increased food demands of the increasing population. Under these changed conditions, some of the channels have become stable but others have problems. However, all channels need periodic maintenance for efficient running.

Since the goal of the ISM project is increasing agricultural production by improving the reliability of water delivery and the equity of water distribution in the irrig. systems throughout the four provinces, the activities of the project were directed to

rehabilitation planning and design, and physical improvements to selected canal systems, to monitoring and evaluation of the result of physical improvements, and provision of necessary training to the PIDs staff to ensure future efficient operation and maintenance of the systems. The TA team provides assistance in each activity to the PIDs.

For rehabilitation planning and design of canals carrying discharges higher than the design capacities and for redesign of canal with hydraulic problems, the existing conditions of the canals in respect of sufficient and reliable observed hydraulic parameters and sediment transport rates were required in order to use the state-of-the-art alluvial channel design criteria. These data were not available with the PIDs. The primary reasons for the non-availability of the data were:

- Absence of specialized institutional arrangement to collect and analyse the data,
- Lack of interest among the engineering staff for monitoring the operation and performance of the canal system or inexperienced staff,
- Practically no hydraulic/sediment monitoring equipment.

Because of current inability of the PIDs to collect hydraulic/sediment data, the United States Agency for Int. Development (USAID) through the Federal Coordination Cell, Office of the Chief Engineering Advisor, Ministry of Water and Power (FCC) engaged ACOP to collect necessary limited hydraulic/sediment data to achieve the objectives of the ISM-II project. This arrangement is temporary and will be terminated at the end of the project. Each PID is required to gain tech. knowledge of data collection, train its regular staff for field and office procedures, and perform all future monitoring for the operation and performance of the canal systems.

The canal systems/subsystems for hydraulic/sediment data collection by ACOP were selected by the PIDs for condition surveys and redesign and by USAID for impact monitoring. The details of these systems/subsystems are provided in an agreement dated May 1989, between FCC and ACOP, and periodic progress reports issued by ACOP. The tasks performed by ACOP include:

- Condition survey;
- Detailed hydraulic/sediment data collection on problematic channels;
- Hydraulic impact evaluation of selected channels proposed for rehabilitation;

- Training to PID staff in hydrologic, hydraulic, sediment and morphologic data collection and analysis.

The details of the above tasks and procedures to perform these tasks are provided in the agreement dated May 1989 between FCC and ACOP, and a letter dated Feb. 06, 1990 from Mr. Alvin P. Newman, Chief Water Resources Division, Agricultural and Rural Development, USAID, addressed to Mr. R. K. Anver, Secretary, Irrigation and Power Department, Government of the Punjab, Lahore.

Objective of the Report

The objective of this report is to help development of an effective hydraulic/sediment monitoring program in each PID to monitor the operation and performance of its canal and drainage systems. The major tasks are:

1. Assess hydraulic/sediment monitoring equipment needs of each PID for its canal system;

2. Prepare alternate equipment procurement lists and specifications for different levels of possible funding by USAID;

3. Investigate local availability of the equipment and evaluate its suitability for the monitoring program;

4. Prepare cost estimates based on alternative equipment procurement lists in local and foreign components;

5. Suggest an appropriate institutional approach for each province for hydraulic/sediment monitoring of its canal systems;

6. Evaluate the hydraulic/sediment monitoring training program being carried out by ACOP and suggest any desirable modification;

7. Prepare a follow-up monitoring program for each province.

Scope of the Report

The report covers the following major topics.

- Hydraulic/Sediment Monitoring by PIDs
- Equipment Requirements of Punjab Province
- Equipment Requirements of Sindh Province
- Equipment Requirements of NWF Province

- Equipment Requirements of Balochistan Province
- Training of PIDs Personnel
- Recommended Monitoring Program for PIDs.

Hydraulic/Sediment Monitoring by PIDs.

Project Requirements

The ISM-II project is designed to develop capabilities in each PID so that after the completion of the project, the PIDs can assure a sustainable system of irrigation operation and management without any external help. Technical assistance for the project is divided into six components:

- Rehabilitation/Civil Works
- Operation and Maintenance
- Equipment Management and Utilization
- Monitoring and Evaluation
- Computerization
- Training

Under the component of "Monitoring and Evaluation," the TA team is to help the PIDs develop the capabilities for monitoring the operation and performance of their irrigation and drainage systems by collecting and evaluating the hydraulic, sediment and morphological data. These data are essential for the future rehabilitation or redesign of the system. The type of data required to be collected by the PIDs will include:

1. History of systems/sub-systems

- Sedimentation in channel bed
- Excessive silt movement through outlets
- Continuous shortages on the outlets at tail
- Encroachment on canal freeboard
- Overgrowth on berms
- Frequent canal breaches

2. Hydraulic Parameters

- Discharges measured by current meters at head and tail, and at other regulating structures
- Discharges estimated at regulating structures using empirical relationships
- Discharges measured by current meters and by empirical relationships at outlets, and geometry of outlets
- Water surface profiles for selected reaches of the systems/subs-systems, within these reaches also collect:
  - Cross sectional profiles at four locations
  - Discharge measurement at one of the cross section including velocity profiles at three verticals

3. Sediment Observations

- o Depth integrated samples at 3 to 10 verticals depending upon the width of channel, at the cross section where discharge was measured.
- o Bed material samples at three verticals (1/6, 1/2, 5/6 of width)
- o Boil samples at regulators

4. Morphological Data

- o Longitudinal profiles of canal beds
- o Cross sectional profiles at selected intervals within a study reach

5. Laboratory and Office Analyses

- o Suspended sediment and bed material samples analysis
- o Cataloguing and computerization of data

The history of systems/sub-systems will help the PIDs to identify the problems with the systems. A channel reach may be considered problematic if one or more of the following is true:

- o Canal cannot pass the design discharge
- o Chronic shortages exist at the tail
- o Periodic silt clearance is required
- o Frequent breaches occur
- o Berms are overgrown
- o Heavy silt passes through outlets

The PIDs, based on the evaluation of the hydraulic, sediment and morphological data will take the necessary corrective measures. If a canal is problematic, it should be redesigned. If a canal is non-problematic but is carrying discharge higher than the design capacity and also needs some modification to the outlets, it should be rehabilitated.

The hydraulic data will help to check the reliability and equity of the system. Reliability is defined as "average percent of days that a planned water supply was available to the tail outlets." Equity is considered as a relationship between water delivery to the farmers near the head versus the farmers near the tail. This

is analysed by comparing the ratio of delivered discharge to design discharge in the head reach versus tail reach outlets.

The above project requirements can be further reclassified into three categories:

- o Routine Hydraulic Survey
- o Detailed Hydraulic/Sediment Survey
- o Laboratory and Office Analyses

The routine survey will essentially involve: updating the performance history of the system/sub-system, at least three or four discharge measurements by current meter during the year at selected locations on the canals (head, tail and other regulating structures), comparison of measured and computed discharges (from empirical relationships of regulating structures or old stage-discharge relationships), comparison of measured (by current meter) and computed (by empirical relationships) discharges of outlets, and survey of longitudinal profiles of canal beds and cross sectional profiles during closure of the system/sub-system. This survey will provide data on the operation and performance of the systems and help to identify the canals that need rehabilitation or redesign.

The detailed hydraulic/sediment survey should be conducted periodically on selected sub-reaches of problematic canals. This will include: survey of water surface profile, discharge measurement and vertical velocity profiles at a selected location within the sub-reach, at least four cross sectional profiles, suspended and bed material sampling, and longitudinal bed profile. This survey will provide data to update the hydraulic design criteria from time to time.

The office analyses will involve establishment and maintenance of sediment laboratory, and cataloguing and computerization of the hydraulic/sediment data.

Current Monitoring Practices:

According to general irrigation practices the field divisions of the PIDs are required to update the history of the systems, collect some hydraulic data including discharges on a routine after every five years basis, and observe longitudinal and cross sectional profiles during the closures of the canals. However, over the years, this practice has been discontinued because of the reasons discussed under the section entitled "Background". Currently, these observations are only made by the PID field divisions on the systems which need repair or improvement.

Type of Equipment

Since this report primarily addresses the requirements of each PID to monitor the operation and performance of its irrigation and drainage systems, the equipment is selected consistent with these two functions. The PIDs also may need equipment for monitoring flow and sediment in the natural streams, for

measuring climatic parameters to determine irrigation water requirements or to perform sedimentation survey in existing reservoirs. The equipment for these tasks is not included. The selected equipment is only suitable for measuring canals and drains and includes:

1. **Hydraulic Equipment:**

Current meters, wading rods, tag lines, headsets, velocity counters, stop watches, waders, boat improvizement sets, sounding reels and accessories, sounding weights, staff gages, water level recorders and survey levels.

2. **Sediment sampling Equipment:**

Handheld and cable suspended depth integrating suspended sediment samplers and bed-material samplers.

3. **Laboratory Equipment:**

Sediment concentration and particle size analysers; balances, ovens, sieve sets, pipette, desiccators, evaporating dishes, cylinders, beakers, etc.

Basis for Equipment Needs

The equipment requirements for each province are discussed in the subsequent sections. These requirements are assessed based on the following criteria:

- Numbers of regions (chief engineers), sub-regions (superintending engineers), divisions (executive engineers) and sub-divisions (sub-divisional officers)
- Areal extent (physical locations) of regional, sub-regional, divisional and sub-divisional offices.
- Minimum transport need to monitor operation and performance of the system
- Maximum participation of field staff

Equipment Requirements of Punjab Province

Field Visit

A field visit was made to Lahore from December 31. 1990 to January 3, 1991. The purpose of the visit was to discuss with the Provincial Advisor of the TA team, Mr. Rue Boswell, and the Provincial Coordinator of the PID, Mr. C.M. Ashraf, (1) the institutional approach for future monitoring of the operation and performance of the irrigation canal and drainage systems and (2) to assess the type and quantity of hydraulic/sediment monitoring equipment required by the PID. The following persons also were contacted to better understand the previous and current monitoring practices in the province and the type of equipment in use.

1. Mr. Ramiz Ahmed Malik, Chief Engineer PID (retired), O&M Specialist, Harza TA team,
2. Mian Abdul Khaliq, Superintending Engineer PID (retired), Harza TA team,
3. Mr. M. Qayyum Bhatty, Senior Research Officer, Irrigation Research Institute, PID,
4. Tariq Masood, Director Hydrology and Research, WAPDA.

The following information was obtained during discussions with the above persons:

1. About 62 divisions and 21 circles under the control of five regional chief engineers are responsible for monitoring the operation and performance of the canal and drainage systems.

2. A list of equipment was provided which included fibre glass boats, life jackets, current meters, wire rope, sounding reels, meter flumes, velocity rods, echo sounders, sounding rods, stop watches, depth integrating samplers, bed load samplers, and analytical balances. The number of each item was based on two to eight sets per division. The quantity required was judged to be too high. It was pointed out that instead of using meter flumes, sounding rods or velocity rods, latest equipment to measure discharge and depth of water should be used. Mr. Ashraf agreed and asked to reframe the list according to the criteria selected by Harza. Also bed load samplers are not required. Bed material samplers will be needed.

3. PID used to collect hydraulic data on the canal system but over the years, this practice has deteriorated. Currently, the problematic canals are judged by field inspections only.

4. Discharge Division Lahore is equipped with

instruments to measure discharges. Its activities are confined to river discharge measurements. It has never been involved in canal measurements.

5. At headworks, the executive engineers headworks have current meters which are used to measure diversions into the canals at the barrages. The executive engineers in charge of canals occasionally make discharge measurements, mostly using velocity rods.

6. C.M. Ashraf agreed that the routine monitoring to check the operation and performance of the canals should be at divisional levels while the detailed hydraulic and sediment data collection, and office analysis, including sediment laboratory should be at circle levels.

7. A few manufacturers in Lahore can provide wading rod sets, sounding weights, boat improvizment sets, hanger bars, flat bottom fibre glass boats, levels and accessories (imported, locally available), staff gages, depth integrating samplers and stop watch (imported, locally available). The costs of these items were obtained through Mr. Tariq Masood.

Irrigation and Drainage Systems

The irrigation and drainage systems in the Punjab Province are under the administrative control of five chief engineers. The number of field units responsible for operation and maintenance of canal and drainage systems are given in Table 1. This table does not include the tubewell divisions, divisions working under the Chief Engineer Floods and Chief Engineer Coordination, and the divisions responsible for bunds (levees). There are five chief engineers (regions), 21 superintending engineers (circles), 62 divisions and 270 sub-divisions.

Activities of ISM/R Project

Under the Irrigation System Management Research (ISM/R) Project, some hydraulic equipment was recommended for the Irrigation Research Institute, (IRI), Lahore. This equipment is only sufficient for the routine operation of the IRI. However, it was learned from Mr. M. Qayyum Bhatty, SRO, that the IRI has prepared a PC-I proforma entitled, "Strengthening, Modernization and Re-organisation of Irrigation Research Institute, Lahore dated June 1990." In this proforma, a field unit is proposed for hydraulic and sediment monitoring. A cost estimate of about 4.5 million rupees is shown to procure sediment samplers, current meters, water level recorders and other undefined equipment. The responsibilities of the field unit are not defined. Mr. Bhatty could not explain whether this unit is supposed to replace the

monitoring duties of canal divisions and circles. Because of uncertainty about the responsibility of the proposed unit, this is assumed to be non-overlapping with the monitoring proposed in this report.

Recommended Institutional Approach

As discussed under the section entitled, "Hydraulic/Sediment Monitoring by PIDs", three tasks are identified.

- Routine Hydraulic Survey
- Detailed Hydraulic/Sediment Survey
- Laboratory and Office Analyses

Four alternative institutional arrangements can be considered to perform the above tasks.

1. A central unit for the province
2. Regional units under chief engineers
3. Sub-regional units under superintending engineers
4. Divisional units under executive engineers

A central unit for the whole province is technically not feasible because the routine survey must be performed under the administrative and technical control of the executive engineers or superintending engineers incharge of the maintenance works. If the survey is performed by a central unit, the local engineers may not cooperate with the survey parties. Also because of the large irrigation system, the transport need and its maintenance, and additional staff required for the surveys will require a large annual budget.

If the central unit is made responsible only to obtain the data from the field units, interpret, analyse and prepare the data for further use, there will be problems with the accuracy of the data collected by the field staff. This may create controversies between the central unit and field units, adversely affecting the monitoring system.

Having the monitoring units at divisional levels responsible for field data collection and office analyses will be highly desirable. However, this will require a large field and office staff and equipment for the 62 divisions in the province.

A most feasible institutional arrangement recommended for the province will be to perform the routine survey at divisional levels and detailed survey and office analyses at a sub-regional (circle) levels. The superintending engineers, incharge of the circles will be technically and administratively responsible for the work done by the circle staff and by the divisions under their control. The data collected by the divisions will be sent to the circles for review, analyses and future use. By performing the routine surveys, the executive engineers will obtain first hand information on the operation and maintenance of their canal

systems. Because these surveys will be performed by the sub-divisional officer and sub-engineers responsible for the maintenance of the canals, no additional staff will be required. If these engineers are transferred, they will carry their expertise to other divisions. This will ensure a continuous monitoring system. Additional staff will be required for the sub-regions (circles).

Generally, the sediment analysis is made by research type staff (non-engineers) in the PIDs and WAPDA. Therefore, non-engineering staff (for minimum, adequate or full operation) is recommended for the sub-regions. The staff should include:

Designation	Number
Junior research officer	1
Research assistant	3
Hydrographer	2
Field assistant	2
Driver	1

An alternative would be to perform the routine survey at sub-regional level, and detailed survey and office analyses at regional (chief engineer) level. This will reduce the quantity of equipment but will need additional staff and transport at both regional and sub-regional levels. Provision of a large additional staff on regular basis may not be feasible because of budgetary constraints imposed from time to time. Also because of the large canal systems operated by the superintending engineers, the routine survey may not be performed successfully on schedule.

Equipment Needs

Equipment needs of the Punjab Irrigation Department are estimated for three levels of possible funding by the USAID. The levels are based on the following criteria:

1. **Minimum Operation**

   Basic equipment provided at sub-regional level to conduct routine and detailed surveys, and to perform laboratory and office analyses. However, the divisional offices will actually perform the routine survey by borrowing the equipment from the circle offices.

2. **Adequate Operation**

   Basic equipment provided at sub-regional level to conduct detailed survey and to perform laboratory and office analyses, and also at divisional level to conduct routine survey.

3. Full Operation

Equipment at same levels as for the adequate operation with additional equipment.

The type and quantity of equipment for the minimum, adequate and full operations are listed in Table 2. The requirements are estimated assuming one piece of each item of equipment for each circle or division, except two pieces of the equipment that will be subjected to frequent wear and tear. For minimum operation, the equipment is provided at circle levels. For the adequate operation, hydraulic equipment is provided at divisional levels while the sediment measuring and analysis equipment is provided at circle levels. The full operation is same as the adequate operation except that additional water level recorders, and sonic sounders, velocity counters, motorized sieve shakers and desiccabs are provided.

The quantity of equipment and cost of each item, with specifications and names of suppliers are given in Tables 3 and 4 for minimum and adequate operations. The total cost is summarized below. The full operation cost is estimated by adding the cost of about 62 velocity counters, 21 sonic sounders (with spares), 21 motorized shakers, 21 desiccabs, 62 sounding weights (30 lbs) and 62 additional water level recorders (with spares) to the cost of adequate operation.

Minimum Operation

Local Cost,	Rs.	2,250,000
Foreign Cost,	US $	520,990

Adequate Operation

Local Cost,	Rs.	5,070,780
Foreign Cost,	US $	1,142,130

Full Operation

Local Cost,	Rs.	5,160,000
Foreign Cost,	US $	1,648,600

The above cost does not include the cost of providing vehicles and office equipment for data reduction. Also the cost of additional staff for the monitoring activities in the circle offices is not included. However, the cost of survey equipment, (levels and levelling staffs) is included in the local cost.

Pilot Project

A pilot project approach is recommended as an alternative to the above three operations. The hydraulic/sediment monitoring should be initiated in five selected circles only. This will reduce the initial cost of equipment and also will provide an opportunity to judge the response and enthusiasm of the PID to the monitoring efforts, the willingness of engineers and sub-engineers to monitor the canal systems under their control along with their routine duties, and to check the difficulties faced by the PID to employ research staff for sediment analysis and office work. The five selected circles are:

1. Lahore Zone (Chief Engineer, Lahore)
   Upper Chenab Canal Circle, three divisions.

2. Sargodha Zone (Chief Engineer, Sargodha)
   Lower Jhelum Canal Circle. four divisions.

3. Multan Zone (Chief Engineer, Multan)
   Muzaffargarh Canal Circle, three divisions.

4. Faisalabad Zone (Chief Engineer, Faisalabad) lower Chenab Canal East Circle, Faisalabad, three divisions.

5. Bahawalpur zone (Chief Engineer, Bahawalpur) Bahawalpur Canal Circle, Bahawalpur, three divisions.

Hydraulic monitoring will be confined to the routine survey and limited sediment sampling of suspended and bed material and will be done at the divisional levels. Detailed hydraulic/sediment monitoring for evaluating canal design criteria will not be performed. Sediment sample analysis, field data evaluation and record keeping will be done at the circle level. Two research assistants and one office assistant will be required in the circle for this work. The cost of equipment will be about Rs. 1,298,700 and US $ 228,700 including 10 percent freight for foreign equipment (Table 5). The cost is based on five circles and 16 divisions.

Equipment Requirements of Sindh Province

Field Visit

A field visit was made to Karachi from 11th to 13th of December 1990. The purpose of the visit was to discuss with the Provincial Advisor of the TA team, Mr. William R. Stoneman, and the Provincial Coordinator of the PID, Mr. Nasir Ali Rajput, (1) the institutional approach for future monitoring of the operation and performance of the irrigation canal and drainage systems and (2) to assess the type and quantity of hydraulic/sediment monitoring equipment required by the PID. The following persons also were contacted to better understand the current monitoring practices in the province and to determine the type of available equipment, if any.

1. Mr. Mir Mohammad Almani. Director Hydrology and Research
2. Mr. Abdul Majid Abro, Executive Engineer, ACOP
3. Mr. Mohammad Munir, Senior Research Officer, ACOP
4. Mr. Gul Mohammad, Workshop Superintendent, Kotri
5. Mr. Khalid Masood, Design Engineer, Harza, ISM-II.

The following information was obtained during discussions with the above persons.

1. Irrigation divisions in the province used to observe water levels at selected locations on the canal system, bed conditions during closure of the canals, depth of water below regulating structures, canal freeboards, etc., practice was discontinued primarily due to day-to-day operations and other functional requirements of limited field staff.

2. Practically, there is no hydraulic/sediment monitoring equipment with the field divisions except a few locally made current meters (Gurley type) with the headworks divisions. These meters are used to measure main canals discharge at the headworks. For any special discharge measurement (in case of dispute over water allocation among different divisions), the Hydrology and Research Directorate is requested to make current meter measurements.

3. Sub-divisional officers (graduate engineers) and sub-engineers are busy on other work tasks and pay little attention to hydraulic monitoring. However, the conditions are changing. If equipment and training are provided to the engineers and sub-engineers, they may keep up the work.

4. Hydraulic/sediment equipment is needed on a divisional basis for routine monitoring. Some of

the expensive equipment may be provided on a circle basis.

5. Some additional staff and transport will be required for the monitoring.

6. Kotri Discharge Sub-Division, working under the administrative control of the Hydrology and Research Directorate has capabilities of manufacturing Gurley current meters, velocity rods, y-rods and enamelled staff gages. However, Mr. Gul Mohammad, the workshop superintendent is an old man, working on work-charge basis after retirement. The younger staff is not well trained. The workshop can produce about 15 to 20 current meters per year. A general complaint about these meters (as explained by Mr. Mohammad Munir, ACOP) is that the brass bearing wears out after a few discharge measurements. This affects the current meter rating.

Irrigation and Drainage Systems

The irrigation and drainage systems in Sindh Province are under the administration control of four chief engineers. The number of field units responsible for operation and maintenance of canal and drainage systems are given in Table 6. This table does not include the tubewell divisions or divisions responsible for the maintenance of bunds. There are four regional offices (Chief engineers), 16 sub-regions (circles), 39 divisions and 153 sub-divisions.

Activities of ISM/R Project

Under the Irrigation System Management Research (ISM/R) Project, some hydraulic monitoring equipment was recommended for Soil Mechanics and Hydraulic Laboratories at Hyderabad. This equipment is only sufficient for the routine operation of the laboratories. The field units of the PID need equipment as recommended in this report.

Recommended Institutional Approach

As discussed under the section entitled, "Hydraulic/Sediment Monitoring by PIDs," three tasks are identified:

- Routine Hydraulic Survey
- Detailed Hydraulic/Sediment Survey
- Laboratory and Office Analyses

Four alternative institutional arrangements can be considered to perform the above tasks:

1. A central unit for the province
2. Regional units under Chief Engineers
3. Sub-regional units under superintending engineers
4. Divisional units under executive engineers

A central unit for the whole province is technically not feasible because the routine survey must be performed under the administrative and technical control of the executive engineers or superintending engineers incharge of the maintenance works. If the survey is performed by a central unit, the local engineers may not cooperate with the survey parties. Also because of the large irrigation system, the transport needs and its maintenance, and additional staff required for the surveys will require a large annual budget.

If the central unit is made responsible only to obtain the data from the field units, interpret, analyse and prepare the data for future use, there will be problems with the accuracy of the data collected by the field staff. This may create controversies between the central and field units, adversely affecting the monitoring system.

The monitoring units at divisional levels responsible for field data collection and office analyses will be highly desirable. However, this will require a large field and office staff and equipment for the 40 divisions in the province.

A most feasible institutional arrangement recommended for the province will be to perform the routine survey at divisional level, and detailed survey and office analyses at a sub-regional (circle) level. The superintending engineers incharge of the circles will be technically and administratively responsible for the work done by the circle staff and by the divisions under their control. The data collected by the division will be sent to the circles for review, analyses and future use. By performing the routine surveys, the executive engineers will obtain first hand information on the operation and maintenance of their canal systems. Because these surveys will be performed by the sub-divisional officer and sub-engineers responsible for the maintenance of the canals, no additional staff will be required. If these engineers are transferred they will carry their expertise to other divisions. This will ensure a continuous monitoring system. Additional staff will be required for the sub-regions (circles).

Generally, the sediment analysis is made by research type staff (non-engineers) in the PIDs and WAPDA. Therefore, non-engineering staff (for minimum, adequate and full operation) is recommended for the sub-regions. This staff should include:

Designation	Number
Junior research officer	1
Research assistant	3
Hydrographer	2
Field assistant	2
Driver	1

An alternative would be to perform the routine survey at sub-regional level, detailed survey and office analyses at regional (chief engineer) level. This will reduce the quantity of equipment required but will need additional staff and transport both at regional and sub-regional levels. Provision of additional staff on regular basis may not be feasible because of budgetary constraints imposed from time to time. Also because of large canal systems operated by the superintending engineers, the routine surveys may not be performed successfully on schedule.

Equipment Needs

Equipment needs of the Sindh Irrigation Department are estimated for three levels of possible funding by the USAID. The level are based on the following criteria:

1. **Minimum Operation**

   Basic equipment, provided at sub-regional level (circle) to conduct routine and detailed surveys and to perform laboratory and office analyses. However, the divisional offices will actually perform the routine survey borrowing the equipment from the circle offices.

2. **Adequate Operation**

   Basic equipment provided at sub-regional level to conduct detailed survey and to perform laboratory and office analyses, and also at divisional level to conduct routine survey.

2. **Full Operation**

   Equipment at same levels as for the adequate operation with additional equipment.

The type and quantity of equipment for the minimum, adequate and full operations are listed in Table 7. The requirements are estimated assuming one piece of equipment for each circle or division except two pieces of the equipment that will be subjected to frequent wear and tear. For minimum operation, the equipment is provided at circle levels. For the adequate operation, hydraulic equipment is provided at divisional levels while the sediment measuring and analysis equipment is provided at circle levels. The full operation is same as the adequate

operation except that additional water level recorders, and sonic sounders, velocity counters, motorized sieve shakers and desiccabs are provided.

The quantity of equipment and cost of each item, with specifications and names of suppliers are given in Tables 8 and 9 for minimum and adequate operations. The total cost is summarized below. The full operation cost is estimated by adding the cost of about 39 sounding weights (30 lbs), 39 velocity counters, 16 sonic sounders, 16 desiccabs, 16 motorized shakers and 39 additional water level recorders to the cost of adequate operation.

Minimum Operation

Local Cost, Rs.	1,657,000
Foreign Cost, US $	397,500

Adequate Operation

Local Cost, Rs.	3,240,000
Foreign Cost, US $	766,100

Full Operation

Local Cost, Rs.	3,270,000
Foreign Cost, US $	1,123,000

The above cost does not include, the cost of providing vehicles and office equipment for data reduction. Also the cost of additional staff for the monitoring activities in the circle offices is not included. However, the cost of survey equipment levels and levelling staff is included in local cost.

Pilot Project

A pilot project approach is recommended as an alternative to the above three operations. The hydraulic/sediment, monitoring should be initiated in four selected circles only. This will reduce the cost of equipment and also provide an opportunity to judge the response and enthusiasm of the PID to the hydraulic/sediment monitoring efforts, the willingness of engineers and sub-engineers to monitor the canal systems under their control along with their routine duties, and to check the difficulties faced by the PID to employ research staff for sediment analysis and office work. The four selected circles are:

1. Kotri Zone (Chief Engineer, Kotri)
   Pinyari Canal Circle, two divisions

2. Sukkur Zone (Chief Engineer, Sukkur)
   Rohri Canal Circle, five divisions
   Nara Canal Circle, three divisions.

3. Guddu Canal (Chief Engineer, Sukkur) Begari Sindh Feeder Circle, two divisions.

Hydraulic monitoring will be confined to the routine survey and limited sediment sampling of suspended and bed material and will be done at the divisional levels. Detailed hydraulic/sediment monitoring for evaluating design criteria for the alluvial canal will not be performed. Sediment sample analysis, field data evaluation and record keeping will be done at the circle levels. Two research assistants and one office assistant will be required in the circle for this work. The cost of equipment will be about Rs. 968,300 and U.S.$ 173,600 including 10 percent freight for foreign equipment (Table 10). The cost is based on four circles and 12 divisions.

Equipment Requirements of Balochistan Province

Field Visit

A field visit was made to Quetta from December 14 to 19, 1990. The purpose of the visit was to discuss with the Provincial Advisor of the TA team Dr. Carlos A. Gandarillas, and the Provincial Coordinator of the PID, Mr. Shirin Khan Luni, (1) the institutional approach for future monitoring of the operation and performance of the irrigation canal and drainage systems and (2) to assess the type and quantity of hydraulic/sediment monitoring equipment required by the PID. The following persons also were contacted or met during the meetings to better understand the previous and current monitoring practices in the province and the type of equipment in use, if any.

1. Mr. Mohammad Amin, Chief Engineer, PID.
2. Mirza Saeed Beg, Chief Design Engineer, PID.
3. Mr. Fazal Din Khan Mandokhel, Superintending Engineer, PID, Kalat.
4. Mr. Mohammad Usman Bab, Director Planning and Development, PID
5. Mr. Ali Akbar Zehri, Executive Engineer, Pat Feeder Canal, PID, Dera Murad Jamal
6. Ch. Abdul Majeed, Superintending Engineer (Retired), O&M Specialist, Harza, Quetta
7. Sh. Mohammad Hussain, Resident Engineer, NESPAK, Quetta
8. Mr. Abdul Mujeeb, Senior Engineer, ACOP, WAPDA.

The following information was obtained during discussions with the above persons:

1. Practically no hydraulic/sediment monitoring equipment exists in the PID. Mr. M. Amin wants to create a hydrology division to work with WAPDA for training. Also PID does need equipment to monitor operations and performance of the canals. Binoculars also are required to read gages on the rivers during the floods.

2. Dr. Gandarillas thinks that a centralized monitoring unit stationed at Quetta is not advisable. First, the unit will have to travel over a large area and second, no engineer or sub-engineer will like to be stationed at Quetta.

3. Pat Feeder and Kirthar canals are unlined. The rest of the canals are small and lined or will be lined under the rehabilitation program. Therefore, sediment sampling equipment may not be needed in most of the divisions.

4. Hydraulic/Sediment Monitoring should be done on divisional basis.

5. Generally, most of the canals are small with steep slopes, construction of permanent structures such as broad-crest weir will be desirable to measure discharges. However, current meter measurements will be needed to check the calibration of these structures.

6. Water courses may be measured with portable flumes or pygmy current meters.

7. Dr. Gandarillas apprehends that the monitoring equipment may not be successfully used primarily due to turn-over of personnel in the department.

Irrigation and Drainage Systems

The irrigation and drainage systems in the Balochistan Province are under the administrative control of one chief engineer stationed at Quetta. The number of field units responsible for operation and maintenance of canal systems, are given in Table 11. This table does not include the tubewell divisions, planning divisions and divisions responsible for maintenance of bunds.

There are one chief engineer, three circles (superintending engineers), eleven divisions (executive engineers) and twenty five sub-divisions.

Activities of ISM/R Project

Mr. Jalil-ud-Din Ahmad USAID Project Officer of the Irrigation System Management Research (ISM/R) was contacted to determine any provision made for hydraulic/sediment monitoring equipment under his project. A list of equipment could not be obtained. However, Mr. Ahmad indicated that the equipment may not be sufficient for all divisions.

Recommended Institutional Approach

A detailed discussion on alternative institutional approaches is provided for the Punjab and Sindh Provinces. In view of the locations of the irrigation systems, scattered all over the province, a most viable institutional arrangement will be the same as recommended for the Punjab or Sindh Province, that is, routine survey at divisional levels and other monitoring and office activities at circle levels.

