

## REPUBLIC OF UNION OF MYANMAR

### Proposed Myanmar Ayeyarwady Integrated River Basin Management Project (AIRBMP)

#### Consulting Services for Environmental and Social Management Framework (ESMF)

#### Updated Terms of Reference (ToR)

### 1. Introduction

The proposed Myanmar Ayeyarwady Integrated River Basin Management Project (AIRBMP) funded by the World Bank through a loan of US\$ 100 million and implemented by the Directorate of Water Resources and Improvement of River Systems (DWRIRS) is designed as a multi-phased approach (Series of Projects) to strengthen integrated, climate resilient management and development of the Ayeyarwady River Basin and national water resources. In the first phase, this approach will focus on developing the institutions and tools needed to enable informed decision making and implement integrated river basin management on the Ayeyarwady, while immediately enhancing the river's productivity with "no/low regrets" investments in the hydro-meteorological observation system and services (to support agricultural productivity and water-related disaster risk management) and in navigation enhancements (to promote transport). Also, the proposed first phase will lay the groundwork needed to undertake large-scale infrastructure investments in possible second or third phase. It will provide the government with the capacity to do basin-wide scenario analyses, to properly identify and assess the complex trade-offs that inevitably arise from large long-lived water infrastructure investment, and to follow economic, environmental and social 'good practice'. The first phase will also support (pre-) feasibility studies for priority investments that are identified in the course of the basin planning framework exercise for potential funding in subsequent phases. Specific project locations linked to channel enhancements on the Ayeyarwady from Mandalay to Nyaung Oo will be selected and identified during project implementation once the relevant modeling and feasibility studies are developed.

The proposed first phase project includes three components: (i) Water Resource Management Institutions, Information & Capacity Building; (ii) Hydromet Observation and Information Systems Modernization; (iii) Ayeyarwady River Navigation Enhancements; and (iv) Emergency Contingency Response. The proposed investments trigger several World Bank policies that are relevant to these ToRs such as *Environmental Assessment* (OP 4.01); *Natural Habitats* (OP 4.04); *Physical Cultural Resources* (OP 4.11), *Involuntary Resettlement* (OP 4.12) and *Indigenous People* (OP 4.10). Brief description of project components are listed below while more details are presented in Annex 1.

Component 1 - Water Resource Management Institutions, Decision Support Systems & Capacity Building - seeks to provide the information, capacity and institutions required to enable government to identify, appraise and manage appropriate development opportunities in the Ayeyarwady. At this moment of rapid reform and rapid investment it is important to ensure that a vision for integrated river basin management guides new investment in the Ayeyarwady, rather

than defaulting to ad hoc investments that can undermine one another and irreversibly compromise the river's full sustainable economic, social and environmental potential. This component will have the following sub-components: 1.1. Institutional development; 1.2. Ayeyarwady Integrated River Basin Planning Framework and Feasibility Studies; and 1.3. Implementation Support.

Component 2 - Hydromet Observation and Information Systems Modernization - seeks to support priority modernization needs in order to improve the quality of water, weather, and climate information and services provided by DMH to the society. The quality of hydro-meteorological data in Myanmar is inadequate due to poor and obsolete equipment, poor status and limited number of observation sites and lack of quality assurance and quality control protocols. This component will include the following sub-components: 2.1 Institutional and Regulatory Strengthening, Capacity Building and Implementation Support for DMH; 2.2. Modernization of the Observation Infrastructure, Data Management Systems and Forecasting, and 2.3 Enhancement of the Service Delivery System of DMH.

Component 3 - Navigation Enhancement on the Ayeyarwady River – will finance civil works to improve inland water transport safety, ease navigation constraints in the priority stretches of the Ayeyarwady River and design a cost-effective and environmentally and socially acceptable strategy for managing the full length of the navigation channel. The component includes the following sub-components: 3.1. Navigation Aids (Mandalay to Yangon); 3.2. Channel Improvements (Mandalay to Nyaung Oo); 3.3. Ayeyarwady River Navigation Strategy (Mandalay to Yangon); and 3.4. Institutional Strengthening and Implementation Support.

