

**GOVERNMENT OF KHYBER PAKHTUNKHWA  
IRRIGATION DEPARTMENT**



**TORs/Guidelines for submission of Proposal  
For**

**Design Review and Construction supervision of Zangotai  
Small Dam District North Waziristan**

**Issued to: \_\_\_\_\_**

**PROJECT DIRECTOR PSU SMALL DAMS, MERGED AREAS**

**DIRECTORATE GENERAL SMALL DAMS**

**SEPTEMBER 2021**

*152*  
**Asstt: Director (PSU)  
Small Dams Section  
Merged Area, Irrg. Deptt.**

## TORS & GUIDE LINES FOR ZANGOTAI SMALL DAM NORTH WAZIRISTAN

### INFROMATION TO CONSULTANTS REGARDING ZANGOTAI SMALL DAM DISTRICT NORTH WAZIRISTAN

The proposed dam site is located in district North Waziristan. The objectives of the project is to conserve flood flows and provide dependable irrigation supplies for the development of irrigated agriculture in the command area located downstream of the proposed dam site. This report covers topographic surveys, hydrology& sedimentation, geology& geo-technical investigations, environmental and engineering aspects beside costing and economic - financial studies.

The proposed dam has a catchment area of 35.38 sq-km (17.67 sq-miles). The drainage divides of the catchment area lie at Pak-Afghan border in district North Waziristan. The daily rainfall data of Bannu gauging station for period of 1970-2018 used in hydrological calculations. Average annual rainfall is 332 mm (13.07 inch). The mean annual inflow at proposed dam site is estimated as 200 Ha m (1623 acre-feet). Designed flood for spillway against 500 years return period is likely to be around 518.36 Cumec (18068 Cusecs).

The geological features of the project area have been evaluated on the basis of the exposed geology and sub-surface investigations conducted. At the proposed dam structural area overburden of about 1-2 meters exists. Geologically the dam area is composed of igneous rocks categorized as ultramafic include harzburgites, pyroxenites, dunites, peridotites and serpentinites. The bed rock defined on right abutment is meta basalt (altered basalt) below overburden. The left abutment is composed of meta igneous rock (Amphibolite) whereas in the main stream have meta basalt after natural cover with overburden material. The overburden is mainly alluvial deposits consisting of pebbles, gravels sand, silt and clayey material.

Samples of soils were collected and got analyzed in soil and water testing laboratories. Major textural groups constitute of sandy loam. Dominant part of the surface soil as well as soil profile is infested with gravels and cobbles. Seedbed preparation is not easy in these soils as the surface is covered with gravels.

The water quality assessment for its suitability to agriculture purposes were also made by collecting both surface and underground water samples and were analyzed. From the test results it is evaluated that water is suitable for irrigation purposes and it is of good quality.

From the topographic surveys it is clear that the Gross Command Area (GCA) is 1100 acres having 600 acres as Culturable Command Area (CCA). The cropping pattern has been proposed in such a way that it should provide maximum benefits to the farmers and should fulfill food grains requirements of the locals. Maximum area in the cropping pattern has been allocated to wheat and maize of 55% and 45% respectively. Annual cropping


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intensity is proposed as 115%, having 52% in Kharif and 59% in Rabi seasons. The cropping pattern is quite similar with the agriculturally developed area of the surroundings.

Environmentally, a limited negative impact will be there during construction in shape of dusts, noise etc, but efforts will be made to minimize the same. The project construction will offer benefits in terms of employment opportunities to local population. Significant positive environmental impacts during operation stage are envisaged. The visualized project benefits will accrue in terms of agricultural expansion, employment opportunities for locals and overall improvement in economy of the project area.

A 29 m high dam (zoned embankment type) has been proposed. The length and the width of the dam crest is 222m and 6 m respectively. Stability of the embankment dam has been ascertained through adopting the standard procedures for embankment design. Numerical models were developed to analyze slope stability, seepage through core and settlement of the dam body. Spillway is proposed to be located on the left side of dam. The spillway envisioned to be 70 m (229.66 feet) ogee type structure with a discharge capacity of about 518.36 Cumecs (18068 cusecs). The spillway width is tapered to 50m at the end of chute. The intake structure is located at right abutment. It is a vertical tower type structure, and will be capable of withdrawing water of the reservoir during the project operation. The conduit is proposed to be placed at lower level, so as to be used for conveying limited flows during construction period as well. It will be a steel pipe properly incased in reinforced concrete with collars at appropriate locations. Irrigation network consists of main channel and minors. The designed capacity of main channel is proposed to be 0.11 Cumecs (3.71 cusecs). Total length of irrigation network will be 8.030 km.

