

AFRICAN DEVELOPMENT BANK



THE GOVERNMENT OF BOTSWANA

**WASTEWATER REUSE AND WATER HARVESTING FOR IRRIGATION STUDY -
REQUEST FOR TECHNICAL ASSISTANCE FUND FOR MIDDLE
INCOME COUNTRIES**

DEPARTMENT OF AGRICULTURE AND AGRO-INDUSTRY

September 2011

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CURRENCY AND MEASURES

Currency Equivalents (June, 2011)

1 UA	=	10.4900 BWP
1 UA	=	1.6007 USD

1. Fiscal Year: 1st April 31st March

1. Measures

km	=	kilometer
l/c/d	=	liters per capita per day
m	=	meter
m ³ /d	=	cubic meter per day
Mm ³	=	Million cubic meters

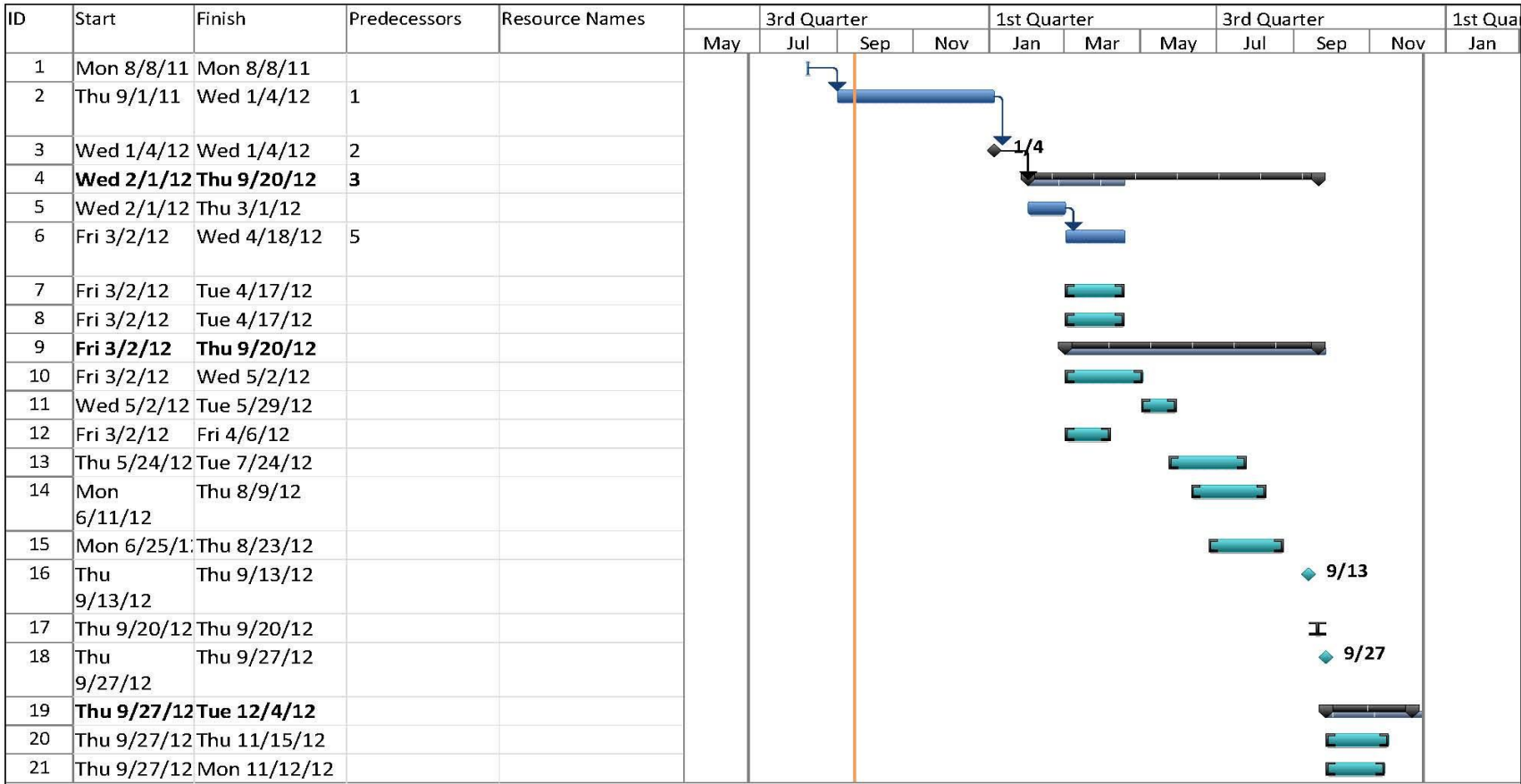
LIST OF ACRONYMES

ADB/ ADF	=	African Development Bank / African Development Fund
DCP	=	Department of Crop Production
DWMPC	=	Department of Waste Management and Pollution Control
DWA	=	Department of Water Affairs
EA	=	Executive Agency
ESIA	=	Environmental and Social Impact Assessment
ESMP	=	Environmental and Social Management Plan
GOB	=	Government of Botswana
MEWT	=	Ministry of Environment, Wildlife and Tourism
MMEWR	=	Ministry of Minerals Energy and Water Resources
MOA	=	Ministry of Agriculture
MOLG	=	Ministry of Local Government
NDP	=	National Environmental Action Plan
WSS	=	Water Supply and Sanitation
WUP	=	Water Utilities Corporation