Component 4 - Emergency Contingency Response – is a provisional zero allocation component added under the project to allow for the rapid reallocation of funds from other components in order to provide preparedness and rapid response support to disaster, emergency and/or catastrophic events, as needed.

In accordance with the World Bank's safeguard policies and procedures (OP/BP 4.01) the overall proposed Project is considered Environmental Assessment (EA) category "A" due to its strategic focus on river basin planning and the interventions to be carried out under Components 2 and 3. This will entail the preparation by the Directorate of Water Resources and Improvement of River Systems (DWIR)/National Water Resources Committee (NWRC) Secretariat of an Environmental and Social Management Framework (ESMF) report including an Environmental and Social Management Plan Framework that will meet both the current related Myanmar environmental legislation and the Bank's Category A requirements. Given that the specific locations and technical details of the works proposed for channel enhancements from Mandalay to Nyaung Oo, the river training between Mandalay and Yangon, the river navigational aids, and the installation of the hydromet stations will not be known by the project appraisal, the preparation of an Environmental and Social Management Framework (ESMF) is the tool required to describe the baseline project environmental conditions and impact, and to provide guidance for environmental and social assessment processes to be undertaken during project

implementation once the respective technical details are available (e.g., principles, rules and procedures to screen, assess, manage and monitor the mitigation measures of possible project environmental and social impacts). The ESMF will be developed to include - based on input from the consultation process, preliminary social assessments with project beneficiaries/ affected people including but not limited to ethnic minorities, and from general social impacts – (i) the project Resettlement Policy Framework (RPF), which can be used to address any land acquisition and voluntary land donation issues that may arise; and (ii) a Community Participation Planning Framework including in Indigenous Peoples Planning Framework, to guide the design of mitigation measures in the event that project activities affect ethnic minorities.

These ToRs are relevant to the development of the project Environmental and Social Management Framework (ESMF). The ESMF role is a tool to identify and assess the potential environmental and social issues and impacts of project financed activities, both positive and negative, when the environmental and social impacts cannot be fully determined until the details have been identified. Stakeholder consultations and preliminary social assessment are therefore key aspects of and inputs to ESMF. Further, the ESMF will set out the principles, rules, and procedures to screen, assess, manage and monitor environmental and social impacts of those investments that are not known at the time of project appraisal. It will contain measures and planning to enhance positive impacts and reduce, mitigate and/or offset adverse impacts, provisions for estimating and budgeting the costs of such measures, roles and responsibilities of stakeholders including but not limited to the agencies responsible for addressing project impacts. It will also include arrangements to ensure free, prior and informed consultations with and meaningful participation of broad stakeholders including ethnic, poor and vulnerable people who derive significant livelihoods from water resources and thus may be significantly affected by changes in their management. The framework approach allows also for screening and mitigation measures by the project owners and implementers to ensure investments are environmentally and socially sustainable and inclusive. The ESMF will also provide processes and procedures with regard to the implementation of RPF and CPPF including the full Social Assessment to be conducted during implementation, and the development and implementation of Resettlement Action Plan (RAP), and Community Participation Plans (CPP) which include all elements of Indigenous Peoples Plan under OP 4.10 for activities identified during project implementation. The Environmental and Social Management Plan Framework may also be developed as separate but as a complementary document.

## **2. Background Information**

The project will be located primarily within the Ayeyarwady River Basin. The basin is home to an extraordinary range of ecosystems, and flora and fauna, including the charismatic and endangered species such as elephants, tigers, leopards, sea turtles, crocodiles, waterfowl and migratory birds, and the Irrawaddy dolphins. It is also home to diverse groups of ethnic minorities who are dependent on the river for livelihoods and subsistence. It is expected that many poor and vulnerable ethnic Burman derive a significant livelihood from the Ayeyarwady River Basin and that they may be significantly affected by changes in the way it is managed.

The project impact area is expected to encompass the Ayeyarwady Basin where water resources management will be strengthened. Works that will be carried out to modernize Myanmar's hydromet observation and information systems (Component 2) are expected to be confined to improvements of existing stations and facilities. Civil works to enhance the channel capacity of the Ayeyarwady (Component 3) are expected to be confined to the river bed.

