TERMS OF REFERENCE FOR CONSULTING SERVICES

PUNJAB IRRIGATED AGRICULTURE INVESTMENT PROGRAM (PIAIP)

LOWER BARI DOAB CANAL IMPROVEMENT PROJECT (LBDCIP)

I. LBDCIP CIVIL WORKS CONSULTANTS

PACKAGE 1-A: DETAILED DESIGN and CONSTRUCTION SUPERVISION for the REHABILITATION and UPGRADING of BALLOKI BARRAGE and the LBDC and BS HEAD REGULATORS

The consultants selected for this work which constitutes a part of Package 1 will be responsible for updating surface water hydrology input, carrying out required surveys and investigations, finalizing detailed design of all required rehabilitation works, procurement and contract management of the civil works for the rehabilitation and upgrading of the Balloki Barrage and the associated head regulators for the Lower Bari Doab Canal (LBDC) and the BS Link Canal. Major problems identified and dictating the need for rehabilitation and upgrading include: (i) significant sediment management problems; (ii) absence of adequate energy dissipation downstream; (iii) inadequate head regulator capacity; (iv) flood management difficulties; and (v) lack of operating equipment and monitoring facilities. PIPD will assign the "Role of the Engineer" to the consultant in regard to this work.

The general scope of services required from the Consultant will include but not be limited to (i) in consultation with PMU, review and update the recommendations of the PPTA consultants as deemed appropriate; (ii) review and update the surface water hydrology for the site to include recent discharge data for the Ravi River as well as revised projected flows and return periods based on the anticipated effects of recent storage provision upstream and continual raising and extension of the flood protection levees along the river upstream of the barrage site; (iii) review the results of the hydraulic model tests carried out in 2005 as a basis on which to specify and supervise additional model studies necessary to finalize the rehabilitation design; (iv) plan and execute additional surveys, geotechnical investigations and other such activities necessary to provide a basis for final design; (v) update the assessment of condition relating to all structure and appurtenant equipment and confirm the extent of the rehabilitation program; (vi) develop a mathematical model of the barrage reach of the Ravi river using suitable hydrodynamic modeling software to predict likely water levels along the river and flows through the barrage, over the spillway and through any emergency breach if applicable, during flood events of varying magnitude; (vii) following calibration, use the model to refine design proposals and define operating rules by simulation of the effects of varying spillway crest levels and lengths and firmly establish trigger levels for breaching of the right marginal bund using flood hydrographs of different magnitudes and characteristic distributions; (viii) analyze design options for all facets of the rehabilitation of the barrage and appurtenant structures with a view to cost effective rehabilitation, including but not limited to structural design of the divide walls and hydraulic optimization of the spillway parameters and structural design of the wier, taking account of frequency of use; (ix) confirm the most cost-effective configuration of and designs for the bridges; (x) prepare the detailed design, construction drawings, bills of quantities, technical specifications and tender documents for all aspects of the rehabilitation works; (xi) undertake full administration of the tender packages including pre-qualification of contractors, invitations to bid, pre-bid consultations, bid evaluation and recommendations for award; (xii) supervise construction of the civil works assuming the role of the Engineer and undertake tasks as defined

under FIDIC agreements; (xiii) prepare required working and as-built drawings; (xiv) Prepare rules for optimal sediment sluicing in the presence of the divide walls, update the rules for both flood management and normal barrage operations incorporating all into a revised operation manual for Balloki Barrage; and (xv) maintain detailed financial accounts and other project records, and prepare other documentation as may be required by the Client or ADB.

The person months of input required to deliver the services described above are summarized below.