Project Simplified Logical Framework

Country and Project Name: Botswana – Proposal for a MIC Grant of UA 0.600 Million to Finance a Wastewater Reuse and Water Harvesting Study						
Project Purpose: To carry out a study on Wastewater Reuse and Water Harvesting and Prepare a bankable project with detailed designs.						
RESULTS CHAIN		PERFORMANCE INDICATORS			MEANS OF VERIFICATION	RISKS/MITIGATION MEASURES
		Indicator	Baseline	Target		
IMPACT	National economy's overreliance on the mining sector reduced	Increase in contribution of the agriculture sector to the economy	2%	6% by 2017	National Statistics Data	<p>Risk: Change of Government priority from support to agriculture</p> <p>Mitigation: Given the current and continuous food price rises, desire of every country including Botswana to be food self-sufficient is assured.</p>
OUTCOMES	A well prepared bankable project with detailed designs.	Amount of land put under irrigation using waste water and water harvested from sand rivers.	0	Over 800 hectares of land put under irrigation by 2017	Study results.	<p>Risk: Study implementation constraints and delays.</p> <p>Mitigation: The Government has already implemented MIC funded operations and has a good experience to enable her carry out the required activities in a timely manner.</p>
OUTPUTS	<p>A Consulting Firm recruited to carry out the study;</p> <p>Approved Feasibility Study Report;</p> <p>Increased public awareness on the potential of reuse of wastewater, and that of water harvesting;</p> <p>Approved detailed designs report and draft tender documents</p>	<p>Feasibility Study Report;</p> <p>Stakeholders' workshops.</p> <p>Detailed Designs Report and Draft Tender Documents;</p>	<p>Feasibility Study approved by August 2012;</p> <p>Stakeholders' workshop held by March 2013</p> <p>Detailed Designs Report and Draft Tender Document completed by May 2013</p>	<p>Feasibility Study Report produced</p> <p>Stakeholders' workshops held</p> <p>Detailed Designs Report and Draft Tender Documents produced</p>	<p>Risk: Not adequate farmer participation</p> <p>Mitigation: Farmers are already using some of the water not adequately treated with danger of contamination. They are therefore ready for the project and that is why the Government is very committed to this study.</p>	
KEY ACTIVITIES	<p>Feasibility Study: UA244,889</p> <p>Detailed Design: UA568,421</p> <p>Contingencies: UA 44,182</p> <p>Total: UA 857,492</p>					

Annex 3 – WW Reuse & Water Harvesting for Irrigation Study – Implementation Schedule



Project: Implementation Schedule Date: Thu 9/15/11	Task		External Milestone		Manual Summary Rollup	
	Split		Inactive Task		Manual Summary	
	Milestone		Inactive Milestone		Start-only	
	Summary		Inactive Summary		Finish-only	
	Project Summary		Manual Task		Deadline	
	External Tasks		Duration-only		Progress	

ID	Start	Finish	Predecessors	Resource Names	3rd Quarter				1st Quarter			3rd Quarter			1st Qua
					May	Jul	Sep	Nov	Jan	Mar	May	Jul	Sep	Nov	Jan
22	Thu 9/27/12	Tue 11/27/12													
23	Thu 9/27/12	Tue 11/27/12													
24	Mon 10/29/12	Thu 12/13/12													
25	Thu 12/13/12	Thu 12/13/12													12/13



Project: Implementation Schedule Date: Thu 9/15/11	Task		External Milestone		Manual Summary Rollup	
	Split		Inactive Task		Manual Summary	
	Milestone		Inactive Milestone		Start-only	
	Summary		Inactive Summary		Finish-only	
	Project Summary		Manual Task		Deadline	
	External Tasks		Duration-only		Progress	

1. INTRODUCTION

1.1 One of the development objectives of the Government of Botswana (GOB) is to diversify the economy and reduce its overdependence on mining, which has been and still is the mainstay of the country's economic growth. One of the key areas of this diversification is to boost agricultural production, presently contributing only 2% of the national GDP. This is a far cry from its contribution of nearly 46% in 1966. Any improvement in agricultural production will also reduce the country's growing reliance on external sources for its food requirements. The sector would also create employment in the process. The proposed efforts are elaborated in the Country's current National Development Plan (NDP 10, 2009-2016).

1.2 Development of agriculture in Botswana is especially hampered by a number of challenges, the most significant of which is limitation in water resources. Being an arid and semi-arid country, it receives only very little rain. This in turn limits the extent of rain-fed agriculture. Irrigated agriculture has still room for expansion. However, it has to compete with other demands especially from domestic and industrial consumers for the limited available water. As such the Government realizes that it is imperative that all available water resources in the country be put to the most advantageous economic use.

1.3 It is in the view of the above that the GOB has undertaken to promote re-use of wastewater for agriculture. The approach is to put the available land within close proximity of wastewater generation under irrigation. Crop production using irrigation is also being expanded using fresh water extracted from sand rivers where practicable. The proposed study will prepare an irrigation project based on these two approaches. It will address the required additional wastewater and bio-solids treatment in the urban areas of Gaborone, Lobatse, Selebi-Phikwe, Serowe and Tonota, in order to render these suitable for crop production. The study will also establish the feasibility of extracting from the sand rivers of Shashe and Motloutse, for irrigation.

2. BACKGROUND

2.1 Water Sector

2.1.1 With rainfall ranging from a high of 550 and low of 200 mm per year, and an estimated annual average evaporation rate of 1400 mm, Botswana is a water stressed country. The bulk of the country i.e. west and southwest, is occupied by the Kalahari and only the northern and eastern rim of the country enjoy any form of vegetation. The rain falls in the summer months of November to April.

2.1.2 The bulk of water users, in particular domestic and industrial consumers are mainly supplied from the 94 dams constructed in various parts of the country, to capture some of the estimated average annual runoff of 696 million cubic metres per year (Mm³/yr). Generally, these water storage dams are found in the northern parts of the country with more abundant rainfall, and water is subsequently delivered to the heavy demand areas of south-east. Due to the growing water demand, majority of the storage dams have been constructed to provide water for the growing urban areas with very few allocating water for irrigation. In addition the rural population and those in the mining enterprises, depend on ground water for their needs.

2.1.3 In terms of portable water for domestic use, Botswana has made commendable efforts in the provision of water supply for its people. It is estimated that nearly 100% of the people in the urban areas and 90% of those in the rural areas have access to clean water. The situation is less favorable in terms of sanitation services. While 69% of the population has access to improved sanitation, it is also known that nearly 16% of the population has no form of sanitation at all.