The additional staff required in each circle will include:

Designation	Number
Junior research officer	1
Research assistant	2

Hydrographer	1
Field assistant	2
Driver	1

Equipment Needs

Equipment needs of the Balochistan Irrigation Department are estimated for three levels of possible funding by the USAID, as discussed in details for the Punjab and Sindh Provinces. These levels are designated as minimum operation, adequate, operation, and full operation. The type and quantity of equipment for these operations are listed in Table 12. The equipment requirements are estimated assuming one piece of each item of equipment for each circle or division except two pieces of the equipment that will be subjected to frequent wear and tear. For minimum operation, the equipment is provided at circle levels. For the adequate operation hydraulic equipment is provided at divisional levels while the sediment measuring and analysis equipment is provided at circle levels. The full operation is same as the adequate operation except that additional water level recorders, and sonic sounders, velocity counters, motorized sieve shakers and desiccab are provided.

In the Balochistan Province, most of the canals are small and steep. This will not need boats and related accessories for flow measurements. Therefore, the equipment for discharge measurements using boat and for suspended sediment sampling from boat, is not based on the number of divisions in the province.

The quantity of equipment and cost of each item, with specification and names of suppliers are given in Tables 13 and 14 for minimum and adequate operations. The total cost is summarised below. The full operation cost is estimated by adding the cost of 11 velocity counters, one sonic sounder (with spares), 11 additional water level recorders (with spares), three motorized sieve shakers, four 30-lbs sounding weights and three desiccabs.

Minimum Operation

Local Cost, Rs.	304,400
Foreign Cost, US $	71,400

Adequate Operation

Local Cost, Rs.	618,800
Foreign Cost, US $	167,300

Full Operation

Local Cost, Rs.	621,900
Foreign Cost, US $	228,200

The above cost does not include the cost of providing vehicles and office equipment for data reduction. Also the cost of additional staff for the monitoring activities in the circle offices is not included. However, the cost of survey equipment (levels and levelling staffs) is included in the local cost component.

Pilot Project

To be consistent with the approach of pilot project in the Punjab and Sindh provinces, the hydraulic/sediment monitoring should be initiated in two circle only. As stated earlier, this will provide an opportunity to judge the response and enthusiasm of the PID to monitoring efforts, the willingness of engineers and sub-engineers to monitor the canal systems under their control along with their routine duties. The Pat Feeder and Sibi Circle located at Dera Murad Jamali and Irrigation Circle, Quetta should be selected for these purpose. There are eight divisions in these circles.

Hydraulic monitoring will be confirmed to the routine survey and limited sediment sampling of suspended and bed material, and will be done at the divisional levels. Detailed hydraulic/sediments monitoring for evaluating design criteria for the alluvial canals will not be performed. Sediment sample analysis, field data evaluation and record keeping will be done at the circle level. Two research assistant and one office assistant will be required for this work. The cost of equipment will be about Rs. 431,000 and U.S. $ 95,370 including 10 percent freight for foreign equipment (Table 15). The cost of providing permanent flow measuring structures such as flumes, weirs, etc. is not included. This should be done by the PID on a need basis.

Equipment Requirements of Northwest Frontier Province

Field Visit

A meeting was arranged on December 21, 1990 in Islamabad with Mr. Gene F. White, Provincial Advisor of the TA team in Peshawar, because he was leaving for vacation. The institutional arrangement for monitoring and equipment needs of the NWFP was discussed. Mr. White provided the following information:

- Mr. White was not sure whether the PID is undertaking routine survey to monitor the operation and performance of its canal systems.
- Sizes of the canals are relatively small. Some of the canals are lined and sediment is not much of a problem. The canals in Bannu and Swat Canal Systems are unlined. These may need sediment sampling.
- In NWFP, the canals are designed using the Manning's equation.
- Echo sounder may be needed in Swat Canal or some canals in Bannu but not essential .
- Hydraulic/Sediment monitoring will be best at divisional levels but if funding is a constraint, the monitoring at circle levels may be sufficient. At circle level, there will be some problem of transport. There is some transport available at divisional level.
- Sediment has ruined the pumps at Warsak Lift Canal but there is not much problem in the canal. In Bannu area, coarse sediment is a problem in the canals.

A field visit was made to Peshawer on December 26, 27, 1990. The purpose of the visit was to discuss with the Provincial Coordinator of the PID, Mr. Saleem Ullah Khan (1) the institutional approach for future monitoring of the operation and performance of the irrigation canal and drainage systems and (2) to assess the type and quantity of hydraulic/sediment monitoring equipment required by the PID. The following persons also were contacted.

1. Mr. Ayub Jan, Executive Engineer, Assistant to Provincial Coordinator.
2. Mr. Mohammad Wasil Sathi, Executive Engineer, Hydrology.
3. Mr. Allah Bux Baloch, Executive Engineer, Warsak Canal.
4. Dr. Farhat Javed, Design Engineer, ISM-II Project.
5. Mr. Hashmat Ullah Awan, Director Water Sector Investment Planning cell, PID.

The following information was obtained during discussions with the above persons.

1. Practically no hydraulic/sediment monitoring equipment exists with executive engineers in-charge of the canal systems. Hydrology Division is well equipped with discharge measuring equipment but the field operation is greatly affected due to lack of transport.

2. Hydrology Division personnel lack training in discharge measurements and installation of gage and discharge measuring facilities. There is an immediate need for training.

3. Canal divisions will require additional staff for monitoring the operation and performance of the canals. Mr. A.B. Baloch feels that the canal divisions are over loaded with routine work. A central unit for the whole province may be more feasible. However, during the discussions, he agreed to a divisional/circle level monitoring. The major problem expressed by him was the transport in the divisions.

4. Mr. A.B. Baloch is interested in echo sounders, not necessarily for canals but for monitoring sediment in Baran Dam.

5. Mr. Awan told that some canals in the PID are under the administrative control of deputy commissioners. Whenever the civil authorities find some problem with the canal performance, they ask the irrigation department for rehabilitation. The PID is not performing any inspection on these canals.

Irrigation and Drainage Systems

The irrigation and drainage systems in the NWFP are under the administrative control of one chief engineer stationed at Peshawer. The number of field units responsible for operation and maintenance of canal systems are given in Table 16. This table does not include the tubewell, SCARP, and planning divisions.

There are one chief engineer, four superintending engineers, twelve executive engineers (divisions) and 28 sub-divisions.

Activities of ISM/R Project

A PC-1 proforma dated June 1990 was prepared by the Government of the NWFP, Irrigation and Public Health Engineering Department for an Irrigation Management Research Project to be funded under USAID ISM/R program. This proforma is essentially based on the

recommendations of Dr. C.E. Brockway. The objectives of the project are to collect discharges in natural streams and canals, precipitation, ground water levels, well discharges, and other related meteorological data. Interpretation, analysis and computeriztion of data is stressed. A new unit is suggested under the Director Design and Hydrology with sub-units at Mingora, Mardan, Peshawer, and Bannu. Equipment is recommended for water flow, sediment, ground water level measurements, surveying, and meteorological monitoring, plus computers, office equipment, and vehicles. The hydraulic/sediment equipment include current meters, waders, water level recorders, portable weirs, sediment samplers and laboratory apparatus. The total provision is about Rs. 488,000. The number of current meters and water level recorders are three and ten, respectively. This provision appears to be too small to monitor the NWFP canal system.

Recommended Institutional Approach

A detailed discussion on alternative institutional approaches is provided for the Punjab and Sindh Provinces. In view of the locations of irrigation systems, scattered all over the province a most viable institutional arrangement will be the same as recommended for the other provinces, that is, routine survey at divisional levels and other monitoring and office activities at circle levels.

The additional staff required in each circle will include.

Designation	Number
Junior research officer	1
Research assistant	2
Hydrographer	1
Field assistant	2
Driver	1

Equipment Needs

Equipment needs of the NWFP Irrigation Department are estimated for three levels of possible funding by USAID, as discussed in detail for the Punjab and Sindh Provinces. These levels are designated as "minimum operation", "adequate operation", and "full operation". The type and quantity of equipment for these operations are listed in Table 17. The equipment requirements are estimated assuming one piece of each item of equipment for each circle or division except two pieces of the equipment that will be subjected to frequent wear and tear. For minimum operation, the equipment is provided at circle levels. For adequate operation, hydraulic equipment is provided at divisional levels while the sediment measuring and analysis equipment is provided at circle levels. The full operation is same as the adequate operation except that additional water level recorders, and sonic

sounders, velocity counters, motorized sieve shakers and desiccab are provided.

In the NWFP, some of the canals are of small sizes with steep slopes. This will not require boats and related accessories for flow and sediment measurements. Therefore, some of the discharge measuring equipment and sediment samplers are not provided for each division.

The quantity of equipment and cost of each item with specifications and names of suppliers are given in Tables 18 and 19 for minimum and adequate operations. The total cost is summarized below. The full operation cost is estimated by adding the cost of twelve velocity counters, two sonic sounder (with spares), twelve water level recorders (with spares), four motorized sieve shakers, four desiccabs and six 30-lb sounding weights.

Minimum Operation

Local Cost,	Rs.	380,440
Foreign Cost,	US $	95,160

Adequate Operation

Local Cost,	Rs.	725,200
Foreign Cost,	US $	199,100

Full Operation

Local Cost,	Rs.	729,900
Foreign Cost,	US $	275,200

The above cost does not include the cost of providing vehicles and office equipment for data reduction. Also the cost of additional staff for the monitoring activities in the circle offices is not included. However, the cost of survey equipment (levels and levelling staffs) is included in the local cost component.

Pilot Project

To be consistent with the approach of pilot project in the other provinces, the hydraulic/sediment monitoring should be initiated in two circles only. As stated earlier, this will provide an opportunity to judge the response and enthusiasm of the PID to the monitoring efforts, the willingness of engineers and sub-engineers to monitor the canal systems under their control along with their routine duties. The Northern Irrigation Circle, located at Mardan and the Southern Circle located at Bannu are recommended for this purpose. There are six divisions in these circles.
Hydraulic monitoring will be confined to the routine

survey and limited sediment sampling of suspended and bed materials, and will be done at the divisional levels. Detailed hydraulic/sediment monitoring for evaluating design criteria for the alluvial canals will not be performed. Sediment sample analysis, field data evaluation and record keeping will be done at the circle level. Two research assistants and one office assistant will be required for this work. The cost of equipment will be about Rs. 397,900 and U.S.$ 80,980 including 10 percent freight for foreign equipment (Table 20). The cost of providing permanent flow measuring structures such as flames, weirs, is not included. This should be done by the PID on a need basis.

Training of PIDs Personnel

A well planned and accurately performed hydraulic/sediment monitoring will provide information and data to enable an assessment of the quality of irrigation service, an enhanced system operation and to make planning decisions regarding maintenance. Therefore, the PIDs personnel should be trained to:

1. Perform detailed hydraulic/sediment surveys to obtain an accurate and reliable data base for future improvement of the hydraulic design criteria for the canals.

2. Properly use the conventional and more advanced hydraulic/sediment monitoring equipment.

3. Successfully monitor the operation and performance of canals, through routine surveys.

4. Perform laboratory analyses and evaluate and maintain field data

Currently, the PID's personnel are very lacking in training. Even the provincial hydrology divisions and/or hydrology directorates do not have trained staff. This is primarily due to two main reasons:

1. Frequent turn-over in the departments

2. Least interest among engineers and sub-engineers to work on hydrologic/hydraulic data collection activities.

The regular canal staff is proposed to conduct the routine hydraulic survey and a special research unit is recommended for a circle office. Once trained, there is less possibility of losing this staff. This is because the canal staff will generally like to be transferred to other running canals and will carry their expertise to other systems. The research staff is generally interested in this type of assignment. Therefore, the training should be given to the regular staff operating and maintaining the canals, and the staff employed for the circle offices.

ACOP Training Program

As part of its agreement with the FCC, ACOP was assigned the responsibility of training the PID's personnel operating and maintaining the canals. A training plan was prepared by ACOP and is being implemented. The plan consists of two sets of training courses:

1. A three-week course was designed for sub-engineers, research assistants and hydrogrphers. The course was meant to emphasize field and laboratory

training, and class room lectures were restricted to field and laboratory practices and potential problems.

2. A five-week course was designed for engineers and research officers, with less emphasis on field measurements and more class room lectures to introduce more advanced knowledge of data collection, computer application, and evaluation, interpretation, and analysis of the hydraulic and sediment data.

The training courses were proposed to be held at Lahore, Faisalabad, and Multan (Punjab Province), Peshawer and Bannu (NWFP), Hyderabad and Sukkur (Sindh Province), and Quetta (Balochistan Province). The sequence of training was classroom lectures, field measurements, classroom lectures, laboratory analysis, data processing, and discussions. A seven - chapter training document also was made available to the participants.

One December 16, 1990, the ACOP field training demonstration on Pat Feeder Canal at Dera Murad Jamali (Quetta Irrigation Region) was inspected. The training documents distributed to the participants also were reviewed. The participants were sub-engineers from various canal divisions. The field training was well organized by Mr. Abdul Mujeeb, Senior Engineer, ACOP. However, the following observations were made on the equipment and measuring procedures.

1. Equipment used for the discharge and sediment measurements was quite worn-out. The sounding reel had a 0.125 inch dia meter steel cable without an inner insulated core. An extra-flexible wire was used to complete the electric circuit to count the revolution of the current meter. The use of extra wire is usually quite cumbersome for a new hydrographer.

2. Locally made sounding weight and hanger bar did not indicate standard 0.6 foot distance from the bottom of the C-50 weight to the center of the current meter suspension point on the bar.

3. USGS BM 54 (bed material) and USGS P61 (suspended point integrating) samplers were demonstrated. These samplers are too heavy to be used conveniently on a small boat. USGS BMH 60 (bed material) sampler should have been demonstrated. For detailed hydraulic surveys, point sampling is not required because the suspended sediment concentration data at various depth is not required for hydraulic design criteria.

4. Steel wire rope of 0.25-inch diameter was stretched as tagline across the canal to measure width

between selected verticals to observe depth and velocity. The rope was tagged at 5-foot intervals. Although the distances between the tags were checked before the measurement a beaded tagline should have been used.

5. Procedure demonstrated to measure water level required a special O - type gage with a vernier scale. This gage eliminates the wave action of flow and water level is measured accurately with a vernier scale. This type of gage is not required for the monitoring work to be undertaken by the PIDs. The gage may be useful for research projects. A wooden peg driven into the bed can provide reasonably accurate water level if distance from top of peg to water level and elevation of the top of the peg are known.

The training document is derived probably from previous publications of ACOP or directly from text books. It is a good document if intended to present general stream gaging and sediment sampling procedures for graduate engineer level. This is certainly above the general comprehension of sub-engineers and hydrographers. The terms like base line experiments, calibration experiments, special experiments, sophisticated methodology, bed shear and morphology are quite confusing for sub-engineers and hydrographers..

Data collection objectives are defined for general stream gaging and there is no reference to what is the objective of training for the canal staff and what they will be required to do. Field measurement procedures include all types of instruments and procedures which will never be used by the PIDs, for example, ice measurements, electronic gages, telemetry, etc.

Proposed Training Program

The ACOP training program will only provide an introduction on general stream gaging to a limited number of participants. Since the PIDs currently do not have the hydraulic/sediment monitoring equipment, the participants cannot practice whatever they learned. The procurement may take some time. During this period, there is a great likelihood of forgetting whatever was learned. This is particularly true because the training document is not designed specifically for the needs of the PID's personnel required to monitor the operation and performance of the canal. It does not provide step-by-step procedures for field data collection, including potential problems.

A new training program will be required for those circles and divisions which will receive the equipment. A new training document also will have to be prepared providing step-by-step instructions to conduct routine survey (to monitor operation and performance of canals) and detailed hydraulic/sediment survey,

and to evaluate, interpret and reduce the data for future use. The training program should be implemented under the supervision of a hydraulic/sediment monitoring specialist, who should also prepare the training documents.

The new field training program should be limited to the methods of discharge measurements, sediment sampling and morphological observations suitable for monitoring the operation and performance of the canals, and for collection of hydraulic parameters and sediment characteristics for possible revision of the hydraulic design criteria in the future. The measurement of discharge should be demonstrated by wading and boat methods, and by using calibrated control structures (regulators, weirs, broad - crested weirs and outlets). The use of staff gages (vertical or inclined) and continuous water level recorders and their field installation also should be demonstrated.

Field training for sediment sampling should include use of depth integrating and bed material samplers, because only total suspended sediment concentration and particle size distribution, and particle size distribution of bed material are required for the canal design. Laboratory procedures should be demonstrated by actual analyses of total concentration and particle size distribution.

Attention of the trainees should be drawn to the field precautions to be exercised to obtain accurate and reliable data, particularly during selection of sites for staff gages/water level recorders and for discharge measuring sites, and during observations of water surface and canal bed profiles. Also potential errors in velocity and depth observations for computing canal or outlet discharges, and during sediment sampling and analysis, should be pointed out.

The training documents should be written for the purpose of educating the trainees with the field and office procedures for canal monitoring and may include:

1. Purpose of Canal Survey

    Canal Discharge
    Suspended Sediment
    Bed Material
    Surface and Bed Profiles
    Cross Sectional Profiles

2. General Methodology

3. Measurement of Canal Water Levels
    Staff Gage
    Recording Gage
    Gage Datum
    Gage Data Reduction

4. Measurement of Discharge
    - Main Canal
        - Wading
        - Boat
        - Calibrated Control Structures
    - Water Course
        - Wading
        - Portable Flumes
        - Outlet Geometry
    - Measurement of Width
    - Measurement of Depth
    - Computation of Flow Area
    - Measurement of Velocity
    - Methods of Mean Velocity Determination

5. Development of Stage - Discharge Relationships

6. Procedures for Sediment Sampling
    - Suspended Sediment
    - Bed Material

7. Methods of Laboratory Analyses

8. Data Interpretation, Evaluation, Reduction and Compilation

9. Evaluation of Reliability of Water Delivery and Equity of Water Distribution.

Recommended Monitoring Program

In principle, each PID should conduct the following monitoring program. However, because of limited equipment provided to a few selected circles, the monitoring program may be confined to updating the performance listing and routine hydraulic survey. Separate report has been prepared to define the responsibilities of the selected divisions and circles under the pilot project schemes defined in this report.

Responsibility of Field Divisional Staff

1. Update the performance history of canals after every five years in respect of silting, scouring, shortages, breaches, encroachments of free board, berm growth, etc.

2. Make discharge measurements on canals and distributaries three or four times during the year by current meter to check the discharge tables and empirical discharge relationships of control structures. Also carry out flow measurements at headworks.

3. Measure water course discharges at different flow conditions in the canals using pygmy current meters (or portable flumes if available) and compare with the discharge estimated using empirical relationships.

4. Based on the above data, check the reliability and equity of the canal system.

5. Prepare longitudinal and cross sectional profiles of the canals/distributaries/minors during the closure periods.

6. Evaluate the data and classify the canals as problematic or non-problematic.

7. Define remedial measure to rehabilitate the canals for submission to concerned authority.

8. Properly document the basic data and results for transmission to the circle office.

Responsibility of Circle Office Staff

1. Review the hydraulic data collected by divisional staff and provide technical guidance.

2. Select reasonable number of problematic canal reaches and perform detailed hydraulic/sediment

survey to collect reliable data for potential revision to the existing design criteria. These surveys should be done in kharif and rabi seasons.

3. Operate sediment laboratory.

4. Conduct longitudinal canal bed surveys using echo sounder during the period selected by the divisional engineer.

5. Evaluate, interpret, analyse and computerize the basic hydraulic/sediment data for future use.

TABLE 1
PUNJAB PROVINCE
NUMBER OF FIELD UNITS FOR OPERATION AND MAINTENANCE OF CANAL AND DRAINAGE SYSTEMS

REGION CHIEF ENGINEER	CIRCLE SUPERINTENDING ENGINEER	DIVISION EXECUTIVE ENGINEER	SUB-DIVISION SDO
Multan (Multan)	L.B.D.C. Circle, Sahiwal	Sahiwal Canal, Sahiwal	
		Balloki Headworks, Balloki	
		Khanewal Canal, Khanewal	
	Haveli Canal Circle, Multan	Multan Canal, Multan	
		Trimmu Barrage, Trimmu	
		Sujabad Canal, Multan	
		Sidhnai Barrge, A. Hakim	
	Muzaffargarh Canal, Multan	Kot Adu Canal, Kot Adu	
		Muzffargarh Canal, Muzaffargarh	
		Taunsa Barrage, Kot Adu	
	Derajat, D.G. Khan	D.G. Khan Canal, D.G. Khan	
		Rajanpur Canal, Rajanpur	
Bahawalpur (Bahawalpur)	Bahawalpur, Bahawalpur	Bahawalpur Canal, BWP	
		Ahmedpur Canal, R.Y. Khan	
		Panjnad Headworks, Panjnad	
	Rahim Yar Khan, R.Y. Khan	R.Y. Khan Canal, R.Y. Khan	
		Khanpur Canal, Khanpur	
		Dallas Canal, R.Y. Khan	
	Malsi Canal, Multan	Lodhran Canal, Lodhran	
		Mailsi Syphon, Thingi	
		Islam Headworks, Islam	
	Bahawalnagar, BWN	Hakra Canal, BWN	
		Fordwah Canal, BWN	
		Sadiqia Canal, BWN	
	Nili Bar, Sahiwal	Western Branch, Thingi	
		Suleimanki Headworks, Suleimanki	
		Easter Bar Canal, Pak Pattan	
Faisalabad (Faisalabad)	Q-B Link, Farooqabad	Qadirabad Canal, Qadirabad	
		Q-B Link, Farooqabad	
	L.C.C. East, Faisalabad	Upper Gugera Canal, Sheikhupura	
		Burala Canal, Faisalabad	
		Lower Gugera Canal, Faisalabad	
	L.C.C. West Faisalabad	Khanki Headworks, Khanki	
		Faisalabad Canal, Faisalbad	
		Jhang Canal, Jhang	
		Hafizabad Canal, Faisalabad	
	Drainage, Faisalabad	Samundri Drain, Faisalabad	
		F.S.L. Drain, Faisalabad	
Lahore	UCC, Lahore	Gujranwala Division, Gujranwala	
		Sheikhupura Division, Sheikhupura	
		Marala Headworks, Marala	

Table 1 (Continued)

	Dilpur Canal, Lahore	Lahore Branch, Lahore
		Khanwah Branch, Sahiwal
		Kasur Branch, Kasur
	Link Canal, Lahore	Chak Bandi, Lahore
		Pasrur, Sialkot
		B.S-Link, Lahore
	Drainage, Lahore	Reachna Drain, Sheikhupura
		Sukhrawa Drain, Sahiwal
		Lahore Drain, Drain
Sargodha (Sargodha)	Drainage, Sargodha	Sargodha Drain, Sargodha
		Drain, M. Bahudin
	Thal Canal, Mianwal	Khushab Canal, Mianwali
		Lyyah Canal, Leyyah
		Bhakkar Canal, Bhakkar
		Kalabagh Canal, Daud Khel
	U.J.C. Jhelum	Gujrat Branch, Gujrat
		Jhelum Branch, Jhelum
	L.J.C. Sargodha	Sargodha Branch, Sargodha
		Rasul Headworks, Rasul
		Kirana Branch, Sargodha
		Shahpur Branch, Sargodha

Regions = 5

Circles = 21

Divisions = 62

Sub-Divisions = 270 approximately, exact number for each division was not provided by the PID.

Note: Table does not include the field units responsible for operation and maintenance of tubewells or maintenance of bunds.

TABLE 2
PUNJAB PROVINCE
TYPE AND QUANTITY OF EQUIPMENT

Type	Quantity		
	Minimum Operation	Adequate Operation	Full Operation
Price Type AA Current Meter (F)	42	124	124
Pygmy Current Meter (F)	42	124	124
Wading Rods Set (L)	42	124	124
Light Duty Tagline (F)	21	62	62
Heavy Duty Tagline (F)	21	62	62
Headset (F)	42	124	124
Velocity Courter (F)	-	-	62
Stop Watch (F)	42	124	124
Rubber Chest Wader (F)	42	124	124
Hip Boots (F	-	124	124
Boat Improvisement Set (L)	21	62	62
Sounding Reel (F)	21	62	62
30-Pound Sounding Weight (L)	-	-	21
50-Pound Sounding Weight (L)	21	62	62
Hanger Bar With Pin (L)	42	124	124
Life Jacket (F)	63	186	186
Fibre Glass Boat (L)	21	62	62
Sonic Sounder (F)	-	-	21
Measuring Tape (L)	21	62	62
Level With Tripod (L)	21	62	62
Levelling Staff (L)	21	62	62
Y-Rod (L)	42	124	124
Water Level Recorder (F)	-	62	124
Staff Gage (L	300(Sites)	300(Sites)	300(Sites)
US DH-48 Sampler (L)	21	21	21
US D-74 Sampler (L)	21	21	21
US BMH 53 Sampler (F)	21	21	21
US BMH 60 Sampler (F)	21	21	21
Glass Bottles for Sampler (F)	42	42	42
Plastic Jars for Sampler (F)	42	42	42
V.A. Tube Analyser (F)	21	21	21
Bottom Withdrawal Tube (F)	42	42	42
Analytical Balance (F)	21	21	21
Electronic Balance (F)	21	21	21
Electric Oven (F)	21	21	21
Sieve Set (Fine) (F)	21	21	21
Sieve Set (Coarse) (F)	21	21	21
Sieve Brush (F)	42	42	42
Sieve Lid (F)	21	21	21
Sieve Pan (F)	21	21	21
Sieve Shaker (Motorized) (F)	-	-	21
Sieve Shaker (Hand operated) (F)	21	21	21
Pipette (F)	42	42	42
Vacuum Pump (F)	21	21	21
Stop Watch (L)	21	21	21

Beaker (Glass) (F)	126	126	126
Cylinder (Glass) (F)	168	188	168
Desiccab (F)	-	-	21
Evaporating Dish (F)	420	420	420
Desicator (F)	21	21	21
Wash Bottle (F)	21	21	21
Filtering Funnel (F)	42	42	42
Stirring Rod (F)	63	63	63
Thermometer (F)	42	42	42
3-Way Stop Cock (F)	42	42	42
French Curve Set (F)	21	21	21

No. of Circles = 21

No. of Divisions = 62

F = Imported

L = Local

- Minimum operation at circle levels
- Adequate operation at divisional and circle levels
- Full operation at divisional and circle levels with additional equipment.
- Spares not listed in this table.

TABLE 3
PUNJAB POVINCE
HYDRAULIC AND SEDIMENT MONITORING EQUIPMENT FOR MINIMUM OPERATION AT CIRCLE LEVELS

S.#	ITEM	SPECIFICATIONS	QUANTITY	UNIT COST		TOTAL COST		SUPPLIER
				Local Rs.	Dollar US$	Local Rs.	Dollar US$	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Hydraulic Equipment								
1.	Current Meter	Price Type AA (vertical axis, horizontal bucket wheel); chrome plated stainless steel; minimum velocity = 0.1 fps and maximum velocity = 20.0 fps; single and penta contacts; furnished complete in a foam cushioned carrying case, along with a rating chart, tail fin assembly, screw driver, assorted spare parts, and special lubricant, both for rod and cable suspension.	42	-	790	-	33,180	Scientific Instruments Inc; 318 West Cherry, Milwaukee,WI 53212 -3922, USA (414)263-1600 Fax (414)263-5506
2.	Mini Current Meter (Pygmy)	Vertical axis, horizontal bucket wheel; chrome plated stainless steel; minimum velocity: .05 fps and maximum velocity = 3.0 fps; furnished complete in a foam cushioned carrying case with assorted spare parts, a rating chart and lubricant: for rod suspension only.	42	-	630	-	26,460	Scientific Instruments Inc.
3.	Standard Wading Rods	Four 2-foot graduated rods in 0.1 foot increments. bottom rod with base plate; an adjustable sliding support capable of holding price Type AA and Pygmy current meters; a flexible two-conductor wire with one end having two-hole conductor for head set and the other end suitable for connecting to current meter and rods. Base plate and slider made from corrosion resistant material; complete set in heavy duty canvas carrying case.	42	2,100	-	88,200	-	Ahmad Enterprises 1-McLeod Road Lahore

Table 3 (Continued)

4.	Light Duty Tagline	About 300 feet long of 0.04 inch diameter stainless steel with a hook at one end, wound on a heavy plastic reel and mounted on a hardwood stake; brass beads every 2 feet for the first 50 feet, every 5 feet from 50 to 200 feet and every 10 feet from 200 to 300 feet.	21	-	525	-	11,025	Scientific Instruments Inc.
5.	Heavy Duty Lee Au Type Tagline	About 500 feet long 1/16 inch diameter open reel with handles; marked with brass beads every 2 feet for the first 50 feet, every 5 feet from 50 to 200 feet, every 10 feet from 200 to 300 feet and every 50 feet from 300 to 500 feet; heavy duty hooks on both ends for attaching to trees or other sturdy objects.	21	-	580	-	12,180	Scientific Instruments Inc.
6.	Headset	Flexible headband, built in compartment for dry cell battery, including flexible wire with two pole connector for connecting to two-conductor wire from current meter on wading rod or from sounding reel.	42	-	65	-	2,730	Scientific Instruments Inc.
7.	Velocity Counter	Electro-mechanical type for tracking number of revolutions of a current meter, working on dry cell batteries, housed in a rugged plastic case	-	-	185	-	-	Scientific Instruments Inc.
8.	Electronic Watch	Electronic, digital reading to 0.01 second, with a neck cord and having easy to use finger tip control buttons.	42	-	70	-	2,940	Scientific Instruments Inc.
9.	Spares for Current Meters	Compatible to the selected current meters; should include: pivot assembly, [illegible]per screw, binding post assy, 3 extra screws for price [illegible] and Pygmy meters; instrument oil, cleaning cloth, two-pole connector (male and female); current wheel assembly	5 Nos. for each item, both for Pygmy and Price AA	-	-	-	300	Scientific Instruments Inc.
10.	Rubber Chest Wader	1. Medium Size 2. Large Size	21 21	- -	160 210	- -	3,360 4,410	Rickly Hydrologic Company, 2710

Table 3 (Continued)

11.	Hip boots	1. Medium Size 2. Large Size	- -	- -	75 105	- -	- -	Joyce Ave; Columbus, Ohio, 43211 USA
12.	Boat Improvize-ment Set	Boom and cross arm, USGS standard	21	5,300	-	111,300	-	Ahmad Enterprises, Lahore
13.	Sounding Reel	USGS A-type light duty, with a maximum load capacity of 100 pounds; two-position handle for leverage, scale reading 0.1 foot; complete with 0.1 inch double conductor cable, "B" type connector and flexible two-conductor wire for connecting reel to headset	21	-	1,460	-	31,080	Scientific Instruments Inc.
14.	Sounding Weight	USGS Columbus (C) type 1. 30 pounds 2. 50 pounds	- 21	790 1,300	- -	- 27,300	- -	M. Ahmad & Sons I-Brandreth Rd, Lahore
15.	Hanger Ear with Pin	USGS type for 30 and 50 pounds Columbus type wights, one foot long	42	260	-	10,920	-	M. Ahmad & Sons
16.	Cable Connector	USGS Type B	10	-	27	-	270	Scientific Inst. Inc.
17.	Sounding Cable	Elsworth double conductor (inner core), 0.1 inch diameter	2,100 ft.	-	6	-	12,600	Scientific Inst. Inc.
18.	Life Jacket	USGS approved model A2 Adult universal, general purpose type-II	63	-	100	-	6,300	ERO Industries, Inc. Harlehurst, GA, 31539, USA
19.	Flat Bottom Fibre Glass Boat	16 feet long and 6 feet wide.	21	30,000	-	630,000	-	Tawnock Corpany Multan Rd. Lahore.
20.	Portable Sonic Depth Recorder	Single range 0 to 50 feet; paper size 8 inches wide and 72 feet long; paper speed 1 or 2 inches per minute; high resolution fine line transreceiver with a frequency of 100KHz; transducer frequency 100 KHz-7.5, voltage input 24 volts DC, weathertight aimuniun construction with water tight connectors, plastic cover and mounting brackets.	-	-	10,500	-	-	1. Ross 600 Series Ross Laboratories Inc: 3135 Fairview Ave; Seattle, WA 98102, USA 2. Raytheon series DE -719, [illegible] Co. Inc. Offices, Lexington, [illegible] 02173 USA.
21.	Spares for Sonic Depth Recorders	Most frequently replaceable parts to be decided by the supplier consistent with model conforming to above specifications, including recoroer charts.	L.S.	-	-	-	-	1. Ross Laboratories 2. Raytheon

Table 3 (Continued)

22.	Metalic Measuring Tape	Length 100 feet, marked in 0.1 foot increments or in inches; housed in a case.	21	210	-	4,410	-	Sibtain Brothers, Karachi
23.	Level with Tripod	Topcon (Japan) automatic levelling, magnification 18 X with standard accessories	21	21,000	-	441,000	-	Sibtain Brothers.
24.	Levelling Staff	Japanese stave pole standard, 15 ft long	21	1,260	-	26,460	-	Sibtain Brothers.
25.	Y - Rod	Standard, for measuring geometry of outlets.	42	2,500	-	105,000	-	Kotri Gaging Subdivision, Hydrology Directorate. Hyderabad
26.	Water Level Recorder	Stevens A-71; English units with 1:6 gage scale; chart speed 2.4 inches per day; chart 10 inches wide and 25 yard long; 4.5 - month negator spring driven clock; 18-inch circumference pulley for perforated tape; stainless steel graduated, perforated tape 50 feet long with set end hooks and index bracket; 8-inch diameter float with counter weight, reversal indicator.	-	-	3,100	-	-	Leupold and Stevens, Inc; P.O. Box 688 Beaverton, Oregon 97075 USA
27.	Spares for Water Level Recorder	1. Recorder chart	-	-	21	-	-	Leupod and Stevens
		2. Pen ink	-	-	9	-	-	
		3. Capillary pen with lucite reservoir	-	-	52	-	-	
		4. 4.5 - month negator spring driven clock	-	-	790	-	-	
		5. Float tape	-	-	210	-	-	
		6. Float	-	-	95	-	-	
		7. Counter weight	-	-	13	-	-	
		8. Pen Cleaner, packet	-	-	9	-	-	
28.	Staff Gage	Special porcelain enamel coated, four inches wide in 3.33-foot sections; graduates to .01 foot and marked every foot. 0.1 and .02 foot						Kotri Gaging Subdivision, Hydrology Directorate Hyderacad. DR
		Ranges: 0-3.33 ft	300	500	-	150,000	-	Ahmad Enterprises, Lahore
		3.33-6.66 ft	300	500	-	150,000	-	
		6.66-9.99 ft	300	500	-	150,000	-	
		9.99-13.33 ft	300	500	-	150,000	-	

Table 3 (Continued)

Sediment Sampling Equipment

1.	Wading Type, Depth Integrating Suspended Sediment Hand Sampler	US DH-48 with wading rod including three sets of spare gaskets, and nozzles of 1/8, 3/16 and 1/4 inch openings, aluminum casting	21	2,100	-	44,100	-	Ahmad Enterprises, Lahore
2.	Reel Type, Depth Intergating Sediment Sampler	US D-74, cast bronze stream lined body, with hanger bar and pin; and including three spare sets of gaskets and nozzles of 1/8, 3/16 and 1/4 inch openings.	21	6,800	-	142,800	-	Ahmad Enterprises
3.	Piston Type Bed Material Hand Sampler	US BMH 53	21	-	420	-	8,820	Minnesota Fabricators, 2315 Highway 51, North St. Paul Min. 55109, USA
4.	Hand line Bed Material sampler	US BMH 60	21	-	1,100	-	23,100	Minnesota Fabricators.
5.	Pint Glass Bottles	For use with DH-48, 24 per box	42	-	75	-	3,150	Minnesota Fabricators.
6.	Plastic Jar	For use with D-74, 12 per box	42	-	25	-	1,050	Minnesota Fabricators.
7.	Sample Label	For use on all bottles or Jars, self adhesive, packet	42	-	25	-	1,050	Minnesota Fabricators.

