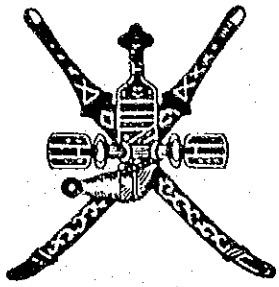
THE SULTANATE OF OMAN

THE DETAILED DESIGN REPORT
ON
THE WADI JIZZI
AGRICULTURAL DEVELOPMENT PROJECT

TENDER DOCUMENT

JUNE 1986

JAPAN INTERNATIONAL COOPERATION AGENCY



SULTANATE OF OMAN

MINISTRY OF AGRICULTURE AND FISHERIES

WADI JIZZI
AGRICULTURAL DEVELOPMENT
PROJECT

TENDER DOCUMENT

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TENDER DOCUMENTS

CONTENTS

SECTION I. CONDITIONS OF PARTICULAR APPLICATION

1. CONDITIONS OF PARTICULAR APPLICATION

The Standard Conditions of Contract are those contained within the "Standard Documents for Building and Civil Engineering Works, 3rd Edition, July 1981, prepared by the Directorate General of Finance, Muscat". It is therefor imperative that each tenderer should possess a copy of the Standard Documents and be fully conversant with its content".

The following points are the revisions to be effected to the above-mentioned Standard Conditions of Contract.

Clause 1.(1)(a) ... To be completed as follows

(a) "Employer" means the government of the Sultanate of Oman and the legal successors in title to the Employer who will employ the Contractor. The address of the Employer shall, for the purpose of the Contract, be deemed to be .....
_____ The Ministry of Agriculture and Fisheries, P.O. Box
_____ 467 Muscat, Sultanate of Oman

Clause 1.(1)(c) ... To be completed as follows;

(c) "Engineer" means
_____ Sanyu Consultants Inc.
_____ Kyowa Bank Bldg., Nishiki, 2-15-22
_____ Naka-ku, Nagoya, 460 JAPAN
_____ Telex: J59901 SANYU, Tel.: 052-201-8761
or other person, persons of firm appointed from time to time by the Employer and notified in writing to the Contractor to act the Engineer for the purposes of the Contract in place of the said Engineer.

(i) Full address in the Sultanate of Oman (including Registration Particulars)

_____ P.O. Box. _____ Muscate

_____ Tel.: _____ Telex: _____

Registration No. _____

(ii) Registered Address of head Office (if different from above)

_____

_____ same as above _____

_____

Class 56 ..... To be deleted in its entirety.

SECTION II. TECHNICAL SPECIFICATIONS

CONTENTS

1. GENERAL SITE CONDITIONS

1.1 PROJECT SUMMARY DATA

1.1.1 Dam Body

Type: Earthfill

Construction Materials:

. Sand and gravel for dam embankment

. Sand for filter embankment

. Riprap for dam surface protection

Dimensions:

. Elevation of dam crest	EL 170.00 m
. - Ditto - (after extra bank)	EL 170.30 m
. Width of dam crest	6.0 m
. Average elevation of foundation (at lowest trench base)	151.00 m
. - Ditto - (after stripping to original ground surface)	EL 152.10 m
. Average height of dam	19.00 m
. Upstream side slope of dam body	1 to 3.00
. Downstream side slope of dam body	1 to 2.50
. Max. width at the base	125.0 m
. Length of dam	1250 m
. Volume of dam embankment	629,000 cu.m

Objectives and purpose:

i) temporary storage of flood flows which will provide for the recharge of local aquifers

1.1.2 Service Spillway

Type: Free overflow channel

Construction Materials:

. Riprap lined approach channel
. Overflow weir
. Gabion lined discharge channel

Dimensions:

. Elevation of crest top	EL 163.9 m
. Elevation of apron top	EL 160.20 m
. Width of overflow weir	184.20 m
. Length of service spillway	745.0 m
. Design flood	4,700 cu.m/sec

1.1.3 Emergency Spillway

Type: Free overflow channel
Construction Materials:
. Riprap lined approach channel
. Wet masonry lined overflow weir
. Gabion lined discharge channel

Dimensions:

. Elevation of crest top	EL 165.70 m
. Elevation of apron top	EL 163.20 m
. Width of overflow weir	278.20 m
. Length of emergency spillway	318.6 m
. Design flood	3,100 cu.m/sec

1.1.4 Service Outlet

Type: Concrete culvert lined with steel liner

Dimensions:

. Inner Diameter	1500 mm
. Length	124.4 m for culvert section
. Bottom slope	1 to 200
. Trash racks	2.90 m x 2.90 m

. Debris deflector	1 set

1.1.5 Emergency Outlet

Type: Concrete culvert lined with steel liner

Dimensions:

. Inner diameter:	1500 mm
. Length	78.0 m for culvert section
. Bottom slope	1 to 200
. Trach racks	2.70 m x 2.40m, 4.26 m x 2.40 m
. Steel roller gate	1.70 m (W) x 1.60 m (H)
. Debris deflector	1 set

1.1.6 Dispersion Facilities

(1) Dispersion Dike

Type: Sand and gravel fill surfaced with riprap and gabion

Construction Materials:

. Sand and gravel for Embankment	
. Hand placed riprap for upstream side surfacing	
. Gabion mattress for downstream side surfacing	
. Corrugated pipe with inner diameter	1200 mm

Dimensions:

. Elevation of crest top	EL 135.40 m
. Length of crest top	243.0 m
. Width of crest	3.00 m
. Average elevation of bottom	EL 133.00 m
. Average height	2.00 m
. Embankment volume	4200 cu.m
. Total length of corrugated pipe	57.00 m

(2) Connection Channel

Dimensions:

. Length of channel	468.49 m
. Width of bottom	12.50 m
. Side slope	1 to 2.00
. Bottom Slope	1 to 500

1.1.7 Monitoring Facilities

(1) Water Level Gauge

Type:	Steel tower with level gauge
Height:	16.0 m
. Diameter of tower	500 mm
. Automatic water gauge	1 set

(2) Observation Well

Type: Borehole well with surface casing

Dimensions:

. Number	5 places
. Total length	270 m
. Drilling diameter	10 inches
. Inner casing	4 inches

1.1.8 Associated Facilities

(1) Relocation Road

Type: Grading finished local road

Dimensions:

. Total length	5,000 m
. Total width	3.5 m

(2) Protection of Historical Facilities

Type: Embankment section of local road

Dimensions:

. Height	3 m
. Length	280 m

1.2 SITE LOCATION AND ACCESS

The access to the construction site will be made as follows:-

(1) Muscat to Sohar - some 220 km in distance towards north-west from Muscat via the four-lane paved Muscat-Shinas road

(2) Sohar to Bani Ghayth (Sihlat) - some 20 km in distance towards south-west from Sohar via the two-lane paved Qabail-Buraimi road

(3) Bani Ghayth to the Construction Site - some 4 km in distance towards south-east from Bani Ghayth via a local road.

The access to the site is possible by saloon car, however four-wheel drive wagon car is recommended to patrol in and around the project area.

1.3 GEOLOGY

Sands and gravels forming a series of terrace probably dating back to Tertiary the oldest of them, flank the mountain and pass into the alluvial plains on the eastern side of the area. Several faces of the terrace are recognized along the Wadi Jizzi.
They are well consolidated. Recent river deposits in the river channel consist of sands and gravels and are very loose.

1.4 METEOROLOGICAL DATA

These are given in Table 1.

1.5 HYDROLOGY

River discharge at dam site is estimated as follows:-

Return Period (years)	Annual Runoff Amount (Million m^3/year)	River Runoff (m^3/sec)
2	2.00	200
5	5.40	540
10	8.00	800
50	12.00	1,200
100	14.00	1,400
200	15.00	1,500
500	17.00	1,700

Table 1 Major Climatic Elements at Sohar

Climatic Element	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sep.	Oct.	Nov.	Dec.	Annual
Rainfall (mm: 1974 - 1984)													
	9.3	44.9	15.0	13.1	2.1	0.0	0.3	0.6	0.4	4.1	3.2	9.0	102.0
Temperature (°C: 1973 - 1984)													
Maximum	24.4	24.5	28.2	33.4	38.0	38.8	37.6	36.4	35.6	33.7	29.4	26.0	32.2
Minimum	11.9	12.6	15.7	18.4	22.2	25.4	27.6	26.7	23.5	18.1	14.0	13.2	19.1
Mean	18.2	18.6	22.0	25.9	30.1	32.1	32.6	31.6	29.6	25.9	21.7	19.6	25.7
Relative Humidity (%: 1973 - 1984)													
Maximum	95.4	94.8	94.3	92.5	88.3	93.5	95.6	96.7	96.1	95.1	95.8	96.7	94.6
Minimum	41.6	41.9	40.5	27.2	22.0	30.0	45.4	51.2	43.1	32.2	37.9	44.3	38.1
Mean	68.5	68.4	67.4	59.9	55.2	61.8	70.5	74.0	69.6	63.7	66.9	70.5	66.4
Pan-Evaporation (mm/day: 1976 - 1984)													
	3.1	3.6	4.7	6.8	8.3	7.8	7.2	6.5	5.9	5.0	3.9	3.0	5.5
Sunshine Hours (hrs/day: 1973 - 1979)													
	7.2	7.7	8.1	8.7	10.3	9.9	8.7	8.5	9.3	9.1	8.4	7.6	8.6
Wind Velocity (Km/day: 1973 - 1984)													
	56.4	61.0	67.2	70.3	73.3	75.2	85.3	84.9	71.0	58.6	49.6	46.3	66.6

2. GENERAL PROVISIONS

2.1 CONSTRUCTION DRAWINGS

The construction drawings shall be prepared by the Contractor for purpose of execution of the works for the Engineer's approval. All works shall be carried out in accordance with the levels, dimensions and details shown on the approved drawings. The levels of the ground and the levels and dimensions of the natural features shown on the drawings are believed but are not guaranteed to be correct. Wherever dimensions or levels are marked on the drawings such dimensions or levels shall take precedence over dimensions scaled from the drawings and scaled dimensions shall be used only in the absence from the drawings and/or elsewhere of other more precise information. Large scale drawings shall be taken in preference to drawings of a smaller scale. Drawings and Bill of Quantities are in Metric Units.

In the event of discrepancies between the drawings and the specification, the specification shall have precedence over the drawings.

2.2 STANDARDS AND CODES OF PRACTICE

Unless otherwise provided the standards according to which work is to be performed or tested are American Society for Testing and Materials (ASTM), wherever these apply. Notwithstanding the above, British Standards (B.S.) shall be applied to the concrete works. Where such standards are mentioned, the latest revision or edition at the time of delivery of tenders shall apply. The Engineer may approve the substitution of other equivalent National Standard Specifications provided a statement of the exact nature of the deviation of substitution and complete specifications for the materials to be used are submitted to the Engineer and his written approval obtained before ordering or using the material in the

permanent works. The Contractor shall obtain and keep on site at least one copy in English of each standard which is referred to in the Specification. These standards shall at all times be available for inspection and use by the Engineer.