Cost Estimates has been prepared on MRS-2020 with location factor of 1.08 for the project area. The cost of the project is assessed as Rs.801.763 million. Keeping in view the scope and quantum of work involved construction period for the project is proposed as 24 months. Economic Internal Rate of Return (EIRR) is estimated as 12.02%.

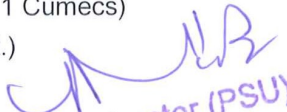
  
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### SALIENT FEATURES

1.	Main Dam	
	Type	Earth Core Rock Fill Dam (ECDRD)
	Crest Elevation	1504 m (4934.34 ft.) AMSL
	Normal pool Level	1500 m (4921.50 ft) AMSL
	Free Board	1.69 m (5.54 ft)
	Crest width	6 m (19.68 ft.)
	Slope upstream face	2.5 H : 1.0 V
	Slope downstream face	2.25 H : 1.0 V
	Height	29 m (95.14 ft.)
	Length of Dam	222 m (728.38ft)
2.	Reservoir	
	Reservoir Area	8.2 Ha (20.2 acre)
	Catchment Area	35.38 Km <sup>2</sup> (13.67 miles <sup>2</sup> )
	Average Annual Rainfall	332.05 mm (13.07 Inch)
	Estimated Average Annual Runoff	200 Ha m (1623 AF)
	Gross storage capacity	82.2 Ha m (666 AF)
	Live storage capacity	68.77Ha m (557 AF)
	Dead storage capacity	13.4 Ha m (109 AF)
3.	Spillway	
	Spillway type	Ogee with Stilling Basin
	Width of spillway	70 m (229.66ft.)
	Outflow against 500 yr Return Period	518.36 Cumecs (18068 Cusecs)
	Surcharge over Spillway	2.31 m (7.58 ft)
4.	Intake Structure and Irrigation Conduit	
	Intake Type	Tower type with access bridge
	Irrigation Conduit Length	108.78 m (355.57 ft.)
	Size of conduit	0.75 m (2.5 ft) dia
	Invert level at intake	1487 m (4878.61 ft.) AMSL
5.	Irrigation System	
	Gross Command Area (GCA)	445.34 Ha (1100 acres)
	Cultivable Command Area (CCA)	242.91 Ha (600 acres)
	Water Demand	154.15 Ha m (1249.22 Acre-ft)
	Design Discharge	3.71 Cusecs (0.11 Cumecs)
	Length of Channel	8030 m (26345 ft.)
6.	Economic Analysis	
	EIRR (%)	12.02 %
	NPV	Rs. 114.093 million
	B/C Ratio	1.19 :1
7.0	Estimated Cost	Rs. 860 million

  
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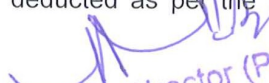
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### INSTRUCTIONS REGARDING SUBMISSION OF PROPOSALS