CONSULTING SERVICES – Package 1-A, Design and Construction Supervision – Rehabilitation and Upgrading of Balloki Barrage

Specialist	**Person Months**
(International)	
Team Leader/Design	11.0
Principal Hydraulic Design Engineer	4.0
Principal Hydrologist	3.0
Mathematical Modeling Specialist	2.0
Mechanical/Electrical Engineer	2.5
Procurement and Contracts Specialist	2.0
Chief Resident Engineer/Construction	8.0
Un-allocated (sediment-transport, geotechnical, etc.)	2.5
(Sub-total)	**(35.0)**
(Domestic)	
Senior Hydraulic Design Engineer	9.0
Principal Structural Engineer	6.0
Senior Hydrologist	5.0
Senior Modeler	4.0
Mechanical/Electrical Engineer	5.0
Senior Geotechnical Engineer	3.0
Contract Engineer	6.0
Environmental Specialist	3.0
Assistant Design Engineers	28.0
Un-allocated	5.0
Resident Engineer/Deputy Team Leader	38.0
Assistant Resident Engineer	28.0
Contract Engineer	8.0
(Sub-total)	**(148.0)**
Technician Level Input[1]	
Miscellaneous semi-technical inputs (see footnote 1) are provided for Under a lump sum provision of $170,000.	
Total	**155.0**

[1] Includes surveyors, draftsmen, auto-CAD operators, quantity surveyors, construction inspectors, etc which are used for costing purposes, but not included in summaries of person-months of consulting input which refer only to professional person months of input.

PACKAGE 1-B: DETAILED DESIGN and CONSTRUCTION SUPERVISION for REHABILITATION and UP-GRADING of the LOWER BARI DOAB MAIN, DISTRIBUTARY AND MINOR CANALS

The consultants performing the services to be provided under this sub-package will be responsible for all surveys, design, procurement, contract administration and construction supervision for the rehabilitation and upgrading of the LBDC main canal and its major off-taking branches including the Gugera Branch Canal, the Sahiwal-Pakpattan Link Canal and the KFS Feeder. Appurtenant structures including aqueducts, drainage siphons and canal escapes will likewise be upgraded as will the network of some 55 distributary canals and associated minor canals supplying irrigation deliveries to about 704,000 ha of irrigated land. The physical condition of LBDC, appurtenant structures and the distribution system is not satisfactory. Canal banks are seriously eroded, sedimentation is a serious problem in certain reaches and freeboard is generally inadequate. The condition of the canal precludes diversions in excess of 8,600 cusecs, and even at this discharge certain critical reaches are quite vulnerable to breaching; facilities for discharge measurement, control of operating levels and discharge as well as the subsequent efficient and transparent management of irrigation service deliveries are woefully missing. PIDP will assign the "Role of the Engineer" to the consultants in regard to this work.

The general scope of work required from the Consultant selected for this sub-package will include but not be limited to (i) in consultation with PMU review and update the recommendations of the PPTA consultants as deemed appropriate; (ii) carry out additional surveys, geotechnical investigations and other supporting studies as required for detailed design; (iii) analyze multiple design options for all facets of main canal rehabilitation and upgrading including cross and head regulators, bridges, siphons, escapes, as well as earthwork sections and applicable construction modalities with a view to cost effective and timely rehabilitation; (iv) evaluate all design options for the distributary and minor canals and associated measurement and control structures in conjunction with the concerned Farmer Organizations reaching agreement on the improvement package for the relevant distributary and identifying any work technically suitable for community contracting[2]; (v) finalize the detailed design, construction drawings, bills of quantities, technical specifications and tender documents for all aspects of each bid package; (vi) undertake full administration of the tendering of each package, including pre-qualification of contractors, invitations to bid, pre-bid consultations, bid evaluation and recommendation for award; (vii) supervise civil works construction assuming the Role of the Engineer and undertaking all tasks as defined under FIDIC agreements; (viii) prepare all working drawings required during the construction period to facilitate timely completion of the civil works; (ix) prepare comprehensive operational manuals for use of the AWB at the main canal level and the FOs/IMUs at the distributary and minor canal level, detailing canal operational rules during both periods of full supply and shortage[3]; and (x) maintain detailed financial accounts and other project records and prepare other documentation as may be required by the client or ADB.

The person months of input required to deliver the services described above are summarized below.

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[2] Contract provisions will be made such that work identified as suitable for community contracting and for which the relevant FO has expressed an interest in undertaking will be sub-contracted to the said FO by the civil works contractor.