2.3 PROGRESS REPORTS AND PHOTOGRAPHS

2.3.1 Weekly Report

At the end of each week, the Contractor shall supply the Engineer with a report (qualitative and quantitative) of the work completed during the week, and with a detailed programme of the work he is intending to carry out for the next week.

2.3.2 Progress Photographs

To record the general progress of the work, as well as particular details and special phases of construction, the Contractor shall take photographs in color film. The photographs of a given part of the works shall always be taken from the same locations and with the same angle. They shall also include photographs of the manufacturing of equipment.

At least two copies shall be made and submitted in proper album one set to the Employer and one to the Engineer.

2.4 RECORDS

The Contractor shall be responsible for keeping and supplying promptly to the Engineer all such records of the work as the Engineer requires throughout the course of the work, including records of his labor force, plant, hours worked, rates, etc. for appraisal of the progress of the work.

2.5 PROGRESS MEETINGS

The Contractor and any subcontractors, suppliers whose presence may be requested must attend meetings (referred to as progress meetings) when called by the Engineer or his Representative for the purpose of discussing the execution of the work. Each meeting will be held at the time and place designated by the Engineer or his Representative. All decisions, instructions and interpretations given by the Engineer or his Representative at these meetings will be recorded and the Contractor will be responsible for conveying records of relevant information to the appropriate sub-contractors and suppliers involved.

2.6 PROTECTION OF MATERIALS AND WORKS

The Contractor shall protect and preserve all materials, equipment and work. In case damage or losses suffered at the works or at any part thereof, he shall, at his own expense, repair and make good the same, so that on completion, the works shall be in good order and condition and in conformity in every respect with the requirements of the contract and the Engineer's instructions. The cost of protection and preservation shall be borne by the Contractor.

2.7 MEASUREMENT AND PAYMENT

No separate payment to cover expenses for the various items under the clause General Provisions will be made and costs shall be deemed to have been included in the rates.

3. MOBILIZATION, DEMOBILIZATION AND SERVICES

3.1 CONTRACTOR'S OFFICE

The Contractor shall provide and maintain on the site an office for the use of his Agent where written instructions by the Engineer's Representative may be delivered and in such case they will be deemed to have been delivered to the Contractor. The Contractor shall move this office as the Engineer may reasonably require for the best supervision of the works.

3.2 ACCOMMODATION FOR EMPLOYEES

The Contractor shall provide and maintain sufficient suitable adequately ventilated and weatherproof shelters and mess rooms for his workmen, together with a sufficient number of proper latrines which shall be properly and regularly cleansed.

Camps for workmen, if provided, shall comply with all relevant Government Regulations, and shall be laid out in an approved and orderly manner. Proper provision shall be made for the disposal of all waste and refuse, and there shall be an adequate supply of water for washing, cooking and drinking purposes. Sleeping quarters shall be properly ventilated and lighted, and the whole camp shall be maintained and cleaned at all times to the satisfaction of the Engineer.

3.3 LABORATORY

The Contractor shall provide at the site within 1 month of the date of the order to proceed a laboratory. This provision will include the supply and erection of the building, the supply of furnitures, their maintenance and servicing, including the supply of water, fuel and electricity power, consumable materials used in the test, and their removal on completion. This provision will also include

for the services of labourers of 5 persons who shall work under the direction of the Engineer or the Engineer's Representative.

The building shall comprise two testing rooms on an area of 50 sq.m. only. The room shall be air-conditioned, and furnishings shall be approved by the Engineer.

The laboratory shall be in an approved position near to the Office of the Engineer's Representative.

The laboratory shall be equipped with a curing water tank with constant water temperature control and shall be equipped with air-coolers or climatiser in order to keep the laboratory rooms at the temperature required in the standards.

The laboratory room shall be weatherproof, etc. and shall be adequately wired for electric light and power, with sufficient light and power points for the efficient use of the equipment installed.

The Contractor shall ensure a continuous supply of electric power to the laboratory and subsidiary rooms at all hours including nights, fridays and public holidays.

The Contractor will provide the necessary testing equipment to carry out the following tests:-

Sieve Analysis
Moisture Content
Field Density
Compaction (Proctor)
Absorption
Specific Gravity
Concrete Strength
Permeability

Soundness Value
Slump Test

A detailed description of the installations and testing requirements will be given by the Engineer.

3.4 FACILITIES FOR THE ENGINEER'S REPRESENTATIVE TO TAKE SAMPLES

The Contractor shall provide facilities for the Engineer's Representative to take samples for testing of any of the fill materials. Such samples may be taken before or after incorporation into the works or at any stage during construction at the discretion of the Engineer's Representative.

No claims for delays due to the taking of samples by the Engineer's Representative will be entertained.

The taking of any samples by the Engineer's Representative shall not relieve the Contractor of his responsibility to ensure that all materials and workmanship fully comply with the Specifications, nor shall it relieve the Contractor of any of his duties under the Contract.

3.5 PROVISION OF EMPLOYEE FOR ENGINEER'S REPRESENTATIVE

The Contractor shall provide all such employees for operation of the Engineer's Representative and his staff for carrying out his supervision work throughout the period of construction.

. Driver	2 persons
. Cook	2 persons
. Typist	1 person
. Janitor	1 person

3.6 ENGINEER'S OFFICES AND GUEST HOUSE

The Contractor shall build, equip and maintain until the end of the period of maintenance or such other shorter time as the Engineer may direct, at a selected location on the site, the office and store as stated here below:

. One office room 150 sq.m approximately;
. One guest house 50 sq.m approximately;

These buildings shall be built at the start of the Contract, according to a programme to be submitted by the Tenderer and shall be completed not later than one month after the order to proceed.

The office and guest house drawings shall be submitted to the Engineer for approval before beginning the erection.

The whole of the accommodation shall be watertight and weather and vermin proof and shall be adequately ventilated, insulated, lighted, painted and fitted with secure doors and window fastenings. It shall be adequately wired for electric light and power. Suitable access for vehicles shall be provided, including a parking space with a light roof to hold not less than three cars.

The Contractor shall submit details of his proposals to the Engineer's Representative before construction of the office and guest house accommodation is begun.

Office and guest house shall be equipped as follows:

Office

- 5 desks: dimensions 1800 x 900 x height 740 mm
  1 three-drawer pedestal + cabinet in return;
- 3 cabinets: 740 x 800 x 400 mm with 1 shelf
  sliding doors - same finish as the desk;

- 5 executive armchairs;
- 5 visitor armchairs;
- 2 tables
- 3 cupboards with shelves
- 3 book cases
- 1 type writer
- 1 copy machine or copying facilities
- 1 drafter

Guest House

- 2 beds
- 3 air conditioners
- 1 table
- 3 chairs
- 1 refrigerator
- 1 set of cooking
- 2 sets of tableware

3.7 TRANSPORT FOR THE ENGINEER

During the period of the Contract or until such earlier date as the Engineer directs, the Contractor shall provide one 2400 cc class saloon car and three 4000 cc class four wheel drive station wagons, such as the Land Cruiser or equivalent, for the sole use of the Engineer and his staff. The vehicles provided shall be new and air-conditioned, and of types approved by the Engineer before orders are placed and shall at all times be maintained in good running order. Should any vehicle at any time become unserviceable, in the opinion of the Engineer the Contractor shall immediately provide a replacement vehicle to the satisfaction of the Engineer. All vehicles shall be insured with fully comprehensive insurance.

The Contractor will be responsible for the supply of the vehicle, garaging, servicing, maintenance, repairs, supply of motor fuel, oil grease, spare parts, insurance and the provision of the two properly trained drivers who must be to the satisfaction of the Engineer.

Upon the completion of the works, the Contractor shall hand over the four vehicles to the Employer after proper maintenance has been completed full satisfaction of the Employer.

3.8 SURVEYING EQUIPMENT

During the period of Contract, the Contractor shall supply, maintain and service as necessary for the sole use of the Engineer and his staff, the following surveying equipment:

- One theodolite such as the WILD T2 with EDM such as the Distomat;
- One automatic surveyor's level such as the ZEISS Ni2;
- One telescopic levelling staff 5 m long with built-in level bubble
- Ten ranging rods
- Two steel tapes 50 m long;
- Four steel tapes 2 m long;
- Two surveyor's umbrellas;
- Two straight rules 1.5 m long;
- Two Carpenter's spirit level 60 cm long;
- Steel or wooden pegs, beacons, lines and other appliances as necessary for proper survey, checking and measurement.

The equipment provided shall be new and each item shall be approved by the Engineer before ordering.

Non-serviceable Equipment shall be immediately replaced. Upon the completion of the works, the Contractor shall hand over all this equipment in good condition to the Employer.

3.9 SURVEYING AND SETTING OUT OF WORKS

The Contractor shall perform all calculations, surveying and setting-out necessary to ensure the accurate location of the structures, parts of structures and auxiliary works which are to be constructed by him. He shall also set out and protect all necessary construction

stakes, grades and reference marks to facilitate and control future work.

Before commencing any important structure defined as such by the Engineer, the Contractor shall provide and install precast concrete posts along the axis at least at both ends as well as in the middle of any straight line and of any curve. Each post shall have a marker and an identifying number.

Prior to the commencement of, as well as after completion of relevant work, the topography shall be surveyed by the Contractor in the presence of the Engineer, normally by means of logitudinal profiles and/or cross sections and this survey will serve as the basis for the measurement and calculation of quantities. No earthmoving shall be carried out at any location until the cross-sections have been agreed upon between the Engineer and the Contractor.

3.10 SUPPLY OF ELECTRICITY

The Contractor shall make his own arrangements for the provision of electricity for use in the execution of the works both temporary and permanent and for the work of any subcontractors.

3.11 COMMUNICATION SYSTEMS

The Contractor shall provide the comminication systems such as telephone lines or wireless connecting the construction site and Sohar/Muscat for Enigneer's use.

3.12 SUPPLY OF WATER

The Contractor shall supply and maintain an adequate source of potable water to the offices, laboratories and accommodation to be erected under this Contract.

The Contractor shall provide and arrange for all water required for construction purposes and ensure that it is of a quality such that it will have no deleterious effect on the works.

The Contractor shall submit proposals to the Engineer for the provision and maintenance of the supply of potable water and these proposals shall be approved by the Engineer before any works are commenced.

3.13 FIRST AID OUTFITS

During the progress of the works, the Contractor shall provide and maintain adequate First Aid outfits in easily accessible positions on each of the several working areas.