1. Two copies of the technical and one copy of financial proposals in stippled/fixed binded form are required to be submitted. Proposal should be in a sealed envelop indicating original or copy on each enclosure, as appropriate.
2. The proposals shall be valid for a period of 180-days after the last date of submission, which is extendable on the expiry of above period through mutual agreement.
3. The technical and financial proposals of the consultants will be evaluated according to criteria for procurement of consultancy services of the Government of Khyber Pakhtunkhwa, applying weight-age formula of 80:20 for technical and financial proposals respectively.
4. Financial proposals "Technically Qualified" consulting firm will be considered and opened by competent forum in presence of the competitive firms representatives. The contract agreement will be governed by laws and regulations of the Govt. of Khyber Pakhtunkhwa.
5. Any observation on the TOR and LOI must be brought into the notice of the department before last date of submission of the proposals. No objection will be entertained after the submission of Technical and Financial proposals.
6. The employer reserves the right for any addition alteration or amendment in the TOR of the Project.
7. Consultants shall be responsible for payment of all taxes in vogue time to time by Govt in respect of personnel and other activities with no liability to the client.
8. Originally signed CVs of the proposed personnel having contact number and postal address along with availability certificate of the personnel for the Project shall be annexed in the Technical proposal.
9. The consultants shall quote the fee including detailed breakup cost and unit cost of all type of studies/investigations including review of previous studies, topographic surveys, Hydrological, Geological, Geo-technical, Environmental, Social and all other surveys, studies required for the assignment.
10. Payment for the personnel will be made as per actual time consumed on the Project but not in excess of the provision of man months made in the T.O.R. of consultancy.
11. Payment to the consultants for Geo-technical investigation and other investigation will be made as per actual work done at the site on the unit cost quoted by the consultant.
12. On the satisfactory performance of the services, the payment to the consultants shall be made as per actual inputs, while in case of incomplete assignment; the payment will be made for the work done in accordance with the breakup of the services submitted by the consultants.

### Other Conditions: -

- 1) Security deposit and income tax/sale tax etc will be deducted as per the prevailing Government rules notified during period of agreement.

  
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- 2) The consultant shall establish Project Manager Office at Peshawar.
- 3) Consultants shall appear in Project meetings and site visits and shall also make presentation if so directed by the department for which no TA/DA, boarding, lodging and claim for incidental charges etc, shall be entertained.
- 4) The consultant except with prior approval of the department shall not sublet the study or any part thereof.
- 5) The consultancy charges shall be inclusive of all costs of topographic survey, subsurface investigations, geophysical surveys and construction materials investigations etc.
- 6) The consultants will provide undertaking for the effect that the key staff would not be employed on the other projects during the currency of this agreement. Any violation will liable the contract for termination.
- 7) If the consultant fails to complete any activity or part of activity the client reserve the right to execute the same at the consultant risk & cost.
- 8) If a project or part of project is dropped due to any reason, man months of the consultant key staff and logistics will be curtailed proportionally.
- 9) Consultant shall quote cost/fees for each stage of study separately i.e. Design Review& Construction Supervision,
- 10) Single agreement will be signed for both stages (Review & Design). However separate letter for supervision will be issued after actual work start at site.
- 11) As per KPPRA rule ( Para 24.2 standard procedure for selection of Consultant) successful consultant is required to submit performance security in form of Pay order , demand draft or bank guarantee @ 5 % of bid cost.
- 12). If the client (Irrigation Department) suffers any lose due to proven Design/ Supervision fault by the consultant. The consultant will be liable to punitive action as per invoke PEC/KPPRA.
- 13) Third party validation of the detail Engineering Design, if required will be paid and arranged by consultant as approval of consultant

  
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### EVALUATION CRITERIA OF PROPOSALS

Proposals of the consultancy firms will be evaluated as under

S.No	Description	Maximum Marks
A	Qualification & Experience of Technical Key Personnel	50
B	Experience of firm in undertaking Projects of dam & Hydraulic structures of similar nature & complexity	30
C	Work Plan/Manning Schedule & Methodology	20
	<b>Total</b>	<b>100</b>

Note.

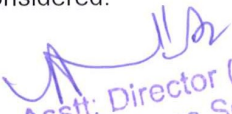
- Each page of the proposal must be numbered, sealed & signed by the owner of firm
- Passing marks in each category will be 60%
- Proposals must be stippled binded. Ring binding will not be considered.
- Client reserves the right to make any change in TORs & marking criteria which is commonly applicable to all proposals
- Any observation/clarification required should be brought in notice of the Client / Employer before submission of the proposal during clarification meeting.
- Proposals shall be submitted in two copies (Marked as Original & Copy)
- Any mis-statement or false information provided in the technical or financial proposal will render the proposal as non-responsive and shall make the firm liable for punitive action under the relevant rules.