2.1.4 Institutionally, the responsibility for water management and control is currently distributed over several Ministries and Departments:

- ◆ The Ministry of Energy, Minerals and Water Resources (MMEWR), through the Department of Water affairs (DWA) is responsible for the management and allocation of water resources in the country, and for the provision of water in the rural areas;
- ◆ The Water Utilities Corporation (WUC), also under MMEWR, on the other hand manages water supply services in the larger urban areas;
- ◆ The Ministry of Local Government (MOLG), through the local authorities, is responsible for wastewater collection, treatment and disposal;
- ◆ Ministry of Environment, Wildlife and Tourism (MEWT), through its Department of Waste Management and Pollution Control (DWMPC) provides technical support to MOLG in the management of wastewater in the country;
- ◆ The Ministry of Agriculture through the department of Crop Production, Division of Agricultural Engineering (DAE) assists the farming community with knowledge and skills to operate and manage their draught power and adopt effective and efficient irrigation technologies. It also ensures that farmers are provided with reliable water sources in the form of earth dams and rehabilitated wells.

In order to ensure effectiveness, there is ongoing reorganization of the sector institutions, aimed at concentrating all the water supply and sanitation services under WUC, while DWA manages the resources.

2.2 Agriculture Sector

2.2.1 Botswana has cultivable land area of approximately 543,984 hectares (ha), of which nearly two thirds has been utilized. Most of agriculture is rain-fed and is dominated by small scale holdings. Commercial farming is basically dependent on irrigation.

2.2.2 Since the eighties, the GOB has pursued an agricultural policy driven by the overriding need to achieve some level of food security, diversify agricultural production base, and increase output and productivity, while at the same time creating employment. A number of initiatives aimed at achieving these policy objectives have been tried. The most notable being Citizen Entrepreneurial Development Agency (CEDA) started basically to provide grants and low interest loans for the sector, Accelerated Rain-fed Arable Programme (ARAP-1985-96), setup to provide grants to farmers for land preparation and development, and preparation of a National Agricultural Master Plan for Arable Agriculture and Dairy Development (NAMPAADD), aimed at modernizing farming through capacity building, and reduction in the cost of inputs through collective procurement. Similar approaches have been tried for the livestock sub-sector.

2.2.3 Although the Government has not been able to raise the very low level of contribution by agriculture to the national GDP (currently standing at 2%), there has been some remarkable achievement. It is estimated that the country is now almost self-sufficient in poultry products, while nearly 50% of country's needs for horticulture is produced internally.

The Government is determined to continue with its efforts to revitalize the agriculture but with more emphasis on diversification, increasing sector efficiency and boosting productivity, marketing and value addition. Above all, the Government wants to ensure that promotion of agriculture is done in an environmentally sustainable manner. The on-going Integrated Support Programme for Arable Agriculture Development (ISPAAD) is addressing some of these areas of focus.

2.3 Environmental Issues

2.3.1 The Government is increasingly becoming aware of the importance of mainstreaming environmental issues in all its development efforts. It is already a signatory of a number of Multilateral Environment Agreements impacting on agriculture including that related to combating desertification, biodiversity and persistent organic pollutants. Botswana is also a signatory of the Ramsar Convention on recognized wetlands, with Okavango Delta being one of the world best renown.

2.3.2 Although there are plenty of legislations meant to protect the environment e.g. land degradation (rangelands), pollution and overuse of the water resources, etc, there has been very little enforcement of the existing laws. The Government is aware of this shortcoming and is determined to be more stringent in addressing the environmental ramifications including those of overuse of water resources. It is expected that with the formation of the Department of Environment in 2007 and the subsequent Environment Management Act, these will facilitate and provide more effective tools to protect the environment. Some of the proposed measures towards cleaner environment include stepping up monitoring of the quality of wastewater being discharged into the environment, wastewater reuse to be subjected to EIA, mainstreaming environmental issues in all development activities and building capacity for the same, and to make it mandatory to undertake EIA for all future developments.

3. THE PROPOSED STUDY

3.1 Objective

The objective of the study is to prepare for implementation, an irrigation project based on both wastewater reuse and water harvesting, covering the identified projects areas of Glen Valley in Gaborone, the urban areas of Lobatse, Selebi-Phikwe, and Serowe. Other areas will include Tonota, and the land along the sand rivers of Shashe and Motloutse to be studied for water harvesting.

3.2 Justification for MIC/TAF Funding

3.2.1 Even before the onset of the current global economic downturn, the GOB had seen the need to diversify the economy to reduce the country's overdependence on the mining sector. Implementation of the diversification strategy has now become urgent following the contraction of the economy during the global economic downturn, which did not spare the price of diamonds.

3.2.2 However, due to the country's limited natural resources, agriculture is one of few options available for country's diversification programme. As demonstrated in the section on agriculture above, the government has been and still continues with its efforts to increase

contribution by agricultural sector to the national GDP. The proposed study is expected to define the way forward and will address one of the major constraints afflicting agriculture in Botswana i.e. that of inadequate water resources. It is estimated that if adequately treated, wastewater could contribute about 16% of the country's available water resources. By prescribing the most cost effective ways of treating both the wastewater and bio-solids, and how to reuse the same for agriculture, it will be possible to utilise this substantial amount of water which is currently being put to minimum direct economic use.

3.2.3 The government's intention as demonstrated by what is happening in the Phase I of the on-going Glen Valley Scheme, is to encourage small scale commercial horticulture farmers to lead the way in the reuse of wastewater and bio-solids (sludge) for agriculture. The subsequent project will therefore promote the development of the private sector in the country. Promotion of private sector growth is one of the identified pillars of economic diversification in the country's development planning. It is also one of the identified priority areas where Bank's support would have strategic advantage.

3.2.4 Botswana is on track to meet all except the health related MDGs. While there are more urgent reasons for this lag especially the very high prevalence of HIV/AIDS, there is still a lot of room for improvement of public health. Indeed, one of the foundations of fighting the HIV/AIDS scourge is to improve general health of the people. Adequate wastewater and related bio-solids treatment and disposal are essential to avoid contamination and transmission of diseases. Past and current practice of wastewater reuse for irrigation leaves a lot of room in addressing the issues of potential areas of contamination during the process. Adequate treatment is often not consistently achieved and the necessary controls and monitoring systems do not seem to have been diligently applied. The proposed study will address these issues and prescribe measures which need to be taken to address the concerns. This will promote improved public health, at the same time ensure that the government achieves its aim of promoting environmentally sustainable agriculture.