Laboratory Equipment For Sediment Analysis

1.	Visual Accumulation Tube sand size Analyser	V.A. tube with automatic tracer and motor (240 Volts-50 cycle); including all accessories for 120 cm tubes; sizes 2.1, 3.4, 5.0 and 7.0 mm inside diameters at lower ends.	21	-	3,800	-	79,800	Federal Interagency Sedimentation Project, St. Anthony Falls Hydraulic Laboratory, [illegible] 3rd Avenue South-East, Minneapolis, Min. [illegible]
2.	Spares for VA Tube	1. VA glass tube: 2.1 mm	21	-	210	-	4,410	Federal Interagency
		2. VA glass tube: 3.4 mm	21	-	210	-	4,410	
		3. VA glass tube: 5.0 mm	21	-	210	-	4,410	
		4. VA glass tube: 7.0 mm	21	-	210	-	4,410	
		5. VAT Charts	LS	-	-	-	600	
3.	Bottom Withdrawal Tube	Standard by St. Anthony Falls Hydraulic Laboratories, including rubber tape and pinch clamp.	42	-	220	-	9,240	Federal Interagency

Table 3 (Continued)

4.	Analytical Balance	Capacity of 200 grams with weight box and .0001 gram sensitivity, beam -.05 to +.05 gram in 200 graduated divisions; two concave stainless steel pans, front and back sliding glass doors case.	21	-	1,800	-	37,800	Soiltest, 66 Albrecht Dr. P.O. Box 3004, Lake Bluff, IL. 60044-9902 USA
5.	Electronic Balance	Capacity of 200 grams, Sensitivity .0001 gram	21	-	2,600	-	54,600	Soiltest, IL.
6.	Electric Oven	Fan-Forced air circulation, temperature range upto 110C, two doors, pilot light, adjustable shelf, welded steel exterior, overall diameter 20"x25"x27".	21	-	1,100	-	23,100	Soiltest, IL.
7.	Sieve set (fine)	USA standard sieves, 3-inch diameter brass sieve, fine series						Soiltest IL.
		No. Openings						
		5 4.00 mm	21	-	38	-	798	
		10 2.00 mm	21	-	38	-	798	
		18 1.00 mm	21	-	38	-	798	
		25 .710 mm	21	-	38	-	798	
		35 .500 mm	21	-	38	-	798	
		45 .355 mm	21	-	38	-	798	
		60 .250 mm	21	-	38	-	798	
		80 .180 mm	21	-	38	-	798	
		120 .125 mm	21	-	38	-	798	
		170 .090 mm	21	-	45	-	948	
		230 .063 mm	21	-	55	-	1,155	
		325 .045 mm	21	-	80	-	1,680	
8.	Sieve set (Coarse)	USA standard sieve; 8 - inch diameter, brass sieve,						Soiltest IL.
		Sieve size						
		5.6 mm	21	-	38	-	798	
		8.0 mm	21	-	38	-	798	
		16.0 mm	21	-	38	-	798	
		31.5 mm	21	-	38	-	798	
		63 mm	21	-	38	-	798	
		100 mm	21	-	38	-	798	
9.	Sieve Brush	Fine hair bristles, wooden handle.	42	-	8	-	336	Soiltest IL.
10.	Sieve Lid	For US Standard 3-inch sieves	21	-	16	-	336	Soiltest IL.
11.	Sieve Pan	For US Standard 3-inch sieves	21	-	16	-	336	Soiltest IL.

Table 3 (continued)

12.	Sieve Shakar (Motorized)	Motorized 220 volts, 50 cycle; capacity eight sieves plus pan and cover, 8-inch sieve sizes.	-	-	740	-	-	Soiltest IL.
13.	Sieve Shaker (Hand operated)	Head-operated shaker; capacity seven sieves, 8-inch diameter.	21	-	350	-	7,350	Soiltest IL.
14.	Stop Watch	Reading to one second, Swiss/China	21	900	-	18,900	-	Ahmad Enterprises, Lahore
15.	Pipette	Pyrex glass;						
		1. 25 ml capacity; tolerance + 0.06 ml	21	-	100	-	2,100	Fisher Scientific 1600 W.Glenlake Ave: Itasca IL. 60143 USA
		2. 50 ml capacity; tolerance + 0.10 ml	21	-	130	-	2,730	
16.	Vacuum Pump	Two series-connected electric pumps, 0.3 mm ultimate pressure in leak proof system, 1/4 HP motor, 240 volts 50 Hz.	21	-	850	-	17,850	Soiltest, IL.
17.	Beaker	Pyrex glass; safe temperature limit 500C;						Soiltest, IL.
		1. 100 ml	42	-	3	-	126	
		2. 250 ml	42	-	3	-	126	
		3. 600 ml	42	-	4	-	168	
18.	Cylinder	Pyrex glass graduated						
		1. 100 ml	42	-	12	-	504	Soiltest, IL.
		2. 250 ml	42	-	18	-	756	
		3. 500 ml	42	-	22	-	924	
		4. 1000 ml	42	-	32	-	1,344	
19.	Desiccab	For cooling samples in moisture-free environment, chemical resistant, high impact molded plastic; aluminum shelves, removable desiccant glass tray	-	-	700	-	-	Soiltest, IL.
20.	Evaporating Dish	Porcelain, glazed inside, partially glazed outside.						Soiltest, IL.
		1. 90 mm diameter 120 ml capacity	210	-	9	-	1,890	
		2. 115 mm diameter 250 ml capacity	210	-	13	-	2,730	
21.	Desiccator	For cooling samples in moisture-free environment, glass construction, 125 mm inside diameter and 75 mm depth to plate	21	-	65	-	1,365	Soiltest, IL.

Table 3 (Continued)

22.	Wash Bottle	Borosilicate florence flask with special molded rubber grip containing valve system, one litre capacity	21	-	78	-	1,638	Soiltest, IL.
23.	Filtering Funnel	Pyrex glass, 60 angle bowle, beaded to reduce chipping, top diameter 127 mm, stem length 100 mm	42	-	80	-	3,360	Fisher Scientific, IL.
24.	Filter Circle	Whatman, ashless filter paper, fine porosity, particle retention .0025 mm, diameter 12.5 cm, packet	42	-	25	-	1,050	Fisher Scientific, IL.
25.	Stirring Rod	Glass, 5 mm diameter, 30 cm long	63	-	2	-	126	Fisher Scientific, IL.
26.	Thermometer	Range - 20 to 110C, minimum graduation one degree, length 300 mm.	42	-	32	-	1,344	Fisher Scientific, IL.
27.	3-Way Stop Cock	Glass construction.	42	-	12	-	504	Fisher Scientific. IL.
28.	French Curve Set	Plastic.	21	-	100	-	2,100	Common Item.

Total: Rs. 2,250,390
U.S. $ 473,628+10% freight = 520,991

TABLE 4
PUNJAB POVINCE
HYDRAULIC AND SEDIMENT MONITORING EQUIPMENT FOR ADEQUATE OPERATION AT DIVISIONAL AND CIRCLE LEVELS

S.#	ITEM	SPECIFICATIONS	QUANTITY	UNIT COST		TOTAL COST		SUPPLIER
				Local Rs.	Dollar US$	Local Rs.	Dollar US$	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Hydraulic Equipment								
1.	Current Meter	Price Type AA (vertical axis, horizontal bucket wheel); chrome plated stainless steel; minimum velocity = 0.1 fps and maximum velocity = 20.0 fps; single and penta contacts; furnished complete in a foam cushioned carrying case, along with a rating chart, tail fin assembly, screw driver, assorted spare parts, and special lubricant, both for rod and cable suspension.	124	-	790	-	97,960	Scientific Instruments Inc: 513 West Cherry, Milwaukee,WI 53212 -3822, USA (414)263-1600 Fax (414)263-5506
2.	Mini Current Meter (Pygmy)	Verticall axis, horizontal bucket wheel; chrome plated stainless steel; minimum velocity: .05 fps and maximum velocity = 3.0 fps; furnished complete in a foam cushioned carrying case with assorted spare parts, a rating chart and lubricant: for rod suspension only.	124	-	630	-	78,120	Scientific Inst. Inc.
3.	Standard Wading Rods	Four 2-foot graduated rods in 0.1 foot increments, bottom rod with base plate; an adjustable sliding support capable of holding price Type AA and Pygmy current meters; a flexible two-conductor wire with one end having two-hole connector for head set and the other end suitable for connecting to current meter and rods. Base plate and slider made from corrosion resistant material; complete set in heavy duty canvas carrying case.	124	2,100	-	260,400	-	Ahmad Enterprises McLeodod Road Lahore

Table 4 (Continued)

4.	Light Duty Tagline	About 300 feet long of 0.04 inch diameter stainless steel with a hook at one end, wound on a heavy plastic reel and mounted on a hardwood stake; brass beads every 2 feet for the first 50 feet, every 5 feet from 50 to 200 feet and every 10 feet from 200 to 300 feet.	62	-	525	-	32,550	Scientific Instruments Inc.
5.	Heavy Duty Lee Au Type Tagline	About 500 feet long 1/16 inch diameter open reel with handles; marked with brass beads every 2 feet for the first 50 feet, every 5 feet from 50 to 200 feet, every 10 feet from 200 to 300 feet and every 50 feet from 300 to 500 feet; heavy duty hooks on both ends for attaching to trees or other sturdy objects.	62	-	580	-	35,960	Scientific Inst. Inc.
6.	Headset	Flexible headband, built in compartment for dry cell battery, including flexible wire with two pole connector for connecting to two-conductor wire from current meter on wading rod or from sounding reel.	124	-	65	-	8,060	Scientific Inst. Inc.
7.	Velocity Counter	Electro-mechanical type for tracking number of revolutions of a current meter, working on dry cell batteries, housed in a rugged plastic case	-	-	185	-	-	Scientific Inst. Inc.
8.	Electronic Watch	Electronic, digital reading to 0.01 second, with a neck cord and having easy to use finger tip control buttons.	124	-	70	-	8,680	Scientific Inst. Inc.
9.	Spares for Current Meters	Compatible to the selected current meters; should include: pivot assembly, hanger screw, binding post assembly; extra screws for price AA and Pygmy meters; instrument oil, cleaning cloth, two-pole connector (male and female); bucket wheel assembly	5 Nos. for each item, both for Pygmy and Price AA	-	-	-	300	Scientific Inst. Inc.
10.	Rubber Chest Wader	1. Medium Size 2. Large Size	62 62	- -	160 210	- -	9,920 13,020	Rickly Hydrologic Company, 2710

Table 4 (Continued)

11.	Hip boots	1. Medium Size 2. Large Size	62 62	- -	75 105	- -	4,650 6,510	Joyce Ave; Columbus, Ohio, 43211 USA
12.	Boat Improvize-ment Set	Boom and cross arm, USGS standard	62	5,300	-	328,600	-	Ahmad Enterprises, Lahore
13.	Sounding Reel	USGS A-type light duty, with a maximum load capacity of 100 pounds; two-position handle for leverage, scale reading 0.1 foot; complete with 0.1 inch double conductor cable, "B" type connector and flexible two-conductor wire for connecting reel to headset	62	-	1,490	-	91,760	Scientific Instruments Inc;
14.	Sounding Weight	USGS Columbus (C) type 1. 30 pounds 2. 50 pounds	- 62	750 1,300	- -	- 80,600	- -	M. Ahmad & Sons I-Brandreth Rd, Lahore
15.	Hanger Bar with Pin	USGS type for 30 and 50 pounds Columbus type weight, one foot long	124	260	-	32,240	-	M. Ahmad & Sons
16.	Cable Connector	USGS Type B	62	-	27	-	1,674	Scientific Inst. Inc.
17.	Sounding Cable	Elsworth double conductor (inner core), 0.1 inch diameter	6,200 ft.	-	6	-	37,200	Scientific Inst. Inc.
18.	Life Jacket	USGS approved model A2 Adult universal, general purpose type-II	186	-	100	-	18,600	ERO Industries, Inc, Harrlehurst, PA, 31539, USA
19.	Flat Bottom Fibre Glass Boat	16 feet long and 6 feet wide.	62	30,000	-	1,860,000	-	Zamrock Company Multan Rd. Lahore.
20.	Portable Sonic Depth Recorder	Single range 0 to 50 feet; paper size 8 inches wide and 72 feet long; paper speed 1 or 2 inches per minute; high resolution fine line transreceiver with a frequency of 100KHz; transducer frequency 100 KHz-7.5, voltage input 24 volts DC, weathertight aluminium construction with water tight connectors, plastic cover and mounting brackets.	-	-	10,500	-	-	1. Ross 600 Series Ross Laboratories Inc; 2138 Fairview Ave: E, Seattle, WA 98102. USA 2. 2. Raytheon Series DE -719. Marine Co. Int. Affairs, Lexington, Mass. 02173 USA.
21.	Spares for Sonic Depth Recorders	Most frequently replaceable parts to be decided by the supplier consistent with model conforming to above specifications, including recorder charts.	L.S.	-	-	-	-	1. Ross Laboratories 2. Raytheon.

Table 4 (Continued)

22.	Metalic Measuring Tape	Length 100 feet, marked in 0.1 foot increments or in inches; housed in a case.	62	210	-	13,020	-	Sibtain Brothers, Karachi
23.	Level with Tripod	Topcon (Japan) automatic levelling, magnification 20 X with standard accessories	62	21,000	-	1,302,000	-	Sibtain Brothers
24.	Levelling Staff	Japanese stave pole standard, 15 ft long	62	1,260	-	78,120	-	Sibtain Brothers
25.	V - Rod	Standard, for measuring geometry of outlets.	124	2,500	-	310,000	-	Kotri Gaging Sub-division. Hydrol-ogy Directorate, Hyderabad
26.	Water Level Recorder	Stevens A-71; English units with 1:6 gage scale; chart speed 2.4 inches per day; chart 10 inches wide and 25 yard long; 4.5 - month negator spring driven clock; 10-inch circumference pulley for perforated tape; stainless steel graduated, perforated tape 50 feet long with set and hooks and index bracket; 8-inch diameter float with counter weight, reversal indicator.	62	-	3,100	-	192,200	Leupold and Stevens, Inc: P.O. Box 688 Beaverton, Oregon 97075 USA
27.	Spares for Water Level Recorder	1. Recorder chart	62	-	21	-	1,302	Leupold and Stevens
		2. Pen ink	62	-	9	-	558	
		3. Capillary pen with lucite reser-voir	62	-	52	-	3,224	
		4. 4.5 - month negator spring driven clock	62	-	790	-	48,980	
		5. Float tape	62	-	210	-	13,020	
		6. Float	62	-	95	-	5,890	
		7. Counter weight	62	-	13	-	806	
		8. Pen Cleaner, packet	62	-	9	-	558	
28.	Staff Gage	Special porcelain enamel coated, four inches wide in 3.33-foot sections; graduated to .01 foot and marked every foot, 0.1 and .02 foot.						Kotri Gaging Sub-division, Hydrol-ogy Directorate Hyderabad. Of
		Range: 0-3.33 ft	300	500	-	150,000	-	Ahmad Enterp[illegible]s, Lahore
		3.33-6.66 ft	300	500	-	150,000	-	
		6.66-9.99 ft	300	500	-	150,000	-	
		9.99-13.33 ft	300	500	-	150,000	-	

Table 4 (Continued)

Sediment Sampling Equipment

1.	Wading Type, Depth Integrating Suspended Sediment Hand Sampler	US DH-48 with wading rod including three sets of spare gaskets, and nozzles of 1/8, 3/16 and 1/4 inch openings, almunium casting	21	2,100	-	44,100	-	Ahmad Enterprises, Lahore
2.	Reel Type, Depth Intergating Sediment Sampler	US D-74, cast bronze stream lined body, with hanger bar and pin; and including three spare sets of gaskets and nozzles of 1/8, 3/16 and 1/4 inch openings.	21	6,800	-	142,800	-	Ahmad Enterprises.
3.	Piston Type Bed Material Hand Sampler	US BMH 53	21	-	420	-	8,820	Minnesota Fabricators, 2315 Highway 61 North St. Paul Min. 55109. USA
4.	Hand line Bed Material sampler	US BMH 60	21	-	1,100	-	23,100	Minnesota Fabricators
5.	Pint Glass Bottles	For use with DH-48, 24 per box	42	-	75	-	3,150	Minnesota Fabricators
6.	Plastic Jar	For use with D-74, 12 per box	42	-	25	-	1,050	Minnesota Fabricators
7.	Sample Label	For use on all bottles or jars, self adhesive, packet	42	-	25	-	1,050	Minnesota Fabricators

Laboratory Equipment For Sediment Analysis

1.	Visual Accumulation Tube sand size Analyser	V.A. tube with automatic tracer and motor (240 Volts-50 cycle); including all accessories for 120 cm tubes; sizes 2.1, 3.4, 5.0 and 7.0 mm inside diameters at lower ends.	21	-	3,800	-	79,800	Federal Inter-agency Sedimentation Project, St. Anthony Falls Hydraulic Laboratory, 3-3rd Avenue South East. Minneapolis. Min. 55414 USA
2.	Spares for VA Tube	1. VA glass tube: 2.1 mm	21	-	210	-	4,410	Federal Interagency
		2. VA glass tube: 3.4 mm	21	-	210	-	4,410	
		3. VA glass tube: 5.0 mm	21	-	210	-	4,410	
		4. VA glass tube: 7.0 mm	21	-	210	-	4,410	
		5. VAT Charts	LS	-	-	-	600	
3.	Bottom Withdrawal Tube	Standard by St. Anthony Falls Hydraulic Laboratories, including rubber tape and pinch clamp.	42	-	220	-	9,240	Federal Interagency

Table 4 (Continued)

4.	Analytical Balance	Capacity of 200 grams with weight box and .0001 gram sensitivity, beam -.05 to +.05 gram in 200 graduated divisions; two concave stainless steel pans, front and back sliding glass doors case.	21	-	1,800	-	37,800	Soiltest, 66 Albrecht Dr. P.O. Box 6004, Lake Bluff, IL. 60044-9902 USA
5.	Electronic Balance	Capacity of 200 grams, Sensitivity .0001 gram	21	-	2,600	-	54,600	Soiltest, IL.
6.	Electric Oven	Fan-Forced air circulation, temperature range upto 110C, two doors, pilot light, adjustable shelf, welded steel exterior, overall diameter 30"x25"x24".	21	-	1,100	-	23,100	Soiltest, IL.
7.	Sieve set (fine)	USA standard sieves, 3-inch diameter brass sieve, fine series						Same as above
		No. Openings						
		5 4.00 mm	21	-	38	-	798	
		10 2.00 mm	21	-	38	-	798	
		18 1.00 mm	21	-	38	-	798	
		25 .710 mm	21	-	38	-	798	
		35 .500 mm	21	-	38	-	798	
		45 .355 mm	21	-	38	-	798	
		60 .250 mm	21	-	38	-	798	
		80 .180 mm	21	-	38	-	798	
		120 .125 mm	21	-	38	-	798	
		170 .090 mm	21	-	45	-	945	
		230 .063 mm	21	-	55	-	1,155	
		325 .045 mm	21	-	80	-	1,680	
8.	Sieve set (Coarse)	USA standard sieve; 8 - inch diameter, brass sieve,						Soiltest, IL.
		Sieve size						
		3.6 mm	21	-	38	-	798	
		8.0 mm	21	-	38	-	798	
		16.0 mm	21	-	38	-	798	
		31.5 mm	21	-	38	-	798	
		63 mm	21	-	38	-	798	
		100 mm	21	-	38	-	798	
9.	Sieve Brush	Fine hair bristles, wooden handle.	42	-	8	-	336	Soiltest, IL.
10.	Sieve Lid	For US Standard 3-inch sieves	21	-	16	-	336	Soiltest, IL.
11.	Sieve Pan	For US Standard 3-inch sieves	21	-	16	-	336	Soiltest, IL.

Table 4 (continued)

12.	Sieve Shakar (Motorized)	Motorized 220 volts, 50 cycle; capacity eight sieves plus pan and cover, 8-inch sieve sizes.	-	-	740	-	-	Soiltest, IL.
13.	Sieve Shaker (Hand operated)	Head-operated shaker; capacity seven sieves, 8-inch diameter.	21	-	350	-	7,350	Soiltest, IL.
14.	Stop Watch	Reading to one second, Swiss/China	21	900	-	18,900	-	Ahmad Enterprises, Lahore
15.	Pipette	Pyrex glass;						Fisher Scientific
		1. 25 ml capacity; tolerance + 0.06 ml	21	-	100	-	2,100	1600 W.Bienlake Ave; Itasca
		2. 50 ml capacity; tolerance + 0.10 ml	21	-	130	-	2,730	IL. 60143 USA
16.	Vacuum Pump	Two series-connected electric pumps, 0.3 mm ultimate pressure in leak proof system, 1/4 HP motor, 240 volts 50 Hz.	21	-	850	-	17,850	Soiltest, IL.
17.	Beaker	Pyrex glass; safe temperature limit 500C;						Soiltest, IL.
		1. 100 ml	42	-	3	-	126	
		2. 250 ml	42	-	3	-	126	
		3. 600 ml	42	-	4	-	168	
18.	Cylinder	Pyrex glass graduated						Soiltest, IL.
		1. 100 ml	42	-	12	-	504	
		2. 250 ml	42	-	18	-	756	
		3. 500 ml	42	-	22	-	924	
		4. 1000 ml	42	-	32	-	1,344	
19.	Desiccab	For cooling samples in moisture-free environment, chemical resistant, high impact molded plastic; aluminium shelves, removable desiccant glass tray	-	-	700	-	-	Soiltest, IL.
20.	Evaporating Dish	Porsclain, glazed inside, partially glazed outside.						Soiltest, IL.
		1. 90 mm diameter 120 ml capacity	210	-	9	-	1,890	
		2. 115 mm diameter 230 ml capacity	210	-	13	-	2,730	
21.	Desiccator	For cooling samples in moisture-free environment, glass construction, 125 mm inside diameter and 75 mm depth to plate	21	-	65	-	1,365	Soiltest, IL.

Table 4 (Continued)

22.	Wash Bottle	Borosilicate florence flask with special molded rubber grip containing valve system, one litre capacity	21	-	78	-	1,638	Soiltest, IL.
23.	Filtering Funnel	Pyrex glass, 60 angle bowie, beaded to reduce chipping, top diameter 127 mm, stem length 100 mm	42	-	80	-	3,360	Fisher Scientific, IL.
24.	Filter Circle	Whatman, ashless filter paper, fine porosity, particle retention .0025 mm, diameter 12.5 cm, packet	42	-	25	-	1,050	Fisher Scientific, IL.
25.	Stirring Rod	Glass, 5 mm diameter, 30 cm long	63	-	2	-	126	Fisher Scientific, IL.
26.	Thermometer	Range - 20 to 110C, minimum graduation one degree, length 300 mm.	42	-	32	-	1,344	Fisher Scientific, IL.
27.	3-Way Stop Cock	Glass construction.	42	-	12	-	504	Fisher Scientific, IL.
28.	French Curve Set	Plastic.	21	-	100	-	2,100	Common Item.

Total: Rs. 5,070,760
U.S. $ 1,038,295+10% freight = 1,142,125

TABLE 5
PUNJAB POVINCE
HYDRAULIC AND SEDIMENT MONITORING EQUIPMENT FOR PILOT PROJECT

S.#	ITEM	SPECIFICATIONS	QUANTITY	UNIT COST		TOTAL COST		SUPPLIER
				Local Rs.	Dollar US$	Local Rs.	Dollar US$	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Hydraulic Equipment							
1.	Current Meter	Price Type AA (vertical axis, horizontal bucket wheel); chrome plated stainless steel; minimum velocity = 0.1 fps and maximum velocity = 20.0 fps; single and penta contacts; furnished complete in a foam cushioned carrying case, along with a rating chart, tail fin assembly, screw driver, assorted spare parts, and special lubricant, both for rod and cable suspension.	32	-	790	-	25,280	Scientific Instruments Inc; 518 West Cherry, Milwaukee,WI 53212 -3822, USA (414)263-1600 Fax (414)263-5506
2.	Mini Current Meter (Pygmy)	Vertical axis, horizontal bucket wheel; chrome plated stainless steel; minimum velocity: .05 fps and maximum velocity = 3.0 fps; furnished complete in a foam cushioned carrying case with assorted spare parts, a rating chart and lubricant; for rod suspension only.	32	-	630	-	20,160	Scientific Inst. Inc.
3.	Standard Wading Rods	Four 2-foot graduated rods in 0.1 foot increments, bottom rod with base plate; an adjustable sliding support capable of holding price Type AA and Pygmy current meters; a flexible two-conductor wire with one end having two-hole conductor for head set and the other end suitable for connecting to current meter and rods. Base plate and slider rods from corrosion resistant material; complete set in heavy duty canvas carrying case.	32	2,100	-	67,200	-	Ahmad Enterprises I-McLeod Road Lahore

Table 5 (Continued)

4. Light Duty Tagline	About 300 feet long of 0.04 inch diameter stainless steel with a hook at one end, wound on a heavy plastic reel and mounted on a hardwood stake; brass beads every 2 feet for the first 50 feet, every 5 feet from 50 to 200 feet and every 10 feet from 200 to 300 feet.	32	-	525	-	16,800	Scientific Instruments Inc.
5. Heavy Duty Lee Au Type Tagline	About 500 feet long 1/16 inch diameter open reel with handles; marked with brass beads every 2 feet for the first 50 feet, every 5 feet from 50 to 200 feet, every 10 feet from 200 to 300 feet and every 50 feet from 300 to 500 feet; heavy duty hooks on both ends for attaching to trees or other sturdy objects.	16	-	580	-	9,280	Scientific Inst. Inc.
6. Heads..	Flexible headband, built in compartment for dry cell battery, including flexible wire with two pole connector for connecting to two-conductor wire from current meter on wading rod or from sounding reel.	32	-	65	-	2,080	Scientific Inst. Inc.
7. Electronic Watch	Electronic, digital reading to 0.01 second, with a neck cord and having easy to use finger tip control buttons.	16	-	70	-	1,120	Scientific Inst. Inc.
8. Spares for Current Meters	Compatible to the selected current meters; should include: pivot assembly, hanger screw, binding post assembly; extra screws for price AA and Pygmy meters; instrument oil, cleaning cloth, two-pole connector (male and female); bucket wheel assembly	5 Nos. for each item, both for Pygmy and Price AA	-	-	-	350	Scientific Inst. Inc.
9. Water Chest [illegible]	1. Medium Size	12	-	160	-	1,920	Rickly Hydrologic
	2. Large Size	4	-	210	-	840	Company, 2710
10. [illegible] scots	1. Medium Size	12	-	75	-	900	Joyce Ave;
	2. Large Size	4	-	105	-	420	Columbus, Ohio, 43211 USA
11. Boat Improvisement Set	Boom and cross arm, USBS standard	16	5,300	-	84,800	-	Ahmad Enterprises, Lahore

Table 5 (Continued)