#### A. Qualification & Experience of Technical Key Personnel

##### ii. Marking criteria of Personnel

S.No	Description	Marks	Criteria
1	Qualification	20	B.Sc. Eng. or M.Sc. (16 Years Education)=80%, MS or M.Phil.=90%, Ph.D.=100%
2	Languages	05	Pashto=2 (R W S) Urdu=1.5 (R W S) English=1.5 (R W S)
3	Experience	30	
	General Experience	7.5	Experience after completion of 16 Years education (15 years of general experience will carry full marks)
	Relevant Experience	15	Experience of particular discipline(10 years of general experience will carry full marks)
	Similar (DAM) Projects	7.5	Full marks for 10 Projects
4	Experience of Local Environment	05	Khyber Pakhtunkhwa=03 Pakistan=02
	<b>Total</b>	<b>60</b>	<b>Will be adjusted to 50</b>

iii. This proforma must be available on top of each CV in addition to the information to be provided as per standard format, Otherwise will not be considered.

  
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1	2	3	4	5	6		
S#	Position	Proposed Personnel	Qualification	Knowledge of Languages	Experience		
					General	Relevant	Dam Projects
7	8	9					
Working Environment/Location	Cell No	Duration with firm					

Note.

- The proposals must contain salary details, last degree, PEC registration certificates of the key staff
- The Personnel & owner of the firm must sign each CV in Original.
- Personnel above the age of 70 will not be eligible

### **B. EXPERIENCE OF FIRM.**

S.No	Description	Maximum Marks
1	Relevant/Specific Experience of Firm (Completed/In progress Dam Projects in last 10 Years)	18 Feasibility Study= 25% marks, Detailed Design= 25% Marks, Procurement= 10% Marks Construction supervision= 40% Total= 100%
2	General Experience of Firm (Any completed Project of Hydraulic Structures in last 10 Years)	12 Feasibility Study= 25% marks, Detailed Design= 25% Marks, Procurement= 10% Marks Construction supervision= 40% Total= 100%

Note

- Five (05) Projects in each category will entitle the firm for full marks as per details stated below
- Consultancy Services of the Projects with cost less than Rs 400 million will not be considered.
- Award & completion documents must be available in support of projects claimed as experience
- Below proforma must be attached for any projects of sr No 1 & 2 in addition to standard format.

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1	2	3	4	5	6	7
S#	Name of Project	Location with Province & Country	Client	Address, Phone & Fax No of Client	Handled as: • Single Firm/ : • Lead Firm/ : • Joint Venture : Partner	Cost of Project
8	9	10		11		
Cost of Services	Scope of services • Feasibility • Detailed design • Procurement • Construction Supervision	Scope of Work				

### UNDERTAKING

It is hereby certified that the above are true statements based on facts and we take full responsibility for the correctness and accuracy of the information supplied herein to the best of our knowledge and belief. This is also to certify that the owner/partners/directors working solely for the consulting engineering profession. This is further to certify that we are independent consulting engineer and have no interest in any construction and conflicting commercial industrial and business activities which are likely to influence our professional independence and neutrality. We also undertake to fully abide by KPPRA act/rules & the Pakistan Engineering Council (Conduct and Practice of Consulting Engineers) Byelaws 1986 & registered with Khyber Pakhtunkhwa Revenue Authority

### TERMS OF REFERENCE FOR DESIGN REVIEW

1. Carry out additional topographic Geodetic, Geophysical surveys (if required and with approval of the client) for the detailed design of dam, appurtenant structures, command area, reservoir area, irrigation system and access road at appropriate scales for construction of the dam project.
2. Carry out additional sub-surface geo-technical investigation (if required and with approval of the client) at dam site and appurtenant structures, reservoir area, CCA and Irrigation network. The investigation will include necessary drilling of bore holes (core drilling) and collection of core samples excavation of test pits, trenches, collection of surface and sub-surface sampling field and laboratory analysis & testing.
3. Carry out review of the Project components including dam embankment, spillway, irrigation conduit, intake and outlet structures, irrigation network, intake structure for drinking water supply, road and buildings etc including the prospects & validity of future rising of the Dam.
4. Physical investigation of dam & reservoir periphery within 500-meter proximity of reservoir / Dams for studying and reporting behavior of seepage through dam/ reservoir