3.2.5 And finally, use of MIC funds for the proposed study is justified as it will contribute to the Bank's overarching goal of improving the quality of its operations. The study will prepare the proposed project and therefore increase the chances of achieving its objectives when implemented. Preparation of projects is also one of the main areas identified for MIC support.

3.3 Summary Description of Study

3.3.1 The Consultant will first prepare a feasibility study, to be followed by detailed designs and draft bid documents of the recommended and agreed project. Activities for each of the two phases of the study are summarized below:

3.3.2 **Feasibility Study** The Consultant will collect all available data relevant to the study including: existing status of the urban centres covered by the project (populations, water consumption, wastewater generation, prospects for future growth, etc.), status of the existing wastewater treatment works (current capacities, treatment processes and efficiencies, volume and quality of discharged effluents and bio-solids, and quality of receiving rivers and streams), availability of land in the vicinity of the treatment works (amount of land available, current usage, level of productivity and number of people within each area, etc.), availability of water and its present utilization from the sand rivers of Shashe and Motloutse (previous hydrological and hygeological studies of these rivers, records of river flows, water quality,

current levels of abstraction and usage, storage potential, etc.), availability of the suitable land for irrigation along these rivers (estimated areas, current land use, population of the areas, etc.), current status of the environment in all the project areas including impacts of the current wastewater treatment works (to the operating staff, neighbouring communities, receiving streams, etc.), impacts of the current land use in areas proposed for irrigation (land ownership, land degradation, agricultural inputs, etc.), water harvesting in sand rivers (possibilities of pollution, over extraction, etc.).

3.3.3 The consultant will analyze available information, recommend and undertake any further field surveys, measurements and investigations required to carry out the study. Recommendations will be made of the most cost effective additional treatment required before the wastewater can be reused for irrigation. Similarly, the different available options for treatment of bio-solids (sludges) for reuse for soil conditioning will be explored. Required land will be demarcated, most suitable crops identified and appropriate irrigation and marketing systems recommended, as well as necessary infrastructure (power and water supply, sanitation and access roads). Similarly, the most appropriate water harvesting methods from the river sands, and irrigation systems will be proposed for the identified land. And finally, an ESIA study will be carried out to address all environmental concerns of the proposed project as required for Bank's projects falling under category I.

3.3.4 **Detailed Design Stage:** The second phase of the study will be the preparation of detailed designs of the project in accordance with the conclusions and recommendations of the feasibility study. Design details including necessary calculations, process design, drawings including those of civil, structural and electro-mechanical works, will be prepared for all components of the project including wastewater treatment, water harvesting techniques, irrigation systems, and the necessary infrastructure. Cost estimates of the project and an implementation schedule will be prepared including all the main components of the project. Design report, drawings and draft bid documents will be prepared in adequate details to form the basis of construction of the works.

3.4 Study Outputs

The study outputs will include:

- a) **A feasibility study report of the proposed project** - This will provide an overview of projected wastewater generation in each of the five study areas so as to facilitate future planning for its reuse. It will determine and recommend the work required to be done to capture as much as possible the wastewater currently being generated, how to treat it and the resultant bio-solids for reuse in agriculture. The land to be irrigated will be demarcated, and preliminary designs prepared for treated wastewater transmission and suitable irrigation systems for each project area, as well as the necessary infrastructure to facilitate farming. Similarly, appropriate water harvesting methods to tap water in the sand rivers of Shashe and Motloutse will be proposed, land identified for irrigation demarcated, together with appropriate irrigation systems and required infrastructure. The study outputs will include the scope of work, cost estimates and implementation schedule, in adequate details to form the basis for funding decisions.
- b) **Detailed Designs Report and Draft Bid Documents** - Detailed designs will be prepared for all the works proposed under the project. These will be done in adequate details to facilitate works construction. Detailed cost estimates and implementation schedule will

also be prepared. Following agreement with the Executing Agency (EA), the consultant will prepare draft bid documents for each contract including BQs, specifications, and contract provisions.

4. STUDY COST ESTIMATE AND FINANCING

4.1 Cost Estimate

The study is estimated to cost a total of USD 1,372,588 (UA 857,492) net of taxes and duties. This cost comprises USD 960,420 (UA 600,000) foreign exchange and USD 412,168 (UA 257,492) in local currency. The cost estimates are based on prevailing fees for consultancy services and include 5 % contingencies allowance. Details are given in Annex 2 attached to this report and the same summarized in Table 4.1 below.

Table 4.1 Cost Estimate by Component in USD and in UA

COSTS SUMMARY						
	USD			UA		
	FC	LC	Total	FC	LC	Total
Feasibility	336,326	55,668	391,993	210,112	34,777	244,889
Detailed D	574,601	335,271	909,872	358,968	209,453	568,421
Total	910,926	390,939	1,301,866	569,080	244,230	813,310
Contingencies (5%)	49,494	21,228	70,722	30,920	13,262	44,182
Grand Total	960,420	412,168	1,372,588	600,000	257,492	857,492

4.2 Financing Plan

The study will be financed by the Bank (from the Technical Assistance Fund for Middle Income Countries (MIC)) and the Government of Botswana (GOM) as shown in Table 4.2 below. The Bank will meet 70 % of the total costs while the Government will meet 30 % of the study cost, i.e. total local costs including local staff, office accommodation, local transportation, investigations, stakeholders' workshop, etc.

Table 4.2. – Financing Plan

Source	USD			UA			%
	FC	LC	Total	FC	LC	Total	
ADB	960,420	0	960,420	600,000	0	600,000	70
GOB	0	412,168	412,168	0.00	257,492	257,492	30
TOTAL	960,420	412,168	1,372,588	600,000	257,492	857,492	100

5. PROCUREMENT

5.1 Procurement Arrangement

5.1.1 All the services under the study will be carried out as one consultancy contract. The procurement of the recruitment of the consultant for the services will be in accordance with the Bank's Rules and Procedures for the Use of Consultants (May 2008 Edition). The recruitment procedure will be on the basis of a shortlist of consulting firms, and the selection will be based on technical quality with price consideration. In summary, the procurement arrangements are:

Table 5.1 Procurement Arrangements

CATEGORY	SHORT-LIST		TOTAL	
	USD	UA	USD	UA
Shortlist				
Consulting Services	1,372,588	857,492	1,372,588	857,492
Total	1,372,588	857,492	1,372,588	857,492

5.1.2 The Department of Crop Production (DCP) of the Ministry of Agriculture (MOA) will be responsible for the procurement of the consulting services. DCP will be assisted by the Department of Waste Management and Pollution Control (DWMPC) of the Ministry of Environment, Wild Life and Tourism. Both these Departments have long experience in the procurement and management during implementation of other studies and projects in the country.