12. Sounding Reel	USGS A-type light duty, with a maximum load capacity of 100 pounds; two-position handle for leverage, scale reading 0.1 foot; complete with 0.1 inch double conductor cable, "B" type connector and flexible two-conductor wire for connecting reel to headset	16	-	1,480	-	23,680	Scientific Instruments Inc;
13. Sounding Weight	USGS Columbus (C) type 50 pounds	16	1,300	-	20,800	-	M. Ahmad & Sons I-Brandreth Rd, Lahore
14. Hanger Bar with Pin	USGS type for 30 and 50 pounds Columbus type weights, one foot long	32	260	-	8,320	-	M. Ahmad & Sons
15. Cable Connector	USGS Type B	10	-	27	-	270	Scientific Inst. Inc.
16. Sounding Cable	Elsworth double conductor (inner core), 0.1 inch diameter	1,600 ft.	-	6	-	9,600	Scientific Inst. Inc.
17. Life Jacket	USGS approved model A2 Adult universal, general purpose type-II	32	-	100	-	3,200	ERO Industries, Inc, Harelhurst, GA, 31539. USA
18. Flat Bottom Fibre Glass Boat	16 feet long and 6 feet wide.	16	30,000	-	480,000	-	Zamrock Company Multan Rd. Lahore.
19. Metalic Measuring Tape	Length 100 feet, marked in 0.1 foot increments or in inches; housed in a case.	16	210	-	3,360	-	Sibtain Brothers, Karachi
20. Level with Tripod	Topcon (Japan) automatic levelling, magnification 20 X with standard accessories	16	21,000	-	336,000	-	Sibtain Brothers
21. Levelling Staff	Japanese stave pole standard, 15 ft long	16	1,260	-	20,160	-	Sibtain Brothers
22. Y - Rod	Standard, for measuring geometry of outlets.	16	2,500	-	40,000	-	Kotri Gaging Sub-division, Hydrology Directorate, Hyderabad
23. Water Level Recorder	Stevens A-71; English units with 1:6 gage scale; chart speed 2.4 inches per day; chart 10 inches wide and 25 yard long; 4.5 - month negator spring driven clock; 18-inch circumference pulley for perforated tape; stainless steel graduated, perforated tape 50 feet	16	-	3,100		47,600	Leupold and Stevens, Inc; P.O. Box 688 Beaverton, Oregon 97075 USA

	long with set end hooks and index bracket: 8-inch diameter float with counter weight, reversal indicator.						
24. Spares for Water Level Recorder	1. Recorder chart	16	-	21	-	336	Leupold & Stevens
	2. Pen ink	16	-	9	-	144	
	3. Capillary pen with lucite reservoir	16	-	52	-	832	
	4. Pen Cleaner, packet	16	-	9	-	144	
25. Staff Gage	Special porclain enamel coated, four inches wide in 3.30-foot sections; graduated to .01 foot and marked every foot, 0.1 and .02 foot.						Kotri Gaging Subdivision, Hydrology Directorate Hyderabad. SR
	Range: 0-3.33 ft	100	500	-	50,000	-	Ahmad Enterprises, Lahore
	3.33-6.66 ft	100	500	-	50,000	-	
	6.66-9.99 ft	100	500	-	50,000	-	
	9.99-13.33 ft	100	500	-	50,000	-	
Sediment Sampling Equipment							
1. Wading Type, Depth Integrating Suspended Sediment Hand Sampler	US DH-48 with wading rod including three sets of spare gaskets, and nozzles of 1/8, 3/16 and 1/4 inch openings, aluminium casting	16	2,100	-	33,600	-	Ahmad Enterprises, Lahore
2. Piston Type Bed Material Hand Sampler	US BMH 53	16	-	420	-	6,720	Minnesota Fabricators, 2515 Highway 61 North St. Paul Min. 55109, USA
3. Pint Glass Bottles	For use with DH-48, 24 per box	16	-	75	-	1,200	Minnesota Fabricators
4. Sample Label	For use on all bottles or jars, self adhesive, packet	16	-	25	-	400	Minnesota Fabricators
Laboratory Equipment For Sediment Analysis							
1. Bottom Withdrawal Tube	Standard by St. Anthony Falls Hydraulic Laboratories, including rubber tape and pinch clamp.	10	-	220	-	2,200	Federal Interagency Sedimentation Project, St. Anthony Falls Hydraulic Laboratory 2-3rd Avenue South-East. Minneapolis, Min. 55414 USA

Table 5 (Continued)

2. Analytical Balance	Capacity of 200 grams with weight box and .0001 gram sensitivity, beam -.05 to +.05 gram in 200 graduated divisions; two concave stainless steel pans, front and back sliding glass doors case.	5	-	1,600	-	9,000	Soiltest, 86 Albrecht Dr. P.O. Box 8004, Lake Bluff, IL. 60044-9902 USA
3. Electric Oven	Fan-Forced air circulation, temperature range upto 110C, two doors, pilot light, adjustable shelf, welded steel exterior, overall diameter 30"x25"x24".	5	-	1,100	-	5,500	Soiltest, IL.
4. Sieve set (fine)	USA standard sieves, 3-inch diameter brass sieve, fine series						Soiltest, IL.
	No. Openings						
	5 4.00 mm	5	-	38	-	190	
	10 2.00 mm	5	-	38	-	190	
	18 1.00 mm	5	-	38	-	190	
	25 .710 mm	5	-	38	-	190	
	35 .500 mm	5	-	38	-	190	
	45 .355 mm	5	-	38	-	190	
	60 .250 mm	5	-	38	-	190	
	80 .180 mm	5	-	38	-	190	
	120 .125 mm	5	-	38	-	190	
	170 .090 mm	5	-	45	-	225	
	230 .063 mm	5	-	55	-	275	
	325 .045 mm	5	-	80	-	400	
5. Sieve set (Coarse)	USA standard sieve; 8 - inch diameter, brass sieve,						Soiltest IL.
	Sieve size						
	5.6 mm	5	-	38	-	190	
	8.0 mm	5	-	38	-	190	
	16.0 mm	5	-	38	-	190	
	31.5 mm	5	-	38	-	190	
	63 mm	5	-	38	-	190	
	100 mm	5	-	38	-	190	
6. Sieve Brush	Fine hair bristles, wooden handle.	10	-	8	-	60	Soiltest IL.
7. Sieve Lid	For US Standard 3-inch sieves	5	-	16	-	80	Soiltest IL.
8. Sieve Pan	For US Standard 3-inch sieves	5	-	16	-	80	Soiltest IL.
9. Sieve Shaker (Hand operated)	Head-operated shaker; capacity seven sieves, 8-inch diameter.	5	-	350	-	1,750	Soiltest, IL.
10. Stop Watch	Reaming to one second, Swiss/China	5	100	-	4,500	-	Ahmad Enterprises, Lahore

Table 5 (Continued)

11. Pipette	Pyrex glass;						Fisher Scientific
	1. 25 ml capacity; tolerance + 0.06 ml	5	-	100	-	500	1600 W.Glenlake Ave; Itasca
	2. 50 ml capacity; tolerance + 0.10 ml	5	-	130	-	650	IL. 60143 USA
12. Vacuum Pump	Two series-connected electric pumps, 0.3 mm ultimate pressure in leak proof system, 1/4 HP motor, 240 volts 50 Hz.	5	-	850	-	4,250	Soiltest, IL.
13. Beaker	Pyrex glass; safe temperature limit 500C;						Soiltest, IL.
	1. 100 ml	10	-	3	-	30	
	2. 250 ml	10	-	3	-	30	
	3. 600 ml	10	-	4	-	40	
14. Cylinder	Pyrex glass graduated						Soiltest, IL.
	1. 100 ml	10	-	12	-	120	
	2. 250 ml	10	-	18	-	180	
	3. 500 ml	10	-	22	-	220	
	4. 1000 ml	10	-	32	-	320	
15. Evaporating Dish	Porcelain, glazed inside, partially glazed outside.						Soiltest, IL.
	1. 90 mm diameter 120 ml capacity	50	-	9	-	450	
	2. 115 mm diameter 250 ml capacity	50	-	13	-	650	
16. Desiccator	For cooling samples in moisture-free environment, glass construction, 125 mm inside diameter and 75 mm depth to plate	5	-	65	-	325	Soiltest, IL.
17. Wash Bottle	Borosilicate florence flask with special molded rubber grip containing valve system one litre capacity	5	-	78	-	390	Soiltest, IL.
18. Filtering Funnel	Pyrex glass, 60 angle bowle, beaded to reduce chipping, top diameter 127 mm, stem length 100 mm	10	-	80	-	800	Fisher Scientific, IL.
19. Filter Circle	Whatman, ashless filter paper, fine porosity, particle retention .0023 mm, diameter 12.5 cm, packet	10	-	25	-	250	Fisher Scientific, IL.
20. Stirring Rod	Glass, 5 mm diameter, 30 cm long	10	-	2	-	20	Fisher Scientific, IL.

Table 5 (Continued)

21. Thermometer	Range - 20 to 110C, minimum graduation one degree, length 300 mm.	10	-	32	-	320	Fisher Scientific, IL.
22. 3-Way Stop Cock	Glass construction.	10	-	12	-	120	Fisher Scientific, IL.
23. French Curve Set	Plastic.	5	-	100	-	500	Common Item.

Total: Rs. 1,298,740
U.S. $ 207,881+10% freight - 228,669

Note : Five Cities (Sixteen divisions)

TABLE 6
SINDH PROVINCE
NUMBER OF FIELD UNITS FOR OPERATION AND MAINTENANCE OF CANAL AND DRAINAGE SYSTEMS

REGION CHIEF ENGINEER	CIRCLE SUPERINTENDING ENGINEER	DIVISION EXECUTIVE ENGINEER	SUB-DIVISION SDO
Guddu (Sukkur)	Desert Pat Feeder, Sukkur	Guddu Barrage, Kashmore	4
		Kandhkot, Kashmore	3
	Begari Sindh Feeder, Sukkur	Begari Division, Jacobabad	4
		Begari Sindh Feeder, Kashmore	3
	Gotki Feeder Circle, Sukkur	Gotki Canal, Gotki	3
		Mirpur Canal, Gotki	3
Sukkur (Sukkur)	Barrage Gates, Sukkur	Sukkur Barrage, Sukkur	3
	Saifullah Nagsi Branch, Larkana	Nagsi Canal, Shadad Kot	3
		Ware Canal, Larkana	3
		Kirtar Canal, Shadad Kot	3
	Western Sindh, Larkana	Rice Canal, Larkana	4
		Dadu North Canal, Larkana	5
		Dadu South Canal, Larkana	8
	Rohri Canal, Hyderabad	Rohri Canal, Moro	8
		Nasrat Canal, Nawabshah	4
		Dad Canal, Nawabshah	3
		Nasir Canal, Hyderabad	4
		Hala Canal, Hyderabad	5
	Khairpur Irrigation, Sukkur	Khairpur East Canal, Khairpur	4
		Khairpur West Canal, Khairpur	4
	Nara Canal, Hyderabad	Thar Canal, Mirpur Khas	4
		Mithrao Canal, Mirpur Khas	5
		Jamrao Canal, Mirpur Khas	5
Kotri (Hyderabad)	Baghar Canal, Hyderabad	Kotri Barrage, Jamshoro	4
		Khairi Baghar Canal, Thatta	6
		Sakro Canal, Mirpur Sakro	4
	Pinyari Canal, Hyderabad	Upper Pinyari Canal, Hyderabad	2
		Lower Pinyari Canal, Sujawal	4
	Left Bank, Hyderabad	Fulili Canal, Hyderabad	4
		Akramwan Canal, Tando M. Khan	4
		Dini Canal	3
	Lower Sindh Drain, Hyderabad	Sujawal Drain, Sujawal	3
		Tando M. Khan Drain, T.M. Khan	5
		Thatta Drain, Thatta	4
Irrigation Development (Hyderabad)	Survey and West., Sukkur	Field Irrigation I, Hyderabad	3
		Field Irrigation II, Hyderabad	2
	Scarp Khairpur, Khairpur	Khairpur Drain, Khairpur	4
	Scarp Sukkur, Sukkur	Shikarpur Drain, Shikarpur	3
		Larkana Drain, Larkana	3

Table 6 (Continued)

Regions = 4

Circles = 16

Divisions = 39

Sub-Divisions = 153

Note: Table does not include the field units responsible for operation and maintenance of tubewells or maintenance of bunds.

TABLE 7
SINDH PROVINCE
TYPE AND QUANTITY OF EQUIPMENT

Type	Quantity		
	Minimum Operation	Adequate Operation	Full Operation
Price Type AA Current Meter (F)	32	78	78
PYgmy Current Meter (F)	32	78	78
Wading Rods Set (L)	32	78	78
Light Duty Tagline (F)	16	39	39
Heavy Duty Tagline (F)	16	39	39
Headset (F)	32	78	78
Velocity Counter (F)	-	-	39
Stop Watch (F)	32	78	78
Rubber Chest Wader (F)	32	78	78
Hip Boots (F)	-	78	78
Boat Improvisement Set (L)	16	39	39
Sounding Reel (F)	16	39	39
30-Pound Sounding Weight (L)	-	-	39
50-Pound Sounding Weight (L)	16	39	39
Hanger Bar With Pin (L)	32	78	78
Life Jacket (F)	48	120	120
Fibre Glass Boat (L)	16	39	39
Sonic Sounder (F)	-	-	16
Measuring Tape (L)	16	39	39
Level With Tripod (L)	16	39	39
Levelling Staff (L)	16	39	39
Y-Rod (L)	32	78	78
Water Level Recorder (F)	-	39	78
Staff Gage (L)	200(Sites)	200(Sites)	200(Sites)
US DH-48 Sampler (L)	16	16	16
US D-74 Sampler (L)	16	16	16
US BMH 53 Sampler (F)	16	16	16
US BMH 60 Sampler (F)	16	16	16
Glass Bottles for Sampler (F)	32	32	32
Plastic Jars for Sampler (F)	32	32	32
V.A. Tube Analyser (F)	16	16	16
Bottom Withdrawal Tube (F)	32	32	32
Analytical Balance (F)	16	16	16
Electronic Balance (F)	16	16	16
Electric Oven (F)	16	16	16
Sieve Set (Fine) (F)	16	16	16
Sieve Set (Coarse) (F)	16	16	16
Sieve Brush (F)	32	32	32
Sieve Lid (F)	16	16	16
Sieve Pan (F)	16	16	16
Sieve Shaker (Motorized) (F)	-	-	16
Sieve Shaker (Hand operated) (F)	16	16	16
Pipette (F)	32	32	32
Vacume Pump (F)	16	16	16
Stop Watch (L)	16	16	16

Table 7 (Continued)

Beaker (Glass) (F)	96	96	96
Cylinder (Glass) (F)	128	128	128
Desiccab (F)	-	-	16
Evaporating Dish (F)	320	320	320
Desicator (F)	16	16	16
Wash Bottle (F)	16	16	16
Filteri · Funnel (F)	32	32	32
Stirring Rod (F)	32	32	32
Thermometer (F)	32	32	32
3-Way Stop Cock (F)	32	32	32
French Curve Set (F)	16	16	16

No. of Circles = 16

No. of Divisions = 39

F = Imported

L = Local

- Minimum operation at circle levels
- Adequate operation at divisional and circle levels
- Full operation at divisional and circle levels with additional equipment.
- Spares are not included in the list.

TABLE 8
SINDH POVINCE
HYDRAULIC AND SEDIMENT MONITORING EQUIPMENT FOR MINIMUM OPERATION AT CIRCLE LEVEL

S.#	ITEM	SPECIFICATIONS	QUANTITY	UNITCOST		TOTAL COST		SUPPLIER
				Local Rs.	Dollar US$	Local Rs.	Dollar US$	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Hydraulic Equipment								
1.	Current Meter	Price Type AA (vertical axis, horizontal bucket wheel); chrome plated stainless steel; minimum velocity = 0.1 fps and maximum velocity = 20.0 fps; single and penta contacts; furnished complete in a foam cushioned carrying case, along with a rating chart, tail fin assembly, screw driver, assorted spare parts, and special lubricant, both for rod and cable suspension.	32	-	790	-	25,280	Scientific Instruments Inc; 518 West Cherry, Milwaukee,WI 53212 -3822, USA (414)263-1600 Fax (414)263-5506
2.	Mini Current Meter (Pygmy)	Verticall axis, horizontal bucket wheel; chrome plated stainless steel; minimum velocity: .05 fps and maximum velocity = 3.0 fps; furnished complete in a foam cushioned carrying case with assorted spare parts, a rating chart and lubricant: for rod suspension only.	32	-	630	-	20,160	Scientific Ienl. Inc.
3.	Standard Wading Rods	Four 2-foot graduated rods in 0.1 foot increments, bottom rod with base plate; an adjustable sliding support capable of holding price Type AA and Pygmy current meters; a flexible two-conductor wire with one end having two-hole conductor for head set and the other end suitable for connecting to current meter and rods. Base plate and slider made from corrosion resistant material; complete set in heavy duty canvas carrying case.	32	2,100	-	67,200	-	Ahmad Enterprises I-Mcleod Road Lahore

Table 8 (Continued)

4.	Light Duty Tagline	About 300 feet long of 0.04 inch diameter stainless steel with a hook at one end, wound on a heavy plastic reel and mounted on a hardwood stake; brass beads every 2 feet for the first 50 feet, every 5 feet from 50 to 200 feet and every 10 feet from 200 to 300 feet.	16	-	525	-	8,400	Scientific Instruments Inc.
5.	Heavy Duty Lee Au Type Tagline	About 500 feet long 1/16 inch diameter open reel with handles; marked with brass beads every 2 feet for the first 50 feet, every 5 feet from 50 to 200 feet, every 10 feet from 200 to 300 feet and every 50 feet from 300 to 500 feet; heavy duty hooks on both ends for attaching to trees or other sturdy objects.	16	-	580	-	9,280	Scientific Inst. Inc.
6.	Headset	Flexible headband, built in compartment for dry cell battery, including flexible wire with two pole connector for connecting to two-conductor wire from current meter on wading rod or from sounding reel.	32	-	65	-	2,080	Scientific Inst. Inc.
7.	Velocity Counter	Electro-mechanical type for tracking number of revolutions of a current meter, working on dry cell batteries, housed in a rugged plastic case	-	-	185	-	-	Scientific Inst. Inc.
8.	Electronic Watch	Electronic, digital reading to 0.01 second, with a neck cord and having easy to use finger tip control buttons.	32	-	70	-	2,240	Scientific Inst. Inc.
9.	Spares for Current Meters	Compatible to the selected current meters; should include: pivot assembly, hanger screw, binding post assembly; extra screws for price AA and Pygmy meters; instrument oil, cleaning cloth, two-pole connector (male and female); bucket wheel assembly	5 Nos. for each item, both for Pygmy and Price AA	-	-	-	250	Scientific Inst. Inc.
10.	Rubber Chest Wader	1. Medium Size 2. Large Size	16 16	- -	160 210	- -	2,560 3,360	Rickly Hydrologic Company, 2710

Table 8 (Continued)

11.	Hip boots	1. Medium Size 2. Large Size	- -	- -	75 105	- -	- -	Joyce Ave; Columbus, Ohio, 43211 USA
12.	Boat Improvement Set	Boom and cross arm, USGS standard	16	5,300	-	84,800	-	Ahmad Enterprises, Lahore
13.	Sounding Reel	USGS A-type light duty, with a maximum load capacity of 100 pounds; two-position handle for leverage, scale reading 0.1 foot; complete with 0.1 inch double conductor cable, "B" type connector and flexible two-conductor wire for connecting reel to measer	16	-	1,480	-	23,680	Scientific Instruments Inc;
14.	Sounding Weight	USGS Columbus (C) type 1. 30 pounds 2. 50 pounds	- 16	790 1,300	- -	- 20,800	- -	M. Ahmad & Sons I-Brandreth Rd, Lahore
15.	Hanger Bar with Pin	USGS type for 30 and 50 pounds Columbus type weight, one foot long	32	260	-	8,320	-	M. Ahmad & Sons
16.	Cable Connector	USGS Type B	8	-	27	-	216	Scientific Inst. Inc.
17.	Sounding Cable	Flowarth double conductor (inner core), 0.1 inch diameter	1,600 ft	-	6	-	9,600	Scientific Inst; Inc.
18.	Life Jacket	USGS approved model A2 Adult universal, general purpose type-II	48	-	100	-	4,800	ERD Industries, Inc, Marlehurst, GA, 31557, USA
19.	Flat Bottom Fibre Glass Boat	16 feet long and 6 feet wide.	16	30,000	-	480,000	-	Zamrock Company Multan Rd. Lahore.
20.	Portable Sonic Depth Recorder	Single range 0 to 50 feet; paper size 8 inches wide and 72 feet long; paper speed 1 or 2 inches per minute; high resolution fine line transreceiver with a frequency of 100KHz; transducer frequency 100 KHz-7.5, voltage input 24 volts DC, weathertight aimunium construction with water tight connecters, plastic cover and mounting brackets.	-	-	10,500	-	-	1. Ross 600 Series Ross Laboratories Inc; 3130 Fairview Ave; Seattle, WA 98102. USA 2. 2. Raytheon Series DE -719, Marine Co. Int. Affairs, lexington, Mass. 02173 USA.
21.	Spares for Sonic Depth Recorders	Most frequently replaceable parts to be decided by the supplier consistent with model conforming to above specifications, including recorder charts.	L.S.	-	-	-	-	1. Ross Laboratories 2. Raytheon

Table 8 (Continued)

22.	Metalic Measuring Tape	Length 100 feet, marked in 0.1 foot increments or in inches; housed in a case.	16	210	-	3,360	-	Sibtain Brothers, Karachi
23.	Level with Tripod	Topcon (Japan) automatic leveiling, magnification 20 X with standard accessories	16	21,000	-	336,000	-	Sibtain Brothers
24.	Levelling Staff	Japanese stave pole standard, 15 ft long	16	1,260	-	20,160	-	Sibtain Brothers
25.	Y - Rod	Standard, for measuring geometry of outlets.	32	2,500	-	80,000	-	Kotri Gaging Subdivision, Hydrology Directorate, Hyderabad
26.	Water Level Recorder	Stevens A-71; English units with 1:6 gage scale; chart speed 2.4 inches per day; chart 10 inches wide and 23 yard long; 4.5 - month negator spring driven clock; 18-inch circumference pulley for perforated tape; stainless steel graduated, perforated tape 50 feet long with set end hooks and index bracket; 8-inch diameter float with counter weight, reversal indicator.	-	-	3,100	-	-	Leupold and Stevens, Inc; P.O. Box 688 Beaverton, Oregon 97075 USA
27.	Spares for Water Level Recorder	1. Recorder chart	-	-	21	-	-	Leupold & Stevens
		2. Pen ink	-	-	9	-	-	
		3. Capillary pen with lucite reservoir	-	-	52	-	-	
		4. 4.5 - month negator spring driven clock	-	-	790	-	-	
		5. Float tape	-	-	210	-	-	
		6. Float	-	-	95	-	-	
		7. Counter weight	-	-	13	-	-	
		8. Pen Cleaner, packet	-	-	9	-	-	
28.	Staff Gage	Special porclain enamel coated, four inches wide in 3.33-foot sections; graduated to .01 foot and marked every foot, 0.1 and .02 foot.						Kotri Gaging Subdivision, Hydrology Directorate Hyderabad. GR
		Range: 0-3.33 ft	200	500	-	100,000	-	Ahmad Enterprises, Lahore
		3.33-6.66 ft	200	500	-	100,000	-	
		6.66-9.99 ft	200	500	-	100,000	-	
		9.99-13.33 ft	200	500	-	100,000	-	

Table 8 (Continued)

Sediment Sampling Equipment

1.	Wading Type, Depth Integrating Suspended Sediment Hand Sampler	US DH-48 with wading rod including three sets of spare gaskets, and nozzles of 1/8, 3/16 and 1/4 inch openings, almunium casting	16	2,100	-	33,600	-	Ahmad Enterprises, Lahore
2.	Reel Type, Depth Intergating Sediment Sampler	US D-74, cast bronze stream lined body, with hanger bar and pin; and including three spare sets of gaskets and nozzles of 1/8, 3/16 and 1/4 inch openings.	16	6,300	-	100,800	-	Same as above
3.	Piston Type Bed Material Hand Sampler	US BMH 53	16	-	420	-	6,720	Minnesota Fabricators, 2515 Highway 61 North St. Paul Min. 55109, USA
4.	Hand line Bed Material sampler	US BMH 60	16	-	1,100	-	17,600	Minnesota Fabricators
5.	Pint Glass Bottles	For use with DH-48, 24 per box	32	-	75	-	2,400	Minnesota Fabricators
6.	Plastic Jar	For use with D-74, 12 per box	32	-	25	-	800	Minnesota Fabricators
7.	Sample Label	For use on all bottles or Jars, self adhesive, packet	32	-	25	-	800	Minnesota Fabricators

Laboratory Equipment For Sediment Analysis

1.	Visual Accumulation Tube sand size Analyser	V.A. tube with automatic tracer and motor (240 Volts-50 cycle); including all accessories for 120 cm tubes; sizes 2.1, 3.4, 5.0 and 7.0 mm inside diameters at lower ends.	16	-	3,800	-	60,800	Federal Inter-agency Sedimentation Project, St. Anthony Falls Hydraulic Laboratory, 2-3rd Avenue South-East. Minneapolis, Min. 55414 USA
2.	Spares for VA Tube	1. VA glass tube: 2.1 mm	16	-	210	-	3,360	Federal Interagency
		2. VA glass tube: 3.4 mm	16	-	210	-	3,360	
		3. VA glass tube: 5.0 mm	16	-	210	-	3,360	
		4. VA glass tube: 7.0 mm	16	-	210	-	3,360	
		5. VAT Charts	LS	-	-	-	500	
3.	Bottom Withdrawal Tube	Standard by St. Anthony Falls Hydraulic Laboratories, including rubber tape and pinch clamp.	32	-	220	-	7,040	Federal Interagency

Table 8 (Continued)

4.	Analytical Balance	Capacity of 200 grams with weight box and .0001 gram sensitivity, beam -.05 to +.05 gram in 200 graduated divisions; two concave stainless steel pans, front and back sliding glass doors case.	16	-	1,800	-	28,800	Soiltest, 86 Albrecht Dr. P.O. Box 8004, Lake Bluff, IL. 60044-9902 USA
5.	Electronic Balance	Capacity of 200 grams, Sensitivity .0001 gram	16	-	2,600	-	41,600	Soiltest, IL.
6.	Electric Oven	Fan-Forced air circulation, temperature range upto 110C, two doors, pilot light, adjustable shelf, welded steel exterior, overall diameter 30"x25"x24".	16	-	1,100	-	17,600	Soiltest, IL.
7.	Sieve set (fine)	USA standard sieves, 3-inch diameter brass sieve, fine series						Soiltest, Il.
		No. Openings						
		5 4.00 mm	16	-	38	-	608	
		10 2.00 mm	16	-	38	-	608	
		18 1.00 mm	16	-	38	-	608	
		25 .710 mm	16	-	38	-	608	
		35 .500 mm	16	-	38	-	608	
		45 .335 mm	16	-	38	-	608	
		60 .250 mm	16	-	38	-	608	
		80 .180 mm	16	-	38	-	608	
		120 .125 mm	16	-	38	-	608	
		170 .090 mm	16	-	38	-	608	
		230 .063 mm	16	-	45	-	720	
		325 .045 mm	16	-	55	-	880	
					80	-	1,280	
8.	Sieve set (Coarse)	USA standard sieve; 8 - inch diameter, brass sieve.						Soiltest, Il.
		Sieve size						
		5.6 mm	16	-	38	-	608	
		8.0 mm	16	-	38	-	608	
		16.0 mm	16	-	38	-	608	
		31.5 mm	16	-	38	-	608	
		63 mm	16	-	38	-	608	
		100 mm	16	-	38	-	608	
9.	Sieve Brush	Fine hair bristles, wooden handle.	32	-	8	-	256	Soiltest, Il.
10.	Sieve Lid	For US Standard 3-inch sieves	16	-	16	-	256	Soiltest, Il.
11.	Sieve Pan	For US Standard 3-inch sieves	16	-	16	-	256	Soiltest, Il.

Table 8 (continued)

12.	Sieve Shakar (Motorized)	Motorized 220 volts, 50 cycle; capacity eight sieves plus pan and cover, 8-inch sieve sizes.	-	-	740	-	-	Soiltest, IL.
13.	Sieve Shaker (Hand operated)	Head-operated shaker; capacity seven sieves, 8-inch diameter.	16	-	350	-	5,600	Soiltest, IL.
14.	Stop Watch	Reading to one second, Swiss/China	16	900	-	14,400	-	Ahmad Enterprises, Lahore
15.	Pipette	Pyrex glass;						
		1. 25 ml capacity; tolerance + 0.06 ml	16	-	100	-	1,600	Fisher Scientific 1600 W.Glenlake Ave; Itasca IL. 60143 USA
		2. 50 ml capacity; tolerance + 0.10 ml	16	-	130	-	2,080	
16.	Vacuum Pump	Two series-connected electric pumps, 0.3 mm ultimate pressure in leak proof system, 1/4 HP motor, 240 volts 50 Hz.	16	-	850	-	13,600	Soiltest, IL.
17.	Beaker	Pyrex glass; safe temperature limit 500C;						Soiltest, IL.
		1. 100 ml	32	-	3	-	96	
		2. 250 ml	32	-	3	-	96	
		3. 600 ml	32	-	4	-	128	
18.	Cylinder	Pyrex glass graduated						Soiltest, IL.
		1. 100 ml	32	-	12	-	384	
		2. 250 ml	32	-	18	-	576	
		3. 500 ml	32	-	22	-	704	
		4. 1000 ml	32	-	32	-	1,024	
19.	Desiccab	For cooling samples in moisture-free environment, chemical resistant, high impact molded plastic; almunium shelves, removable desiccant glass tray	-	-	700	-	-	Soiltest, IL.
20.	Evaporating Dish	Porcelain, glazed inside, partially glazed outside.						Soiltest, IL.
		1. 90 mm diameter 120 ml capacity	160	-	9	-	1,440	
		2. 115 mm diameter 250 ml capacity	160	-	13	-	2,080	
21.	Desiccator	For cooling samples in moisture-free environment, glass construction, 125 mm inside diameter and 75 mm depth to plate	16	-	65	-	1,040	Soiltest, IL.

Table 8 (Continued)

22.	Wash Bottle	Borosilicate florence flask with special molded rubber grip containing valve system, one litre capacity	16	-	78	-	1,248	Soiltest, IL.
23.	Filtering Funnel	Pyrex glass, 60 angle bowle, beaded to reduce chipping, top diameter 127 mm, stem length 100 mm	32	-	80	-	2,560	Fisher Scientific, IL.
24.	Filter Circle	Whatman, ashless filter paper, fine porosity, particle retention .0025 mm, diameter 12.5 cm, packet	32	-	25	-	800	Fisher Scientific, IL.
25.	Stirring Rod	Glass, 5 mm diameter, 30 cm long	32	-	2	-	64	Fisher Scientific, IL.
26.	Thermometer	Range - 20 to 110C, minimum graduation one degree, length 300 mm.	32	-	32	-	1,024	Fisher Scientific, IL.
27.	3-Way Stop Cock	Glass construction.	32	-	12	-	394	Fisher Scientific, IL.
28.	French Curve Set	Plastic.	16	-	100	-	1,600	Common Item.