  
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5. Sediment Study & modeling for estimation of appropriate sedimentation & life of reservoir
6. Seismic criteria for resistance against earthquake on Dams and all ancillary components shall be applied in the review/ updation.
7. Prepare and submit draft design review report, specifications, tender drawings and tender documents.
8. Prepare and submit Review of Design Report, specification, tender drawings and tender documents.
9. Revision of PC-I due to cost overruns, changes in design approach with time or change in physical scope of work& submission of Revised PC-I in required number.
10. Prepare and submit construction drawings.
11. Periodic review of the construction drawings in accordance with latest site situation & requirements as proposed by the consultants/client from time to time.
12. Carry out Detail Command Survey & layout of canal network.
13. Preparation of chakbandi & warabandi system for Irrigation system.
14. Submission of complete Detail design calculations of all component of Dam in separate chapters.
15. Backup data for all design calculation will be provided to client
16. Keep provision of future rising of Dam in design if required/possible.
17. Determine capital cost, recurrent cost estimate of various components of the project using current schedule of rates (MRS 2020 Khyber Pakhtunkhwa or any other approved by Government of Khyber Pakhtunkhwa).
18. Preparation of construction Schedule, CPM and Cash Flows.
19. The consultant shall submit separate comprehensive report on revalidation/ authentication of all aspects of the detail design already completed.

### **TERMS OF REFERENCE FOR CONSTRUCTION SUPERVISION**

1. Review of Design documents for any omission / correction etc before start of construction activities.
2. Review of Construction Drawings.
3. Assist the employer in Tendering Process/Bid Evaluation.
4. Approval of construction schedule submitted by contractor.
5. Supervise construction of the project in the capacity of Engineers Representative, to ensure that the project including all components are being constructed satisfactorily in accordance with approved drawing design specifications and required quality. Incase of any variation a detail report duly supported with document, laboratory tests be submitted to the Client / Employer, through the Engineer for the project.
6. Submission of Revised Construction Drawings in accordance with actual site conditions including detail survey for project component/additional project component.

  
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7. Supervise and check the setting out of all component structures and general layout of the project.
8. Recommend to the client the source of appropriate construction material, for approval.
9. Coordinate between contractor and employer to implement the project in accordance with the contract.
10. Supervise the material testing in contractor's field laboratory and keep record of respective test reports.
11. Provide adequate technical assistance, consultation and advice to the Client / Employer in matters that crop up during execution, may include redesigning and connected issues.
12. Prepare and submit Monthly Progress Report to the Client / Employer.
13. Participation and Coordination in progress meeting convened at site and in Regional or Divisional offices at Peshawar or any other place as and when required.
14. Furnish "Detail Cost Estimate" and make periodic updating of the cost of project along with reasons for increase/decrease of cost of individual items.
15. Revision of PC-I if cost of the project over runs beyond approved cost or if there is a substantial change in the scope of work but the project cost remains within the approved cost.
16. Verification/checking of contractors statements of executed quantities for making progressive payment to the contractor.
17. Verification and checking of the interim and final payment to the contractor for approval of the employer.
18. Provide adequate consultation and advice to the employer on contractual issues/corrigendum (s).
19. Initiation and Issuance of variation order after approval of the employer.
20. To provide sufficient and appropriate technical and support staff at site as per requirement or as directed by Client / Employer in the interest of work.
21. Preparation of chakbandi and warabandi for outlets in the Irrigation system.
22. To submit duly verified as built drawings.
23. The consultants shall provide assistance during the defect liability period and visit the project from time to time for pointing out any defect etc. the same shall be reported to the employer in the form of punch list and monitor its rectification.
24. To appear, if required, and assist the client in the court of law, in case of any litigation by the contractor or stakeholder.

  
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### REPORTING AND DOCUMENTATION FOR

#### REVIEW OF DESIGN

- i. Preparation of draft design review report, draft construction drawing, draft tender documents and specifications (05 copies).
- ii. Preparation final updated detail design review report, construction drawing, tender documents and specifications documents ( 05 copies).
- iii. Preparation of regular monthly progress report (05 copies).

#### CONSTRUCTION SUPERVISION

- i. Preparation of regular monthly progress report (05 copies).
- ii. Preparation and submission of as built drawings in ( 05 copies).
- iii. All correspondence, surveys, lab test results and construction drawings along with soft copies in binded form.
- iv. Preparation of Chakbandi and Warabandi.
- v. Preparation of operation and maintenance manual for the project.
- vi. Preparation of PC-IV for the project (05 copies).
- vii. Preparation of draft revised PC-I Proforma in (05 copies) and final revised PC-I Proforma in required numbers if required as directed by the client.
- viii. Preparation and submission of Punch list in deficit liability period.