[3] Detailing of these operational guidelines will be carried out jointly and in consultation with the irrigation modernization engineers supporting the FOs and AWB under the consulting package for institutional support.

CONSULTING SERVICES – Package 1-B
Design and Construction Supervision – Rehabilitation and Upgrading of LBDC & Distributaries

Specialist	**Person Months**
(International)	
Team Leader, Design and Supervision	60.0
(Sub-total)	**(60.0)**
(Domestic)	
Principal Irrigation Design Engineer	45.0
Principal Structural Design Engineer	45.0
Mechanical Engineer	54.0
Environmental Specialist	42.0
Procurement and Contracts Engineer	54.0
Institutional Specialist	54.0
Resident Construction Engineer	52.0
Assistant Design and Construction Engineers	309.0
(Sub-total)	**(655.0)**
Technician Level Input [4]	
Miscellaneous semi-technical inputs (see footnote 6) Lump sum of $3.0 million	
Total	**715.0**

[4] Includes, surveyors, draftsmen, auto-CAD operators, quantity surveyors, etc. used for costing purposes as well as sub-contract services required. Not included in the person-months of consulting services which refer only to professional person-months of input.

PACKAGE 2 – PROJECT MANAGEMENT UNIT SUPPORT

The services to be provided under Package 2 are a diverse mix of administrative, technical and institutional building support for PMU. The package will serve to strengthen PMU's capacity with respect to project and financial management, overseeing resettlement activities, procurement of goods and services, and monitoring and evaluation.

The general scope of the services required from the consultants will include but not be limited to (i) assist the PD and the Director Finance in establishing a comprehensive computerized financial management system at both the central PMU and the field PIU levels, ensuring that it is in full compliance with the requirements of both the Punjab Government and ADB; (ii) establish internal procedures for management of the project imprest account in Lahore and the second generation imprest accounts for PIDA and DOFWM, including procedures for preparation and submittal of documentation for liquidation and replenishment of the accounts in-line with normal ADB practice; (iii) establish arrangements for periodic audit of all Project accounts such that both the audited accounts and audit reports are available in a timely manner and a format most useful to all reviewers; (iv) develop material for and conduct in-house training for all PMU accounting staff; (v) develop an appropriate MIS system for the implementation of the whole of the LBDC Project as well as subsequent projects to be proposed for financing under ADB's MFF; (vi) establish a resettlement unit within PMU, capable of competently developing and satisfactorily monitoring of resettlement plans and capable of implementation of a suitable and timely resettlement program for the whole of the LBDC command; (vii) training of selected PMU staff with a view to strengthening of PIPD's ability to adequately oversee resettlement activities; (viii) develop an appropriate mechanism and procedures for monitoring and evaluation of all field activities and preparation of indicators for assessment of performance; and (ix) put in place a procurement system within PMU having prescribed procedures for ICB, NCB, international shopping and off the shelf purchases which is fully consistent with both ADB Guidelines and Government of Punjab standard practice.

The person months of input required to deliver the services described above are summarized below.

CONSULTING SERVICES - Package 2
PMU Support

Specialist	**Person Months**
(International)	
Management/Financial Specialist/Team Leader	60.0
Monitoring and Evaluation	13.0
Resettlement Specialist	13.0
Procurement Specialist	6.0
Environmental Specialist	5.0
(Sub-total)	**(97.0)**

(Domestic)	
Monitoring and Evaluation Specialist	60.0
Environmental Specialist	48.0
Financial Management Specialist	12.0
Resettlement Expert	54.0
(Sub-total)	**(174.0)**
Total	**271.0**

PACKAGE 3 – GROUNDWATER MONITORING, MODELING, AND MANAGEMENT

The consultants selected to provide this package of services will support a groundwater cell established within PMU charged with evaluating the effects of the increased surface water supplies under the Project on the deteriorating groundwater conditions currently noted in the LBDC command characterized by falling water-tables and deteriorating groundwater quality.