Total: Rs. 1,65/,000
U.S. $ 360,902+10% freight = 396,992

TABLE 9
SINDH POVINCE
HYDRAULIC AND SEDIMENT MONITORING EQUIPMENT FOR ADEQUATE OPERATION AT DIVISIONAL AND CIRCLE LEVELS

S.#	ITEM	SPECIFICATIONS	QUANTITY	UNIT COST		TOTAL COST		SUPPLIER
				Local Rs.	Dollar US$	Local Rs.	Dollar US$	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Hydraulic Equipment								
1.	Current Meter	Price Type AA (vertical axis, horizontal bucket wheel); chrome plated stainless steel; minimum velocity = 0.1 fps and maximum velocity = 20.0 fps; single and penta contacts; furnished complete in a foam cushioned carrying case, along with a rating chart, tail fin assembly, screw driver, assorted spare parts, and special lubricant, both for rod and cable suspension.	78	-	790	-	61,620	Scientific Instruments Inc; 518 West Cherry, Milwaukee,Wi 53212 -3922, USA (414)263-1600 Fax (414)263-3506
2.	Mini Current Meter (Pygmy)	Vertical axis, horizontal bucket wheel; chrome plated stainless steel; minimum velocity: .05 fps and maximum velocity = 3.0 fps; furnished complete in a foam cushioned carrying case with assorted spare parts, a rating chart and lubricant; for rod suspension only.	78	-	630	-	49,140	Scientific Inst. Inc.
3.	Standard Wading Rods	Four 2-foot graduated rods in 0.1 foot increments, bottom rod with base plate; an adjustable sliding support capable of holding price Type AA and Pygmy current meters; a flexible two-conductor wire with one end having two-pole connector for head set and the other end suitable for connecting to current meter and rods. Base plate and slider made from corrosion resistant material; complete set in heavy duty canvas carrying case.	78	2,100	-	163,800	-	Ahmad Enterprises 1-Nicleod Road Lahore

Table 9 (Continued)

4.	Light Duty Tagline	About 300 feet long of 0.04 inch diameter stainless steel with a hook at one end, wound on a heavy plastic reel and mounted on a hardwood stake; brass beads every 2 feet for the first 50 feet, every 5 feet from 50 to 200 feet and every 10 feet from 200 to 300 feet.	39	-	525	-	20,475	Scientific Instruments Inc.
5.	Heavy Duty Lee Au Type Tagline	About 500 feet long 1/16 inch diameter open reel with handles; marked with brass beads every 2 feet for the first 50 feet, every 5 feet from 50 to 200 feet, every 10 feet from 200 to 300 feet and every 50 feet from 300 to 500 feet; heavy duty hooks on both ends for attaching to trees or other sturdy objects.	39	-	580	-	22,620	Scientific Inst. Inc.
6.	Headset	Flexible headband, built in compartment for dry cell battery, including flexible wire with two pole connector for connecting to two-conductor wire from current meter on wading rod or from sounding reel.	78	-	65	-	5,070	Scientific Inst. Inc.
7.	Velocity Counter	Electro-mechanical type for tracking number of revolutions of a current meter, working on dry cell batteries, housed in a rugged plastic case	-	-	185	-	-	Scientific Inst. Inc.
8.	Electronic Watch	Electronic, digital reading to 0.01 second, with a neck cord and having easy to use finger tip control buttons.	78	-	70	-	5,460	Scientific Inst. Inc.
9.	Spares for Current Meters	Compatible to the selected current meters; should include: pivot assembly, hanger screw, binding post assembly; extra screws for price AA and Pygmy meters; instrument oil, cleaning cloth, two-pole connector (male and female); bucket wheel assembly	5 Nos. for each [illegible], [illegible] for Pygmy and Price AA	-	-	-	250	Scientific Inst. Inc.
10.	Rubber Chest Wader	1. Medium Size 2. Large Size	39 39	- -	160 210	- -	6,240 8,190	Rickly Hydrologic Company, 2710

Table 9 (Continued)

11.	Hip boots	1. Medium Size 2. Large Size	39 39	- -	75 105	- -	2,925 4,095	Joyce Ave; Columbus, Ohio, 43211 USA
12.	Boat Improvize-ment Set	Boom and cross arm, USGS standard	39	5,300	-	206,700	-	Ahmad Enterprises, Lahore
13.	Sounding Reel	USGS A-type light duty, with a maximum load capacity of 100 pounds; two-position handle for leverage, scale reading 0.1 foot; complete with 0.1 inch double conductor cable, "B" type connector and flexible two-conductor wire for connecting reel to headset	39	-	1,460	-	57,720	Scientific Instruments Inc;
14.	Sounding Weight	USGS Columbus (C) type 1. 30 pounds 2. 50 pounds	- 39	790 1,300	- -	- 50,700	- -	M. Ahmad & Sons I-Brandreth Rd, Lahore
15.	Hanger Bar with Pin	USGS type for 30 and 50 Pounds Columbus type weights, one foot long	78	260	-	20,280	-	M. Ahmad & Sons
16.	Cable Connector	USGS Type B	39	-	27	-	1,053	Scientific Inst; Inc.
17.	Sounding Cable	Elsworth double conductor (inner core), 0.1 inch diameter	3,900 ft.	-	6	-	23,400	Scientific Inst; Inc.
18.	Life Jacket	USGS approved model A2 Adult universal, general purpose type-II	120	-	100	-	12,000	ERO Industries, Inc, Harzlehurst, GA, 31539, USA
19.	Flat Bottom Fibre Glass Boat	16 feet long and 6 feet wide.	39	30,000	-	1,170,000	-	Zaarock Company Multan Rd. Lahore.
20.	Portable Sonic Depth Recorder	Single range 0 to 50 feet; paper size 8 inches wide and 72 feet long; paper speed 1 or 2 inches per minute; high resolution fine line transreceiver with a frequency of 100KHz; transducer frequency 100 KHz-7.5, voltage input 24 volts DC, weathertight aluminium construction with water tight connectors, plastic cover and mounting brackets.	-	-	10,500	-	-	1. Ross 600 Series Ross Laboratories Inc: 3138 Fairview Ave; E, Seattle, WA 98102, USA I. 2. Raytheon Series DE -719, Marine Co. Int. Affairs, lexington, Mass. 02173 USA.
21.	Spares for Sonic Depth Recorders	Most frequently replaceable parts to be decided by the supplier consistent with model conforming to above specifications, including recorder charts.	L.S.	-	-	-	-	1. Ross Laboratories 2. Raytheon

Table 9 (Continued)

22.	Metalic Measuring Tape	Length 100 feet, marked in 0.1 foot increments or in inches; housed in a case.	39	210	-	8,190	-	Sibtain Brothers, Karachi
23.	Level with Tripod	Topcon (Japan) automatic levelling, magnification 20 X with standard accessories	39	21,000	-	819,000	-	Sibtain Brothers
24.	Levelling Staff	Japanese stave pole standard, 15 ft long	39	1,260	-	49,140	-	Sibtain Brothers
25.	Y - Rod	Standard, for measuring geometry of outlets.	78	195,000	-	200,000	-	Kotri Gaging Subdivision, Hydrology Directorate, Hyderabad
26.	Water Level Recorder	Stevens A-71; English units with 1:6 gage scale; chart speed 2.4 inches per day; chart 10 inches wide and 25 yard long; 4.5 - month negator spring driven clock; 18-inch circumference pulley for perforated tape; stainless steel graduated, perforated tape 50 feet long with set end hooks and index bracket; 8-inch diameter float with counter weight, reversal indicator.	39	-	3,100	-	120,900	Leupold and Stevens, Inc; P.O. Box 688 Beaverton, Oregon 97075 USA
27.	Spares for Water Level Recorder	1. Recorder chart	39	-	21	-	819	Leupold & Stevens
		2. Pen ink	39	-	9	-	351	
		3. Capillary pen with lucite reservoir	39	-	52	-	2,028	
		4. 4.5 - month negator spring driven clock	39	-	790	-	30,810	
		5. Float tape	39	-	210	-	8,190	
		6. Float	39	-	95	-	3,705	
		7. Counter weight	39	-	13	-	507	
		8. Pen Cleaner, packet	39	-	9	-	351	
28.	Staff Gage	Special porclain enamel coated, four inches wide in 3.33-foot sections; graduated to .01 foot and marked every foot, 0.1 and .5 foot.						Kotri Gaging Subdivision, Hydrology Directorate Hyderabad. OR
		Range: 0-3.33 ft	200	500	-	100,000	-	Ahmad Enterprises, Lahore
		3.33-6.66 ft	200	500	-	100,000	-	
		6.66-9.99 ft	200	500	-	100,000	-	
		9.99-13.33 ft	200	500	-	100,000	-	

Table 9 (Continued)

Sediment Sampling Equipment

1.	Wading Type, Depth Integrating Suspended Sediment Hand Sampler	US DH-48 with wading rod including three sets of spare gaskets, and nozzles of 1/8, 3/16 and 1/4 inch openings, almunium casting	16	2,100	-	33,600	-	Ahmad Enterprises, Lahore
2.	Reel Type, Depth Intergating Sediment Sampler	US D-74, cast bronze stream lined body, with hanger bar and pin; and including three spare sets of gaskets and nozzles of 1/8, 3/16 and 1/4 inch openings.	16	6,800	-	108,800	-	Ahmad Enterprises
3.	Piston Type Bed Material Hand Sampler	US BMH 53	16	-	420	-	6,720	Minnesota Fabricators, 2515 Highway 61 North St. Paul Min. 55109, USA
4.	Hand line Bed Material sampler	US BMH 60	16	-	1,100	-	17,600	Minnesota Fabricators
5.	Pint Glass Bottles	For use with DH-48, 24 per box	32	-	75	-	2,400	Minnesota Fabricators
6.	Plastic jar	For use with D-74, 12 per box	32	-	25	-	800	Minnesota Fabricators
7.	Sample Label	For use on all bottles or Jars, self adhesive, packet	32	-	20	-	640	Minnesota Fabricators

Laboratory Equipment For Sediment Analysis

1.	Visual Accumulation Tube sand size Analyser	V.A. tube with automatic tracer and motor (240 Volts-50 cycle); including all accessories for 120 cm tubes; sizes 2.1, 3.4, 5.0 and 7.0 mm inside diameters at lower ends.	16	-	3,800	-	60,800	Federal Inter-agency Sedimen-tation Project, St. Anthony Falls Hydraulic Labora-tory, 2-3rd Avenue South-East, Minneapolis, Min. 55414 USA
2.	Spares for VA Tube	1. VA glass tube: 2.1 mm 2. VA glass tube: 3.4 mm 3. VA glass tube: 5.0 mm 4. VA glass tube: 7.0 mm 5. VAT Charts	16 16 16 16 LS	- - - - -	210 210 210 210 -	- - - - -	3,360 3,360 3,360 3,360 300	Federal Interagency
3.	Bottom Withdrawal Tube	Standard by St. Anthony Falls Hydraulic Laboratories, including rubber tape and pinch clasp.	32	-	220	-	7,040	Federal Interagency

Table 9 (Continued)

4.	Analytical Balance	Capacity of 200 grams with weight box and .0001 gram sensitivity, beam -.05 to +.05 gram in 200 graduated divisions; two concave stainless steel pans, front and back sliding glass doors case.	16	-	1,600	-	28,800	Soiltest, 66 Albrecht Dr. P.O. Box 6004, Lake Bluff, IL. 60044-9902 USA
5.	Electronic Balance	Capacity of 200 grams, Sensitivity .0001 gram	16	-	2,600	-	41,600	Soiltest, IL.
6.	Electric Oven	Fan-Forced air circulation, temperature range upto 110C, two doors, pilot light, adjustable shelf, welded steel exterior, overall diameter 30"x25"x24".	16	-	1,000	-	17,600	Soiltest, IL.
7.	Sieve set (fine)	USA standard sieves, 3-inch diameter brass sieve, fine series						Soiltest; Il.
		No. Openings						
		5 4.00 mm	16	-	38	-	608	
		10 2.00 mm	16	-	38	-	608	
		18 1.00 mm	16	-	38	-	608	
		25 .710 mm	16	-	38	-	608	
		35 .500 mm	16	-	38	-	608	
		45 .355 mm	16	-	38	-	608	
		60 .250 mm	16	-	38	-	608	
		80 .180 mm	16	-	38	-	608	
		120 .125 mm	14	-	38	-	608	
		170 .090 mm	16	-	45	-	720	
		230 .063 mm	16	-	55	-	880	
		325 .045 mm	16	-	80	-	1,280	
8.	Sieve set (Coarse)	USA standard sieve; 8 - inch diameter, brass sieve,						Soiltest, Il.
		Sieve size						
		5.6 mm	16	-	38	-	608	
		8.0 mm	16	-	38	-	608	
		16.0 mm	16	-	38	-	608	
		31.5 mm	16	-	38	-	608	
		63 mm	16	-	38	-	608	
		100 mm	16	-	38	-	608	
9.	Sieve Brush	Fine hair bristles, wooden handle.	32	-	8	-	256	Soiltest, Il.
10.	Sieve Lid	For US Standard 3-inch sieves	16	-	16	-	256	Soiltest, Il.
11.	Sieve Pan	For US Standard 3-inch sieves	16	-	16	-	256	Soiltest, Il.

Table 9 (continued)

12.	Sieve Shakar (Motorized)	Motorized 220 volts, 50 cycle; capacity eight sieves plus pan and cover, 8-inch sieve sizes.	-	-	740	-	-	Soiltest, IL.
13.	Sieve Shaker (Hand operated)	Head-operated shaker; capacity seven sieves, 8-inch diameter.	16	-	350	-	5,600	Soiltest, IL.
14.	Stop Watch	Reading to one second, Swiss/China	16	900	-	14,400	-	Ahmad Enterprises, Lahore
15.	Pipette	Pyrex glass;						Fisher Scientific 1600 W.Glenlake Ave; Itasca IL. 60143 USA
		1. 25 ml capacity; tolerance + 0.06 ml	16	-	100	-	1,600	
		2. 50 ml capacity; tolerance + 0.10 ml	16	-	130	-	2,080	
16.	Vacuum Pump	Two series-connected electric pumps, 0.3 mm ultimate pressure in leak proof system, 1/4 HP motor, 240 volts 50 Hz.	16	-	850	-	13,600	Soiltest, IL.
17.	Beaker	Pyrex glass; safe temperature limit 500C;						Soiltest, IL.
		1. 100 ml	32	-	3	-	96	
		2. 250 ml	32	-	3	-	96	
		3. 600 ml	32	-	4	-	128	
18.	Cylinder	Pyrex glass graduated						Soiltest, IL.
		1. 100 ml	32	-	12	-	384	
		2. 250 ml	32	-	18	-	576	
		3. 500 ml	32	-	22	-	704	
		4. 1000 ml	32	-	32	-	1,024	
19.	Desiccab	For cooling samples in moisture-free environment, chemical resistant, high impact molded plastic: aluminum shelves, removable desiccant glass tray	-	-	700	-	-	Soiltest, IL.
20.	Evaporating Dish	Porecian, glazed inside, partially glazed outside.						Soiltest, IL.
		1. 90 mm diameter 120 ml capacity	160		9	-	1,440	
		2. 115 mm diameter 250 ml capacity	160	-	13	-	2,080	
21.	Desiccator	For cooling samples in moisture-free environment, glass construction, 125 mm inside diameter and 75 mm depth to plate	16	-	65	-	1,040	Soiltest, IL.

Table 9 (Continued)

22.	Wash Bottle	Borosilicate florence flask with special molded rubber grip containing valve system, one litre capacity	16	-	78	-	1,248	Soiltest, IL.
23.	Filtering Funnel	Pyrex glass, 60 angle bowle, beaded to reduce chipping, top diameter 127 mm, stem length 100 mm	32	-	80	-	2,560	Fisher Scientific, IL.
24.	Filter Circle	Whatman, ashless filter paper, fine porosity, particle retention .0025 mm, diameter 12.5 cm, packet	32	-	25	-	800	Fisher Scientific, IL.
25.	Stirring Rod	Glass, 5 mm diameter, 30 cm long	32	-	2	-	64	Fisher Scientific, IL.
26.	Thermometer	Range - 20 to 110C, minimum graduation one degree, length 300 mm.	32	-	32	-	1,024	Fisher Scientific, IL.
27.	3-Way Stop Cock	Glass construction.	32	-	12	-	384	Fisher Scientific, IL.
28.	French Curve Set	Plastic.	16	-	100	-	1,600	Common Item.

Total: Rs. 3,239,610
U.S. $ 696,415+10% freight = 766,057

TABLE 10
SINDH POVINCE
HYDRAULIC AND SEDIMENT MONITORING EQUIPMENT FOR A PILOT PROJECT

S.#	ITEM	SPECIFICATIONS	QUANTITY	UNITCOST		TOTAL COST		SUPPLIER
				Local Rs.	Dollar US$	Local Rs.	Dollar US$	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Hydraulic Equipment								
1.	Current Meter	Price Type AA (vertical axis, horizontal bucket Wheel); chrome plated stainless steel; minimum velocity = 0.1 fps and maximum velocity = 20.0 fps; single and penta contacts; furnished complete in a foam cushioned carrying case, along with a rating chart, tail fin assembly, screw driver, assorted spare parts, and special lubricant, both for rod and cable suspension.	24	-	790	-	15,760	Scientific Instruments Inc; 518 West Cherry, Milwaukee,WI 53212 -3922, USA (414)263-1600 Fax (414)263-5506
2.	Mini Current Meter (Pygmy)	Vertical axis, horizontal bucket wheel; chrome plated stainless steel; minimum velocity: .05 fps and maximum velocity = 5.0 fps; furnished complete in a foam cushioned carrying case with assorted spare parts, a rating chart and lubricant: for rod suspension only.	24	-	630	-	15,120	Scientific Inst. Inc.
3.	Standard Wading Rods	Four 2-foot graduated rods in 0.1 foot increments, action rod with base plate; an adjustable sliding support capable of holding price Type AA and Pygmy current meters; a flexible two-conductor wire with one end having two-hole connector for head set and the other end suitable for connecting to current meter and rods. Base plate and slider made from corrosion resistant material; complete set in heavy duty canvas carrying case.	24	2,100	-	50,400	-	Ahmad Enterprises 1-Mcleod Road Lahore

Table 10 (Continued)

4.	Light Duty Tagline	About 300 feet long of 0.04 inch diameter stainless steel with a hook at one end, wound on a heavy plastic reel and mounted on a hardwood stake; brass beads every 2 feet for the first 50 feet, every 5 feet from 50 to 200 feet and every 10 feet from 200 to 300 feet.	24	-	525	-	12,600	Scientific Instruments Inc.
5.	Heavy Duty Lee Au Type Tagline	About 500 feet long 1/16 inch diameter open reel with handles; marked with brass beads every 2 feet for the first 50 feet, every 5 feet from 50 to 200 feet, every 10 feet from 200 to 300 feet and every 50 feet from 300 to 500 feet; heavy duty hooks on both ends for attaching to trees or other sturdy objects.	12	-	580	-	6,960	Scientific Inst. Inc.
6.	Headset	Flexible headband, built in compartment for dry cell battery, including flexible wire with two pole connector for connecting to two-conductor wire from current meter on wading rod or from sounding reel.	24	-	65	-	1,550	Scientific Inst. Inc.
7.	Electronic Watch	Electronic, digital reading to 0.01 second, with a neck cord and having easy to use finger tip control buttons.	12	-	70	-	840	Scientific Inst. Inc.
8.	Spares for Current Meters	Compatible to the selected current meters; should include: pivot assembly, hanger screw, binding post assembly; extra screws for price AA and Pygmy meters; instrument oil, cleaning cloth, two-pole connector (male and female); bucket wheel assembl.	5 Nos. for each item, both for Pygmy and Price AA	-	-	-	350	Scientific Inst. Inc.
9.	Rubber Chest Wader	1. Medium Size 2. Large Size	8 4	- -	160 210	- -	1,280 840	Rickly Hydrologic Company, 2710

Table 10 (Continued)

10.	Hip boots	1. Medium Size 2. Large Size	8 4	- -	75 105	- -	600 420	Joyce Ave; Columbus, Ohio, 43211 USA
11.	Boat Improvize-ment Set	Boom and cross arm, USGS standard	12	5,300	-	63,600	-	Ahmad Enterprises, Lahore
12.	Sounding Reel	USGS A-type light duty, with a maximum load capacity of 100 pounds; two-position handle for leverage, scale reading 0.1 foot; complete with 0.1 inch double conductor cable, "B" type connector and flexible two-conductor wire for connecting reel to headset	12	-	1,480	-	17,760	Scientific Instruments Inc;
13.	Sounding Weight	USGS Columbus (C) type 50 pounds	12	1,300	-	15,600	-	M. Ahmad & Sons I-Bandreth Rd, Lahore
14.	Hanger Bar with Pin	USGS type for 30 and 50 pounds Columbus type weight, one foot long.	24	260	-	6,240	-	M. Ahmad & Sons
15.	Cable Connector	USGS Type B	10	-	27	-	270	Scientific Inst. Inc.
16.	Sounding Cable	Elsworth double conductor (inner core), 0.1 inch diameter	1,200	-	6	-	7,200	Scientific Inst. Inc.
17.	Life Jacket	USGS approved model A2 Adult universal, general purpose type-II	24	-	100	-	2,400	ERO Industries, Inc, Harzlehurst, GA, 31539, USA
18.	Flat Bottom Fibre Glass Boat	16 feet long and 6 feet wide.	12	30,000	-	360,000	-	Zamrock Company Multan Rd. Lahore.
19.	Metalic Measuring Tape	Length 100 feet, marked in 0.1 foot increments or in inches; housed in a case.	12	210	-	2,520	-	Sibtain Brothers, Karachi
20.	Level with Tripod	Toscon (Japan) automatic levelling, magnification 20 X with standard accessories	12	21,000	-	252,000	-	Sibtain Brothers
21.	Levelling Staff	Japanese stave pole standard, 15 ft long	12	1,260	-	15,120	-	Sibtain Brothers
22.	V - Rod	Standard, for measuring geometry of outlets.	12	2,500	-	30,000	-	Kotri Gaging Sub-division, Hydrology Directorate, Hyderabad

Table 10 (Continued)

23.	Water Level Recorder	Stevens A-71; English units with 1:6 gage scale; chart speed 2.4 inches per day; chart 10 inches wide and 25 yard long; 4.5 - month negator spring driven clock; 18-inch circumference pulley for perforated tape; stainless steel graduated, perforated tape 50 feet long with set end hooks and index bracket; 8-inch diameter float with counter weight, reversal indicator.	12	-	3,100	-	37,200	Leupold and Stevens, Inc; P.O. Box 688 Beaverton, Oregon 97075 USA
24.	Spares for Water Level Recorder	1. Recorder chart	12	-	21	-	252	Leupold & Stevens
		2. Pen ink	12	-	9	-	108	
		3. Capillary pen with lucite reservoir	12	-	52	-	624	
		4. Pen Cleaner, packet	12	-	9	-	108	
25.	Staff Gage	Special porcelain enamel coated, four inches wide in 3.33-foot sections; graduated to .01 foot and marked every foot, 0.1 and .02 foot.						Kotri Gaging Subdivision, Hydrology Directorate Hyderabad. OR
		Range: 0-3.33 ft	72	500	-	36,000	-	Ahmad Enterprises, Lahore
		3.33-6.66 ft	72	500	-	36,000	-	
		6.66-9.99 ft	72	500	-	36,000	-	
		9.99-13.33 ft	72	500	-	36,000	-	

Table 10 (Continued)

Sediment Sampling Equipment

1.	Wading Type, Depth Integrating Suspended Sediment Hand Sampler	US DH-48 with wading rod including three sets of spare gaskets, and nozzles of 1/8, 3/16 and 1/4 inch openings, aleunium casting	12	2,100	-	25,200	-	Ahmad Enterprises, Lahore
2.	Piston Type Bed Material Hand Sampler	US BMH 53	12	-	420	-	5,040	Minnesota Fabricators, 2515 Highway 61 North St. Paul Min. 55109, USA
3.	Pint Glass Bottles	For use with DH-48, 24 per box	12	-	75	-	900	Minnesota Fabricators
4.	Sampler Label	For use on all bottles or Jars, self adhesive, packet	12	-	25	-	300	Minnesota Fabricators

Laboratory Equipment For Sediment Analysis

1.	Bottom Withdrawal Tube	Standard by St. Anthony Falls Hydraulic Laboratories, including rubber tape and pinch clamp.	8	-	220	-	1,760	Federal Interagency Sedimentation Project, St. Anthony Falls Hydraulic Laboratory, 2-3rd Avenue South-Minneapolis, Min. 55414 USA
2.	Analytical Balance	Capacity of 200 grams with weight box and .0001 gram sensitivity, beam -.05 to +.05 gram in 200 graduated divisions; two concave stainless steel pans, front and back sliding glass doors case.	4	-	1,800	-	7,200	Soiltest, Co Aldrecht Dr. P.O. Box 6004, Lake Bluff, IL. 60044-7902 USA
3.	Electric Oven	Fan-Forced air circulation, temperature range upto 110C, two doors, pilot light, adjustable shelf, welded steel exterior, overall diameter 30"x25"x24".	4	-	1,100	-	4,400	Soiltest, IL.
4.	Sieve set (fine)	USA standard sieves, 3-inch diameter brass sieve, fine series						Soiltest, IL.
		No. Openings						
		5 4.00 mm	4	-	38	-	152	
		10 2.00 mm	4	-	38	-	152	
		18 1.00 mm	4	-	38	-	152	
		25 .710 mm	4	-	38	-	152	
		35 .500 mm	4	-	38	-	152	
		45 .355 mm	4	-	38	-	152	
		60 .250 mm	4	-	38	-	152	
		80 .180 mm	4	-	38	-	152	

		120 .125 mm 170 .090 mm 230 .063 mm 325 .045 mm	4 4 4 4	- - - -	38 45 55 80	- - - -	152 180 220 320	
5.	Sieve set (Coarse)	USA standard sieve; 8 - inch diameter, brass sieve, Sieve size 5.6 mm 8.0 mm 16.0 mm 31.5 mm 63 mm 100 mm	 4 4 4 4 2 2	 - - - - - -	 38 38 38 38 35 35	 - - - - - -	 152 152 152 152 152 152	Soiltest, IL.
6.	Sieve Brush	Fine hair bristles, wooden handle.	8	-	8	-	64	Soiltest, IL.
7.	Sieve Lid	For US Standard 3-inch sieves	4	-	16	-	64	Soiltest, IL.
8.	Sieve Pan	For US Standard 3-inch sieves	4	-	16	-	64	Soiltest, IL.
9.	Sieve Shaker (Hand operated)	Head-operated shaker; capacity seven sieves, 8-inch diameter.	4	-	350	-	1,400	Soiltest, IL.
10.	Stop Watch	Reading to one second, Swiss/China	4	900	-	3,600	-	Ahmad Enterprises, Lahore
11.	Pipette	Pyrex glass; 1. 25 ml capacity; tolerance + 0.06 ml 2. 50 ml capacity; tolerance + 0.10 ml	 4 4	 - -	 100 130	 - -	 400 520	Fisher Scientific 1600 W.Glenlake Ave; Itasca IL. 60143 USA
12.	Vacuum Pump	Two series-connected electric pumps, 0.3 mm ultimate pressure in leak proof system, 1/4 HP motor, 240 volts 50 Hz.	4	-	850	-	3,400	Soiltest, IL.
13.	Beaker	Pyrex glass; safe temperature limit 500C; 1. 100 ml 2. 250 ml 3. 600 ml	 8 8 8	 - - -	 3 3 4	 - - -	 24 24 32	Soiltest, IL.
14.	Cylinder	Pyrex glass graduated 1. 100 ml 2. 250 ml 3. 500 ml 4. 1000 ml	 8 8 8 8	 - - - -	 12 18 22 32	 - - - -	 96 144 176 256	Soiltest, IL.

Table 10 (Continued)

15.	Evaporating Dish	Porcelain, glazed inside, partially glazed outside.						Soiltest, IL.
		1. 90 mm diameter 120 ml capacity	40	-	9	-	360	
		2. 115 mm diameter 250 ml capacity	40	-	13	-	520	
16.	Desiccator	For cooling samples in moisture-free environment, glass construction, 125 mm inside diameter and 75 mm depth to plate	4	-	65	-	260	Soiltest, IL.
17.	Wash Bottle	Borosilicate florence flask with special molded rubber grip containing valve system, one litre capacity	4	-	78	-	312	Soiltest, IL.
18.	Filtering Funnel	Pyrex glass, 60 angle bowle, beaded to reduce chipping, top diameter 127 mm, stem length 100 mm	8	-	80	-	640	Fisher Scientific, IL.
19.	Filter Circle	Whatman, ashless filter paper, fine porosity, particle retention .0025 mm, diameter 12.5 cm, packet	8	-	25	-	200	Fisher Scientific, IL.
20.	Stirring Rod	Glass, 5 mm diameter, 30 cm long	8	-	2	-	16	Fisher Scientific, IL.
21.	Thermometer	Range - 20 to 110C, minimum graduation one degree, length 300 mm.	8	-	32	-	256	Fisher Scientific, IL.
22.	3-Way Stop Cock	Glass construction.	8	-	12	-	96	Fisher Scientific, IL.
23.	French Curve Set	Plastic.	4	-	100	-	400	Common Item.

Total: Rs. 968,250
U.S. $ 157,776+10% freight = 173,554

Note : Four Circles (twelve divisions)

TABLE 11
BALOCHISTAN PROVINCE
NUMBER OF FIELD UNITS FOR OPERATION AND MAINTENANCE OF CANAL AND DRAINAGE SYSTEMS

REGION CHIEF ENGINEER	CIRCLE SUPERINTENDING ENGINEER	DIVISION EXECUTIVE ENGINEER	SUB-DIVISION SDO
Balochistan (Quetta)	Irrigation Quetta, Quetta	Quetta, Quetta	2
		Pishin Canal, Pishin	2
		Hydrology, DMJ	2
	Irrigation Loralai, Loralai	Zhob Canal, Zhob	2
		Loralai Canal, Loralai	3
		Kohlu, Kohlu	1
	Pat Feeder and Sibi, Dera Murad Jamali (DMJ)	Sibi, Sibi	3
		Kachhi, Kachhi	2
		Kirter Canal, DMJ	3
		Pat Feeder Canal, DMJ	3
		Dera Bugti Canal, Dera Bugti	2

Regions = 1

Circles = 3

Divisions = 11

Sub-Divisions = 25

Note: Table does not include the field units responsible for operation and maintenance of tubewells or maintenance of bunds.

TABLE 12
BALOCHISTAN PROVINCE
TYPE AND QUANTITY OF EQUIPMENT

Type	Quantity		
	Minimum Operation	Adequate Operation	Full Operation
Price Type AA Current Meter (F)	6	22	22
PYgmy Current Meter (F)	6	22	22
Wading Rods Set (L)	6	22	22
Light Duty Tagline (F)	3	11	11
Heavy Duty Tagline (F)	2	4	4
Headset (F)	6	22	22
Velocity Counter (F)	-	-	11
Stop Watch (F)	6	22	22
Rubber Chest Wader (F)	6	22	22
Hip Boots (F)	-	22	22
Boat Improvizement Set (L)	2	4	4
Sounding Reel (F)	2	4	4
30-Pound Sounding Weight (L)	-	-	4
50-Pound Sounding Weight (L)	2	4	4
Hanger Bar With Fin (L)	4	8	8
Life Jacket (F)	6	12	12
Fibre Glass Boat (L)	2	4	4
Sonic Sounder (F)	-	-	1
Measuring Tape (L)	3	11	11
Level With Tripod (L)	3	11	11
Levelling Staff (L)	3	11	11
Y-Rod (L)	3	11	11
Water Level Recorder (F)	-	11	22
Staff Gage (L)	60(Sites)	60(Sites)	60(Sites)
US DH-48 Sampler (L)	3	3	3
US D-74 Sampler (L)	2	3	3
US BMH 53 Sampler (F)	3	3	3
US BMH 60 Sampler (F)	2	3	3
Glass Bottles for Sampler (F)	6	6	6
Plastic Jars for Sampler (F)	6	6	6
V.A. Tube Analyser (F)	3	3	3
Bottom Withdrawal Tube (F)	6	6	6
Analytical Balance (F)	3	6	6
Electronic Balance (F)	3	3	3
Electric Oven (F)	3	3	3
Sieve Set (Fine) (F)	3	3	3
Sieve Set (Coarse) (F)	3	3	3
Sieve Brush (F)	6	6	6
Sieve Lid (F)	3	3	3
Sieve Pan (F)	3	3	3
Sieve Shaker (Motorized) (F)	-	-	3
Sieve Shaker (Hand operated) (F)	3	3	3
Pipette (F)	6	6	6
Vacume Pump (F)	3	3	3
Stop Watch (L)	3	3	3

Table 12 (Continued)

Beaker (Glass) (F)	18	18	18
Cylinder (Glass) (F)	24	24	24
Desiccab (F)	-	-	3
Evaporating Dish (F)	60	60	60
Desicator (F)	3	3	3
Wash Bottle (F)	3	3	3
Filtering Funnel (F)	6	6	6
Stirring Rod (F)	9	9	9
Thermometer (F)	6	6	6
3-Way Stop Cock (F)	6	6	6
French Curve Set (F)	3	3	3

No. of Circles = 3

No. of Divisions = 11

F = Imported

L = Local

- Minimum operation at circle levels
- Adequate operation at divisional and circle levels
- Full operation at divisional and circle levels with additional equipment.
- Spares are not included in the list.