5.2 General Procurement Notice

A General Procurement Notice will be agreed upon with the GOB and will be issued for publication in ADB and UNDP web sites, upon approval by the Board of Directors of the Grant Proposal.

5.3 Review Process

The following documents will be subject to prior review and approval by the Bank before promulgation: (i) Shortlist of Consulting firms (ii) Request for Proposal document (iii) Report on evaluation of proposals submitted by the firms (iv) Draft Contract Agreement for the services, and Minutes of Contract Negotiations.

5.4 Disbursement

The disbursement for the study will be by direct payment method. All disbursements applications will be on the basis of the agreed payment schedule contained in the contract agreement. This disbursement method is justified because the services will be carried out under one contract only. The payments will be subject to the Bank's Disbursement Rules as set out in its disbursement handbook, in particular the rules on suspension of disbursement. Each payment will be made within 45 days from the date of submission of invoices, unless the report is not accepted for any reason by the executing agency. Below is an indicative schedule of payments to the Consultant. However, the schedule is subject to discussion and agreement by the parties to the contract.

<u>Milestone</u>	<u>% of Total Cost</u>
Mobilization Advance	20%
Submission of Draft Feasibility Study Report	20%
Submission of Final Feasibility Study Report	10%
Submission of Detailed Design Report	20%
Submission of Draft Tender Documents	15%

6. IMPLEMENTATION

6.1 The study implementation will be the responsibility of DCP, assisted by DWMPC. DCP is currently responsible for implementation of crop production projects in the MOA, while DWMPC provides technical support to the local authorities in the management of the wastewater facilities. Due to the spread of the study areas, a Study Implementation Team (SIT) will be constituted comprising a senior person from DCP to be the Coordinator and the main liaison officer for the study, a representative from DWMPC who should be a Sanitary Engineer, and one person from each of the five project councils to be the main contact person at the local level.

6.2 The study will be carried out over a period of 8 months. The consultant will therefore be expected to commence the work as soon as the contract is signed and a go ahead is given. The key milestones of the study are given in the table below, while an implementation schedule is annexed to this Memo.

	<u>Activity</u>		<u>Target End Date</u>
i)	Contract Signature	-	M
ii)	Inception Report	-	M+2
iii)	Draft EIA Report	-	M+3.5
iv)	Draft Feasibility Report	-	M+4
v)	Final Feasibility Report	-	M+5
vi)	Detailed Design Report	-	M+8
vii)	Draft Tender Documents	-	M+8

7 LETTER OF AGREEMENT

Following approval of the funding, the Bank will draft a Letter of Agreement in line with the attached draft format provided in Annex 3 of the Guidelines for the Administration and Utilization of Technical Assistance Fund for MIC. The authorized representative at the Ministry of Finance and Development Planning, being the authorized representative of GOB, would sign on behalf of Government.