3.14 FLAGGING, LIGHTING AND WATCHING

The Contractor shall be responsible for properly watching and lighting the works where they are not on enclosed land.

In this matter and as to flagging and traffic control, he shall comply with the requirements of the Employer, the Police and/or the Competent Authority.

3.15 SIGNPOSTS, NOTICE BOARDS AND COMMEMORATION PLAQUE

The Contractor shall provide 20 warning signposts and three notice boards, each 2 m by 0.5 m in size made by wooden, at the places indicated by the Engineer.

The warning signposts shall be erected along the boundary of the construction sites for the protection of works. The notice board shall describe and illustrate the general informations of the Project for visitors. The Contractor shall also establish one commemoration plaque (refer to the commemoration plaque of "Wadi Al-Khawd dam") at the place designated by the Engineer.

Actual number, size and design of the signposts, notice boards and commemoration plaque shall be proposed by the Contractor to the satisfaction of the Engineer and the Employer in due time.

3.16 SAFETY

All necessary safety precautionary measures shall be taken for the safety of the workmen of all staff and of the works and shall be in accordance with the regulations and instructions to be issued from time to time by the Engineer and as required by the relevant laws of the Government.

3.17 CLEANING UP SITE

The site of all permanent and temporary works in connection with this Contract is to be carefully cleaned up and the site is to be handed over to the Employer in a neat and clean condition to the satisfaction of the Engineer.

Compliance with this clause shall be a condition precedent to the issue of a Certificate of Completion.

3.18 ACCESS ROAD

The Contractor shall design, construct and maintain numbers of access roads in and around the sites during construction period. The Contractor shall submit to the Engineer the detail plan of the access roads.

3.19 MEASUREMENT AND PAYMENT

Payment for the various items of Mobilization, Demobilization and Services will be made on the basis of contract lump sum prices including furnishing, transport, erection, maintenance depreciation, dismantling, removal, dislocation of the

installation and restoration of the site to its original or better state as well as the appropriate facilities to the Engineer for site staff, insurances and all extras.

Payment shall not exceed 4% of the base tender total price of which 20% will be for demobilization.

4. RIVER DIVERSION AND CARE OF WATER

4.1 CONDITIONS IMPOSED TO THE CONTRACTOR

The Contractor is responsible for the diversion of and any flooding of the Wadi Jizzi during the construction of the dam embankment and appurtenant works described in the tender documents.
The Contractor shall:-

- Construct and maintain all the works involved in river diversion and care of water.
- Carry out in due time all excavations and embankments required by these works.
- Plan, install, maintain and run all pumping and other equipment necessary to dewater the lower depression of the site from floods.

After completion, temporary works used for the river diversion shall be either incorporated in the permanent works or removed as the Engineer will direct. The Contractor shall submit with the tender, a detailed proposed for his method concerning the river diversion and care of water. The final programme of such works should meet the approval of the Engineer before starting the permanent works.

4.2 RESPONSIBILITIES OF THE CONTRACTOR

The Contractor is responsible for all the damage occasioned made by water during construction of the permanent works. The Contractor is responsible for all the damage to the foundation and to the works by surface and subsurface water or by the failure of any works of diversion or river diversion constructed by himself. If such damage occurs, the Contractor shall repair and make good the same at his own cost. However, the Contractor shall not be responsible for the reinstatement of the Works should floods of the

following magnitude be experienced. When the flood water depth exceed 4.0 m measured at the water level gauge located at a position just upstream of the bridge, where the Qabail-Buraimi road crosses the Wadi Jizzi, exceeds 4.0 m level. This depth is considered to correspond approximately to the flood of a return period of 500 years. The Contractor is responsible for the efficiency, the safety and maintaining the programme of his works.

4.3 MEASUREMENT AND PAYMENT

Payment of river diversion works including their maintainance, dewatering, pumping costs, incorporation in the permanent works, complete removal of them and all extras is provided under the appropriate item in the Bill of Quantities given as lamp sum.

5. EXCAVATION

5.1 CLEARING AND STRIPPING

5.1.1 Scope of Work

This work consists of clearing and stripping the project area including the site of the permanent works and the borrow areas within the limits designated and marked by the Engineer. All trees, stumps, bushes, roots, rubbish, any other vegetation or deleterious material and topsoil shall be removed.

It applies also to levelling work where specified or necessary or requested by the Engineer on completion of the works. For this purpose the stripped topsoil may have to be stock piled and its height in temporary stock piles shall be specified by the Engineer.

5.1.2 Execution

The Contractor shall perform the work of clearing, stripping and removal of topsoil in such a way as to remove all deleterious material. The suitable material required for the project and removed during the clearing and stripping operations by fault of the Contractor, shall be replaced by him at his own expense. All deleterious material removed by the clearing and stripping operations shall be removed from the project area or burned or otherwise disposed of as specified or directed by the Engineer. Care shall be exercised so that the disposal of such material does not destroy or damage public or private property. The stripped topsoil shall be dumped in the areas designated as spoil banks on the drawings. Within areas where excavation or filling is to be carried out, the ground shall be cleared and stripped of all living or dead trees, stumps, root mats and topsoil shall be removed to a depth of not less than 0.25 m. Any excavation of

unsuitable material authorised by the Engineer to a depth greater than 0.25 m will be paid for as excavation.

With the exception of excavated areas, all depressions made below the ground surface by the removal of stumps or roots shall be refilled with suitable material and compacted to the satisfaction of the Engineer.

Smooth transitions between natural slopes and project features shall be made by the Contractor, depressions and other surface anomalies shall be filled and levelled.

Where private materials or trees or fences etc. are to be removed, the property owner shall be given due notice in advance and the Engineer's approval obtained before proceeding with the work. All such operations including reinstatement will be at the expense of the Contractor and are deemed to be included in the rates.

5.2 COMMON EXCAVATION

5.2.1 Materials

All materials specified as common excavation shall be removed without blasting by normal excavation methods and equipment like excavators, bulldozers, ripping or by hand tools.

5.2.2 Execution

For all fill and cut, cross sections shall be made at intervals of maximum 50 m and as dictated by ground surface conditions.

Proper strutting, protection of slopes, particular methods of excavation to reduce risk of slides, etc. shall be provided for. In the event of soil slides occurring during the work, all damage

will be the Contractor's responsibility as well as the additional removing of soil resulting from such damage and reinstatement to the payment line by an approved method and by the use of materials all to the Engineers approval and statisfaction.

Where the nature of the soil is such as to cause any movements, initial excavation operations shall be carried out with special care.

If for any cause whatsover excavation is carried out beyond the specified line and level, other than as directed by the Engineer, or as shown on the drawings, the Contractor shall, at his own cost, take the necessary measures to reinstate the required line and level with approved material (backfill or concrete) and in such a manner as the Engineer may direct.

Excavation bottoms must be trimmed horizontally and/or in slopes subject to the approval of the Engineer.

Excavated material approved by the Engineer for use as fill shall either be stockpiled in a way and in an area to be specified by the Engineer or hauled directly to the fill position. In any case the Contractor shall not be entitled to claim for the double handling of excavated material.

No excavation for foundation work shall be backfilled before it has been inspected by the Engineer and its base suitably prepared by trimming and/or compaction as specified under Section 7 of this specification.

5.2.3 Excavation Material Suitable to Embankment Material

The suitable excavation material from both service spillway and emergency spillway will be used as embankment material for

construction of the dam body upon the results of soil test and the Engineer's judgement.

5.2.4 Backfill

Backfill shall consist of soil substantially free from vegetable or organic matter and may contain a proportion of rock fragments or cobbles not exceeding 20 cm in size, provided that these are not likely, in the opinion of the Engineer, to interfere with compaction to promote settlement or to cause damage to any structures or pipes. Backfill behind walls, where shown on the Drawings or ordered by the Engineer, shall comprise granular material with no more than 10 percent by weight passing a No.100 U.S. Standard Sieve. Backfill shall be deposited in layers, the compacted thickness of which shall not exceed 25 cm. Each layer shall be compacted until its dry density is nowhere less than 95% of the maximum obtained in the standard compaction test performed on representative samples. The moisture content of the backfill shall be adjusted where this is necessary to enable the specified density to be consistently achieved. The compaction equipment employed shall be to the satisfaction of the Engineer and shall include rollers, earthmoving plant, loaded or unloaded trucks, mechanial rammers, vibrating floats and hand rammers of at least 6.5 kg weight.

5.2.5 Grading of Road Surface

The grading of road surface shall be conducted in accordance with the route, slope and section as illustrated on the Drawings. In case undesirable materials are to remain a specific instruction has been given by the Engineer. The road surface shall be finished as smooth as possible.

The equipment to be used shall be those approved by the Engineer.

5.3 MEASUREMENT AND PAYMENT

All works executed for clearing, stripping and removal of topsoil to 0.25 m. will be paid by the solid volume of material in cubic meters according to the bill of quantities. The contract unit price for clearing and stripping as specified above shall include all removal, stockpiling, burning, disposing, etc. as required.

The measurement for payment of every type of excavation is based on the solid volume of material in cubic meters which is removed in accordance with the drawings or as directed by the Engineer. The measurement will be made by means of surveys performed by the Contractor and approved by the Engineer before and after the excavation.

No payment will be made for excavation beyond the excavation line needed for strutting, shuttering, or any other reason which the Contractor proposes and which assists the Contractor in the construction of the works and which the Engineer may approve. No additional payment will be made for dewatering of excavations, for excavating under water for dealing with inflowing or outflowing water to the excavation, for delays in excavations due to ground or surface water.

5.4 PERMITS FOR EXCAVATION AND BLASTING

Before commencing any work related to clearing, stripping and excavation the Contractor shall apply and obtain the relative permits.

6. GABIONS

6.1 GENERAL

Only the use of gabion cages and filling material approved by the Engineer will be allowed. Gabions shall be installed by the Contractor according to the recommendations of the manufacturer, if any. The installation of the gabions includes all works and materials required for the complete installation of the gabions as indicated on the drawings. All wires will be galvanised.

6.2 GABION CAGES

Gabion cages with diaphragm of reputable manufacturer subdividing the total volume of the gabion into subvolumes of maximum 1 m^3, have to be used (e.q. Maccaferri). The gabion wire must be galvanised. A life expectancy of more than 25 years must be guaranteed by the manufacturer. The size of the cages must not exceed 2 x 1 x 0.5 m. The size of the meshes shall be 80 x 100 mm the wire gauge being 2.7 mm nominal and galvanized with minimum 240 gram/m^2 (0.8 oz.per sq.ft.) zinc coating in accordance with ASTM A90.

The cages must be securely wired together to all corners and edges. Where there is more than one course of gabions, those in the upper course must be laced to those below. Cages may be laced together before filling in. In this way, the placing of empty units should be well in advance of the filling operations.