The general scope of services required from the consultants will be provision of support for and assistance in carrying out (i) restructuring of the GIS and the groundwater database to expand its utility and facilitate meaningful data transfer to central groundwater data repositories; (ii) provision of additional monitoring wells and wells for pumping tests to further define and quantify aquifer hydraulic parameters and water quality sampling from various depths to better define vertical distribution of water quality within the aquifer system; (iii) develop, calibrate and operate a finite difference groundwater model of the aquifer underlying the LBDC command to serve as a tool in formulating and evaluating groundwater management strategies; (iv) evaluate local well drilling and construction practice with a view to development of a training and certification program for local drillers and a lay training program for farmers regarding water well technology for the well owner (consumer); and (v) introduce as appropriate improved and alternative well technologies, improved well logging techniques and review the practicalities of real time data transfer of groundwater monitoring information to central data collection points. The person-months required for these activities are as follows.

CONSULTING SERVICES – Package 3
Groundwater Monitoring, Modeling and Management

Specialist	**Person Months**
(International)	
Senior Hydro-geologist/Team Leader	24.0
Senior GIS/Database Specialist	9.0
Groundwater Modeler	9.0
Drilling Advisor	7.0
(Sub-total)	**(49.0)**
(Domestic)	
Senior Hydro-geologist/Deputy Team Leader	60.0
GIS/Groundwater Specialist	36.0
Groundwater Modeler	29.0
Senior Drilling Specialist	20.0
(Sub-total)	**(145.0)**
Total	**194.0**

PACKAGE 4: ON FARM WATER MANAGEMENT AND AGRICULTURAL SUPPORT

The consultants selected for this package will support PMU and DOFWM, IMUs, FOs, and KPs in ensuring that farmers throughout the LBDC command, strengthen their capabilities with respect to effective management of on-farm irrigation water deliveries and application of improved agronomic production techniques to the level commensurate with optimal use of the increased supply of water envisaged under the Project.

The general scope of the services required under this package include but are not limited to: (i) designing and evaluating the impact of field programs consisting of both on farm water management demonstration and training coupled with introduction of appropriate crop production techniques including input selection and use; (ii) assisting PMU and DOFWM in ensuring the selection of watercourses for the field programs are representative in terms of farming system and canal and groundwater supply, carried out with the cooperation and participation of FOs, will lead to cost-effective and easily accessible demonstration centers having maximum impact on the farming communities; identifying suitable crops/soils/topography within the field program sites for establishment of drip and sprinkler irrigation systems and consulting with private sector hardware suppliers to support such demonstrations, (iii) support DOFWM in field program implementation with emphasis equal to that accorded improved water management directed toward crop input demonstrations, promote linkages between farmers and the private sector and ensure integration of the field programs with District level agricultural extension initiatives and ongoing on farm water management programs; and (iv) ensure that the field programs are fully accessible by women and develop strategy and procedures for full participation of female headed farming households in all Project activities.

CONSULTING SERVICES – Package 4
On Farm Water Management and Agricultural Support

Specialist	**Person Months**
(International)	
On-Farm Water Management Specialist/Team Leader	12.0
Ag Extension and Communication Specialist	14.0
Gender Specialist	3.0
(Sub-total)	**(29.0)**
(Domestic)	
On-Farm Water Management Specialist/Deputy Team Leader	36.0
Agricultural Extension and Communication Specialist	38.0
Gender Specialist	43.0
(Sub-total)	**(117.0)**
Total	**146.0**

PACKAGE 5: INSTITUTIONAL STRENGTHENING, CAPACITY BUILDING AND IMPROVED OPERATION, MAINTENANCE and MANAGEMENT OF THE CANAL SYSTEM

The services provided under this package will support PIDA and its Farmer Organization Support Offices (FOSOs) and staff assigned to IMUs in their overall efforts under the Project to enhance the participation of water users in irrigation system management at all levels and the LBDC Circle of PIPD in improved management and operation of the main canal with aims of improving system operation and maintenance, ensuring more equitable distribution of canal water throughout the command and along each distributary and minor canal and instituting resource based conjunctive use management of surface and groundwater in the Project area. Management transfer activities will occur from the outset at the FO level and at an appropriate time at the AWB level.