8. CONCLUSIONS AND RECOMMENDATIONS

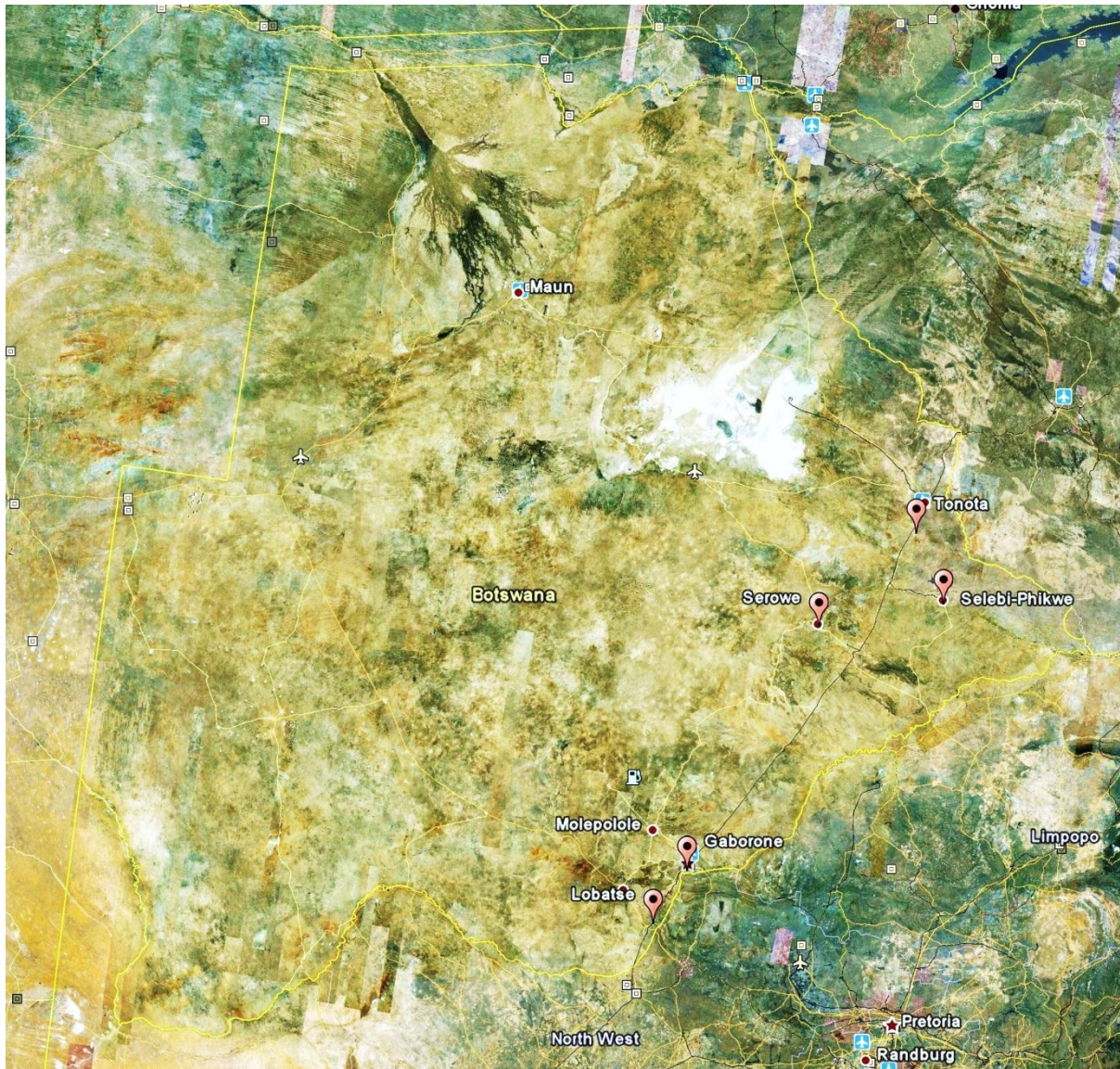
8.1 Conclusions

As elaborated in its current development plans, the Government of Botswana is keen to have Agriculture sector play a more prominent role in the country's economic growth, than has been the case hitherto. However, the sector is faced with a number of constraints. The most serious of these is lack of adequate water resources in the country. Rain-fed agriculture is unpredictable due to frequent droughts. This leaves irrigated agriculture as the only area with potential for growth. Still, this too has to compete with other demands for the limited water resources in the country. The proposed study will contribute towards achievement of the Government's objective for the sector, as it will elaborate the further treatment required to render wastewater and bio-solids suitable for reuse in agriculture. In addition, the study will seek to expand water harvesting from sand rivers for irrigation.

8.2 Recommendation

It is recommended that the Board approves a grant not exceeding UA 600,000 from the resources of the MIC Fund to the Government of Botswana to carry out the study described herein.

BOTSWANA WW REUSE & HARVESTING FOR IRRIGATION – STUDY
LOCATION MAP



ANNEX 2: BOTSWANA - WASTEWATER REUSE AND WATER HARVESTING FOR IRRIGATION STUDY - COST ESTIMATE											
1. FEASIBILITY STUDY		No of MM			USD			UA			
A.	Consultant's Staff	Home	Field	Total	Unit Price	Total	F.C.	L.C.	Total	F.C.	L.C.
1	Study Manager/Civil Engineer	0.5	3.5	4	10000	42,172.52	42,172.52		26346.30	26346.30	
2	Wastewater Treatment Specialist	0.5	1.5	2	9000	18,977.63	18,977.63		11855.83	11855.83	
3	Sanitation Engineer (2 No.)	1	4	5	9000	47,444.08	47,444.08		29639.58	29639.58	
4	Hydrogeologist/Hydrologist	0.5	1.5	2	9000	18,977.63	18,977.63		11855.83	11855.83	
5	Water/Waste Water Quality Specialist	0.5	0.5	1	9000	9,488.82	9,488.82		5927.92	5927.92	
6	Irrigation Engineer	0.5	1.5	2	9000	18,977.63	18,977.63		11855.83	11855.83	
7	Agronomist/Soil Specialist	0.5	1.5	2	9000	18,977.63	18,977.63		11855.83	11855.83	
8	Electro-Mechanical Engineer	0.5	1.5	2	9000	18,977.63	18,977.63		11855.83	11855.83	
9	Structural Engineer	0.5	1	1.5	9000	14,233.22	14,233.22		8891.87	8891.87	
10	Financial Management/Analyst	0.5	0.5	1	9000	9,488.82	9,488.82		5927.92	5927.92	
11	Agro-Economist	0.5	1.5	2	9000	18,977.63	18,977.63		11855.83	11855.83	
12	Market Specialist	0.5	1	1.5	9000	14,233.22	14,233.22		8891.87	8891.87	
13	Social and Gender Specialist	0.5	1.5	2	9000	18,977.63	18,977.63		11855.83	11855.83	
14	Compost/Biosolids Specialist	0.5	1.5	2	9000	18,977.63	18,977.63		11855.83	11855.83	
15	Environmental/Climate Change Specialist	0.5	3.5	4	9000	37,955.26	37,955.26		23711.67	23711.67	
16	Institutional Specialist	0.5	0.5	1	9000	9,488.82	9,488.82		5927.92	5927.92	
	Sub Total	8.5	26.5	35		336,325.81	336,325.81		210111.71	210111.71	
B.	Local Staff										
1	Surveyor		MM	4	2000	8,434.50		8434.50311	5269.26		5269.26
2	Assistant Environmentalist		MM	4	1600	6,747.60		6747.60249	4215.41		4215.41
3	Technicians/Draftmen (3No.)		MM	12	1600	20,242.81		20242.8075	12646.22		12646.22
4	Secretary		MM	4	1400	5,904.15		5904.15218	3688.48		3688.48
5	Office Assistant		MM	4	1400	5,904.15		5904.15218	3688.48		3688.48
6	Drivers (2No.)		MM	8	1000	8,434.50		8434.50311	5269.26		5269.26
	Sub-Total			36		55,667.72		55667.7205	34777.11		34777.11
	2. DETAILED DESIGNS										
C.	Consultant's Staff										
1	Study Manager/Civil Engineer	0.5	2.5	3	10000	31,629.39	31,629.39		19759.72	19759.72	
2	WW Treatment Specialist	0.5	1.5	2	9000	18,977.63	18,977.63		11855.83	11855.83	
3	Sanitary Engineer (2No.)	1	3	4	9000	37,955.26	37,955.26		23711.67	23711.67	
4	Irrigation Engineer	0.5	1.5	2	9000	18,977.63	18,977.63		11855.83	11855.83	
5	Agronomist	0.5	1.5	2	9000	18,977.63	18,977.63		11855.83	11855.83	
6	Electro-Mechanical Engineer	0.5	1.5	2	9000	18,977.63	18,977.63		11855.83	11855.83	
7	Hydrologist/Hydrogeologist	0.5	0.5	1	9000	9,488.82	9,488.82		5927.92	5927.92	
8	Structural Engineer	0.5	1.5	2	9000	18,977.63	18,977.63		11855.83	11855.83	
9	Financial Expert	0.5	0.5	1	9000	9,488.82	9,488.82		5927.92	5927.92	
10	Social/Gender Specialist	0.5	0.5	1	9000	9,488.82	9,488.82		5927.92	5927.92	
11	Institutional Specialist	0.5	0.5	1	9000	9,488.82	9,488.82		5927.92	5927.92	
12	Climate Change (CDM) Specialist	0.5	0.5	1	9000	9,488.82	9,488.82		5927.92	5927.92	
13	Compost/Biosolids Specialist	0.5	1.5	2	10000	21,086.26	21,086.26		13173.15	13173.15	
14	Environmentalist	0.5	0.5	1	9000	9,488.82	9,488.82		5927.92	5927.92	
	Sub Total	7.5	17.5	25		242,491.96	242,491.96		151491.20	151491.20	
D.	Local Staff										
1	Surveyor		MM	2.5	2000	5,271.56		5,271.56	3293.29		3293.29
2	Technician/Draftsmen (2 No.)		MM	6	1600	10,121.40		10,121.40	6323.11		6323.11
3	Secretary		MM	3	1400	4,428.11		4,428.11	2766.36		2766.36
4	Office Assistant		MM	3	1400	4,428.11		4,428.11	2766.36		2766.36
5	Drivers (2 No.)		MM	6	1000	6,325.88		6,325.88	3951.94		3951.94
	Sub-Total					30,575.07		30,575.07	19101.06		19101.06