To avoid bulging on the outside of the structure, tie wires shall be fitted inside the gabion compartment, between the outer and inner skins. The ties shall be of the same binding wire as used for lacing and should be passed around at least two meshes on each side of the compartment.

Vertical ties shall be fixed to the bottom of the cage prior to filling and tied down to the lid on completion. At least three ties are used per square metre of surface.

6.3 FILLING MATERIAL

Only approved infilling material of cobbles or rock shall be used. Size range of fill material shall be 100 - 200 mm, but max. 5% of weight between 100 - 150 mm, and carefully filled by hand. Cobbles must be fairly rounded and rock pieces fairly blocky without elongated or flaky pieces. The specific gravity of infilling material must not be less than 2.5 and it must be clean, hard, durable, non friable and its Soundness value when tested in accordance to ASTM C88-63 "Soundness of Aggregates by Use of NaSO4 or MgSO4" must not exceed 12% when tested by the Sodium Sulphate method and 18% by the Magnesium Sulphate method.

The borrow areas are not specified but the verification of the suitability of infilling material will be the responsibility of the Contractor.

6.4 FILLING OF GABION CAGES

The gabion cages shall be filled carefully according to the recommendation of the gabion cage manufacturer, if any, and the Engineer. Groups of gabion cages shall be fixed together and filled simultaneously. Galvanized wires shall be stretched across the cage in order to retain its cubic shape. Depending on the action of the water, these wires will be stretched horizontally or vertically. The gabions when filled thoroughly shall be closed and attached to each other using galvanized wire of 2.7 mm nominal wire gauge.

The gabions shall be slightly overfilled to allow for subsequent settlement, the lid will be laced down with binding wire to the top of all sides and diaphragms.

It will be necessary to stretch the lid to fit exactly to the cage sides.

6.5 BEDDING OF GABIONS

The gabions shall be placed on level surfaces formed by compacting the existing foundation material or fill material derived from the excavations. Gabions must not be bedded on organic or cohesive soil. Compaction of the gabion bedding material must be to the requirements of Section 7 of this specification. No local projection greater than 75 mm will be permitted above the level surface and the Engineer must give his approval of the prepared surface before commencement of gabion placing.

To avoid the suction of fine material under or behind the gabion, the gabion cages shall be placed either on a filter layer such as gabion bedding or a geotextile layer. (The spcification for geotextile layer is noted on the Drawings.)

6.6 MEASUREMENT AND PAYMENT

The measurement for payment of the gabions will be according to the corresponding items in the bill of quantities.

The payment of the gabions also include all supplies of materials and installations.

7. EMBANKMENT

7.1 SCOPE OF WORK

The Contractor shall prepare the foundation for and provide, mix, place, compact, arrange and trim the materials for the dam comprising filling, bedding material to riprap and riprap according to the limits, lines, grades and cross sections shown on the drawings or as directed by the Engineer.

7.2 BORROW AREAS FOR CONSTRUCTION MATERIALS

The location of probable borrow areas for construction materials for the dam and appurtenant structures are located as shown on the drawings.

- Dam Embankment:	the embankment material to the dam body shall be obtained from the excavated soils in the dam foundation and the spillways
- Dam Filter Embankment:	river bottom designated by the Engineer
- Riprap, Gabion and Masonry:	material which must be processed to render it suitable and as specified is available in the periphery of the relevant construction site.

7.3 FOUNDATION TREATMENT

The area to be overlain by the dam embankment shall be stripped excavated and made as smooth and regular as practicable. Vegetation, topsoil, blocks and boulders shall be removed as specified in Section 5 or as directed by the Engineer. Excavations shall be to the lines, levels and slopes shown on the drawings.

Any depressions at the foundation level resulting from the stripping and excavation operations shall be filled with similar material compacted to a density corresponding to that being attained with the adjoining zone. On the slopes any overhanging material shall be excavated, but only to the minimum extent necessary, to provide a smooth slope and to allow a satisfactory compaction or placing of the abutting material.

The surface of rock upon which fill or other construction material is to be placed shall be cleaned of all loose material by airwater jets. Faults, fissures and seams in rock shall be cleaned to a satisfactory depth and to firm rock on the sides.

7.4 EMBANKMENT OPERATIONS

a) Placing of embankment materials

Placing of materials shall be carried out in accordance with the typical cross sections presented on the drawings.

The embankment shall be raised uniformly in layers with an inclination acceptable to the Engineer.

Material shall be dumped directly near its final location on the previous layer and not on the layer being placed, in order to minimize segregation resulting from its spreading. The direction of the traffic and the edge of the placement area shall be parallel to the embankment axis.

No organic matter or other unsuitable fill shall be permitted in the embankment. The Contractor shall present to the Engineer full details of the proposed placing operations including the number and kinds of equipment which he intends to use.

It is intended that the optimum compaction conditions be ascertained in full-scale tests, including determination of maximum possible compaction as a reference, preparatory to construction with associated laboratory testing, to establish the characteristics of the compaction which shall be done by heavy vibrating rollers of 11 tons static weight, the speed of travel of which should be below 3 km/h. The thickness of the spreading layers will be in the following ranges:

- Spreading Thickness to Dam Embankment: 0.3 m in average
- Bedding to Riprap: 0.25 m in average (perpendicular to slope)
- Riprap: 1.0 m maximum
- Wet Masonry: 0.30 m maximum

The decision on the number of passes required to compact the embankment will be based on the results of the trial compaction tests.

Temporary slopes in the embankment must not be steeper than 1 to 2.5.

Granular fill must be fully compacted and to achieve this overplacing at the dam embankment edges must be carried out by at least 0.5 m. Following compaction the dam embankment slope must be trimmed by manpower or by the use of a suitable machine to the slopes shown on the drawing-slope trimming may be carried out in lifts which will depend on the technical characteristics of the machinery to be utilized by the Contractor.

Material deriving from the trimming of the dam embankment slopes may be used again as embankment material if not excessively segregated.

Bedding material to the riprap shall be placed to a thickness of 0.25 m on slopes which are less than 1 to 2.5. Elsewhere bedding material shall be rear dumped on the slope and either machine or hand spread and tamped to the required thickness of 0.25.

b) Water contents

Except riprap, all material shall be placed in a moist condition. Water content limits will be established as part of the field and laboratory compaction testing both prior to and during construction.

c) Compaction

The compaction procedure of dam embankment is subject to the results of field embankment - tests as specified in 7.5. The following is for the Tenderer's reference sake.

- Dam Body Embankment: spreading thickness ..... 0.3 m
  number of compaction passes .....
  more than 4 passes
  equipment .....vibrating roller of more than 11 tons
  watering .....apply to 5% in average amount of the embankment volume by watering lorry or by hose

- Dam Intercepter Embankment:
  spreading thickness ..... 0.2 m
  number of compaction ..... more than 3 passes
  equipment ..... flat vibration of more than 100 kg

One pass is defined to be the compaction in two directions over the same surface, the compacting engine returning to its starting point.

The selection of the compaction procedure will be made on the basis of the field and laboratory tests performed prior to construction operations.

The compaction of the fill adjoining the gabions and structures which cannot be sufficiently compacted with the usual equipment, shall instead be carefully compacted by tamping machines or equivalent equipment and that without any extra payment.

d) Field Permeability Test

Field permeability tests shall be conducted at each three layers (The thickness of one layer is approximately 0.3 meter in average.) and at three places on the layer using pits which collected samples used for laboratory tests by falling head permeability test method.

e) Slope Surface Trimming

For the slope surface, including berm, the Contractor shall perform the trimming on the slope surface in such manner that the slope surface is uniformly even as lines and grades shown on the Drawings. Rearranging of the slope surface by equipment or by hand in place will be required to conform the specified slope gradients to receive the riprap bedding or riprap without bedding.

7.5 IN SITU TESTS

a) Compaction control

Fullscale compaction tests as recommended and approved by the Engineer shall be performed on any embankment material.

The frequency of in situ density tests will be one test every 50 m^3 of compacted fill for the first week or up to 5,000 m^3 of compacted fill deposition, and one test every 300 m^3 of compacted fill deposition thereafter.

Field density must in all cases exceed 95% of the Proctor maximum dry density of the material as determined by the Vibrating Plate method described in B.S. 1377 "Methods of Testing Soils for Civil Engineering Purposes".

7.6 EMBANKMENT MATERIAL

7.6.1 Embankment Material to Dam Body

The embankment material is obtained from the excavated soils in the dam foundation and spillways. The required grading size to the dam body material shall be with the following limit:

in mm	Percentage Passing
100	100
50	95 - 85
30	90 - 70
20	75 - 60
10	65 - 50
5	60 - 40
3	45 - 30
1	30 - 17
0.5	17 - 12
0.2	14 - 10
0.075	10 - 5

7.6.2 Embankment Material to Dam Filter

The embankment material to dam filter is borrowed from river bottom designated by the Engineer. The required grading size to the dam filter material shall be with the following limit:

in mm	Percentage Passing
80	100
50	92 - 68
30	75 - 40
20	65 - 30
10	45 - 15
5	30 - 10
2	15 - 5
1	12 - 2
0.5	10 - 0
0.075	2 - 0

7.6.3 Riprap

Riprap shall derive from hard, sound, durable rock and rock pieces shall be free from cracks, seams and other defects. The specific gravity of the riprap must be greater than 2.5 and its Soundness value when tested in accordance to the A.S.T.M. C88-63 "Soundness of Aggregate by Use of NaSO4 or MgSO4" must not exceed 12% when tested by the Sodium Sulphate method or 18% by the Magnesium Sulphate method. Furthermore the Los Angeles Abrasion value when tested in accordance to the A.S.T.M. C131-66 "Resistance to Abrasion of Small Size Coarse Aggregate by Use of Los Angeles Machine", for 500 revolutions must be greater than 50%.

Riprap to be placed on the slope may derive in part or in total from river cobbles and boulders.

The riprap stone sizes and weights shall be strictly controlled to be within the following ranges:

	For Upstream Slope	For Downstream Slope
Minimum Dimension (anyone)	0.10 m	0.10 m
Mean Dimension	0.30	0.20
Maximum Dimension (anyone)	0.50	0.40
Minimum Weight	2 kg	2 kg
Maximum Weight	200 kg	100 kg

The riprap shall be dumped on the dam embankment slope following the placing and compaction of the bedding material. The riprap shall be mechanically worked in place to form a tightly knit slope protection layer of a thickness as specified.

Segregation of larger or smaller pieces resulting in a patchy riprap zone shall be avoided. The following additional work may have to be carried out to ensure the effectiveness of the riprap zone to provide protection to the dam embankment slopes from the action of waves:

- hand placing of rock pieces in cavities between larger pieces.
- barring and wedging of unstable rock pieces to a more stable position.
- pop blasting of excessively large rock pieces or those which project excessively above the theoretical slope line.