The general scope of services required will include but not be limited to: (i**)** assist PIDA in preparing appropriate strategy for mobilizing and strengthening of KPs and FOs followed by preparation of procedural manuals for social organizers; (ii) continual monitoring of KP and FO formation in the LBDC command; (iii) development of comprehensive curricula and materials for the training of FO office bearers; (iv) assist PIDA in identification and recruitment of suitable training providers and monitoring and evaluation of the courses; (v) assist PIDA and AWB in the development of an appropriate system for assessing and collecting *abiana* and/or any other service charges in an accountable and transparent manner; (vi) preparation of training curricula and materials for financial management training of FOs, IMUs and AWB (LBDC Circle/PIPD); (vii) preparation of guidelines and procedures for the establishment and management of IMUs, including staffing plans; (viii) development of appropriate procedures and plans for the operation of upgraded distributary and minor canals; (ix) development of appropriate plans and procedures for the operation and management of the upgraded LBDC main canal system; and (x) prepare various rules, regulations and considerations for inclusion in an AWB charter including staffing requirements and financial management aspects; and preparation of model Customer Services Contracts.

The person months of input for the services described above are summarized below.

CONSULTING SERVICES – Package 5
Institutional Strengthening, Capacity Building and Improved Operation, Maintenance and Management of the Canal System

Specialist (International)	**Person Months**
FO Development Specialist/Team Leader	20.0
Training Specialist/FOs[5]	6.0
Management Specialist/AWB[6]	8.0
MIS Specialist/AWB	6.0
Training Specialist/AWB	5.0
Irrigation Modernization Engineer/AWB	14.0
(Unallocated)	4.0
(Sub-total)	**(63.0)**

[5] FOs indicates services directed to KPs, FOs, and IMUs
[6] AWB indicates services directed to AWB, be it the LBDC Circle of PIPD or the subsequent autonomous body.

(Domestic)	
FO Development Specialist/Deputy Team Leader	46.0
Training Specialist/FOs	30.0
Communication Specialist/FOs	5.0
Financial Management /FOs	16.0
Irrigation Modernization Specialist/FOs	16.0
Management Specialist/AWB	8.0
HRD Specialist/AWB	7.0
Financial Management Specialist/AWB	10.0
Training Specialist/AWB	12.0
MIS Specialist/AWB	10.0
Communication Specialist/AWB	6.0
Irrigation Modernization Specialist/AWB	18.0
(Sub-total)	**(184.0)**
Total	**247.0**

PACKAGE 6: – PREPARATION of REMAINING PIAIP PROJECTS

(i) R&U of the Pakpattan Canal System and Sulemanki Barrage; (ii) R&U of the Thal Branch Canals and Distribution System; (iii) R&U of the Trimmu Barrage; (iv) R&U of the Sidhnai Canal System; and (v) R&U of the Pajnaud Barrage

and

DETAILED DESIGN

of

(i) R&U of the Pakpattan Main Canal and Sulemanki Barrage; (ii) R&U OF The Thal Branch Canals and Distribution System; and (iii) R&U of Trimmu Barrage

The consultants performing the services under this package will support IIPMU and PIPD to both prepare and carry out detailed design for the civil works for Projects to be financed under subsequent tranches of the proposed PIAIP. Project studies for all five sub-projects will initially be at full feasibility level and upon establishment of economic viability; detailed design is to be undertaken for three of the projects and tender documents for all civil works under those three projects prepared. The design activities for R&U of the Pakpattan Main Canal and Sulemanki Barrage will overlap with the preparation phase for the Thal Branch Canals and Distribution System and Trimmu Barrage and likewise, preparation of Sidhnai Canal and Pajnaud Barrage Improvement will commence before completion of detailed designs for the Thal the Trimmu Barrage. Tender documents for the Sulemanki Barrage and for the Pakpattan Main canal will be ready for issuance immediately upon ADB approval of the relevant PRF while detailed design work on the distributary and minor canals will be deferred as necessary pending the formation of the FOs early in the implementation period of rehabilitation work for the Pakpattan Main Canal and Sulemanki Barrage. This approach will ensure timely utilization of the proceeds of loan two under PIAIP and minimize the commitment charges incurred by the Government while at the same time allowing full consultation with the concerned FOs during distributary and minor canal design.[7] In carrying out the assignment, the consultants will carefully monitor the ongoing activities under LBDCIP and incorporate into the studies and designs all lessons to be learned there from.