ANNEX 2: BOTSWANA - WASTEWATER REUSE AND WATER HARVESTING FOR IRRIGATION STUDY - COST ESTIMATE (CONT)										
No of MM		USD					UA			
C	Reimbursable/Miscellaneous									
1	International Travel	No.	30	2000	63,258.77	63,258.77		39519.44	39519.44	
2	Per Diem incl.CC and Env.	day	1275	200	268,849.79	268,849.79		167957.64	167957.64	
3	House Accomodation	month	7	1500	11,070.29		11,070.29	6915.90		6915.90
4	Office Accommodation	month	7	2500	18,450.48		18,450.48	11526.50		11526.50
5	Local Transport (5 vehicles incl.field work environmental)	month	8	8500	71,693.28		71,693.28	44788.70		44788.70
6	Documentation	LS			23,194.88		23,194.88	14490.46		14490.46
7	Wastewater, Crop, Soil Analysis	LS			63,258.77		63,258.77	39519.44		39519.44
8	Site Investigations/Environmental audits	LS			57,987.21		57,987.21	36226.16		36226.16
9	Public Consultations Workshops/Training/	LS			6,325.88		6,325.88	3951.94		3951.94
10	Consultations	No.	5	10000	52,715.64		52,715.64	32932.87		32932.87
	Sub-Total				636,804.98	332,108.56	304,696.42	397829.07	207477.08	190351.99
	TOTAL				1,301,865.55	910,926.34	390,939.22	813310.15	569079.99	244230.16
	Contingencies 5%				70,722.13	49,493.64	21,228.48	44182.00	30920.00	13262.00
	GRAND TOTAL				1,372,587.68	960,419.98	412,167.70	857492.15	599999.99	257492.16

Your Excellency, Minister of Finance and Development Planning

Republic of Botswana

Gaborone, Botswana

Your Excellency,

Subject: Grant in the amount of **UA 600,000** (approximately USD 960,420) to the Republic of Botswana for financing the preliminary studies and detailed designs for the Water Re-use and Water Harvesting Project

Letter of Agreement

I have the honor to inform you that the African Development Bank has accepted to provide a grant of an amount not exceeding **UA 600,000** (USD 960,420) to the Republic of Botswana to finance some activities and expenses that are necessary for the preparation of the Water Re-use and Water Harvesting Project.

The grant is tied to the objectives and conditions listed in the documents hereto attached and the beneficiary, by signing this letter of agreement, confirms that he is authorized to commit, deduct, and utilize the resources of the grant for the attainment of the said objectives and conditions.

This grant does not engage nor does it commit the Bank to finance, partially or wholly, the Water Re-use and Water Harvesting Project for which this grant is being provided.

On behalf of the Republic of Botswana, you are kindly requested to confirm your acceptance of the aforementioned and of the conditions in the annex by signing, dating and forwarding this letter of agreement to the Bank. This agreement will come into force after it has been countersigned by the Bank.

Please accept, Your Excellency, the assurances of my highest consideration and esteem.

African Development Bank

By

Vice-president, Operations -----

Date-----

APPROVED AND CERTIFIED

The Republic of Botswana

By: -----

His Excellency, the Minister of Finance and Development Planning

Date:-----

BOTSWANA

Wastewater Reuse and Water Harvesting for Irrigation Study

Summary Terms of Reference

Wastewater Reuse and Water Harvesting for Irrigation Study Summary Terms of Reference

1. Introduction

1.1 One of the development objectives of the Government of Botswana (GOB) is to diversify the economy and reduce its overdependence on mining, which has been and still is the mainstay of the country's economic growth. One of the key areas of this diversification is to boost agricultural production, presently contributing only 2% of the national GDP. However, development of agriculture in Botswana is hampered by a number of challenges, the most significant of which is limitation in water resources. It is in the view of the above that the GOB has undertaken to promote re-use of wastewater for agriculture.

1.2 The goal is to put the available land within close proximity of wastewater generation under irrigation. Crop production using irrigation will also be expanded using fresh water extracted from sand rivers where practicable. The proposed study will therefore prepare an irrigation project based on these two approaches (waste water reuse and water harvesting).

1.3 The purpose of the study is to collect necessary information and carry out analysis to determine the viability of using waste water for irrigation. It will also assess the amount of water that can be produced from treatment of the available waste water in the urban areas of Gaborone, Lobatse, Selebi-Phikwe, Serowe and Tonota, and the cost of such treatment, in order to render the water suitable for crop production. In addition, it will assess the feasibility of extracting water from the sand rivers of Shashe and Motloutse, for irrigation.