### MODE OF PAYMENT

#### Review of Design (Completion period 03-months)

- I. Submission of draft updated design review report, draft construction drawing, draft tender documents and specifications.50%
- II Submission of final updated detail design report, construction drawing, tender documents and specifications documents. 50%

#### Construction Supervision (Completion period24-months)

- I. Payment will be made to the consultants as per actual physical & personnel inputs regardless of the approval/award of submitted proposals.
- II. No other expenses as Remunerations or Direct cost will be paid to the consultants by the client.
- III. 5% of each running payment shall be withheld by the employer as security deposit, which shall be released on satisfactory completion of services and submission of all reports/documents stipulated in TOR and admittance, thereof by the employer.

**Note:** The mode of payment indicated is tentative subject to alteration and is not to be considered as the cost of any activity but it is progressive payment for the facilitation of the consultants.



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### PROFESSIONALS/ KEY PERSONNEL'S REQUIREMENTS

Consultant Bid Cost will be sum of Key Personnel's & Logistic requirement as per below details. Payment of survey, other investigation & vehicle (Running & maintenance) will be made as per actual inputs & will be adjusted in the end of study

#### A. DESIGN REVIEW - 03 Months

##### SALARY COST

S.No	Description	Months	Rate (Rs)	Amount (Rs.)
1	Project Manager	3.0		
2	Design Engineer	2.0		
3	Hydraulic Engineer	2.0		
4	Hydrologist	2.0		
5	Irrigation Engineer	2.0		
6	Agriculture and Soil Expert	2.0		
7	Lab Technician	3.0		
8	Quantity Surveyor	3.0		
9	Surveyor/Inspector	3.0		
10	Geologist	2.0		
11	Helpers	6.0		
Sub Total				

##### DIRECT COST

S.No	Description	Months	Rate(Rs)	Amount
1	Monthly provision for head office, site office, furniture, computers, utility bills, stationery and vehicle etc	3		
2	Mobilization/Demobilization of drilling rig/Geo Tech investigation machinery	1		
3	Drilling by diamond drilling, holes of minimum 75 mm dia, vertical or at specified inclination using diamond core drilling bit, double barrel tube in masonry, concrete or rock including cost of materials, machinery, labour , water , collection of core samples , logging & labeling samples, supplying wooden core box and re drilling in case of collapse of sides etc, complete excluding cost of mobilization & demobilization.( For depth 0 to 50 m vertical and inclined)	60 m		
	Laboratory Testing (Mentioned in TORS)			
Sub Total				
Total for Design Review				

#### B. CONSTRUCTION SUPERVISION - 24 Months

##### a. Salary/Remuneration Cost

S.No	Description	Man Month	Rates (Rs.)	Amount
1	Project Manager /Team Leader	8.0		
2	Design Engineer	3.0		
3	Resident Engineer	24.0		
	Assistant resident Engineer	24.0		
4	Laboratory Technician	24.0		
5	Quantity Surveyor	12.0		
6	Surveyor	24.0		
7	Work Supervisor	24.0		



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8	CAD Operator	12.0		
9	Inspector for Defect Liability Period (DLP)	12.0		
10	Geologist	3.0		
11	Ziladar for preparation of chakbandi and warbandi	6.0		
12	Patwari as assistant to Zilladar	6.0		
			<b>Total a</b>	
<b>b. Supporting Staff</b>				
1	Computer Operator	24		
2	Driver	24		
3	Peon	24		
4	Chowkidar	48		
			<b>Total b</b>	
<b>c. Direct Cost</b>				
S.No	Description	Man Month	Billing Rates (Rs.)	Total Amount (Rs.)
1	Furnished Office & Accommodation	24		
2	Utilities, Electricity, Water , Heating and Telephone etc	24		
3	Office supplies, Stationery + Fax, Photostat, Courier etc.	24		
4	Rental Vehicle Including POL , repairs etc;	24		
			<b>Total c</b>	
			<b>Total B = (a+b+c)</b>	
			<b>Grand Total (A+B+C)</b>	
			<b>Grand Total Rs. Million</b>	

### **Qualifications and Experience of consultant's key personnel.**

Consultants will assign adequately qualified key personnel to carry out the implementation of the Project as described in TOR, person-month inputs for which are indicated above. The key personnel should possess the qualifications and experience as indicated against each position.