The finish of the riprap slope protection must be to the entire satisfaction of the Engineer and the impression which must be given is of a closely packed, well knit and interlocking assembly of either angular cuboidally shaped rock pieces or rounded irregularly shaped cobbles and boulders.

7.6.4 Wet Masonry

The wet masonry shall be placed in position scale and dimension as shown on the drawings.

The wet masonry shall consist of random sized rock pieces of the same specification as for the riprap material. The stones must be clean and free of dust or clay. The shape of stones must be such that they may fit closely together.

The wet masonry shall be constructed in approximately 0.30 m thick layer. A half of the stone shall be embedded into a well compacted regular concrete foundation with 0.30 m thick.

The wet mosonry shall be cleaned and hand finished to ensure close packing of stones and compliance to lines and levels as shown on the drawings.

7.6.5 Underdrain

As for filling material to the underdrain, such small gravels or crushed rocks shall be fixed to the trench of such a dimension as is approved, provided that water shall fully pass through the underdrain. In case concrete has been placed on the trench or other materials have been embanked thereon, the trench shall be covered with paper or other appropriate materials, lest those materials should be mixed into the interior of the trench.

7.7 MEASUREMENT AND PAYMENT

The measurement for payment of each item under embankment, bedding material, riprap and wet masonry is per cubic metre of volume placed and includes all operations described above and including excavation from borrow areas, borrowing from excavations, stockpiling, selection and treatment, mixing and blending of materials, transport to the embankment, placing and compaction, trimming of dam slopes, finishing off etc.

The total volume of material placed and compacted during construction shall be determined on the basis of the elevations

determined at the commencement and end of construction and excavation periods respectively. Any additional volumes incurred, due to settlements during the construction period will be included in the prices.

No payment will be made for wetting or drying operations, and the entire costs of this shall be included in the unit prices of the placing and compaction.

No payment will be made for material placed with excessive moisture content. Removal and replacement of such material shall be at the Contractor's expense. In the case of wet masonry, payment will include handplacing and joining and bedding preparation.

The costs of the material tests in the field and laboratory, the laboratory equipment, operators and supervisory personnel shall be included in the relevant prices of the embakment works.

No separate payment shall be made for test and laboratory operation.

8. CONCRETE

8.1 GENERAL

Except where they are varied by the requirements this specification, the provisions of B.S.C.P. 114, Code of Practice for the structural use of Reinforced Concrete in building, together with the latest amendments, shall be held to be incorporated in these Specifications.

8.2 MATERIALS

a) Cement

The cement used shall be ordinary Portland cement conforming to B.S. 12, for all works, except where specifically mentioned in the drawing. The Contractor shall maintain for the Engineer's inspection, a record of receipts and consumption of cement, indicating the source, the age and the date of receipt of cement. If required by the Engineer, the cement will be tested in accordance with the requirement of B.S.12. Any cement which does not meet the required standard, shall be rejected, and removed from the site.

b) Aggregates

All aggregates shall conform to B.S. 882 and Omanian standards. Fine aggregates shall comply with grading zone 2 or 3 in Table 2 of B.S. 882.

c) Water

The water shall be clean and uncontaminated. It shall be free from oil and harmful chemical and organic impurities. Where tests are

considered necessary, they shall be carried to comply with B.S. 3148.

d) Reinforcement

The reinforcement should be one of the following:

i) Mild steel reinforcement shall be round bars complying with B.S. 4449.
ii) High yield steel reinforcement shall comply with B.S. 4449 or B.S. 4461.
iii) Fabric reinforcement shall comply with B.S. 4483 and shall be delivered to site in flat sheets only.

e) Water stops (Sealing strips)

All types of waterstop shall be tested in a recognized laboratory prior to shipment to the site. Water stops shall be tested as to their tensile strength, elongation, duration, water absorption, specific gravity, effect of alkali and impact resistance.

All reinforcement bars should be stored properly on site to avoid rusting. Loose scales shall be removed with a wire brush and rust shall be cleaned in a manner approved by the Engineer. Any exposed reinforcement left projecting shall be cement washed, if required.

The Contractor shall obtain prior approval from the Engineer, of the steel proposed to be used for the project, by submitting the Manufacturer's Test Certificate and only such steel, as approved by the Engineer, shall be used.

Bar reinforcement shall be tied in position at each intersection or as approved, using 16 gauge soft annealed iron wire.

f) Dowel bar

Dowel bar shall be furnished and placed in the joints of the concrete structures. The dowel bar shall be smooth round reinforcing bar and the dowel bar shall be cleaned and painted with red lead on the full length of the bar and the paint shall be thoroughly dry before placement in concrete. The dowel bar shall be spaced as shown on the drawings and placed across the joints so that one-dowel shall be positioned parallel to each other and to the surfaces of the structures. Special care shall be taken to maintain the dowel bar accurately in position during placement operations. Immediately before placement of concrete, the half-length of dowel to be initially embedded shall be coated with a film of oil. Before final set of the concrete in the initial placement, the dowel bar shall be twisted to break bond.

g) Boulder concrete

The boulder concrete shall be placed inside of the spillway crest as shown on the drawings. The concrete portion of the boulder concrete shall be identical to the plain concrete and the boulder size shall be 10-30 cm free from silt, clay and any such impurity.

8.3 *GRADES AND STRENGTH REQUIREMENT OF CONCRETE*

The concrete for this project will generally be in two grades namely:

a) Base or plain concrete which will be used as levelling layer under reinforced concrete and bed concrete for channels and alike construction.

b) Reinforced concrete which will be used for the protection wall.

All concrete work is to be done as per the drawings.

Following Tables shows general requirement of both these grades, the Contractor has to carry out trials and prepare a suitable mix under the supervision of the Engineer. The designed mix should give the required strength and density. No concrete work shall proceed until the Engineer has approved suitable mix for different grades. If a change in grading is unavoidable the mix must be redesigned accordingly.

(I) Grain size distribution of aggregates

Grain diam mm	0.2	0.8	2.0	8.0	16.0	30.0
Percentage passing by weight %	4-8	10-16	16-26	39-52	63-73	100%

(II) Strength

Grades	Max.size of aggregates (mm)	Water Cement Ratio	Min. Cement contents kg/m^3	Min. Density kg/m^3	Min.Cube strength kg/cm^2	
					7 days	28 days
Base or Plain Concrete	30	0.50-0.60	200	2400	125	180
Reinforced Concrete	30	0.50-0.55	300	2400	190	270

8.4 MEASUREMENT AND PAYMENT

Measurement for payment will be based on the number of cubic meters placed within the lines and grades shown on the drawings.

Payment will be made at the unit price of the bill of quantities, and shall include all costs for cement, for borrowing,

transportation, crushing, screening, washing and storage of aggregates, for batching, transportation, placing, compacting, fine surface finishing, curing, protecting, repair works equipment, tools, labour, and formwork which will provide for fine surface finish to the concrete.

9. PIPE WORKS

9.1 GENERAL

The Contractor shall construct conduit pipe, drains and the like to the lines and levels shown on the drawings. No pipe shall be laid until the ground formation for it has been approved by the Engineer. Before any pipe is lowered into the trench, it shall be cleaned and sounded for cracks and flaws and any damaged coating, lining or sheathing shall be repaired. Gradients shall not normally be flatter than 1 to 200 except where pipework is ordered to be laid horizontal.

The deflections at proprietary joints shall not exceed those recommended by the manufacturer and for other joints shall be as directed by the Engineer. All proprietary flexible joints for steel pipes and their bitumen protection where applicable,shall be made strictly in accordance with the manufacturer's instructions.

The Contractor shall submit the manufacturer's catalog data, certified outline drawings and the like for the pipe works to the Engineer for his approval.

9.2 REFERENCE STANDARDS

Codes and standards of following organizations are referenced herein.

a) American Society for Testing and Materials (ASTM)

b) American Association of State Highway and Transportation Officials (AASHTO)

c) American Water Works Association (AWWA)

d) American Petroleum Institute (API)

9.3 STEEL LINER

Steel liner shall comply with ASTM-A 53, A 105 and A 120, as the case may be. Pipes shall be weldless or lapwelded as specified. Welded pipes shall be made from not more than 2 plates with 2 longitudinal welds and no circumferential welds will be permitted except for large diameter pipes, built-up bends and flanges. Each pipe barrel when welded up shall be truly cylindrical and circular in cross section and shall comply with the tolerances laid down in the ASTM quoted. Unless directed otherwise, internal coatings and linings for steel and cast iron pipes and specials comply in all respects with the requirements of the appropriate U.S. Standard. The Contractor shall protect coatings, coverings and linings during and after erection to minimize such damage from whatever cause.

All welding shall be carried out in accordance with the requirements of the Engineer and shall comply with the requirements of ASTM -A 233 and A 316 wherever applicable.

9.4 CORRUGATED PIPE

Pipes for culverts to the dispersion facilities shall be made of flange coupling type corrugated steel pipe 1200mm in diameter and shall meet the requirement of JIS G3471, SCP 1R or equivalent specifications. Materials of the pipe shall be JIS G3101, SS34 and JIS G3131 SPHC or equivalent specifications accepted by the Engineer.

Unless otherwise specified, all sections shall be rigidly jointed by galvanized bolts and nuts with approved packing material.

9.5 POLYVINYL CHLORIDE PIPE

The perforated polyvinyl chloride (PVC) pipe shall be fabricated by the manufacturer approved by the Employer and shall be in accordance with ASTM-D 1785: D2241 and/or in JIS K 6741 "Unplasticized Polyvinyl Chloride (PVC) Pipes".

All fittings shall be the socket type for rubber ring joints or for solvent welded joints as designated in JIS A 6743, JWWA K 119 or equivalent, and shall be compatible with the pipe where installed.

Unless noted otherwise, materials and strength of fittings shall be the same as those of the connecting pipe.

9.6 BEDDING AND PLACING PIPE

Culvert pipe shall be laid on the surface of partly constructed embankment to lines and grades shown on the drawings steel liner shall be installed on approved support frame.

Each pipe shall be carefully examined before being laid and defective or damaged pipe shall not be used. Under no circumstances shall pipe be laid in water or before bedding has been accurately prepared. Pipes shall be lifted (not rolled) onto their bedding. Pipe joints shall be drawn up evenly with a double come-along or as recommended by pipe manufacturer.

9.7 BACKFILLING AND COMPACTION

Backfill shall be of approved material. Backfill shall proceed in 15 cm layers with care being taken to ensure thorough compaction under haunches of pipe.

Hand-held compactors shall be used for all work in immediate vicinity of pipe and cut-off. Test for density will be made as necessary to ensure conformance to compaction requirements. Back-fill around pipe, cut-off, and headwalls shall be at approved moisture content for maximum dry density.