2. Sector Background

2.1 Government policy in agriculture has shifted from targeting food self-sufficiency to promoting marketing in non-traditional agriculture. Having been overwhelmingly dominated by imports, largely from South Africa, horticulture in Botswana has resurged as an income earning activity. Over the last five years, national production of horticulture has risen from about 20% of total consumption to nearly 40%. The potential for increasing production not only to meet national requirements, but also, eventually, for exports is significant. If the constraint of water can be met, the climate in specific regions of the country is suitable for year-round production of horticultural production.

2.2 Surface water is limited, and even absent in most of western and northern Botswana, except around the environmentally sensitive Okavango Delta and Chobe River. Groundwater is

also limited and recharge is generally low. Most of the perennial surface water resources are shared with neighboring countries. Botswana is classified as a semi-arid to arid country, and evaporation exceeds the rainfall. Arable agriculture in Botswana is severely constrained by a variable rainfall ranging from about 650 mm in the extreme northeast to 250 mm in the extreme southwest. This rainfall water is often harvested and returned into the river system to be used further downstream for domestic and productive sectors. Productive sectors are mostly livestock and mining companies, while crop farming, primarily rainfed, has the least of the country's flowing waters share. Agriculture needs therefore to be enhanced through irrigation using harvested water, thus promoting horticulture production for economically depressed farmers.

2.3 The rapid increase in water use by households leaves little water for productive uses. Reuse of wastewater in the productive sectors would, therefore, benefit production and economic growth. Most of the wastewater is available in south-eastern Botswana, which faces most severe shortage of water resources. Treatment activities in that region aim at reusing wastewater, which results from domestic use, business and government. Sewage ponds are the most common treatment technology, producing low-quality water that is mostly discharged into rivers. Such discharges benefit the environment (vegetation and groundwater recharge) as well as some downstream economic activities, but may pose pollution and health risks when used for irrigation. Further treating these discharges for use in agriculture will contribute to poverty reduction and improvement of environmental conditions.

2.4 **Institutional arrangements:** Currently, the various responsibilities in the water and sanitation sector are split between several Ministries. The Ministry of Energy, Minerals and Water Resources (MMEWR) through the Department of Water affairs (DWA) is responsible for the management and allocation of water resources in the country. The Ministry of Local Government (MOLG) is responsible through the local authorities for wastewater collection, treatment and disposal. And finally, the Ministry of Environment, Wildlife and Tourism (MEWT) safeguards and protects the environment by issuing and enforcing standards including those related to wastewater discharge and bio-solids disposal into the environment. The Ministry of Agriculture is a client for water use for irrigation.

3. The Proposed Study

3.1 Objective of the Study

3.1.1 The objective of the study is to design an irrigation project based on both wastewater and water harvested from sand rivers.

3.1.2 The Consultant will first prepare a feasibility study, to be followed by detailed designs and draft bid documents of the recommended and agreed project. Activities for each of the two phases of the study are summarized below:

1st stage: Feasibility study

3.1.3 The Consultant will collect all available data relevant to the study including: existing status of the urban centers covered by the project (populations, water consumption, wastewater generation, prospects for future growth, etc.), status of the existing wastewater treatment works (current capacities, treatment processes and efficiencies, volume and quality of discharged effluents, etc.), availability of suitable land for irrigation in the proximity of treated water, amount of water that can be extracted from the sand rivers and implication for downstream users, efficient methods of extraction, and available irrigable land along these rivers, etc.

3.1.4 The feasibility study will be carried out and presented in adequate details to enable its findings and recommendations to form the basis for making funding decisions for investment project. Further surveys and field investigations will be carried out as local conditions for each project location demand.

2nd Stage: Detailed designs stage

3.1.5 The second phase of the study will be the preparation of detailed designs of the project in accordance with the conclusions and recommendations of the feasibility study. Design details including necessary calculations, process design, drawings including civil, structural and electro-mechanical will be prepared for all components of the project including wastewater and bio-solids treatment, water harvesting techniques, irrigation systems, and the necessary infrastructure.

3.2 Implementation mechanism

3.2.1 The Executing Agency (EA) for the study will be the Department of the Crop Production (DCP) of the Ministry of Agriculture (MOA) supported by the Department of Waste Management and Pollution Control (DWMPC) of METW. The EA will, through a Study Implementation Team (SIT) supervise and monitor the consultant's work.

3.2.2 The SIT shall be comprised of one senior staff from MOA (to be the study Coordinator), another from DWMPC, and one staff from each of the local authorities covered by the project, will be constituted to be responsible for the study implementation.

3.2.3 The Coordinator will be the liaison officer on all matters regarding the study. Together with the rest of the members of the SIT, the Coordinator will be responsible for timely provision to the consultant of information, data and documentation required for the smooth implementation of the study.

3.2.4 The study will be carried out over a period of 8 months. The schedule of submission of the various reports is as shown below:

i)	Inception Report	-	2 months after contract signature
ii)	Draft EIA Report	-	3.5 months after contract signature
iii)	Draft Feasibility Report	-	4 months after contract signature
iv)	Final Feasibility Report	-	5 months after contract signature
v)	Detailed Design Report	-	8 months after contract signature
vi)	Draft bid Documents	-	8 months after contract signature

3.3 Payment Modalities

3.3.1 Each payment will be made within 45 days from the date of submission of the corresponding reports and invoice; unless the report is not accepted for any reason by the EA. Total payments shall not exceed the total fixed price of the consultancy contract.

4. Study Outputs

4.1.1 The study outputs will include:

4.1.2 **A feasibility study report of the proposed project** - This will provide an overview of projected wastewater generation in each of the study areas so as to facilitate future planning for its reuse. It will determine and recommend the work required to be done to capture as much as possible the wastewater currently being generated, how to treat it and the resultant bio-solids for reuse in agriculture. The land to be irrigated will be demarcated and preliminary designs prepared for treated wastewater transmission and suitable irrigation systems for each project area, as well as the necessary infrastructure to facilitate farming. The feasibility study will also provide details relating to water harvesting from the sans rivers, amount available for irrigation, optimal extraction methods and environmental implications.

4.1.3 **Detailed Designs Report and Draft Bid Documents** - Detailed designs will be prepared for all the works proposed under the project. These will be done in adequate details to facilitate works construction. Detailed cost estimates and implementation schedule will also be prepared. Following agreement with the EA, the consultant will prepare draft bid documents for each contract including bill of quantities, specifications, and contract provisions.