#### **Project Manager/Team Leader**

- ❖ Should have at least a Bachelor Degree in Civil Engineering from a recognized university. Additional qualification will carry extra marks
- ❖ Should be able to lead the team of consultations and assist Small Dams Organization in timely completion of the services with quality output.
- ❖ Overall experience should be 15-years with 5-years in design related activities and 02-years as Team Leader for the Projects.

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### **Design Engineer/ Dam Specialist**

- ❖ Should have Master degree in Water Resources / Dam Engineering from recognized university.
- ❖ Post Master qualification in related discipline will be given additional weight age.
- ❖ He should have at least overall experience of 15-years with 5-years' experience in exposure to the design related activities.

### **Hydraulic Specialist**

- ❖ Should have Master degree in Water Resources / Hydraulics from recognized university.
- ❖ Post Master qualification in related discipline will be given additional weight age.
- ❖ He should have at least overall experience of 15-years with 5-years' experience in exposure to the design related activities.

### **Geologist**

- ❖ Should have Master/M. Phil degree in Geology from recognized university.
- ❖ Post Master qualification in related discipline will be given additional weight age.
- Should have at least overall experience of 15 years with 5-years' experience in exposure to the related activities

### **Hydrology Expert**

- ❖ Should have Master degree in Water Resources from recognized university.
- ❖ Post Master qualification in related discipline will be given additional weight age.
- ❖ He should have at least overall experience of 15-years with 5-years' experience in exposure to the design related activities.

### **Irrigation Engineer**

- ❖ Should have Master degree in Irrigation/Water Resources from recognized university.
- ❖ Post Master qualification in related discipline will be given additional weight age.
- ❖ He should have at least overall experience of 15-years with 5-years' experience in exposure to related activities.

### **Soil and Agriculture Expert**

- ❖ Should have Master degree in Agriculture or equivalent qualification in the field from recognized university.
- ❖ Post Master qualification in related discipline will be given additional weight age.
- ❖ He should have at least overall experience of 15-years with 5-years' experience in exposure to related activities.

## TORS & GUIDE LINES FOR ZANGOTAI SMALL DAM NORTH WAZIRISTAN

### **Resident Engineer**

- ❖ Resident Engineer will be a graduate Civil Engineer. He will have at least 15 years of professional experience in the similar type of projects & preference will be given to the similar projects supervised in merged area.

### **Assistant Resident Engineer**

- ❖ Assistant Resident Engineer will be a graduate Civil Engineer. He will have at least 10 years of professional experience in the similar type of projects & preference will be given to the similar projects supervised in merged area

  
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Small Dams Section  
Merged Area, Irrg. Deptt.



## TORS & GUIDE LINES FOR ZANGOTAI SMALL DAM NORTH WAZIRISTAN

### ANNEXURE-I

#### I. DETAIL FOR (GEO-TECHNICAL INVESTIGATION)

##### 1. DRILLING

Core drilling in all kind sub-surface formation, vertical and angle hole (at five locations).

- a. Abutments & Nullah Bed = 05 holes
- b. Spillway fall = 3 holes (crest, fall & exit)
- c. Upstream of main Dam axis in Nullah bed (300-500 meter u/s of the main centerline of dam body).

##### NOTE:

All the bore holes shall be selected in consultation with the Engineer for the project. All kind of drilling activities/sub-surface investigations should be supervised by an experienced Geologist.

##### DRILLING MACHINE

Straight rotary rig (Portable)

##### HOLE DIA

N-Q size (76 mm inner dia)

##### CASING

Drilling through casing in overburden materials, using casing shoe bit (101 mm inner dia)

##### DRILLING DEPTH

- a. Both Abutments: - Height of dam.
- b. Nullah bed: - Up to top bed rock +5 meter penetration in bed rock or equal to Dam Height or at least 1-1/2 times the base width of Dam.
- c. Spillway: - At least 5 Meter penetration in bed rock.
- d. U/s of Dam body: At least 20 meter deep & if rock encountered at shallow depth then 6 meter penetration in bed rock.