TABLE 13
BALOCHISTAN POVINCE
HYDRAULIC AND SEDIMENT MONITORING EQUIPMENT FOR MINIMUM OPERATION AT CIRCLE LEVEL

S.#	ITEM	SPECIFICATIONS	QUANTITY	UNIT COST		TOTAL COST		SUPPLIER
				Local Rs.	Dollar US$	Local Rs.	Dollar US$	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Hydraulic Equipment								
1.	Current Meter	Price Type AA (vertical axis, horizontal bucket Wheel); chrome plated stainless steel; minimum velocity = 0.1 fps and maximum velocity = 20.0 fps; single and penta contacts; furnished complete in a foam cushioned carrying case, along with a rating chart, tail fin assembly, screw driver, assorted spare parts, and special lubricant, both for rod and cable suspension.	6	-	790	-	4,740	Scientific Instruments Inc; 518 West Cherry, Milwaukee,Wi 53212 -3822, USA (414)265-1600 Fax (414)265-5506
2.	Mini Current Meter (Pygmy)	Verticail axis, horizontal bucket wheel; chrome plated stainless steel; minimum velocity: .05 fps and maximum velocity = 3.0 fps; furnished complete in a foam cushioned carrying case with assorted spare parts, a rating chart and lubricant; for rod suspension only.	6	-	630	-	3,780	Scientific Inst. Inc.
3.	Standard Wading Rods	Four 2-foot graduated rods in 0.1 foot increments, bottom rod with base plate; an adjustable sliding support capable of holding price Type AA or Pygmy current meters; a flexible two-conductor wire with one end having two-hole connector for head set and the other end suitable for connecting to current meter and rods. Base plate and slider made from corrosion resistant material; complete set in heavy duty canvas carrying case.	6	2,100	-	12,600	-	Ahmad Enterprises I-McCleod Road Lahore

Table 13 (Continued)

4.	Light Duty Tagline	About 300 feet long of 0.04 inch diameter stainless steel with a hook at one end, wound on a heavy plastic reel and mounted on a hardwood stake; brass beads every 2 feet for the first 50 feet, every 5 feet from 50 to 200 feet and every 10 feet from 200 to 300 feet.	3	-	525	-	1,575	Scientific Instruements Inc.
5.	Heavy Duty Lee Au Type Tagline	About 500 feet long 1/16 inch diameter open reel with handles; marked with brass beads every 2 feet for the first 50 feet, every 5 feet from 50 to 200 feet, every 10 feet from 200 to 300 feet and every 50 feet from 300 to 500 feet; heavy duty hooks on both ends for attaching to trees or other sturoy objects.	2	-	580	-	1,160	Scientific Inst. Inc.
6.	Headset	Flexible headband, built in compartment for dry cell battery, including flexible wire with two pole connector for connecting to two-conductor wire from current meter on wading rod or from sounding reel.	6	-	65	-	390	Scientific Inst. Inc.
7.	Velocity Counter	Electro-mechanical type for tracking number of revolutions of a current meter, working on dry cell batteries, housed in a rugged plastic case	-	-	185	-	-	Scientific Inst. Inc.
8.	Electronic Watch	Electronic, digital reading to 0.01 second. With a neck cord and having easy to use finger tip control buttons.	6	-	70	-	420	Scientific Inst. Inc.
9.	Spares for Current Meters	Compatible to the selected current meters; should include: pivot assembly, hanger screw, binding post assembly; extra screws for price AA and Pygmy meters; instrument oil, cleaning cloth, two-pole connector (male and female); bucket wheel assembly	5 Nos. for each item, both for Pygmy and Price AA	-	-	-	250	Scientific Inst. Inc.
10.	Rubber Chest Wader	1. Medium Size 2. Large Size	3 3	- -	160 210	- -	480 630	Nickl Hydrologic Company, 2710

Table 13 (Continued)

11.	Hip boots	1. Medium Size 2. Large Size	- -	- -	75 105	- -	- -	Joyce Ave; Columbus, Ohio, 43211 USA
12.	Boat Improvize-ment Set	Boom and cross arm, USGS standard	2	5,300	-	10,600	-	Ahmad Enterprises, Lahore
13.	Sounding Reel	USGS A-type light duty, with a maximum load capacity of 100 pounds; two-position handle for leverage, scale reading 0.1 foot; complete with 0.1 inch double conductor cable, "B" type connector and flexible two-conductor wire for connecting reel to readset	2	-	1,480	-	2,960	Scientific Instruments Inc; 518 West Cherry, Milwankee, Mi 53212-3822, USA
14.	Sounding Weight	USGS Columbus (C) type 1. 30 pounds 2. 50 pounds	- 2	790 1,300	- -	- 2,600	- -	M. Ahmad & Sons I-Brandreth Rd, Lahore
15.	Hanger Bar with Pin	USGS type for 30 and 50 pounds Columbus type weight, one foot long	4	260	-	1,040	-	M. Ahmad & Sons
16.	Cable Connector	USGS Type B	4	-	27	-	108	Scientific Inst. Inc.
17.	Sounding Cable	Elsworth double conductor (inner core), 0.1 inch diameter	200	-	6	-	1,200	Scientific Inst. Inc.
18.	Life Jacket	USGS approved model A2 Adult universal, general purpose type-II	6	-	100	-	600	ERO Industries, Inc, Harzlehurst, GA, 31539, USA
19.	Flat Bottom Fibre Glass Boat	16 feet long and 6 feet wide.	2	30,000	-	60,000	-	Zamrock Company Multan Rd. Lahore.
20.	Portable Sonic Depth Recorder	Single range 0 to 30 feet; paper size 8 inches wide and 72 feet long; paper speed 1 or 2 inches per minute; high resolution fine line transreceiver with a frequency of 100Khz; transducer frequency 100 KHz-7.5, voltage input 24 volts DC, weathertight aluminum construction with water tight connectors, plastic cover and mounting brackets.	-	-	10,300	-	-	1. Ross 600 Series Ross Laboratories Inc: 3178 Fairview Ave; E. Seattle, WA 98102. USA 2. 2. Raytheon Series DE -719. Marine Co. Int. Affairs, Lexington, Mass. 02173 USA.
21.	Spares for Sonic Depth Recorders	Most frequently replaceable parts to be decided by the supplier consistent with model conforming to above specifications, including recorder charts.	L.S.	-	-	-	-	1. Ross Laboratories 2. Raytheon

Table 13 (Continued)

22.	Metalic Measuring Tape	Length 100 feet, marked in 0.1 foot increments or in inches; housed in a case.	3	210	-	630	-	Sibtain Brothers, Karachi
23.	Level with Tripod	Topcon (Japan) automatic levelling, magnification 20 X with standard accessories	3	21,000	-	63,000	-	Sibtain Brothers
24.	Levelling Staff	Japanese stave pole standard, 15 ft long	3	1,260	-	3,780	-	Sibtain Brothers
25.	Y - Rod	Standard, for measuring geometry of outlets.	3	2,500	-	7,500	-	Kotri Gaging Subdivision, Hydrology Directorate, Hyderabad
26.	Water Level Recorder	Stevens A-71; English units with 1:6 gage scale; chart speed 2.4 inches per day; chart 10 inches wide and 25 yard long; 4.5 - month negator spring driven clock; 18-inch circumference pulley for perforated tape; stainless steel graduated, perforated tape 50 feet long with set end hooks and index bracket; 8-inch diameter float with counter weight, reversal indicator.	-	-	3,100	-	-	Leupold and Stevens, Inc; P.O. Box 688 Beaverton, Oregon 97075 USA
27.	Spares for Water Level Recorder	1. Recorder chart	-	-	21	-	-	Leupold and Stevens
		2. Pen ink	-	-	9	-	-	
		3. Capillary pen with lucite reservoir	-	-	52	-	-	
		4. 4.5 - month negator spring driven clock	-	-	790	-	-	
		5. Float tape	-	-	210	-	-	
		6. Float	-	-	95	-	-	
		7. Counter weight	-	-	13	-	-	
		8. Pen Cleaner, packet	-	-	9	-	-	
28.	Staff Gage	Special porclain enamel coated, four inches wide in 3.30-foot sections; graduated to .01 foot and marked every foot, 0.1 and .02 foot.						Kotri Gaging Subdivision, Hydrology Directorate Hyderabad. 03
		Range: 0-3.33 ft	60	500	-	30,000	-	Ahmad Enterprises. Lahore
		3.33-6.66 ft	60	500	-	30,000	-	
		6.66-9.99 ft	60	500	-	30,000	-	
		9.99-13.33 ft	60	500	-	30,000	-	

Table 13 (Continued)

Sediment Sampling Equipment

1.	Wading Type, Depth Integrating Suspended Sediment Hand Sampler	US DH-48 with wading rod including three sets of spare gaskets, and nozzles of 1/8, 3/16 and 1/4 inch openings, almunium casting	3	2,100	-	6,300	-	Ahmad Enterprises, Lahore
2.	Reel Type, Depth Intergating Sediment Sampler	US D-74, cast bronze stream lined body, with hanger bar and pin; and including three spare sets of gaskets and nozzles of 1/8, 3/16 and 1/4 inch openningS.	2	6,800	-	13,600	-	Ahmad Enterprises
3.	Piston Type Bed Material Hand Sampler	US BMH 53	3	-	420	-	1,260	Minnesota Fabricators, 2315 Highway 61 North St. Paul Min. 55109, USA
4.	Hand line Bed Material sampler	US BMH 60	2	-	1,100	-	3,300	Minnesota Fabricators
5.	Pint Glass Bottles	For use with DH-48, 24 per box	6	-	75	-	450	Minnesota Fabricators
6.	Plastic Jar	For use with D-74, 12 per box	6	-	25	-	150	Minnesota Fabricators
7.	Sampler Label	For use on all bottles or Jars, self adhesive, packet	6	-	25	-	150	Minnesota Fabricators

Laboratory Equipment For Sediment Analysis

1.	Visual Accumulation Tube sand size Analyser	V.A. tube with automatic tracer and motor (240 Volts-50 cycle); including all accessories for 120 cm tubes; sizes 2.1, 3.4, 5.0 and 7.0 mm inside diameters at lower ends.	3	-	3,800	-	11,400	Federal Inter-egency Sedimen-tation Project, St. Anthony Falls Hydraulic Labora-tory, 2-3rd River e South-East. Minneapolis, Min. 55414 USA
2.	Spares for VA Tube	1. VA glass tube: [illegible] mm	3	-	210	-	630	Federal Interagency
		2. VA glass tube: [illegible] mm	3	-	210	-	630	
		3. VA glass tube: 5.0 mm	3	-	210	-	630	
		4. VA glass tube: 7.0 mm	3	-	210	-	630	
		5. VAT Charts	LS	-	-	-	150	
3.	Bottom Withdrawal Tube	Standard by St. Anthony Falls Hydraulic Laboratories, including rubber tape and pinch clamp.	6	-	220	-	1,320	Federal Interagency

Table 13 (Continued)

4.	Analytical Balance	Capacity of 200 grams with weight box and .0001 gram sensitivity, beam -.05 to +.05 gram in 200 graduated divisions; two concave stainless steel pans, front and back sliding glass doors case.	3	-	1,800	-	5,400	Soiltest, 36 Albrecht Dr. P.O. Box 8004, Lake Bluff, IL. 60044-9902 USA
5.	Electronic Balance	Capacity of 200 grams, Sensitivity .0001 gram	3	-	2,600	-	7,800	Soiltest, IL.
6.	Electric Oven	Fan-Forced air circulation, temperature range upto 110C, two doors, pilot light, adjustable shelf, welded steel exterior, overall diameter 30"x25"x24".	3	-	1,100	-	3,300	Soiltest, IL.
7.	Sieve set (fine)	USA standard sieves, 3-inch diameter brass sieve, fine series						Same as above
		No. Openings						
		5 4.00 mm	3	-	38	-	114	
		10 2.00 mm	3	-	38	-	114	
		18 1.00 mm	3	-	38	-	114	
		25 .710 mm	3	-	38	-	114	
		35 .500 mm	3	-	38	-	114	
		45 .355 mm	3	-	38	-	114	
		60 .250 mm	3	-	38	-	114	
		80 .180 mm	3	-	38	-	114	
		120 .125 mm	3	-	38	-	114	
		170 .090 mm	3	-	45	-	135	
		230 .063 mm	3	-	55	-	165	
		325 .045 mm	3	-	80	-	240	
8.	Sieve set (Coarse)	USA standard sieve; 8 - inch diameter, brass sieve,						Soiltest, IL.
		Sieve size						
		5.6 mm	3	-	38	-	114	
		8.0 mm	3	-	38	-	114	
		16.0 mm	3	-	38	-	114	
		31.5 mm	3	-	38	-	114	
		63 mm	3	-	36	-	114	
		100 mm	3	-	38	-	114	
9.	Sieve Brush	Fine hair bristles, wooden handle.	6	-	8	-	48	Soiltest IL.
10.	Sieve Lid	For US Standard 3-inch sieves	3	-	16	-	48	Soiltest IL.
11.	Sieve Pan	For US Standard 3-inch sieves	3	-	16	-	48	Soiltest IL.

Table 13 (continued)

12.	Sieve Shakar (Motorized)	Motorized 220 volts, 50 cycle; capacity eight sieves plus pan and cover, 8-inch sieve sizes.	-	-	740	-	-	Soiltest, Il.
13.	Sieve Shaker (Hand operated)	Head-operated shaker; capacity seven sieves, 8-inch diameter.	3	-	350	-	1,050	Soiltest Il.
14.	Stop Watch	Reading to one second, Swiss/China	3	900	-	2,700	-	Ahmad Enterprises, Lahore
15.	Pipette	Pyrex glass;						Fisher Scientific 1600 W.Glenlake Ave; Itasca IL. 60143 USA
		1. 25 ml capacity; tolerance + 0.06 ml	3	-	100	-	300	
		2. 50 ml capacity; tolerance + 0.10 ml	3	-	130	-	390	
16.	Vacuum Pump	Two series-connected electric pumps, 0.3 mm ultimate pressure in leak proof system. 1/4 HP motor, 240 volts 50 Hz.	3	-	850	-	2,550	Soiltest, IL.
17.	Beaker	Pyrex glass; safe temperature limit 500C;						Soiltest, IL.
		1. 100 ml	6	-	3	-	18	
		2. 250 ml	6	-	3	-	18	
		3. 600 ml	6	-	4	-	24	
18.	Cylinder	Pyrex glass graduated						Soiltest, IL.
		1. 100 ml	6	-	12	-	72	
		2. 250 ml	6	-	18	-	108	
		3. 500 ml	6	-	22	-	132	
		4. 1000 ml	6	-	32	-	192	
19.	Desiccab	For cooling samples in moisture-free environment, chemical resistant, high impact molded plastic; aluminum shelves, removable desiccant glass tray	-	-	700	-	-	Soiltest, IL.
20.	Evaporating Dish	Porcelain, glazed inside, partially glazed outside.						Soiltest, IL.
		1. 90 mm diameter 120 ml capacity	30	-	9	-	270	
		2. 115 mm diameter 230 ml capacity	30	-	13	-	390	
21.	Desiccator	For cooling samples in moisture-free environment, glass construction, 125 mm inside diameter and 75 mm depth to plate	3	-	65	-	195	Soiltest, IL.

Table 13 (Continued)

22.	Wash Bottle	Borosilicate florence flask with special molded rubber grip containing valve system, one litre capacity	3	-	78	-	234	Soiltest, IL.
23.	Filtering Funnel	Pyrex glass, 60 angle bowle, beaded to reduce chipping, top diameter 127 mm, stem length 100 mm	6	-	80	-	480	Fisher Scientific, IL.
24.	Filter Circle	Whatman, ashless filter paper, fine porosity, particle retention .0025 mm, diameter 12.5 cm, packet	6	-	25	-	150	Fisher Scientific, IL.
25.	Stirring Rod	Glass, 5 mm diameter, 30 cm long	9	-	2	-	18	Fisher Scientific, IL.
26.	Thermometer	Range - 20 to 110C, minimum graduation one degrees, length 300 mm.	6	-	32	-	132	Fisher Scientific, IL.
27.	3-Way Stop Cock	Glass construction.	6	-	12	-	72	Fisher Scientific, IL.
28.	French Curve Set	Plastic.	3	-	100	-	300	Common Item.

Total: Rs. 304,350
U.S. $ 64,922+10% freight = 71,414

TABLE 14
BALOCHISTAN POVINCE
HYDRAULIC AND SEDIMENT MONITORING EQUIPMENT FOR ADEQUATE OPERATION AT DIVISIONAL AND CIRCLE LEVELS

S.#	ITEM	SPECIFICATIONS	QUANTITY	UNIT COST		TOTAL COST		SUPPLIER
				Local Rs.	Dollar US$	Local Rs.	Dollar US$	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Hydraulic Equipment								
1.	Current Meter	Price Type AA (vertical axis, horizontal bucket Wheel); chrome plated stainless steel; minimum velocity = 0.1 fps and maximum velocity = 20.0 fps; single and penta contacts; furnished complete in a foam cushioned carrying case, along with a rating chart, tail fin assembly, screw driver, assorted spare parts, and special lubricant, both for rod and cable suspension.	22	-	790	-	17,380	Scientific Instruments Inc; 518 West Cherry, Milwaukee,Wi 53212 -3822, USA (414)263-1600 Fax (414)263-5506
2.	Mini Current Meter (Pygmy)	Verticall axis, horizontal bucket wheel; chrome plated stainless steel; minimum velocity: .05 fps and maximum velocity = 3.0 fps; furnished complete in a foam cushioned carrying case with assorted spare parts, a rating chart and lubricant; for rod suspension only.	22	-	630	-	13,860	Same as above
3.	Standard Wading Rods	Four 2-foot graduated rods in 0.1 foot increments, bottom rod with base plate; an adjustable sliding support capable of holding price Type AA and Pygmy current meters; a flexible two-conductor wire with one end having two-hole conductor for head set and the other end suitable for connecting to current meter and rods. Base plate and slider made from corrosion resistant material; complete set in heavy duty canvas carrying case.	22	2,100	-	46,200	-	Ahmad Enterprises I-Mecleod Road Lahore

Table 14 (Continued)

4.	Light Duty Tagline	About 300 feet long of 0.04 inch diameter stainless steel with a hook at one end, wound on a heavy plastic reel and mounted on a hardwood stake; brass beads every 2 feet for the first 50 feet, every 5 feet from 50 to 200 feet and every 10 feet from 200 to 300 feet.	11	-	525	-	5,775	Scientific Instruments Inc.
5.	Heavy Duty Lee Au Type Tagline	About 500 feet long 1/16 inch diameter open reel with handles; marked with brass beads every 2 feet for the first 50 feet, every 5 feet from 50 to 200 feet, every 10 feet from 200 to 300 feet and every 50 feet from 300 to 500 feet; heavy duty hooks on both ends for attaching to trees or other sturdy objects.	4	-	580	-	2,320	Scientific Inst. Inc.
6.	Headset	Flexible headband, built in compartment for dry cell battery, including flexible wire with two pole connector for connecting to two-conductor wire from current meter on wading rod or from sounding reel.	22	-	65	-	1,430	Scientific Instrument Inc.
7.	Velocity Counter	Electro-mechanical type for tracking number of revolutions of a current meter, working on dry cell batteries, housed in a rugged plastic case	-	-	185	-	-	Scientific Inst. Inc.
8.	Electronic Watch	Electronic, digital reading to 0.01 second, with a neck cord and having easy to use finger tip control buttons.	22	-	70	-	1,540	Scientific Inst. Inc.
9.	Spares for Current Meters	Compatible to the selected current meters; should include: pivot assembly, hanger screw, binding post assembly; extra screws for price AA and Pygmy meters; instrument oil, cleaning cloth, two-pole connector (male and female); bucket wheel assembly	5 Nos. for each item, both for Pygmy and Price AA	-	-	-	250	Scientific Inst. Inc.
10.	Rubber Chest Wader	1. Medium Size 2. Large Size	11 11	- -	160 210	- -	1,760 2,310	Rickly Hydrologic Company, 2710

Table 14 (Continued)

11.	Hip boots	1. Medium Size 2. Large Size	11 11	- -	75 105	- -	825 1,155	Joyce Ave; Columbus, Ohio, 43211 USA
12.	Boat Improvize-ment Set	Boom and cross arm, USGS standard	4	5,300	-	21,200	-	Ahmad Enterprises, Lahore
13.	Sounding Reel	USGS A-type light duty, with a maximum load capacity of 100 pounds; two-position handle for leverage, scale reading 0.1 foot; complete with 0.1 inch double conductor cable, "B" type connector and flexible two-conductor wire for connecting reel to headset	4	-	1,480	-	5,920	Scientific Instruments Inc;
14.	Sounding Weight	USGS Columbs (C) type 1. 30 pounds 2. 50 pounds	- 4	790 1,300	- -	- 5,200	- -	M. Ahmad & Sons I-Brandreth Rd, Lahore
15.	Hanger Bar with Pin	USGS type for 30 and 50 Columbs type weights, one foot long	8	260	-	2,080	-	M. Ahmad & Sons
16.	Cable Connector	USGS Type B	4	-	27	-	108	Scientific Inst. Inc.
17.	Sounding Cable	Elsworth double conductor (inner core), 0.1 inch diameter	400	-	6	-	2,400	Scientific Inst. Inc.
18.	Life Jacket	USGS approved model A2 Adult universal, general purpose type-II	12	-	100	-	1,200	ERO Industries, Inc, Harzlehurst, GA, 31539, USA
19.	Flat Bottom Fibre Glass Boat	16 feet long and 6 feet wide.	4	30,000	-	120,000	-	Zamrock Company Multan Rd. Lahore.
20.	Portable Sonic Depth Recorder	Single range 0 to 50 feet; paper size 8 inches wide and 72 feet long; paper speed 1 or 2 inches per minute; high resolution fine line transreceiver with a frequency of 100KHz; transducer frequency 100 KHz-7.5, voltage input 24 volts DC, weathertight aluminum construction with water tight connectors, plastic cover and mounting brackets.	-	-	10,500	-	-	1. Ross 600 Series Ross Laboratories Inc; 3138 Fairview Ave; Seattle, WA 98102, USA 2. 2. Raytheon Series DE -719, Marine Co. Int. Affairs, lexington, Mass. 02173 USA.
21.	Spares for Sonic Depth Recorders	Most frequently replaceable parts to be decided by the supplier consistent with model conforming to above specifications, including recorder charts.	L.S.	-	-	-	-	1. Ross Laboratories 2. Raytheon

Table 14 (Continued)

22.	Metalic Measuring Tape	Length 100 feet, marked in 0.1 foot increments or in inches; housed in a case.	11	210	-	2,310	-	Sibtain Brothers, Karachi
23.	Level with Tripod	Topcon (Japan) automatic levelling, magnification 20 X with standard accessories	11	21,000	-	231,000	-	Sibtain Brothers
24.	Levelling Staff	Japanese stave pole standard, 15 ft long	11	1,260	-	13,860	-	Sibtain Brothers
25.	Y - Rod	Standard, for measuring geometry of outlets.	11	2,500	-	27,500	-	Kotri Gaging Subdivision, Hydrology Directorate, Hyderabad
26.	Water Level Recorder	Stevens A-71; English units with 1:6 gage scale; chart speed 2.4 inches per day; chart 10 inches wide and 25 yard long; 4.5 - month negator spring driven clock; 18-inch circumference pulley for perforated tape; stainless steel graduated, perforated tape 50 feet long with set end hooks and index bracket; 8-inch diameter float with counter weight, reversal indicator.	11	-	3,100	-	34,100	Leupold and Stevens, Inc; P.O. Box 688 Beaverton, Oregon 97075 USA
27.	Spares for Water Level Recorder	1. Recorder chart	11	-	21	-	231	Leupold and Stevens
		2. Pen ink	11	-	9	-	99	
		3. Capillary pen with lucite reservoir	11	-	52	-	572	
		4. 4.5 - month negator spring driven clock	11	-	790	-	8,690	
		5. Float tape	11	-	210	-	2,310	
		6. Float	11	-	95	-	1,045	
		7. Counter weight	11	-	13	-	143	
		8. Pen Cleaner, packet	11	-	9	-	99	
28.	Staff Gage	Special porcelain enamel coated, four inches wide in 3.33-foot sections; graduated to .01 foot and marked every foot, 0.1 and .02 foot.						Kotri Gaging Subdivision, Hydrology Directorate Hyderabad. OR
		Range: 0-3.33 ft	60	500	-	30,000	-	Ahsad Enterprises, Lahore
		3.33-6.66 ft	60	500	-	30,000	-	
		6.66-9.99 ft	60	500	-	30,000	-	
		9.99-13.33 ft	60	500	-	30,000	-	

Table 14 (Continued)

Sediment Sampling Equipment								
1.	Wading Type, Depth Integrating Suspended Sediment Hand Sampler	US DH-48 with wading rod including three sets of spare gaskets, and nozzles of 1/8, 3/16 and 1/4 inch openings, aluminum casting	3	2,100	-	6,300	-	Ahmad Enterprises, Lahore
2.	Reel Type, Depth Intergating Sediment Sampler	US D-74, cast bronze stream lined body, with hanger bar and pin; and including three spare sets of gaskets and nozzles of 1/8, 3/16 and 1/4 inch openings.	3	6,800	-	20,400	-	Ahmad Enterprises
3.	Piston Type Bed Material Hand Sampler	US BMH 53	3	-	420	-	1,260	Minnesota Fabricators, 2515 Highway 61 North St. Paul Min. 55109, USA
4.	Hand line Bed Material sampler	US BMH 60	3	-	1,100	-	3,300	Minnesota Fabricators
5.	Pint Glass Bottles	For use with DH-48, 24 per box	6	-	70	-	450	Minnesota Fabricators
6.	Plastic Quarts Jar	For use with D-74, 12 per box	6	-	25	-	150	Minnesota Fabricators
7.	Sample Label	For use on all bottles or Jars, self adhesive, packet	6	-	25	-	150	Minnesota Fabricators
Laboratory Equipment For Sediment Analysis								
1.	Visual Accumulation Tube sand size Analyser	V.A. tube with automatic tracer and motor (240 Volts-50 cycle); including all accessories for 120 cm tubes; sizes 2.1, 3.4, 5.0 and 7.0 mm inside diameters at lower ends.	3	-	3,800	-	11,400	Federal Inter-agency Sedimentation Project, St. Anthony Falls Hydraulic Laboratory, 2-3rd Avenue South-East. Minneapolis, Min. 55414 USA
2.	Spares for VA Tube	1. VA glass tube: 2.1 mm	3	-	210	-	630	Federal Interagency
		2. VA glass tube: 3.4 mm	3	-	210	-	630	
		3. VA glass tube: 5.0 mm	3	-	210	-	630	
		4. VA glass tube: 7.0 mm	3	-	210	-	630	
		5. VAT Charts	LS	-	-	-	150	
3.	Bottom Withdrawal Tube	Standard by St. Anthony Falls Hydraulic Laboratories, including rubber tape and pinch clamp.	6	-	220	-	1,320	Federal Interagency

Table 14 (Continued)

4.	Analytical Balance	Capacity of 200 grams with weight box and .0001 gram sensitivity, beam -.05 to +.05 gram in 200 graduated divisions; two concave stainless steel pans, front and back sliding glass doors case.	3	-	1,800	-	5,400	Soiltest, 86 Albrecht Dr. P.O. Box 6004, Lake Bluff, IL. 60044-9902 USA
5.	Electronic Balance	Capacity of 200 grams, Sensitivity .0001 gram	3	-	2,600	-	7,800	Soiltest, IL.
6.	Electric Oven	Fan-Forced air circulation, temperature range upto 110C, two doors, pilot light, adjustable shelf, welded steel exterior, overall diameter 30"x25"x24".	3	-	1,100	-	3,300	Soiltest, IL.
7.	Sieve set (fine)	USA standard sieves, 3-inch diameter brass sieve, fine series						Soiltest, Il.
		No. Openings						
		5 4.00 mm	3	-	38	-	114	
		10 2.00 mm	3	-	38	-	114	
		18 1.00 mm	3	-	38	-	114	
		25 .710 mm	3	-	38	-	114	
		35 .500 mm	3	-	38	-	114	
		45 .355 mm	3	-	38	-	114	
		60 .250 mm	3	-	38	-	114	
		80 .180 mm	3	-	38	-	114	
		120 .125 mm	3	-	38	-	114	
		170 .090 mm	3	-	38	-	114	
		230 .063 mm	3	-	45	-	135	
		325 .045 mm	3	-	55	-	165	
			3	-	80	-	240	
8.	Sieve set (Coarse)	USA standard sieve; 8 - inch diameter, brass sieve,						Soiltest, Il.
		Sieve size						
		5.6 mm	3	-	38	-	114	
		8.0 mm	3	-	38	-	114	
		16.0 mm	3	-	38	-	114	
		31.5 mm	3	-	38	-	114	
		63 mm	3	-	38	-	114	
		100 mm	3	-	38	-	114	
9.	Sieve Brush	Fine hair bristles, wooden handle.	6	-	8	-	48	Soiltest, Il.
10.	Sieve Lid	For US Standard 3-inch sieves	3	-	16	-	48	Soiltest, Il.
11.	Sieve Pan	For US Standard 3-inch sieves	3	-	16	-	48	Soiltest, Il.

Table 14 (continued)

12.	Sieve Shakar (Motorized)	Motorized 220 volts, 50 cycle; capacity eight sieves plus pan and cover, 8-inch sieve sizes	-	-	740	-	-	Soiltest IL.
13.	Sieve Shaker (Hand operated)	Hand-operated shaker; capacity seven sieves, 8-inch diameter.	3	-	350	-	1,050	Soiltest, IL.
14.	Stop Watch	Reading to one second, Swiss/China	3	900	-	2,700	-	Ahmad Enterprises, Lahore
15.	Pipette	Pyrex glass;						
		1. 25 ml capacity; tolerance + 0.06 ml	3	-	100	-	300	Fisher Scientific 1600 W.Glenlake Ave; Itasca IL. 60143 USA
		2. 50 ml capacity; tolerance + 0.10 ml	3	-	130	-	390	
16.	Vacuum Pump	Two series-connected electric pumps, 0.3 mm ultimate pressure in leak proof system, 1/4 HP motor, 240 volts 50 Hz.	3	-	850	-	2,550	Soiltest, IL.
17.	Beaker	Pyrex glass; safe temperature limit 500C;						Soiltest, IL.
		1. 100 ml	6	-	3	-	18	
		2. 250 ml	6	-	3	-	18	
		3. 600 ml	6	-	4	-	24	
18.	Cylinder	Pyrex glass graduated						Soiltest, IL.
		1. 100 ml	6	-	12	-	72	
		2. 250 ml	6	-	18	-	108	
		3. 500 ml	6	-	22	-	132	
		4. 1000 ml	6	-	32	-	192	
19.	Desiccab	For cooling samples in moisture-free environment, chemical resistant, high impact molded plastic; aluminum shelves, removable desiccant glass tray	-	-	700	-	-	Soiltest, IL.
20.	Evaporating Dish	Poreclain, glazed inside, partially glazed outside.						Soiltest, IL.
		1. 90 mm diameter 120 ml capacity	30	-	9	-	270	
		2. 115 mm diameter 250 ml capacity	30	-	13	-	390	
21.	Desiccator	For cooling samples in moisture-free environment, glass construction, 125 mm inside diameter and 75 mm depth to plate	3	-	65	-	195	Soiltest, IL.