Compaction shall be to 95% of maximum dry denstiy as determined by ASTM D1557.

9.8 TESTING

Compaction testing shall be performed in accordance with the specifications in dam embankment.

Field density tests shall be performed in accordance with ASTM D1557. An average of five field density tests for compaction around each culvert should be estimated. Additional tests will be required where previous tests show that additional compactive effort is required. Cost of these additional test shall be borne by the Contractor.

9.9 MEASUREMENT AND PAYMENT

Payment will be made according to the items listed in the Bill of Quantities.

10. METAL WORKS

10.1 GENERAL

The works to be done under this section shall comprise the supply of all plant, labour, materials and all necessary works for supplying and installing miscellaneous steel assemblies or members, including embedded parts and anchors, to be incorporated in the works, as shown on the drawings, or as required by the Engineer and as specified herein.

No dimension shall be less than specified, unless the Contractor is authorized by the Engineer to do so.

10.2 REFERENCE STANDARDS

All materials, equipment, fabrication and testing shall conform to the latest applicable standards contained in the following standards.

a) American Society for Testing and Materials (ASTM)

b) American Institute of Steel Construction (AISC)

c) American Welding Society (AWS)

d) American Society of Mechanical Engineers (ASME)

10.3 STEEL ROLLER GATE

The Contractor shall design, furnish, install, paint and test the steel roller gate with hoists and appurtenant equipments for the emergency outlet as shown on the drawings. All drawings, designs and specifications shall be provided by the competent manufacturer and approved by the Engineer.

10.4 TRASH RACKS

The Contractor shall furnish and install the trash racks as shown on the drawings. Trash racks and frames will be made of structural steel shapes, bars and plates. Fabrication detail drawings shall be furnished by the Contractor and shall be approved by the Engineer.

10.5 DEBRIS DEFLECTOR

Debris deflector shall be located at the inlet of each pipe culvert. The Contractor shall utilize salvaged or new 90 lb. steel rails, 152 mm x 152 mm x 19 mm equal angles, or 127 mm x 44 kg/m structural tees as approved by the Engineer, welded with 6 mm fillet welds as shown on the drawings.

10.6 MATERIAL

All materials shall be new and shall be the best available for the purpose, considering strength, ductility, durability and suitability for the intended service, and shall conform to ASTM or other internationally accepted standards.

Materials, parts, components and equipment not manufactured by the Contractor shall be purchased from reputable and reliable manufacturers. Materials to be used in the major parts of the metal works under this Contract shall meet the requirements of ASTM A283 grade D, ASTM A36 and ASTM A440.

10.7 MANUFACTURING

Cutting of steel shall be performed with precision. No cracks or unevenness shall be permitted. Welding shall be executed by metal arc welding. AWS Code "Standard Specifications for Welded Highway

and Railway Bridges Design, Construction and Repair" shall be applicable for gates and trash racks.

The Contractor shall submit a painting plan including the color and quality of paint, the time and method of painting for the approval of the Engineer.

10.8 PAINTING

10.8.1 General

All painting works shall be performed in accordance with the construction drawings, specifications and instructions of the Engineer. Prior to commencement, documents and samples concerning calour, material, specifications, etc shall be submitted to the Engineer.

10.8.2 Surface Preparation

Preparatory works for painting metal surfaces shall be as given in the table as presented on the follows:

Work Process	Treatment Method	Extent of Treatment
Complete removal of rust & dirt	complete removal of millscales rust and other fixed substances by sand blasting or shot blasting	95% removal of rust, etc. from the metal surface. Fixed mill-scales shall remain only as a slight station.

10.8.3 Materials

Paint shall be well mixed to a uniform consistency prior to the use. Synthetic resion paint shall be used for metal surfaces. Detailed specifications shall be as presented on the follows:

Factory	1) Zinc cromite lead primer (base)	20 μ
"	2) Epoxy resin (first)	60 "
	3) - do - (second)	60 "
Field	- do - (surface)	30 "

10.9 TESTS AND INSPECTION

The Contractor shall, at his own expense, conduct field operation tests. The plan for tests shall state the time schedule, place, method and equipment for the approval of the Engineer.

10.10 MEASUREMENT AND PAYMENT

Payment will be made according to the items listed in the Bill of Quantities.

11. OBSERVATION WELLS

11.1 GENERAL

The Contractor shall construct the following monitoring observation wells at the location designated on the drawings.

. NJ-1	40 m	I.D. 4" O.D. 10"
. NJ-2	70	- ditto -
. NJ-3	70	- ditto -
. NJ-4	70	- ditto -
. NJ-5	20	- ditto -

11.2 DRILLING

The Contractor shall drill the observation wells with outer diameter 10 inches up to the depths specified at the locations designated on the drawings using rotary drilling machinery.

11.3 GRAVEL PACK

The Contractor shall fill the space between the drilling hole and PVC pipe with the gravel. The gravel pack shall be such quality as specified in 8.2 b).

11.4 STEEL CASING

The Contractor shall provide and install the steel casing with 10-inch diameter to the depths directed by the Engineer.

The steel casing shall be grouted in position by filling the annular space between the drilling and the casing with grout. Grout shall be placed by tremie pipes or hoses and it shall be allowed to set undisturbed for a period of at least 12 hours or as directed by the Engineer.

11.5 PVC PIPE FOR PLASTIC WELL SCREEN AND CASING

When PVC pipe with 4-inch diameter for the plastic well screen and casing is used, the material shall not be jacked, hammered, rammed or forced in any way in order to install it, nor shall the material be cut or drilled. The Contractor shall follow manufacturer's recommendations for installation and assembly of such materials. In no case shall any screen or casing be allowed to bear on the lower end, rather the casing and screen shall be supported from above. Should well screen or casing be damaged or separated due to the negligence of the Contractor, then he shall replace them at this own expense.

11.6 CENTRALIZER

Centralizers shall be set up between the surface casing and the PVC pipe with on interval of 4.0 meters. The centralizers shall be straight Centralizer made of PVC or approved by the Engineer. The space between the centralizer and the surface casing shall be less than one centimeter.

11.7 CONSTRUCTION OF WELL HEAD

After the installation of well screen and casing, the ends of the surface casing and well casing shall be cut off to the lengths required to produce the necessary well head block. These cuts shall be square and neat in appearance.

A standard well cap shall be provided and fitted as shown in the drawings. Care shall be taken to ensure that the well cap is closely fitted and fully seated on the top of the surface casing.

11.8 DEVELOPING OF WELLS

The Contractor shall develop the borehole by means of jetting, surging by water or air, and water lifting by air as instructed by the Engineer. The development shall be continued until the lifted water is judged to be free from sand as otherwised instructed by the Engineer.

11.9 PUMPING TESTS

The Contractor shall provide all plant, equipment, materials and labour for the performance of pumping test. The Contractor shall carry out the pumping test on each well during 12 hours as directed by the Engineer.

The provision of an accurate and correctly executed aquifer pumping test is a prime responsibility of the Contractor and shall be considered as such by the Engineer.

11.10 MEASUREMENT AND PAYMENT

Payment will be made according to the items listed in the Bill of Quantities.

12. WATER LEVEL GAUGE

12.1 General

The Contractor shall fabricate, furnish and install water level gauge as shown on the drawing. The water level gauge consists of the steel tower and the automatic water gauge.

12.2 STEEL TOWER

The steel tower shall consist of the steel pipe with 500 mm diameter, 17.5 m long and concrete block surrounded by the gabion as illustrated on the drawings.

The steel tower shall be firmly embedded in concrete block. Material and workmanship to steel tower fabrication shall conform to standard specifications for pipe works.

12.3 AUTOMATIC WATER GAUGE

The Contractor shall install the automatic water gauge to the steel tower. The automatic water gauges shall be standard type with following specifications.

Measuring Depth : 0 - 20 m
Float Diameter : 250 mm
Accuracy : less than 3 mm
Record Period : one month or three months
Drum Driving : quartz clock

12.4 STAFF GAUGE

The contractor shall install staff gauges at the slope surface of both sides of the service and emergency spillway crest. Details of the staff gauge are shown on the drawings.

12.5 MEASUREMENT AND PAYMENT

Payment will be made according to the items listed in the Bill of Quantities.

13. RELOCATION ROAD

13.1 GENERAL

A relocation road from the left bank of Wadi Jizzi to existing road (the right side of Wadi Jizzi, refer to Drawing No 34) shall be constructed by the Contractor according to the attached drawings

13.2 GRADING

Since the road shall be constructed at the terrace deposit ranging to the left bank and at river surface of Wadi Jizzi, the road surface shall be graded by bulldozers or graders so as to maintain smooth driving of vehicles.

13.3 MAINTENANCE

The relocation road will be used for transportations of construction materials, equipment, etc. during construction period of the dam. Therefore, the road shall be maintained in good conditions by the Contractor's responsibility.

After the completion of the dam construction, the road will be used by persons who are living in upstream villages of Wadi Jizzi. The road shall be taken over to the Employer in good conditions.

13.4 MEASUREMENT AND PAYMENT

Payment will be made according to the Bill of Quantities.

14 PARTICULAR REQUIREMENTS

14.1 Field Laboratory

14.1.1 Building

The Contractor shall provide and maintain the laboratory building with services, equipment, apparatus, fitting, furniture and relevant B.S. literature for testing. This laboratory is for the use of the Engineer's Representative and the labour shall be supplied by the Contractor and supervised by the Engineer's Representative.

The laboratory equipment and apparatus shall be of an approved type and shall be adequate in the opinion of the Engineer to carry out all the tests as listed in the specifications.

Air-conditioning, electric light, gas, power, and water shall be supplied to the laboratory by the Contractor.

The laboratory office shall be furnished with new funiture and equipment. The followings are a listing of the minimum basic furniture and equipment to be provided by the Contractor.