##### DRILLING FLUID

Plain water is allowed whereas bentonit is not allowed as a drilling fluid however cement can be used as per site condition and as per instructions by the client.

  
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### FIELD TEST

- (a) At constant head (03-meters interval depth)
- (b) At falling head (03-meters interval depth)

### Calculation of K Values

- ii. Water pressure test/LUGEON test at 03-meters interval.
- iii. Collection of UDS by Shelby/Denison/Pitcher sampler.
- iv. Standard penetration tests SPT using split spoon sampler.
- v. Assessment of %age core recovery.
- vi. RQD assessment.
- vii. Water samples collection.
- viii. Preservation of core samples in core boxes.
- ix. Preservation of soil samples in plastic jars.
- x. SPT, CPT or Denison test as per encountered sub-surface formation at 1-1.5 meters interval depth or as directed by the site Engineer/Geologist.

**Preservation of rock core samples in core boxes, labeling packing and storage along with transportation of core boxes to core shed PD PSU Small Dams Merged Area or as directed by Engineer.**

Transportation of selected rock core samples for testing to CMTL Laboratory WAPDA Lahore for the required test.

Taking of water samples from the bore hole and transportation to CMTL Laboratory WAPDA Lahore for chemical analysis.

Installation of 3-inch dia PVC pipe in line the drilled hole as a pizometer and or sounding purpose .

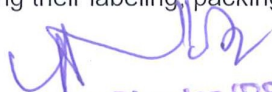
Excavation of test pits at 4-locations 6×6 feet up to maximum 15-feet deep below ground level or up to the bed rock/ground water, including back filling of pits to original ground level.

Collection of composite bulk samples from test pits including their labeling, packing, storage and transportation to testing Lab, CMTL, WAPDA Lahore.

Excavation of trenches 3-5 feet/up to bed rock and 10-feet long including backfilling of the trenches to original ground condition.

Collection of disturbed samples from trenches including their labeling, packing, storage and transportation to testing lab, CMTL, WAPDA Lahore.

Providing photographs of core and core boxes.

  
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## TORS & GUIDE LINES FOR ZANGOTAI SMALL DAM NORTH WAZIRISTAN

### LABORATORY TESTING CONSTRUCTION MATERIAL STUDIES

S.NO	DESCRIPTION	QTY
1	Sieve Analysis/Gradation of coarse & fine Aggregates	15
2	Flakiness and Elongation Index	8
3	Atterberg Limits (LL, PL, PI)	8
4	Specific Gravity wet and dry	6
5	Sodium sulphate soundness test	6
6	Los Angeles Abrasion Test (Coarse Aggregate)	6
7	Un-confined compression and direct shear tests of clay samples	6
8	Crushing Strength of rock and rip rap some samples	5
9	Direct shear (rock and soil)	6
10	Swell potential of soil samples	6
11	Uniaxial Compressive strength test with Modulus of Elasticity	6
12	Water Absorption test of coarse and fine aggregates	4
13	Alkali Silica Reaction tests	4
14	Organic impurity test	4
15	Complete chemical analysis of water sample i/c TDC, Cl, SO <sub>4</sub> and pH	4
16	Coefficient of permeability	4
17	Abrasion test	3

### LABORATORY TESTING CONSTRUCTION MATERIAL STUDIES

S.NO	DESCRIPTION	QTY
1	Grain Size Analysis	8
2	Hydrometer Analysis	8
3	Atterberg Limits (LL, PL, PI)	5
4	NMC	6
5	Un-confined compression test	
	Dry condition	6
	Saturated condition	6
6	Unconsolidated Un-drained Triaxial Test (UU0)	4
7	Consolidated Un-drained Test (CU)	4
8	Consolidation Characteristics	4
9	Swell Potential of Dam Core Materials	4
10	Standard Proctor Compaction	4
11	Modified Proctor Compaction	5

11 Geo physical survey (refraction survey) parallel to Dam axis & at least 2 cross section at the valley floor perpendicular to Dam axis (300-500 meter in depth)

12. Providing photographs of core & core boxes

  
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