Table 14 (Continued)

22.	Wash Bottle	Borosilicate florence flask with special molded rubber grip containing valve system, one litre capacity	3	-	79	-	237	Soiltest, IL.
23.	Filtering Funnel	Pyrex glass, 60 angle bowle, beaded to reduce chipping, top diameter 127 mm, stem length 100 mm	6	-	80	-	480	Fisher Scientific, IL.
24.	Filter Circle	Whatman, ashless filter paper, fine porosity, particle retention .0025 mm, diameter 12.5 cm, packet	6	-	25	-	150	Fisher Scientific, IL.
25.	Stirring Rod	Glass, 5 mm diameter, 30 cm long	9	-	2	-	18	Fisher Scientific, IL.
26.	Thermometer	Range - 20 to 110C, minimum graduation one degree, length 300 mm.	6	-	32	-	192	Fisher Scientific, IL.
27.	3-Way Stop Cock	Glass construction.	6	-	12	-	72	Fisher Scientific, IL.
28.	French Curve Set	Plastic.	3	-	100	-	300	Common Item.

Total: Rs. 618,750
U.S. $ 152,124+10% freight = 167,336

TABLE 15
BALOCHISTAN POVINCE
HYDRAULIC AND SEDIMENT MONITORING EQUIPMENT FOR PILOT PROJECT

S.#	ITEM	SPECIFICATIONS	QUANTITY	UNITCOST		TOTAL COST		SUPPLIER
				Local Rs.	Dollar US$	Local Rs.	Dollar US$	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Hydraulic Equipment								
1.	Current Meter	Price Type AA (vertical axis, horizontal bucket Wheel); chrome plated stainless steel; minimum velocity = 0.1 fps and maximum velocity = 20.0 fps; single and penta contacts; furnished complete in a foam cushioned carrying case, along with a rating chart, tail fin assembly, screw driver, assorted spare parts, and special lubricant, both for rod and cable suspension.	16	-	790	-	12,640	Scientific Instruments Inc; 518 West Cherry, Milwaukee,Wi 53212 -3822, USA (414)263-1600 Fax (414)263-5506
2.	Mini Current Meter (Pygmy)	Verticall axis, horizontal bucket wheel; chrome plated stainless steel; minimum velocity: .05 fps and maximum velocity = 3.0 fps; furnished complete in a foam cushioned carrying case with assorted spare parts, a rating chart and lubricant; for rod suspension only.	16	-	630	-	10,080	Scientific Inst. Inc.
3.	Standard Wading Rods	Four 2-foot graduated rods in 0.1 foot increments, bottom rod with base plate; an adjustable sliding support capable of holding price Type AA and Pygmy current meters; a flexible two-conductor wire with one end having two-hole conductor for head set and the other end suitable for connecting to current meter and rods. Base plate and slider made from corrosion resistant material; complete set in heavy duty canvas carrying case.	16	2,100	-	33,600	-	Ahmad Enterprises 1-Mcleod Road Lahore

Table 15 (Continued)

4.	Light Duty Tagline	About 300 feet long of 0.04 inch diameter stainless steel with a hook at one end, wound on a heavy plastic reel and mounted on a hardwood stake; brass beads every 2 feet for the first 50 feet, every 5 feet from 50 to 200 feet and every 10 feet from 200 to 300 feet.	16	-	525	-	8,400	Scientific Instruments Inc.
5.	Heavy Duty Lee Au Type Tagline	About 500 feet long 1/16 inch diameter open reel with handles; marked with brass beads every 2 feet for the first 50 feet, every 5 feet from 50 to 200 feet, every 10 feet from 200 to 300 feet and every 50 feet from 300 to 500 feet; heavy duty hooks on both ends for attaching to trees or other sturdy objects.	3	-	580	-	1,740	Scientific Inst. Inc.
6.	Headset	Flexible headband, built in compartment for dry cell battery, including flexible wire with two pole connector for connecting to two-conductor wire from current meter on wading rod or from sounding reel.	16	-	65	-	1,040	Scientific Inst. Inc.
7.	Electronic Watch	Electronic, digital reading to 0.01 second, with a neck cord and having easy to use finger tip control buttons.	8	-	70	-	560	Scientific Inst. Inc.
8.	Spares for Current Meters	Compatible to the selected current meters; should include: pivot assembly, hanger screw, binding post assembly; extra screws for price AA and Pygmy meters; instrument oil, cleaning cloth, two-pole connector (male and female); bucket wheel assembly	5 Nos. for each item, both for Pygmy and Price AA	-	-	-	250	Scientific Inst. Inc.
9.	Rubber Chest Wader	1. Medium Size 2. Large Size	6 2	- -	160 210	- -	960 420	Rickly Hydrologic Company, 2710

Table 15 (Continued)

10.	Hip boots	1. Medium Size 2. Large Size	6 2	- -	75 105	- -	450 210	Joyce Ave; Columbus, Ohio, 43211 USA
11.	Boat Improvize-ment Set	Rope and cross arm, USGS standard	3	5,300	-	15,900	-	Ahmad Enterprises, Lahore
12.	Sounding Reel	USGS A-type light duty, with a maximum load capacity of 100 pounds; two-position handle for leverage, scale reading 0.1 foot; complete with 0.1 inch double conductor cable, "B" type connector and flexible two-conductor wire for connecting reel to headset	3	-	1,480	-	4,440	Scientific Instruments Inc;
13.	Sounding Weight	USGS Columbus (C) type 1. 50 pounds	3	1,300	-	3,900	-	M. Ahmad & Sons I-Brandreth Rd, Lahore
14.	Hanger Bar with Pin	USGS type for 30 and 50 Columbus type weights, one foot long	6	260	-	1,560	-	M. Ahmad & Sons
15.	Cable Connector	USGS Type B	3	-	27	-	81	Scientific Inst. Inc.
16.	Sounding Cable	Elsworth double conductor (inner core), 0.1 inch diameter	300	-	6	-	1,800	Scientific Inst. Inc.
17.	Life Jacket	USGS approved model A2 Adult universal, general purpose type-II	9	-	100	-	900	ERO Industries, Inc, Harzlehurst, GA, 31539, USA
18.	Flat Bottom Fibre Glass Boat	16 feet long and 6 feet wide.	3	30,000	-	90,000	-	Zamrock Company Multan Rd. Lahore.
19.	Metalic Measuring Tape	Length 100 feet, marked in 0.1 foot increments or in inches; housed in a case.	8	210	-	1,680	-	Sibtain Brothers, Karachi
20.	Level with Tripod	Topcon (Japan) automatic levelling, magnification 20 X with standard accessories	8	21,000	-	168,000	-	Sibtain Brothers
21.	Levelling Staff	Japanese stave pole standard, 15 ft long	8	1,260	-	10,080	-	Sibtain Brothers
22.	Y - Rod	Standard, for measuring geometry of outlets.	3	2,500	-	7,500	-	Kotri Gaging Sub-division, Hydrol-ogy Directorate, Hyderabad

Table 15 (Continued)

23.	Water Level Recorder	Stevens A-71; English units with 1:6 gage scale; chart speed 2.4 inches per day; chart 10 inches wide and 25 yard long; 4.5 - month negator spring driven clock; 18-inch circumference pulley for perforated tape; stainless steel graduated, perforated tape 50 feet long with set end hooks and index bracket; 8-inch diameter float with counter weight, reversal indicator.	8	-	3,100	-	24,800	Leupold and Stevens, Inc; P.O. Box 688 Beaverton, Oregon 97075 USA
24.	Spares for Water Level Recorder	1. Recorder chart	8	-	21	-	168	Leupold & Stevens
		2. Pen ink	8	-	9	-	72	
		3. Capillary pen with lucite reservoir	8	-	52	-	416	
		4. Pen Cleaner, packet	8	-	9	-	72	
25.	Staff Gage	Special porclain enamel coated, four inches wide in 3.33-foot sections; graduated to .01 foot and marked every foot, 0.1 and .02 foot.						Kotri Gaging Subdivision, Hydrology Directorate Hyderabad. OR
		Range: 0-3.33 ft	40	500	-	20,000	-	Ahmad Enterprises, Lahore
		3.33-6.66 ft	40	500	-	20,000	-	
		6.66-9.99 ft	40	500	-	20,000	-	
		9.99-13.33 ft	40	500	-	20,000	-	

Sediment Sampling Equipment

1.	Wading Type, Depth Integrating Suspended Sediment Hand Sampler	US DH-48 with wading rod including three sets of spare gaskets, and nozzles of 1/8, 3/16 and 1/4 inch openings, alemunium casting	8	2,100	-	16,800	-	Ahmad Enterprises, Lahore
2.	Piston Type Bed Material Hand Sampler	US BMH 53	8	-	420	-	3,360	Minnesota Fabricators, 2515 Highway 61 North St. Paul Min. 55109, USA
3.	Pint Glass Bottles	For use with DH-48, 24 per box	8	-	75	-	600	Minnesota Fabricators
4.	Sample Label	For use on all bottles or Jars, self adhesive, packet	8	-	25	-	200	Minnesota Fabricators

Laboratory Equipment For Sediment Analysis

1.	Bottom Withdrawal Tube	Standard by St. Anthony Falls Hydraulic Laboratories, including rubber tape and pinch clamp.	4	-	220	-	880	Federal Interagency Sedimentation Project, St. Anthony Falls Hydraulic Laboratory, 2-3rd Avenue South-East. Minneopolis, Min. 55414 USA.
2.	Analytical Balance	Capacity of 200 grams with weight box and .0001 gram sensitivity, beam -.05 to +.05 gram in 200 graduated divisions; two concave stainless steel pans, front and back sliding glass doors case.	2	-	1,800	-	3,600	Soiltest, 86 Albrecht Dr. P.O. Box 6004, Lake Bluff, IL. 60044-9902 USA
3.	Electric Oven	Fan-Forced air circulation, temperature range upto 110C, two doors, pilot light, adjustable shelf, welded steel exterior, overall diameter 30"x25"x24".	2	-	1,100		2,200	Soiltest, IL.
4.	Sieve set (fine)	USA standard sieves, 3-inch diameter brass sieve, fine series						Soiltest, Il.
		No. Openings						
		5 4.00 mm	2	-	38	-	76	
		10 2.00 mm	2	-	38	-	76	
		18 1.00 mm	2	-	38	-	76	
		25 .710 mm	2	-	38	-	76	
		35 .500 mm	2	-	38	-	76	
		45 .355 mm	2	-	38	-	76	
		60 .250 mm	2	-	38	-	76	
		80 .180 mm	2	-	38	-	76	
		120 .125 mm	2	-	38	-	76	
		170 .090 mm	2	-	38	-	76	
		230 .063 mm	2	-	45	-	90	
		325 .045 mm	2	-	55	-	110	
			2	-	80	-	160	
5.	Sieve set (Coarse)	USA standard sieve; 8 - inch diameter, brass sieve,						Soiltest, Il.
		Sieve size						
		5.6 mm	2	-	38	-	76	
		8.0 mm	2	-	38	-	76	
		16.0 mm	2	-	38	-	76	
		31.5 mm	2	-	38	-	76	
		63 mm	2	-	38	-	76	
		100 mm	2	-	38	-	76	

Table 15 (Continued)

6.	Sieve Brush	Fine hair bristles, wooden handle.	4	-	8	-	32	Soiltest, Il.
7.	Sieve Lid	For US Standard 3-inch sieves	2	-	16	-	32	Soiltest, Il.
8.	Sieve Pan	For US Standard 3-inch sieves	2	-	16	-	32	Soiltest, Il.
9.	Sieve Shaker (Hand operated)	Head-operated shaker; capacity seven sieves, 8-inch diameter.	2	-	350	-	700	Soiltest, Il.
10.	Stop Watch	Reading to one second, Swiss/China	2	900	-	1,800	-	Ahmad Enterprises, Lahore
11.	Pipette	Pyrex glass;						Fisher Scientific 1600 W.Glenlake Ave; Itasca IL. 60143 USA
		1. 25 ml capacity; tolerance + 0.06 ml	2	-	100	-	200	
		2. 50 ml capacity; tolerance + 0.10 ml	2	-	130	-	260	
12.	Vacuum Pump	Two series-connected electric pumps, 0.3 mm ultimate pressure in leak proof system, 1/4 HP motor, 240 volts 50 Hz.	2	-	850	-	1,700	Soiltest, IL.
13.	Beaker	Pyrex glass; safe temperature limit 500C;						Soiltest, IL.
		1. 100 ml	4	-	3	-	12	
		2. 250 ml	4	-	3	-	12	
		3. 600 ml	4	-	4	-	16	
14.	Cylinder	Pyrex glass graduated						Soiltest, IL.
		1. 100 ml	4	-	12	-	48	
		2. 250 ml	4	-	18	-	72	
		3. 500 ml	4	-	22	-	88	
		4. 1000 ml	4	-	32	-	128	
15.	Evaporating Dish	Poreciain, glazed inside, partially glazed outside.						Soiltest, IL.
		1. 90 mm diameter 120 ml capacity	20	-	9	-	180	
		2. 115 mm diameter 250 ml capacity	20	-	13	-	260	
16.	Desiccator	For cooling samples in moisture-free environment, glass construction, 125 mm inside diameter and 75 mm depth to plate	2	-	65	-	130	Soiltest, IL.
17.	Wash Bottle	Borosilicate florence flask with special molded rubber grip containing valve system, one litre capacity	2	-	78	-	156	Soiltest, IL.

Table 15 (Continued)

18.	Filtering Funnel	Pyrex glass, 60 angle bowle, beaded to reduce chipping, top diameter 127 mm, stem length 100 mm	4	-	80		320	Fisher Scientific, IL.
19.	Filter Circle	Whatman, ashless filter paper, fine porosity, particle retention .0025 mm, diameter 12.5 cm, packet	4	-	25	-	100	Fisher Scientific, IL.
20.	Stirring Rod	Glass, 5 mm diameter, 30 cm long	4	-	2	-	8	Fisher Scientific, IL.
21.	Thermometer	Range - 20 to 110C, minimum graduation one degree, length 300 mm.	4	-	32	-	128	Fisher Scientific, IL.
22.	3-Way Stop Cock	Glass construction.	4	-	12	-	48	Fisher Scientific, IL.
23.	French Curve Set	Plastic.	2	-	100	-	200	Common Item.

Total: Rs. 430,820
U.S. $ 86,701+10% freight = 95,371

Note : Two Circles (eight divisions)

TABLE 16
NORTHWEST FRONTIER PROVINCE
NUMBER OF FIELD UNITS FOR OPERATION AND MAINTENANCE OF CANAL AND DRAINAGE SYSTEMS

REGION CHIEF ENGINEER	CIRCLE SUPERINTENDING ENGINEER	DIVISION EXECUTIVE ENGINEER	SUB-DIVISION SDO
NWFP (Peshawar)	Malakand Irrigation, Mangora	Chitral, Chitral	1
		Hazara, Abbotabad	3
		Malakand, Mangora	2
	Southern Circle, Bannu	Marvat Canal, Bannu	3
		Bannu Canal, Bannu	2
		Paharpur Canal, D.I. Khan	1
	Central Circle, Peshawar	Kohat, Kohat	2
		Peshawar Canal, Peshawar	3
		Warsak Canal, Peshawar	3
	Northern Irrigation, Mardan	Swabi, Swabi	4
		Malakand, Malakand	2
		Mardan, Mardan	2

Regions = 1

Circles = 4

Divisions = 12

Sub-Divisions = 28

Note: Table does not include the field units responsible for operation and maintenance of tubewells or maintenance of bunds.

TABLE 17
NORTHWEST PROVINCE
TYPE AND QUANTITY OF EQUIPMENT

Type	Quantity		
	Minimum Operation	Adequate Operation	Full Operation
Price Type AA Current Meter (F)	8	24	24
PYgmy Current Meter (F)	8	24	24
Wading Rods Set (L)	8	24	24
Light Duty Tagline (F)	4	12	12
Heavy Duty Tagline (F)	3	6	6
Headset (F)	8	24	24
Velocity Counter (F)	-	-	12
Stop Watch (F)	8	24	24
Rubber Chest Wader (F)	8	24	24
Hip Boots (F)	-	24	24
Boat Improvizement Set (L)	3	6	6
Sounding Reel (F)	3	6	6
30-Pound Sounding Weight (L)	-	-	6
50-Pound Sounding Weight (L)	3	6	6
Hanger Bar With Pin (L)	6	12	12
Life Jacket (F)	9	18	18
Fibre Glass Boat (L)	3	6	6
Sonic Sounder (F)	-	-	2
Measuring Tape (L)	4	12	12
Level With Tripod (L)	4	12	12
Levelling Staff (L)	4	12	12
Y-Rod (L)	4	12	12
Water Level Recorder (F)	-	12	24
Staff Gage (L)	60(Sites)	60(Sites)	60(Sites)
US DH-48 Sampler (L)	4	4	4
US D-74 Sampler (L)	3	3	3
US BMH 53 Sampler (F)	4	4	4
US BMH 60 Sampler (F)	3	3	3
Glass Bottles for Sampler (F)	8	8	8
Plastic Jars for Sampler (F)	8	8	8
V.A. Tube Analyser (F)	4	4	4
Bottom Withdrawal Tube (F)	8	8	8
Analytical Balance (F)	4	4	4
Electronic Balance (F)	4	4	4
Electric Oven (F)	4	4	4
Sieve Set (Fine) (F)	4	4	4
Sieve Set (Coarse) (F)	4	4	4
Sieve Brush (F)	8	8	8
Sieve Lid (F)	4	4	4
Sieve Pan (F)	4	4	4
Sieve Shaker (Motorized) (F)	-	-	4
Sieve Shaker (Hand operated) (F)	4	4	4
Pipette (F)	8	8	8
Vacuum Pump (F)	4	4	4
Stop Watch (L)	4	4	4

Table 17 (Continued)

Beaker (Glass) (F)	24	24	24
Cylinder (Glass) (F)	32	32	32
Desiccab (F)	-	-	4
Evaporating Dish (F)	80	80	80
Desicator (F)	4	4	4
Wash Bottle (F)	4	4	4
Filtering Funnel (F)	8	8	8
Stirring Rod (F)	12	12	12
Thermometer (F)	8	8	8
3-Way Stop Cock (F)	8	8	8
French Curve Set (F)	4	4	4

No. of Circles = 4

No. of Divisions = 12

F = Imported

L = Local

- Minimum operation at circle levels
- Adequate operation at divisional and circle levels
- Full operation at divisional and circle levels with additional equipment.
- Spares are not included in the list.

TABLE 18
NORTHWEST FRONTIER POVINCE
HYDRAULIC AND SEDIMENT MONITORING EQUIPMENT FOR MINIMUM OPERATION AT CIRCLE LEVEL

S.#	ITEM	SPECIFICATIONS	QUANTITY	UNITCOST		TOTAL COST		SUPPLIER
				Local Rs.	Dollar US$	Local Rs.	Dollar US$	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Hydraulic Equipment								
1.	Current Meter	Price Type AA (vertical axis, horizontal bucket Wheel); chrome plated stainless steel; minimum velocity = 0.1 fps and maximum velocity = 20.0 fps; single and penta contacts; furnished complete in a foam cushioned carrying case, along with a rating chart, tail fin assembly, screw driver, assorted spare parts, and special lubricant, both for rod and cable suspension.	8	-	790	-	6,320	Scientific Instruments Inc; 518 West Cherry, Milwaukee,Wi 53212 -3522, USA (414)263-1600 Fax (414)263-5506
2.	Mini Current Meter (Pygmy)	Verticall axis, horizontal bucket Wheel; chrome plated stainless steel; minimum velocity: .05 fps and maximum velocity = 3.0 fps; furnished complete in a foam cushioned carrying case with assorted spare parts, a rating chart and lubricant; for rod suspension only.	8	-	630	-	5,040	Scientific Inst. Inc.
3.	Standard Wading Rods	Four 2-foot graduated rods in 0.1 foot increments, bottom rod with base plate; an adjustable sliding support capable of holding price Type AA and Pygmy current meters; a flexible two-conductor wire with one end having two-hole conductor for head set and the other end suitable for connecting to current meter and rods. Base plate and slider made from corrosion resistant material; complete set in heavy duty canvas carrying case.	8	2,100	-	16,800	-	Ahmad Enterprises I-McLeod Road Lahore

Table 1B (Continued)

4.	Light Duty Tagline	About 300 feet long of 0.04 inch diameter stainless steel with a hook at one end, wound on a heavy plastic reel and mounted on a hardwood stake; brass beads every 2 feet for the first 50 feet, every 5 feet from 50 to 200 feet and every 10 feet from 200 to 300 feet.	4	-	525	-	2,100	Scientific Instruments Inc.
5.	Heavy Duty Lee Au Type Tagline	About 500 feet long 1/16 inch diameter open reel with handles; marked with brass beads every 2 feet for the first 50 feet, every 5 feet from 50 to 200 feet, every 10 feet from 200 to 300 feet and every 50 feet from 300 to 500 feet; heavy duty hooks on both ends for attaching to trees or other sturdy objects.	3	-	580	-	1,740	Scientific Inst. Inc.
6.	Headset	Flexible headband, built in compartment for dry cell battery, including flexible wire with two pole connector for connecting to two-conductor wire from current meter on wading rod or from sounding reel.	8	-	65	-	520	Scientific Inst. Inc.
7.	Velocity Counter	Electro-mechanical type for tracking number of revolutions of a current meter, working on dry cell batteries, housed in a rugged plastic case	-	-	185	-	-	Scientific Inst. Inc.
8.	Electronic Watch	Electronic, digital reading to 0.01 second, with a neck cord and having easy to use finger tip control buttons.	8	-	70	-	560	Scientific Inst. Inc.
9.	Spares for Current Meters	Compatible to the selected current meters; should include: pivot assembly, hanger screw, binding post assembly; extra screws for price AA and Pygmy meters; instrument oil, cleaning cloth, two-pole connector (male and female); bucket wheel assembly	5 Nos. for each item, both for Pygmy and Price AA	-	-	-	250	Scientific Inst. Inc.
10.	Rubber Chest Wader	1. Medium Size 2. Large Size	4 4	- -	160 210	- -	640 840	Rickly Hydrologic Company, 2710

Table 18 (Continued)

11.	Hip boots	1. Medium Size 2. Large Size	- -	- -	75 105	- -	- -	Joyce Ave; Columbus, Ohio, 43211 USA
12.	Boat Improvize-ment Set	Boom and cross arm, USGS standard	3	5,300	-	15,900	-	Ahmad Enterprises, Lahore
13.	Sounding Reel	USGS A-type light duty, with a maximum load capacity of 100 pounds; two-position handle for leverage, scale reading 0.1 foot; complete with 0.1 inch double conductor cable, "B" type connector and flexible two-conductor wire for connecting reel to headset	3	-	1,480	-	4,440	Scientific Instruments Inc;
14.	Sounding Weight	USGS Columbus (C) type 1. 30 pounds 2. 50 pounds	- 3	790 1,300	- -	- 3,900	- -	M. Ahmad & Sons I-Brandreth Rd, Lahore
15.	Hanger Bar with Pin	USGS type for 30 and 50 pounds Columbus type weight, one foot long	6	260	-	1,560	-	M. Ahmad & Sons
16.	Cable Connector	USGS Type B	2	-	27	-	54	Scientific Inst. Inc.
17.	Sounding Cable	Elsworth double conductor (inner core), 0.1 inch diameter	350 ft	-	6	-	2,100	Scientific Inst. Inc.
18.	Life Jacket	USGS approved model A2 Adult universal, general purpose type-II	9	-	100	-	900	ERD Industries, Inc, Harzlehurst, GA, 31539, USA
19.	Flat Bottom Fibre Glass Boat	16 feet long and 6 feet wide.	3	30,000	-	90,000	-	Zamrock Company Multan Rd. Lahore.
20.	Portable Sonic Depth Recorder	Single range 0 to 50 feet; paper size 8 inches wide and 72 feet long; paper speed 1 or 2 inches per minute; high resolution fine line transreceiver with a frequency of 100KHz; transducer frequency 100 KHz-7.5, voltage input 24 volts DC, weathertight aluminum construction with water tight connectors, plastic cover and mounting brackets.	-	-	10,500	-	-	1. Ross 600 Series Ross Laboratories Inc; 3138 Fairview Ave; E, Seattle, WA 98102, USA 2. 2. Raytheon Series DE -719, Marine Co. Int. Affairs, lexington, Mass. 02173 USA.
21.	Spares for Sonic Depth Recorders	Most frequently replaceable parts to be decided by the supplier consistent with model conforming to above specifications, including recorder charts.	L.S.	-	-	-	-	1. Ross Laboratory 2. Raytheon

Table 18 (Continued)

22.	Metalic Measuring Tape	Length 100 feet, marked in 0.1 foot increments or in inches; housed in a case.	4	210	-	840	-	Sibtain Brothers, Karachi
23.	Level with Tripod	Topcon (Japan) automatic levelling, magnification 18 X with standard accessories	4	21,000	-	84,000	-	Sibtain Brothers
24.	Levelling Staff	Japanese stave pole standard, 15 ft long	4	1,260	-	5,040	-	Sibtain Brothers
25.	Y - Rod	Standard, for measuring geometry of outlets.	4	2,500	-	10,000	-	Kotri Gaging Sub-division, Hydrol-ogy Directorate, Hyderabad
26.	Water Level Recorder	Stevens A-71; English units with 1:6 gage scale; chart speed 2.4 inches per day; chart 10 inches wide and 25 yard long; 4.5 - month negator spring driven clock; 18-inch circumference pulley for perforated tape; stainless steel graduated, perforated tape 50 feet long with set end hooks and index bracket; 8-inch diameter float with counter weight, reversal indicator.	-	-	3,100	-	-	Leupold and Stevens, Inc; P.O. Box 688 Beaverton, Oregon 97075 USA
27.	Spares for Water Level Recorder	1. Recorder chart	-	-	21	-	-	Leupold & Stevens
		2. Pen ink	-	-	9	-	-	
		3. Capillary pen with lucite reser-voir	-	-	52	-	-	
		4. 4.5 - month negator spring driven clock	-	-	790	-	-	
		5. Float tape	-	-	210	-	-	
		6. Float	-	-	95	-	-	
		7. Counter weight	-	-	13	-	-	
		8. Pen Cleaner, packet	-	-	9	-	-	
28.	Staff Gage	Special porclain enamel coated, four inches wide in 3.33-foot sections; graduated to .01 foot and marked every foot, 0.1 and .02 foot.						Kotri Gaging Sub-division, Hydrol-ogy Directorate Hyderabad. OR
		Range: 0-3.33 ft	60	500	-	30,000	-	Ahmad Enterprises. Lahore
		3.33-6.66 ft	60	500	-	30,000	-	
		6.66-9.99 ft	60	500	-	30,000	-	
		9.99-13.33 ft	60	500	-	30,000	-	

Table 18 (Continued)

Sediment Sampling Equipment

1.	Wading Type, Depth Integrating Suspended Sediment Hand Sampler	US DH-48 with wading rod including three sets of spare gaskets, and nozzles of 1/8, 3/16 and 1/4 inch openings, almunium casting	4	2,100	-	8,400	-	Ahmad Enterprises, Lahore
2.	Reel Type, Depth Intergating Sediment Sampler	US D-74, cast bronze stream lined body, with hanger bar and pin; and including three spare sets of gaskets and nozzles of 1/8, 3/16 and 1/4 inch openings.	3	6,800	-	20,400	-	Ahmad Enterprises
3.	Piston Type Bed Material Hand Sampler	US BMH 53	4	-	420	-	1,680	Minnesota Fabricators, 2315 Highway 61 North St. Paul Min. 55109, USA
4.	Hand line Bed Material sampler	US BMH 60	3	-	1,100	-	3,300	Minnesota Fabricators
5.	Pint Glass Bottles	For use with DH-48, 24 per box	8	-	75	-	600	Minnesota Fabricators
6.	Plastic Jar	For use with D-74, 12 per box	8	-	25	-	200	Minnesota Fabricators
7.	Sample Label	For use on all bottles or Jars, self adhesive, packet	8	-	25	-	200	Minnesota Fabricators

Laboratory Equipment For Sediment Analysis

1.	Visual Accumulation Tube sand size Analyser	V.A. tube with automatic tracer and motor (240 Volts-50 cycle); including all accessories for 120 cm tubes: sizes 2.1, 3.4, 5.0 and 7.0 mm inside diameters at lower ends.	4	-	3,800	-	15,200	Federal Interagency Sedimentation Project, St. Anthony Falls Hydraulic Laboratory, 2-3rd Avenue South-East. Minneapolis, Min. 55414 USA
2.	Spares for VA Tube	1. VA glass tube: 2.1 mm	4	-	210	-	840	Federal
		2. VA glass tube: 3.4 mm	4	-	210	-	840	Interagency
		3. VA glass tube: 5.0 mm	4	-	210	-	840	
		4. VA glass tube: 7.0 mm	4	-	210	-	840	
		5. VAT Charts	LS	-	-	-	200	
3.	Bottom Withdrawal Tube	Standard by St. Anthony Falls Hydraulic Laboratories, including rubber tape and pinch clamp.	8	-	220	-	1,760	Federal Interagency

Table 18 (Continued)

4.	Analytical Balance	Capacity of 200 grams with weight box and .0001 gram sensitivity, beam -.05 to +.05 gram in 200 graduated divisions; two concave stainless steel pans, front and back sliding glass doors case.	4	-	1,800	-	7,200	Soiltest, 66 Albrecht Dr. P.O. Box 8004, Lake Bluff, IL. 60044-9902 USA
5.	Electronic Balance	Capacity of 200 grams, Sensitivity .0001 gram	4	-	2,600	-	10,400	Soiltest, IL.
6.	Electric Oven	Fan-Forced air circulation, temperature range upto 110C, two doors, pilot light, adjustable shelf, welded steel exterior, overall diameter 30"x28"x24".	4	-	1,100	-	4,400	Soiltest, IL.
7.	Sieve set (fine)	USA standard sieves, 3-inch diameter brass sieve, fine series						Soiltest, IL.
		No. Openings						
		5 4.00 mm	4	-	38	-	152	
		10 2.00 mm	4	-	38	-	152	
		18 1.00 mm	4	-	38	-	152	
		25 .710 mm	4	-	38	-	152	
		35 .500 mm	4	-	38	-	152	
		45 .355 mm	4	-	38	-	152	
		60 .250 mm	4	-	38	-	152	
		80 .180 mm	4	-	38	-	152	
		120 .125 mm	4	-	38	-	152	
		170 .090 mm	4	-	38	-	152	
		230 .063 mm	4	-	45	-	180	
		325 .045 mm	4	-	55	-	220	
					80	-	320	
8.	Sieve set (Coarse)	USA standard sieve; 8 - inch diameter, brass sieve,						Soiltest, IL.
		Sieve size						
		5.6 mm	4	-	38	-	152	
		8.0 mm	4	-	38	-	152	
		16.0 mm	4	-	38	-	152	
		31.5 mm	4	-	38	-	152	
		63 mm	4	-	38	-	152	
		100 mm	4	-	38	-	152	
9.	Sieve Brush	Fine hair bristles, wooden handle.	8	-	8	-	64	Soiltest, IL.
10.	Sieve Lid	For US Standard 3-inch sieves	4	-	16	-	64	Soiltest, IL.
11.	Sieve Pan	For US Standard 3-inch sieves	4	-	16	-	64	Soiltest, IL.