14.1.2 Furniture

2 - Metal desks 1.5m x 0.75m, 6 side drawers and one center drawer art metal or approved equal with desk

4 - Straight chairs

2 - Tables 1.5m x 1.5m

2 - Wall boards 2.5m x 1.5m

2 - Cupboards with shelves and locks

1 - Field cabinet

3 - Air-conditioners (1 HP)

1 - Set of shelves for the concrete wet room

14.1.3 Test Equipment

2 - Sets of siene analysis (8 inches in diameter)

5 - Hydrometers graduated in grams per liter

5 - Hydrometer jars 1,000mℓ

5 - Thermometers accurate to 1°C

3 - Beakers 500mℓ

2 - Each sieve brushes of wire and Fine

2 - Unit weight measure

1 - Set sand equivalent test apparatus
2 - Modified compaction hammers (15kg, 50cm drop)
3 - Modified compaction moulds (ϕ30cm)
3 - Straight edges
2 - Mixing trowels
10 - Mixing pans (50cm x 50cm x 15cm deep)
1 - Spring scale (capacity 10kg, sensitivity 10 grams)
1 - Balance (" 1,000g, " 0.1g)
2 - Balances (" 25kg, ' 1g)
1 - Field scale
2 - Moisture test apparatus
8 - Cylindrical moulds
1 - Slump cone test (complete)
1 - Compression tests (100ton) with guard
2 - Cylinder capping sets
2 - Capping compounds (100kg)
1 - Concrete test hammer
1 - Drying oven, 60cm x 50cm, external size thermostatically controlled capable of maintaining a temperature of 110°± 5°C
LS - Miscellaneous items of equipment

14.2 Welding

Welding of parts shall be in accordance with the Standard Code for Arc and Gas Welding in ASTM or equivalent specifications, and shall only be made at the places shown on the diagrams, specified or permitted by the Engineer. All weldings shall be made by welders certified as to their ability to perform welding in accordance with accepted testing requirements.

Prior to commencement of the welding, all surface shall be cleaned thoroughly of loose scale, slag, rust another foriegn matters with a wire brush, scraper or other means. The Contractor, during the welding operaton, shall install suitable protective devices against wind, rain and leakage of water. The Contractor shall finish rough and protruding welded surfaces smoothly with a grinder to allow the unobstructed flow of water.

The joints of steel liners shall be thouroughly welded from both

the inside and the outside.

14.3 Gate

14.3.1 Material

All materials shall be new and shall be the best available for the purpose, considering strength, ductility, durability and suitability for the intended services and shall conform to ASTM or equivalent specifications. Materials, parts, components and equipment not manufactured by the Contractor and requried for the equipment shall be purchased from reputable and reliable manufacturers.

14.3.2 Design Data

1) Gate

. Type	Steel slide gate
. Clear span	1.7 m
. Effective height	1.6m
. Design head	6.23m (WL 163.9 - EL 157.67)
. Sealing sytem	Water tight on the front four sides with rubber seals
. Operation system	Manual
. Corrosion allowance	1 mm for each surface in contact with water

2) Steel Liner

	Outlet Conduit	
	Service	Emergency
. Length	114 m	66 m
. Diameter	1,500 mm	1,500 mm
. Thickness	6 mm	6 mm
. Internal water head	18.0 m	11.53 m
. Corrosion allowance	1 mm	1 mm

14.3.3 Allowable Stress and Safety Factor

Unless otherwise specified, allowable stress or safety factors of materials to be used shall conform to the provisions below. The use of special material shall be subject to the approval of the Engineer.

		ASTM A 283 Garde D and A 36 SS 41 and SM 41	ASTM A 440 SM 50
1)	Tensile stress	1,200kg/cm^2	1,600kg/cm^2
2)	Compressive stress	-do-	-do-
3)	Shear stress	700kg/cm^2	900kg/cm^2
4)	Safety factor	not less than 5	

14.3.4 Welded Joint Effectiveness

Welded joint effectiveness to be used in design shall be as follows:

Type of Joint	Joint Effectiveness		Remarks
	Workshop	Field	
Butt joint	95	90	
Fillet joint	95	90	

14.4 Test and Inspection

14.4.1 The Contractor shall, at his own expense, conduct shop and field test. The plan for shop and field tests shall state the time schedule for such tests, place, outline of testing equipment and test methods. The record of shop tests shall include the name of the test, time and place, results and name of inspector.

14.4.2 Tests and Inspection for Gate and Trushracks

	Item	Shop Tests	Field Tests
1)	Material test	0	-
2)	Qualification test for welding	0	-
3)	Appearance and measurement inspection	0	0
4)	Inspection of trial assembly	0	-
5)	Performance test of operating device	0	-
6)	No load operation test	-	0

14.4.3 Tests and Inspection for Steel Liner

	Item	Shop Tests	Field Tests
1)	Material test	0	-
2)	Qualification test for welding	0	-
3)	Inspection of edge preparation	0	0
4)	Inspection of appearance and measurement of section	0	-
5)	Inspection of welding	0	-
6)	Inspection of painting	-	0

SECTION III. BILL OF QUANTITIES

SECTION VI. BILL OF QUANTITIES

GENERAL DESCRIPTION

1. References

This Bill of Quantities is to be read in conjunction with the Conditions of Contract, the Technical Specifications and Drawings.

2. Descriptions of Works and Materials

General directions and descriptions of works and materials as stated in the Technical Specifications and Conditions of Contract are not necesarily repeated in the Bill of Quantities.

3. Quantities in the Bill of Quantities

The quantities of works and materials in the Bill of Quantities are estimated only and shall not be considered as limiting or extending the works to be done and the materials to be supplied by the Contractor. All the proper works done and materials supplied by the Contractor will be measured and paid for at the unit price quoted in the Bill of Quantities.

4. Unit Price

Unless expressly stated otherwise, all unit price and lump sums entered in the Bill of Quantities shall be deemed to include the following items:

(1) Labour and all costs in connection with the execution of the works.

(2) The supply of materials, goods, storage and all costs in connection therewith including waste and delivery to the site.

(3) Plant, equipment and all costs in connection therewith.

(4) All temporary works necessary for efficient execution of the works, except where temporary works are separately itemized in the Bill of Quantities.

(5) All general obligations, liabilities and risks involved in the execution of the works set forth or reasonably implied in the documents on which the bid is based.

(6) Overheads consisting of personnel expenses, administrative expenses, tax, insurance, duties, profit, etc.

(7) All matters and things necessary for the proper completion and maintenance of the works.

5. Lump-Sums

The lump-sums entered in the Bill of Quantities shall cover all costs for relevant work, service and obligations mentioned in lump-sum item and include an allowance to cover all items indicated in clause 1.1.4 "Unit Price". The lump-sum shall be a fixed amount and no alternation or modification shall be made.

Payment of any lump-sums will be made in accordance with the provisions defined in the relevant item of this Preamble. Unless indicated otherwise against the relevant item, payments will be made by monthly instalments in accordance with the construction period from the commencement to the completion of the relevant works.

6. Measurement and Payment

Measurement for payment shall be made in accordance with the procedures laid down in the Technical Specifications and the Bill of Quantities.

7. Unpriced Items

The Contractor shall fulfill all the requirements and obligations of all clauses of the Conditions of Contract and Technical Specifications. A unit price or amount shall be inserted against eahc item in the Bill of Quantities whether or not quantities are stated. Items against which no unit price or amount has been inserted shall be deemed to be covered by other unit price or amount in the Bill of Quantities. The cost of such requirements or obligations shall be marked NIL in the cash column.

Unit Price inserted in the Bill of Quantities shall further be deemed to include for everything necessary to provide complete and finished to the full extent of the Contract and all works shall be completed and ready for use to the entire satisfaction of the Engineer.

8. Units

The following unit have been used in the Bill of Quantities:-

m	=	meter	hr.	=	hour
cm	=	centimeter	No.	=	number
mm	=	millimeter	Ø	=	diameter
kg	=	kilogramme	ha.	=	hectare
ton	=	tonne	Mon.	=	month
sq.m	=	square meter	L.S.	=	lump sum
cu.m	=	cubic meter	P.S.	=	provisional sum

Bill No. 1 Mobilization, Demobilization and Services

Item	Description	Unit	Quantity	Unit Cost (R.O.)	Amount (R.O.)
1-1	Mobilization, Demobilization and Services				
a)	Provision of Office and Guest House for Engineers	L.S.			
b)	Maintenance of Office and Guest House for Engineers	L.S.			
c)	Dismantling of Office and Guest House for Engineers	L.S.			
d)	Progress Photographs	L.S.			
e)	Construction Drawing	L.S.			
f)	Provision of Laboratory with Apparatus	L.S.			
g)	Labours for Laboratory Tests	Persons	5		
h)	Driver for Engineers	Persons	2		
i)	Cook for Engineer	Persons	2		
j)	Typist for Engineer	Person	1		
k)	Jonitor for Engineer	Person	1		
l)	Vehicles for Engineer	Nos	4		
m)	Survey Equipment for Engineer	L.S.			
n)	Warning Signpost	Nos	20		
o)	Notice Signpost	Nos	3		
p)	Construction of Commemoration Plaque	No	1		
q)	Miscellaneous for Mobilization, Demobilization and Services	L.S.			
	Total of Bill No 1 carried to Summary				

Bill No. 2 Dam Body

Item	Description	Unit	Quantity	Unit Cost (R.O.)	Amount (R.O.)
2-1	Clearing and Stripping	cu.m	23,100		
2-2	Common Excavation	cu.m	44,700		
2-3	Dam Embankment	cu.m	629,300		
2-4	Filter (Vertical)	cu.m	25,600		
2-5	Filter (Horizontal)	cu.m	5,400		
2-6	Slope Surface Trimming	sq.m	76,900		
2-7	Hand Placed Riprap	cu.m	31,700		
2-8	Riprap Bedding (t = 0.25 m)	cu.m	12,200		
2-9	Gabion Constructed at Crest Shoulders	cu.m	450		
	Total of Bill No. 2 carried to Summary				

Bill No. 3 Service Spillway

Item	Description	Unit	Quantity	Unit Cost (R.O.)	Amount (R.O.)
3-1	Clearing and Stripping	cu.m	44,200		
3-2	Common Excavation	cu.m	987,100		
3-3	Reinforced Concrete	cu.m	5,400		
3-4	Reinforcing Bar	ton	60.5		
3-5	Dowel Bar	ton	2.5		
3-6	Plain Concrete	cu.m	350		
3-7	Wet Masonry	cu.m	850		
3-8	Boulder Concrete	cu.m	1,100		
3-9	Gabion	cu.m	26,000		
3-10	Hand Placed Riprap	cu.m	13,500		
3-11	Embankment of Dike	cu.m	37,800		
3-12	Slope Surface Trimming	sq.m	5,500		
3-13	Underdrain	cu.m	150		
3-14	Geotextile Mat	sq.m	55,400		
	Total of Bill No. 3 carried to summary				

Bill No. 4 Emergency Spillway

Item	Description	Unit	Quantity	Unit Cost (R.O.)	Amount (R.O.)
4-1	Clearing and Stripping	cu.m	26,000		
4-2	Common Excavation	cu.m	367,000		
4-3	Plain Concrete	cu.m	1,500		
4-4	Wet Masonry	cu.m	2,800		
4-5	Gabion	cu.m	14,800		
4-6	Hand Placed Riprap	cu.m	6,800		
4-7	Dike Embankment	cu.m	4,300		
4-8	Slope Surface Trimming	sq.m	700		
4-9	Underdrain	cu.m	200		
4-10	Geotextile Mat	sq.m	23,500		
	Total of Bill No. 4 carried to Summary				