The general scope of the services required to be provided under the contract will include, but not be limited to: (i) assist IIPMU in reconnaissance review of candidate projects to ensure that they are prima facie, in conformance with the agreed selection criteria; (ii) undertake necessary feasibility level studies, institutional analysis, environmental assessment, resettlement considerations and preliminary design necessary to establish the economic viability of investment in an integrated irrigation infrastructure, water resource management, and institutional reform package, most probably patterned after LBDCIP; (iii) preparing feasibility level outputs documenting the viability of the civil works, institutional reform and capacity building while adequately addressing both environmental and resettlement issues and outlining in detail the implementation arrangements, service delivery mechanisms and monitoring and evaluation procedures; (iv) for the three selected projects, subsequent to establishment of the

[7] In the case of the Thal Branch Canals and Distribution System, the Government of Punjab has ensured that the formation of FOs will proceed using their own resources and that the FOs will be established and ready to participate in the design process for the distributary and minor canals.

proposed project's feasibility carry out required additional surveys and geotechnical, hydrological and other investigations necessary for final design; (v) analyze design options for all aspects of the head-works (if applicable) and main canal rehabilitation[8] and upgrading including cross and head regulators, bridges, measurement structures, escapes, lining and all necessary earthworks as well as evaluating potential construction modalities to be considered with a view to timely and cost effective rehabilitation; (vi) evaluate all design options for the distributary and minor canals including associated measurement and control structures as well as outlets in conjunction with the concerned FO, reaching agreement on the package of improvements for the relevant distributary; and (vii) finalize the detailed design, construction drawings, bills of quantities, technical specifications and tender documentation for all aspects of each bid package.

The indicative person months of input required to deliver the services described above are summarized below.

CONSULTING SERVICES – Package 6
Preparation and Detailed Design of Subsequent Projects

Specialist	**Person-months**
(International)	
Team Leader	48
Lead Design Engineer	28
Principal Irrigation Planning Engineer	12
Principal Groundwater/Drainage Engineer	6
Principal Agriculturist	6
Principal Economist	8
Principal Hydrologist	9
Principal Hydraulic Engineer	9
Principal Structural Engineer	9
Principal Mechanical Engineer	6
Principal Geotechnical Engineer	6
Principal Procurement and Contracts Engineer	12
(Sub-total)	**(159)**
(Domestic)	
Deputy Team Leader Preparation	48
Deputy Team Leader Design	36
Irrigation Planning Engineers	48
Rural Sociologist/ME Specialist	40
Institutional Specialist	12
Hydro-geologist	24
Drainage Engineer	36
Agriculturist	18
Economist/Cost-tab Specialist	36

[8] Preparation and design activities for the Thal Branch Canals and Distribution System and Trimmu Barrage and preparation work for the Sidhnai Canal and the Pajnaud Barrage will be undertaken by the consultants simultaneously, even though they represent separate investment packages.

Resettlement Specialist	36
Environment Specialist	36
Irrigation Design Engineer (3)	96
Design/Planning Engineers (4)	192
Barrage Specialist	48
Hydraulics Design and Planning Engineer (2)	96
Hydrologist	36
Structural Design Engineers (3)	96
Geotechnical Engineer	48
Mechanical Engineer	48
Procurement and Contracts Engineer	36
Unallocated	184
(Sub-total)	**(1250)**
TOTAL	**1409**