Table 18 (continued)

12.	Sieve Shakar (Motorized)	Motorized 220 volts, 50 cycle; capacity eight sieves plus pan and cover, 8-inch sieve sizes.	-	-	740	-	-	Soiltest, IL.
13.	Sieve Shaker (Hand operated)	Head-operated shaker; capacity seven sieves, 8-inch diameter.	4	-	350	-	1,400	Soiltest, IL.
14.	Stop Watch	Reading to one second, Swiss/China	4	900	-	3,600	-	Ahmad Enterprises, Lahore
15.	Pipette	Pyrex glass;						Fisher Scientific 1600 W.Glenlake Ave; Itasca IL. 60143 USA
		1. 25 ml capacity; tolerance + 0.06 ml	4	-	100	-	400	
		2. 50 ml capacity; tolerance + 0.10 ml	4	-	130	-	520	
16.	Vacuum Pump	Two series-connected electric pumps, 0.3 mm ultimate pressure in leak proof system, 1/4 HP motor, 240 volts 50 Hz.	4	-	850	-	3,400	Soiltest, IL.
17.	Beaker	Pyrex glass; safe temperature limit 500C;						Soiltest, IL.
		1. 100 ml	8	-	3	-	24	
		2. 250 ml	8	-	3	-	24	
		3. 600 ml	P	-	4	-	32	
18.	Cylinder	Pyrex glass graduated						Soiltest, IL.
		1. 100 ml	8	-	12	-	96	
		2. 250 ml	8	-	18	-	144	
		3. 500 ml	8	-	22	-	176	
		4. 1000 ml	8	-	32	-	256	
19.	Desiccab	For cooling samples in moisture-free environment, chemical resistant, high impact molded plastic: aimunium shelves, removable desiccant glass tray	-	-	700	-	-	Soiltest, IL.
20.	Evaporating Dish	Porcelain, glazed inside, partially glazed outside.						Soiltest, IL.
		1. 70 mm diameter 120 ml capacity	40	-	9	-	360	
		2. 115 mm diameter 250 ml capacity	40	-	13	-	520	
21.	Desiccator	For cooling samples in moisture-free environment, glass construction, 125 mm inside diameter and 75 mm depth to plate	4	-	65	-	260	Soiltest, IL.

Table 1B (Continued)

22.	Wash Bottle	Borosilicate florence flask with special molded rubber grip containing valve system, one litre capacity	4	-	78	-	312	Soiltest, IL.
23.	Filtering Funnel	Pyrex glass, 60 angle bowle, beaded to reduce chipping, top diameter 127 mm, stem length 100 mm	8	-	80	-	640	Fisher Scientific, IL.
24.	Filter Circle	Whatman, ashless filter paper, fine porosity, particle retention .0025 mm, diameter 12.5 cm, packet	8	-	25	-	200	Fisher Scientific, IL.
25.	Stirring Rod	Glass, 5 mm diameter, 30 cm long	12	-	2	-	24	Fisher Scientific, IL.
26.	Thermometer	Range - 20 to 110C, minimum graduation one degree, length 300 mm.	8	-	32	-	256	Fisher Scientific, IL.
27.	3-Way Stop Cock	Glass construction.	8	-	12	-	72	Fisher Scientific, IL.
28.	French Curve Set	Plastic.	4	-	100	-	400	Common Item.

Total: Rs. 360,440
U.S. $ 85,512+10% freight = 95,163

TABLE 19
NORTHWEST FRONTIER POVINCE
HYDRAULIC AND SEDIMENT MONITORING EQUIPMENT FOR ADEQUATE OPERATION AT DIVISIONAL AND CIRCLE LEVELS

S.#	ITEM	SPECIFICATIONS	QUANTITY	UNITCOST		TOTAL COST		SUPPLIER
				Local Rs.	Dollar US$	Local Rs.	Dollar US$	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Hydraulic Equipment								
1.	Current Meter	Price Type AA (vertical axis, horizontal bucket Wheel); chrome plated stainless steel; minimum velocity = 0.1 fps and maximum velocity = 20.0 fps; single and penta contacts; furnished complete in a foam cushioned carrying case, along with a rating chart, tail fin assembly, screw driver, assorted spare parts, and special lubricant, both for rod and cable suspension.	24	-	790	-	18,960	Scientific Instruments Inc; 518 West Cherry, Milwaukee,Wi 53212 -3822, USA (414)263-1600 Fax (414)263-5506
2.	Mini Current Meter (Pygmy)	Vertical axis, horizontal bucket wheel; chrome plated stainless steel; minimum velocity: .05 fps and maximum velocity = 3.0 fps; furnished complete in a foam cushioned carrying case with assorted spare parts, a rating chart and lubricant; for rod suspension only.	24	-	630	-	15,120	Scientific Inst. Inc.
3.	Standard Wading Rods	Four 2-foot graduated rods in 0.1 foot increments, bottom rod with base plate; an adjustable sliding support capable of holding price Type AA and Pygmy current meters; a flexible two-conductor wire with one end having two-hole conductor for head set and the other end suitable for connecting to current meter and rods. Base plate and slider made from corrosion resistant material; complete set in heavy duty canvas carrying case.	24	2,100	-	50,400	-	Ahmad Enterprises 1-McLeod Road Lahore

Table 19 (Continued)

4.	Light Duty Tagline	About 300 feet long of 0.04 inch diameter stainless steel with a hook at one end, wound on a heavy plastic reel and mounted on a hardwood stake; brass beads every 2 feet for the first 50 feet, every 5 feet from 50 to 200 feet and every 10 feet from 200 to 300 feet.	12	-	525	-	6,300	Scientific Instruments Inc.
5.	Heavy Duty Lee Au Type Tagline	About 500 feet long 1/16 inch diameter open reel with handles; marked with brass beads every 2 feet for the first 50 feet, every 5 feet from 50 to 200 feet, every 10 feet from 200 to 300 feet and every 50 feet from 300 to 500 feet; heavy duty hooks on both ends for attaching to trees or other sturdy objects.	6	-	580	-	3,480	Scientific Inst. Inc.
6.	Headset	Flexible headband, built in compartment for dry cell battery, including flexible wire with two pole connector for connecting to two-conductor wire from current meter on wading rod or from sounding reel.	24	-	65	-	1,560	Scientific Inst. Inc.
7.	Velocity Counter	Electro-mechanical type for tracking number of revolutions of a current meter, working on dry cell batteries, housed in a rugged plastic case	-	-	185	-	-	Scientific Inst. Inc.
8.	Electronic Watch	Electronic, digital reading to 0.01 second, with a neck cord and having easy to use finger tip control buttons.	24	-	70	-	1,680	Scientific Inst. Inc.
9.	Spares for Current Meters	Compatible to the selected current meters; should include: pivot assembly, hanger screw, binding post assembly; extra screws for price AA and Pygmy meters; instrument oil, cleaning cloth, two-pole connector (male and female); bucket wheel assembly	5 Nos. for each item, both for Pygmy and Price AA	-	-	-	250	Scientific Inst. Inc.
10.	Rubber Chest Wader	1. Medium Size 2. Large Size	12 12	- -	160 210	- -	1,920 2,520	Rickly Hydrologic Company, 2710

Table 19 (Continued)

11.	Hip boots	1. Medium Size 2. Large Size	12 12	- -	75 105	- -	900 1,260	Joyce Ave; Columbus, Ohio, 43211 USA
12.	Boat Improvize-ment Set	Boom and cross arm, USGS standard	6	5,300	-	31,800	-	Ahmad Enterprises, Lahore
13.	Sounding Reel	USGS A-type light duty, with a maximum load capacity of 100 pounds; two-position handle for leverage, scale reading 0.1 foot; complete with 0.1 inch double conductor cable, "B" type connector and flexible two-conductor wire for connecting reel to headset	6	-	1,480	-	8,880	Scientific Instruments Inc;
14.	Sounding Weight	USGS Columbus (C) type 1. 30 pounds 2. 50 pounds	- 6	790 1,300	- -	- 7,800	- -	M. Ahmad & Sons I-Brandreth Rd, Lahore
15.	Hanger Bar with Pin	USGS type for 30 and 50 pounds Columbus type weight, one foot long	12	260	-	3,120	-	M. Ahmad & Sons
16.	Cable Connector	USGS Type B	6	-	27	-	162	Scientific Inst. Inc.
17.	Sounding Cable	Elsworth double conductor (inner core), 0.1 inch diameter	600 ft	-	6	-	3,600	Scientific Inst. Inc.
18.	Life Jacket	USGS approved model A2 Adult universal, general purpose type-II	18	-	100	-	1,800	ERO Industries, Inc, Harzlehurst, GA, 31539, USA
19.	Flat Bottom Fibre Glass Boat	16 feet long and 6 feet wide.	6	30,000	-	180,000	-	Zamrock Company Multan Rd. Lahore.
20.	Portable Sonic Depth Recorder	Single range 0 to 50 feet; paper size 8 inches wide and 72 feet long; paper speed 1 or 2 inches per minute; high resolution fine line transreceiver with a frequency of 100KHz; transducer frequency 100 KHz-7.5, voltage input 24 volts DC, weathertight aluminium construction with water tight connectors, plastic cover and mounting brackets.	-	-	10,500	-	-	1. Ross 600 Series Ross Laboratories Inc: 3133 Fairview Ave: E, Seattle, WA 98102, USA 2. 2. Raytheon Series DE -719, Marine Co. Int. Affairs, lexington, Mass. 02173 USA.
21.	Spares for Sonic Depth Recorders	Most frequently replaceable parts to be decided by the supplier consistent with model conforming to above specifications, including recorder charts.	L.S.	-	-	-	-	1. Ross laboratories 2. Raytheon

Table 19 (Continued)

22.	Metalic Measuring Tape	Length 100 feet, marked in 0.1 foot increments or in inches; housed in a case.	12	210	-	2,520	-	Sibtain Brothers, Karachi
23.	Level with Tripod	Topcon (Japan) automatic levelling, magnification 20 X with standard accessories	12	21,000	-	252,000	-	Sibtain Brothers
24.	Levelling Staff	Japanese stave pole standard, 15 ft long	12	1,260	-	15,120	-	Sibtain Brothers
25.	Y - Rod	Standard, for measuring geometry of outlets.	12	2,500	-	30,000	-	Kotri Gaging Sub-division, Hydrology Directorate, Hyderabad
26.	Water Level Recorder	Stevens A-71; English units with 1:6 gage scale; chart speed 2.4 inches per day; chart 10 inches wide and 28 yard long; 4.5 - month negator spring driven clock; 18-in.h circumference pulley for perforated tape; stainless steel graduated, perforated tape 50 feet long with set end hooks and index bracket; 8-inch diameter float with counter weight, reversal indicator.	12	-	3,100	-	37,200	Leupold and Stevens, Inc; P.O. Box 688 Beaverton, Oregon 97075 USA
27.	Spares for Water Level Recorder	1. Recorder chart	12	-	21	-	252	Leupold & Stevens
		2. Pen ink	12	-	9	-	108	
		3. Capillary pen with lucite reservoir	12	-	52	-	624	
		4. 4.5 - month negator spring driven clock	12	-	790	-	7,480	
		5. Float tape	12	-	210	-	2,520	
		6. Float	12	-	95	-	1,140	
		7. Counter weight	12	-	13	-	156	
		8. Pen Cleaner, packet	12	-	9	-	108	
28.	Staff Gage	Special porcain enamel coated, four inches wide in 3.33-foot sections; graduated to .01 foot and marked every foot, 0.1 and .02 foot.						Kotri Gaging Sub-division, Hydrology Directorate Hyderabad. OR
		Range: 0-3.33 ft	60	500	-	30,000	-	Ahmad Enterprises, Lahore
		3.33-6.66 ft	60	500	-	30,000	-	
		6.66-9.99 ft	60	500	-	30,000	-	
		9.99-13.33 ft	60	500	-	30,000	-	

Table 19 (Continued)

Sediment Sampling Equipment

1.	Wading Type, Depth Integrating Suspended Sediment Hand Sampler	US DH-48 with wading rod including three sets of spare gaskets, and nozzles of 1/8, 3/16 and 1/4 inch openings, aimunium casting	4	2,100	-	8,400	-	Ahmad Enterprises, Lahore
2.	Reel Type, Depth Intergating Sediment Sampler	US D-74, cast bronze stream lined body, with hanger bar and pin; and including three spare sets of gaskets and nozzles of 1/8, 3/16 and 1/4 inch openings.	3	6,800	-	20,400	-	Ahmad Enterprises
3.	Piston Type Bed Material Hand Sampler	US BMH 53	4	-	420	-	1,680	Minnesota Fabricators, 2315 Highway 61 North St. Paul Min. 55109, USA
4.	Hand line Bed Material sampler	US BMH 60	3	-	1,100	-	3,300	Minnesota Fabricators
5.	Pint Glass Bottles	For use with DH-48, 24 per box	8	-	75	-	600	Minnesota Fabricators
6.	Plastic Jar	For use with D-74, 12 per box	8	-	25	-	200	Minnesota Fabricators
7.	Sample Label	For use on all bottles or Jars, self adhesive, packet	8	-	25	-	200	Minnesota Fabricators

Laboratory Equipment For Sediment Analysis

1.	Visual Accumulation Tube sand size Analyser	V.A. tube with automatic tracer and motor (240 volts-50 cycle); including all accessories for 120 .m tubes; sizes 2.1, 3.4, 5.0 and 7.0 mm inside diameters at lower ends.	4	-	3,800	-	15,200	Federal Interagency Sedimentation Project, St. Anthony Falls Hydraulic Laboratory, 2-3rd Avenue South-East, Minneapolis, Min. 55414 USA
2.	Spares for VA Tube	1. VA glass tube: 2.1 mm	4	-	210	-	840	Federal Interagency
		2. VA glass tube: 3.4 mm	4	-	210	-	840	
		3. VA glass tube: 5.0 mm	4	-	210	-	840	
		4. VA glass tube: 7.0 mm	4	-	210	-	840	
		5. VAT Charts	LS	-	-	-	200	
3.	Bottom Withdrawal Tube	Standard by St. Anthony Falls Hydraulic Laboratories, including rubber tape and pinch clamp.	8	-	220	-	1,760	Federal Interagency

Table 19 (Continued)

4.	Analytical Balance	Capacity of 200 grams with weight box and .0001 gram sensitivity, beam -.05 to +.05 gram in 200 graduated divisions; two concave stainless steel pans, front and back sliding glass doors case.	4	-	1,800	-	7,200	Soiltest, 86 Albrecht Dr. P.O. Box 6004, Lake Bluff, IL. 60044-9902 USA
5.	Electronic Balance	Capacity of 200 grams, Sensitivity .0001 gram	4	-	2,600	-	10,400	Soiltest, IL.
6.	Electric Oven	Fan-Forced air circulation, temperature range upto 110C, two doors, pilot light, adjustable shelf, welded steel exterior, overall diameter 30"x25"x24".	4	-	1,100	-	4,400	Soiltest, IL.
7.	Sieve set (fine)	USA standard sieves, 3-inch diameter brass sieve, fine series						Soiltest, IL.
		No. Openings						
		5 4.00 mm	4	-	38	-	152	
		10 2.00 mm	4	-	38	-	152	
		18 1.00 mm	4	-	38	-	152	
		25 .710 mm	4	-	38	-	152	
		35 .500 mm	4	-	38	-	152	
		45 .355 mm	4	-	38	-	152	
		60 .250 mm	4	-	38	-	152	
		80 .180 mm	4	-	38	-	152	
		120 .125 mm	4	-	38	-	152	
		170 .090 mm	4	-	45	-	180	
		230 .063 mm	4	-	55	-	220	
		325 .045 mm	4	-	80	-	320	
8.	Sieve set (Coarse)	USA standard sieve; 8 - inch diameter, brass sieve,						Soiltest, IL.
		Sieve size						
		5.6 mm	4	-	38	-	152	
		8.0 mm	4	-	38	-	152	
		16.0 mm	4	-	38	-	152	
		31.5 mm	4	-	38	-	152	
		63 mm	4	-	38	-	152	
		100 mm	4	-	38	-	152	
9.	Sieve Brush	Fine hair bristles, wooden handle.	8	-	8	-	64	Soiltest, IL.
10.	Sieve Lid	For US Standard 3-inch sieves	4	-	16	-	64	Soiltest, IL.
11.	Sieve Pan	For US Standard 3-inch sieves	4	-	16	-	64	Soiltest, IL.

Table 19 (continued)

12.	Sieve Shakar (Motorized)	Motorized 220 volts, 50 cycle; capacity eight sieves plus pan and cover, 8-inch sieve sizes.	-	-	740	-	-	Soiltest, IL.
13.	Sieve Shaker (Hand operated)	Head-operated shaker; capacity seven sieves, 8-inch diameter.	4	-	350	-	1,400	Soiltest, IL.
14.	Stop Watch	Reading to one second, Swiss/China	4	900	-	3,600	-	Ahmad Enterprises, Lahore
15.	Pipette	Pyrex glass;						Fisher Scientific 1600 W.Glenlake Ave; Itasca IL. 60143 USA
		1. 25 ml capacity; tolerance + 0.06 ml	4	-	100	-	400	
		2. 50 ml capacity; tolerance + 0.10 ml	4	-	130	-	520	
16.	Vacuum Pump	Two series-connected electric pumps, 0.3 mm ultimate pressure in leak proof system, 1/4 HP motor, 240 volts 50 Hz.	4	-	850	-	3,400	Soiltest, IL.
17.	Beaker	Pyrex glass; safe temperature limit 500C;						Soiltest, IL.
		1. 100 ml	8	-	3	-	24	
		2. 250 ml	8	-	3	-	24	
		3. 600 ml	8	-	4	-	32	
18.	Cylinder	Pyrex glass graduated						Soiltest, IL.
		1. 100 ml	8	-	12	-	96	
		2. 250 ml	8	-	18	-	144	
		3. 500 ml	8	-	22	-	176	
		4. 1000 ml	8	-	32	-	256	
19.	Desiccab	For cooling samples in moisture-free environment, chemical resistant, high impact molded plastic; almunium shelves, removable desiccant glass tray	-	-	700	-	-	Soiltest, IL.
20.	Evaporating Dish	Porecian, glazed inside, partially glazed outside.						Soiltest, IL.
		1. 90 mm diameter 120 ml capacity	40	-	9	-	360	
		2. 115 mm diameter 250 ml capacity	40	-	13	-	520	
21.	Desiccator	For cooling samples in moisture-free environment, glass construction, 125 mm inside diameter and 75 mm depth to plate	4	-	65	-	260	Soiltest, IL.

Table 19 (Continued)

22.	Wash Bottle	Borosilicate florence flask with special molded rubber grip containing valve system, one litre capacity	4	-	78	-	312	Soiltest, IL.
23.	Filtering Funnel	Pyrex glass, 60 angle bowle, beaded to reduce chipping, top diameter 127 mm, stem length 100 mm	8	-	80	-	640	Fisher Scientific, IL.
24.	Filter Circle	Whatman, ashless filter paper, fine porosity, particle retention .0025 mm, diameter 12.5 cm, packet	8	-	25	-	200	Fisher Scientific, IL.
25.	Stirring Rod	Glass, 5 mm diameter, 30 cm long	12	-	2	-	24	Fisher Scientific, IL.
26.	Thermometer	Range - 20 to 110C, minimum graduation one degree, length 300 mm.	8	-	32	-	256	Fisher Scientific, IL.
27.	3-Way Stop Cock	Glass construction.	8	-	12	-	96	Fisher Scientific, IL.
28.	French Curve Set	Plastic.	4	-	100	-	400	Common Item.

Total: Rs. 725,160
U.S. $ 181,012+10% freight = 199,113.

TABLE 20
NORTHWEST FRONTIER POVINCE
HYDRAULIC AND SEDIMENT MONITORING EQUIPMENT FOR PILOT PROJECT

S.#	ITEM	SPECIFICATIONS	QUANTITY	UNITCOST		TOTAL COST		SUPPLIER
				Local Rs.	Dollar US$	Local Rs.	Dollar US$	
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Hydraulic Equipment								
1.	Current Meter	Price Type AA (vertical axis, horizontal bucket Wheel); chrome plated stainless steel; minimum velocity = 0.1 fps and maximum velocity = 20.0 fps; single and penta contacts; furnished complete in a foam cushioned carrying case, along with a rating chart, tail fin assembly, screw driver, assorted spare parts, and special lubricant, both for rod and cable suspension.	12	-	790	-	9,480	Scientific Instruments Inc; 518 West Cherry, Milwaukee,Wi 53212 -3922, USA (414)263-1600 Fax (414)263-5506
2.	Mini Current Meter (Pygmy)	Verticall axis, horizontal bucket wheel; chrome plated stainless steel; minimum velocity: .05 fps and maximum velocity = 3.0 fps; furnished complete in a foam cushioned carrying case with assorted spare parts, a rating chart and lubricant; for rod suspension only.	12	-	630	-	7,560	Scientific Inst. Inc.
3.	Standard Wading Rods	Four 2-foot graduated rods in 0.1 foot increments, bottom rod with base plate; an adjustable sliding support capable of holding price Type AA and Pygmy current meters; a flexible two-conductor wire with one end having two-pole conductor for head set and the other end suitable for connecting to current meter and rods. Base plate and slider made from corrosion resistant material; complete set in heavy duty canvas carrying case.	12	2,100	-	25,200	-	Ahmad Enterprises Ferozepur Road Lahore

Table 20 (Continued)

4.	Light Duty Tagline	About 300 feet long of 0.04 inch diameter stainless steel with a hook at one end, wound on a heavy plastic reel and mounted on a hardwood stake; brass beads every 2 feet for the first 50 feet, every 5 feet from 50 to 200 feet and every 10 feet from 200 to 300 feet.	12	-	525	-	6,300	Scientific Instruments Inc.
5.	Heavy Duty Lee Au Type Tagline	About 500 feet long 1/16 inch diameter open reel with handles; marked with brass beads every 2 feet for the first 50 feet, every 5 feet from 50 to 200 feet, every 10 feet from 200 to 300 feet and every 50 feet from 300 to 500 feet; heavy duty hooks on both ends for attaching to trees or other sturdy objects.	4	-	580	-	2,320	Scientific Inst. Inc.
6.	Headset	Flexible headband, built in compartment for dry cell battery, including flexible wire with two pole connector for connecting to two-conductor wire from current meter on wading rod or from sounding reel.	12	-	65	-	780	Scientific Inst. Inc.
7.	Electronic Watch	Electronic, digital reading to 0.01 second, with a neck cord and having easy to use finger tip control buttons.	6	-	70	-	420	Scientific Inst. Inc.
8.	Spares for Current Meters	Compatible to the selected current meters; should include: pivot assembly, hanger screw, binding post assembly; extra screws for price AA and Pygmy meters; instrument oil, cleaning cloth, two-pole connector (male and female); bucket wheel assembly	5 Nos. for each item, both for Pygmy and Price AA	-	-	-	250	Scientific Inst. Inc.
9.	Rubber Chest Wader	1. Medium Size 2. Large Size	4 2	- -	160 210	- -	640 420	Rickly Hydrologic Company, 2710 Joyce Ave
10.	Hip boots	1. Medium Size 2. Large Size	4 2	- -	75 105	- -	300 210	Columbus, Ohio, 43211 USA
11.	Boat Improvisement Set	Boom and cross arm, USBS standard	4	5,300	-	21,200	-	Ahmad Enterprises, Lahore

Table 20 (Continued)

12.	Sounding Reel	USGS A-type light duty, with a maximum load capacity of 100 pounds; two-position handle for leverage, scale reading 0.1 foot; complete with 0.1 inch double conductor cable, "B" type connector and flexible two-conductor wire for connecting reel to headset	4	-	1,480	-	5,920	Scientific Instruments Inc;
13.	Sounding Weight	USGS Columbus (C) type 50 pounds	4	1,300	-	5,200	-	M. Ahmad & Sons I-Erandreth Rd, Lahore
14.	Hanger Bar with Pin	USGS type for 30 and 50 pounds Columbus type weights, one foot long	9	260	-	2,080	-	M. Ahmad & Sons
15.	Cable Connector	USGS Type B	4	-	27	-	108	Scientific Inst. Inc.
16.	Sounding Cable	Elsworth double conductor (inner core), 0.1 inch diameter	400	-	6	-	2,400	Scientific Inst. Inc.
17.	Life Jacket	USGS approved model A2 Adult universal, general purpose type-II	12	-	100	-	1,200	ERO Industries, Inc, Harrisburst, GA, 31539, USA
18.	Flat Bottom Fibre Glass Boat	16 feet long and 6 feet wide.	4	30,000	-	120,000	-	Zamrock Company Multan Rd. Lahore.
19.	Metalic Measuring Tape	Length 100 feet, marked in 0.1 foot increments or in inches; housed in a case.	6	210	-	1,260	-	Sibtain Brothers, Karachi
20.	Level with Tripod	Topcon (Japan) automatic levelling, magnification 20 X with standard accessories	6	21,000	-	126,000	-	Sibtain Brothers
21.	Levelling Staff	Japanese stave pole standard, 15 ft long	6	1,260	-	7,560	-	Sibtain Brothers
22.	V - Rod	Standard, for measuring geometry of outlets.	6	2,500	-	15,000	-	Kotri Gaging Sub-division, Hydrology Directorate, Hyderabad
23.	Water Level Recorder	Stevens A-71; English units with 1:6 gage scale; chart speed 2.4 inches per day; chart 10 inches wide and 25 yard long; 4.5 - month negator spring driven clock; 18-inch circumference pulley for perforated tape; stainless steel graduated, perforated tape 50 feet long with set end hooks and index	6	-	3,100	-	18,600	Leupold and Stevens, Inc; P.O. Box 688 Beaverton, Oregon 97075 USA

Table 20 (Continued)

		bracket; 8-inch diameter float with counter weight, reversal indicator.						
24.	Spares for Water Level Recorder	1. Recorder chart	6	-	21	-	126	Leupold & Stevens
		2. Pen ink	6	-	9	-	54	
		3. Capillary pen with lucite reservoir	6	-	52	-	312	
		4. Pen Cleaner, packet	6	-	9	-	54	
25.	Staff Gage	Special porclain enamel coated, four inches wide in 3.33-foot sections; graduated to .01 foot and marked every foot, 0.1 and .02 foot.						Kotri Gaging Subdivision, Hydrology Directorate Hyderabad. DR
		Range: 0-3.33 ft	30	500	-	15,000	-	Ahmad Enterprises, Lahore
		3.33-6.66 ft	30	500	-	15,000	-	
		6.66-9.99 ft	30	500	-	15,000	-	
		9.99-13.33 ft	30	500	-	15,000	-	
Sediment Sampling Equipment								
1.	Wading Type, Depth Integrating Suspended Sediment Hand Sampler	US DH-48 with wading rod including three sets of spare gaskets, and nozzles of 1/8, 3/16 and 1/4 inch openings, aluminium casting	6	2,100	-	12,600	-	Ahmad Enterprises, Lahore
2.	Piston Type Bed Material Hand Sampler	US BMH 53	6	-	420	-	2,520	Minnesota Fabricators, 2515 Highway 61 North St. Paul Min. 55109, USA
3.	Pint Glass Bottles	For use with DH-48, 24 per box	6	-	75	-	450	Minnesota Fabricators
4.	Sample Label	For use on all bottles or Jars, self adhesive, packet	6	-	25	-	150	Minnesota Fabricators
Laboratory Equipment For Sediment Analysis								
1.	Bottom Withdrawal Tube	Standard by St. Anthony Falls Hydraulic Laboratories, including rubber tape and pinch clamp.	4	-	220	-	880	Federal Interagency Sedimentation Project, St. Anthony Falls Hydraulic Laboratory, 2-3rd Avenue South-East. Minneapolis Min. 55414 USA.

Table 20 (Continued)

2.	Analytical Balance	Capacity of 200 grams with weight box and .0001 gram sensitivity, beam -.05 to +.05 gram in 200 graduated divisions; two concave stainless steel pans, front and back sliding glass doors case.	2	-	1,800	-	3,600	Soiltest, B6 Albrecht Dr. P.O. Box 8004, Lake Bluff, IL. 60044-9902 USA
3.	Electric Oven	Fan-Forced air circulation, temperature range upto 110C, two doors, pilot light, adjustable shelf, welded steel exterior, overall diameter 30"x25 x24".	2	-	1,100	-	2,200	Soiltest, IL.
4.	Sieve set (fine)	USA standard sieves, 3-inch diameter brass sieve, fine series						Soiltest, Il.
		No. Openings						
		5 4.00 mm	2	-	38	-	76	
		10 2.00 mm	2	-	38	-	76	
		18 1.00 mm	2	-	38	-	76	
		25 .710 mm	2	-	38	-	76	
		35 .500 mm	2	-	38	-	76	
		45 .355 mm	2	-	38	-	76	
		60 .250 mm	2	-	38	-	76	
		80 .180 mm	2	-	38	-	76	
		120 .125 mm	2	-	38	-	76	
		170 .090 mm	2	-	38	-	76	
		230 .063 mm	2	-	45	-	90	
		325 .045 mm	2	-	55	-	110	
					80	-	160	
5.	Sieve set (Coarse)	USA standard sieve; 8 inch diameter, brass sieve,						Soiltest, Il.
		Sieve size						
		5.6 mm	2	-	38	-	76	
		8.0 mm	2	-	38	-	76	
		16.0 mm	2	-	38	-	76	
		31.5 mm	2	-	38	-	76	
		63 mm	2	-	38	-	76	
		100 mm	2	-	38	-	76	
6.	Sieve Brush	Fine hair bristles, wooden handle.	4	-	8	-	32	Soiltest, Il.
7.	Sieve Lid	For US Standard 3-inch sieves	2	-	16	-	32	Soiltest, Il.
8.	Sieve Pan	For US Standard 3-inch sieves	2	-	16	-	32	Soiltest, Il.
9.	Sieve Shaker (Hand operated)	Head-operated shaker; capacity seven sieves, 8-inch diameter.	2	-	350	-	700	Soiltest, Il.
10.	Stop Watch	Reading to one second, Swiss/China	2	900	-	1,800	-	Ahmad Enterprises, Lahore

Table 20 (Continued)

11.	Pipette	Pyrex glass;						
		1. 25 ml capacity; tolerance + 0.06 ml	2	-	100	-	200	Fisher Scientific 1600 W.Glenlake Ave; Itasca IL. 60143 USA
		2. 50 ml capacity; tolerance + 0.10 ml	2	-	130	-	260	
12.	Vacuum Pump	Two series-connected electric pumps, 0.3 mm ultimate pressure in leak proof system, 1/4 HP motor, 240 volts 50 Hz.	2	-	850	-	1,700	Soiltest, IL.
13.	Beaker	Pyrex glass; safe temperature limit 500C;						Soiltest, IL.
		1. 100 ml	4	-	3	-	12	
		2. 250 ml	4	-	4	-	12	
		3. 600 ml	4	-	4	-	16	
14.	Cylinder	Pyrex glass graduated						Soiltest, IL.
		1. 100 ml	4	-	12	-	48	
		2. 250 ml	4	-	18	-	72	
		3. 500 ml	4	-	22	-	88	
		4. 1000 ml	4	-	32	-	128	
15.	Evaporating Dish	Porcelain, glazed inside, partially glazed outside.						Soiltest, IL.
		1. 90 mm diameter 120 ml capacity	20	-	9	-	180	
		2. 115 mm diameter 250 ml capacity	20	-	13	-	260	
16.	Desiccator	For cooling samples in moisture-free environment, glass construction, 125 mm inside diameter and 75 mm depth to plate	2	-	65	-	130	Soiltest, IL.
17.	Wash Bottle	Borosilicate florence flask with special molded rubber grip containing valve system, one litre capacity	2	-	78	-	156	Soiltest, IL.
18.	Filtering Funnel	Pyrex glass, 60 [illegible] powle, beaded to reduce chipping, top diameter 127 mm, stem length 100 mm	4	-	80	-	320	Fisher Scientific, IL.
19.	Filter Circle	Whatman, ashless filter paper, fine porosity, particle retention .0025 mm, diameter 12.5 cm, packet	4	-	25	-	100	Fisher Scientific, IL.
20.	Stirring Rod	Glass, 5 mm diameter, 30 cm long	4	-	2	-	8	Fisher Scientific, IL.

Table 20 (Continued)

21.	Thermometer	Range - 20 to 110C, minimum graduation one degree, length 300 mm.	4	-	32	-	128	Fisher Scientific, IL.
22.	3-Way Stop Cock	Glass construction.	4	-	.12	-	48	Fisher Scientific, IL.
23.	French Curve Set	Plastic.	2	-	100	-	200	Common Item.

Total: Rs. 397,900
U.S. $ 73,616+10% freight = 80,978

Note : Two Circles (Six divisions)