Bill No. 5 Service Outlet Conduit

Item	Description	Unit	Quantity	Unit Cost (R.O.)	Amount (R.O.)
5-1	Common Excavation	cu.m	5,000		
5-2	Backfill	cu.m	800		
5-3	Plain Concrete	cu.m	200		
5-4	Reinforced Concrete	cu.m	750		
5-5	Reinforcing Bar	ton	22		
5-6	Steel Liner (ϕ1,500mm, t=6mm)	m	114		
5-7	Trashrack	ton	1.3		
5-8	Perforated PVC Pipe (ϕ300mm ℓ=1.0m)	pcs	6		
5-9	Wet Masonry	cu.m	320		
5-10	Hand Placed Riprap	cu.m	180		
5-11	Debris Deflection (steel rail)	set	1		
	Total of Bill No. 5 carried to Summary				

Bill No. 6 Emergency Outlet Conduit

Item	Description	Unit	Quantity	Unit Cost (R.O.)	Amount (R.O.)
6-1	Common Excavation	cu.m	4,400		
6-2	Backfill	cu.m	1,700		
6-3	Plain Concrete	cu.m	200		
6-4	Reinforced Concrete	cu.m	500		
6-5	Reinforcing Bar	ton	12		
6-6	Steel Liner (ϕ1,500mm t=6mm)	m	66		
6-7	Trashrack	ton	1.6		
6-8	Steel Gate	set	1		
6-9	Wet Masonry	cu.m	350		
6-10	Debris Deflection	set	1		
	Total of Bill No. 6 carried to Summary				

Bill No. 7 Dispersion Facilities

Item	Description	Unit	Quantity	Unit Cost (R.O.)	Amount (R.O.)
7-1	Clearing and Stripping	cu.m	1,300		
7-2	Common Excavation	cu.m	10,300		
7-3	Sand Bed	cu.m	30		
7-4	Corrugated Steel Pipe (ϕ1,200mm t=2mm ℓ=1.0m)	nos	57		
7-5	Dike Embankment	cu.m	4,200		
7-6	Gabion	cu.m	1,400		
7-7	Hand Placed Riprap	cu.m	1,200		
7-8	Wet Masonry	cu.m	40		
7-9	Slope Surface Trimming	sq.m	3,900		
7-10	Geotextile Mat	sq.m	4,800		
7-11	Debris Deflection	set	1		
	Total of Bill No. 7 carried to Summary				

Bill No. 8 Water Level Gauge

Item	Description	Unit	Quantity	Unit Cost (R.O.)	Amount (R.O.)
8-1	Common Excavation	cu.m	40		
8-2	Plain Concrete	cu.m	40		
8-3	Gabion	cu.m	50		
8-4	Fabrication of Steel Tower	set	1		
8-5	Automatic Water Gauge	set	1		
8-6	Installation of Tower	set	1		
8-7	Staff Gauges	set	4		
	Total of Bill No. 8 carried to Summary				

Bill No. 9 Observation Well

Item	Description	Unit	Quantity	Unit Cost (R.O.)	Amount (R.O.)
9-1	Common Excavation	cu.m	30		
9-2	Plain Concrete Pack	cu.m	1		
9-3	Drilling (10 inch)	m	270		
9-4	Gravel Pack	cu.m	15		
9-5	Reinforced Concrete	cu.m	5		
9-6	Reinforcing Bar	ton	0.4		
9-7	Provision & Installation of 10-inch Steel Casing	m	20		
9-8	Provision & Installation of 4-inch PVC Pipe	m	155		
9-9	Provision & Installation of 4-inch PVC Screen	m	95		
9-10	Pumping Test (12 hrs/well)	hr	60		
9-11	Well Development	hr	30		
	Total of Bill No. 9 carried to Summary				

Bill No. 10 Relocation Road

Item	Description	Unit	Quantity	Unit Cost (R.O.)	Amount (R.O.)
10-1	Common Excavation	cu.m	2,000		
10-2	Grading of Road Surface	100sq.m	147		
10-3	Maintenance	L.S.			
	Total of Bill No. 10 carried to Summary				

Bill No. 11 Protection of Historical Facility

Item	Description	Unit	Quantity	Unit Cost (R.O.)	Amount (R.O.)
11-1	Clearing and Stripping	cu.m	1,400		
11-2	Dike Embankment	cu.m	2,400		
11-3	Hand Placed Riprap	cu.m	700		
11-4	Slope Surface Trimming	sq.m	2,300		
	Total of Bill No. 11 carried to Summary				

Bill No. 12 Diversion Facilities

Item	Description	Unit	Quantity	Unit Cost (R.O.)	Amount (R.O.)
12-1	Clearing and Stripping	cu.m	5,100		
12-2	Common Excavation	cu.m	66,600		
12-3	Embankment	cu.m	32,200		
12-4	Hand Placed Riprap	cu.m	750		
12-5	Slope Surface Trimming	sq.m	2,500		
	Total of Bill No. 12 carried to Summary				

SUMMARY OF COSTS

BILL NO.	Description	Amount
1	Mobilization, Demobilization and Services	R.O. _____
2	Dam Body	R.O. _____
3	Service Spillway	R.O. _____
4	Emergency Spillway	R.O. _____
5	Service Outlet Conduit	R.O. _____
6	Emergency Outlet Conduit	R.O. _____
7	Dispersion Facilities	R.O. _____
8	Water Level Gauge	R.O. _____
9	Observation Well	R.O. _____
10	Relocation Road	R.O. _____
11	Protection of Historical Facility	R.O. _____
12	River Diversion and Care of Water	R.O. _____
	Total of Bill No. 1 to 12	R.O. _____
	Contingencies (10% of Bill Nos 1-12)	R.O. _____
	Provisional Sum for Inspection, Cleaning and Repairs during the Maintenance Period	R.O. _____
	Total Carried to Form of Tender	R.O. _____

SECTION IV. SCHEDULE OF DAYWORK RATES

SECTION VII. SCHEDULE OF DAYWORK RATES

a) Labour

The Rates for the various classes of labour in the Schedule shall cover all the Contractor's obligations whatsoever in providing and maintaining such labour at the place of work including wages, payment for special conditions and for skill, bonus, travelling and subsistence allowance and expenses, watching and lighting, insurances of all kinds, site supervision, administrative and welfare charges, the use and maintenance of protective clothing, the use and maintenance of staging, scaffolding, portable electric tools, non-mechanical plant and hand tools of every kind, overheads, profit and all incidental expenses.

The time of gangers or charge-hands working with their gangs will be paid for at the Contract Rate for "ganger", but the cost of supervision-foremen and walking-gangers shall be deemed to be included under site supervision.

The Contract Rates for labour are for units of man-days and a day shall be deemed to relate to a working day of eight (8) hours. However, the work efficiency of labours during the holy month of Ramadan will be reduced. Any less time shall be rounded to the nearest hours or half-hour and an hourly rate with 30% surcharge will be applied. Thereby the maximum daily wage shall not exceed that of 8 hours. Any overtime in excess of 8 hours shall be rounded to the nearest hours or half-hour and an hourly rate with 30% surcharge will be applied.

b) Plant

The Rates for plant in the Schedule shall apply to all plant whether belonging to the Contractor or hired by him and shall cover all the Contractor's obligations whatsoever in providing and maintaining such plant at the place of work including all fuel and lubricants, all ancillary equipment necessary for efficient operation and use of the plant, overheads and profits but excluding operators.

Payment for plant on daywork will be limited to items listed in the Schedule unless otherwise agreed by the Engineer.

The Rates for plant shall apply both to plant which is already available at Site and to plant brought to Site especially for daywork but in the latter case the Contractor shall be paid his additional costs in transporting such plant to and from the Site.

SCHEDULE OF DAYWORKS

No.	Description	Unit	Rate (R.O)
A.	Labour		
A-1	Foreman	hour	
A-2	Skilled Labour	"	
A-3	Unskilled Labour	"	
A-4	Operator	"	
A-5	Iron Worker	"	
A-6	Mason	"	
A-7	Ganger	"	
B.	Material		
B-1	Cement	ton	
B-2	Gabion Cage	No.	
B-3	Concrete Aggregate	cu.m	
B-4	Cobbles	"	
B-5	Steel Bar	ton	
C.	Equipment		
C-1	Bulldozer, 18-ton class	hour	
C-2	-do-, 21 ton	"	
C-3	Front End Loader, 4.0 cu.m	"	
C-4	Backhoe Shovel, 1.2 cu.m	"	
C-5	Dump Truck, 20 ton	"	
C-6	-do- , 10 ton	"	
C-7	Vibrating Roller, 11 ton	"	
C-8	Water Lorry, 10 cu.m	"	
C-9	Crane, 15 ton	"	
C-10	Grader, 150 HP	"	

SECTION V. TENDER DRAWINGS

SECTION V. TENDER DRAWINGS

Dwg. No.1.	General Plan	
" 2.	Detention Dam	(1) (Typical Section and Profile)
" 2.	"	(2) (Cross Section)
" 4.	"	(3) (Cross Section)
" 5.	Service Spillway	(1) (Profile & Plan)
" 6.	"	(2) (Detail of Cross Section, Access) Road
" 7.	"	(3) (Typical Section of Weir)
" 8.	"	(4) (Detail of Staff Gauge)
" 9.	"	(5) (Detail of Weir)
" 10.	"	(6) (Detail of Cross Section)
" 11.	"	(7) (Detail of Cross Section)
" 12.	Emergency Spillway	(1) (Plan & Profile)
" 13.	"	(2) (Detail of Weir and Typical) Section
" 14.	"	(3) (Typical Cross Section)
" 15.	"	(4) (Weir and Staff Gauge)
" 16.	Service Outlet	(1) (Plan and Profile)
" 17.	"	(2) (Drop Inlet and Trash Rack)
" 18.	"	(3) (Under Drain)
" 19.	"	(4) (Typical Section and Detail of Conduit)
" 20.	"	(5) (Tailrace)
" 21.	Emergency Outlet	(1) (Plan and Profile)
" 22.	"	(2) (Detail of Conduit Entrace)
" 23.	"	(3) (Trash Rack)
" 24.	"	(4) (Steel Roller Gate)
" 25.	"	(5) (Detail of Roller Gate Portion)
" 26.	"	(6) (Typical Section and Exist) Section
" 27.	"	(7) (Trailrace)

Dwg.No.28.	Dispersion Facilities	(1) Location Map, Longitudinal Profile Typical Section, Connection Channel
" 29.	"	(2) Detail
" 30.	"	(3) Connection Channel
" 31.	Water Level Gauge	
" 32.	Observation Well	
" 33.	Debris Deflectors	
" 34.	Associated Facilities	
" 35.	Map of Water Surface	
" 36.	Location Geometric	
" 37.	Coffer Dam