The screening and application procedures for any environmental impacts on natural habitats and cultural resources will be provided in the ESMF and followed during project implementation.

The project will finance installation of hydromet observation stations for which site specific simple EMPs will be developed during project implementation, including specific operation requirements in line with established SOPs (annexed to ESMF).

### 3. The Objective of the Assignment

The objective of this assignment is the following:

- (i) Develop an **Environmental and Social Management Framework (ESMF)** with **Environmental Social Management Plan Framework** for the relevant Component 2 and 3 investments;
- (ii) Carry out a preliminary social assessment to collect social baseline and provide inputs to the design of the project and the development of ESMF.
- (iii) Develop a simple **Resettlement Policy Framework (RPF)** to address potential land acquisition, restriction of access to livelihood and voluntary land donation that may occur during implementation. RPF should fully address requirements of OP 4.12.
- (iv) Develop a Community Participation Planning Framework (CPPF) which fully addresses the **Indigenous Peoples Policy Framework** defined under OP 4.10. CPPF will be part of the ESMF and aims to ensure that poor and vulnerable people including but not limited to ethnic minorities will be fully consulted with and meaningfully participate in project implementation processes; and
- (v) An **Executive Summary (ES)** (max 12 pages) that will include information summarized from the ESMF document.

The Consultant will assist DWRIRS in carrying-out the required public and stakeholder consultations and disclosure process as necessary for the above draft safeguard documents. The documents will be made publicly accessible by posting it on the Client's website in local language and sufficient time in advance of the public debates.

### 4. The Scope of the Assignment

The main task of the Consultant is to assist DWRIRS in integrating environmental and social factors into the investments proposed under the AIRBM project. For the tasks detailed below, the Consultant will visit the project areas and will be in constant coordination with appropriate local government authorities, stakeholders, including farmers and their families, NGOs and/or research institutes. During the project site visits particular attention should be paid to affected people views on direct, indirect and induced environmental and social impacts during the project's civil works, and on how their livelihoods can be enhanced as a result of improved river basin management.

The assignment includes the following main tasks as part of ESMF preparation:

**Task 1 Brief outline of project location(s) and description of proposed project activities**

- (i) The Consultant will provide a brief description of typical features of the geographical area in the selected project locations in terms of current population, social and economic activities - particularly issues related to livelihoods as well as social and public recreational assets, geography, and environment. Then, from site visits and any available technical documents, the Consultant should provide a brief description of the relevant components of the project, using maps (at appropriate scale) where necessary, and including information such as historical ownership data, general location, planned construction activities, etc.
- (ii) The Consultant is responsible for obtaining all necessary field data that are required to complete this task; also, the Consultant will take all necessary activities and steps in coordination with relevant institutions.

**Task 2 Brief descriptions of Existing Environmental and Social Conditions in the project area of impact** The Consultant will review, evaluate and present available baseline data on the relevant environmental, social, economic and physical cultural heritage characteristics within the project area of impact taking into account the present activities (e.g., current irrigated agricultural practices, water supply, river transportation, tourism, etc.) relevant to the project investments in a strategic manner. Specifically, the baseline conditions should include general information in the 3 regions on:

- a. Physical environment: geology, topography, sediments/soils, surface and ground water hydrology, land pollution, water quality, air quality and sources of air/noise emissions, integration of the river basin management activities in the overall environment (e.g., existing dams, water supply systems, sanitation, climate change aspects);
- b. Meteorology: wind patterns, monthly average temperatures, rainfall, snowfall and runoff characteristics; extreme storm and precipitation events;
- c. Biological environment: existing terrestrial and river flora and fauna at the sites; particular rare and endangered species; sensitive habitats, including wetlands, parks or reserves in areas likely to be affected by works; species of commercial importance;
- d. Social, economic impacts: community structure around port areas; inventory of community activities and production systems (e.g., fishing, industry, farming, small businesses); level of income, any public infrastructure and social services (goods and services); and a description of any direct, indirect and induced impacts on livelihoods;
- e. Information on disadvantaged groups, ethnic minorities or persons for whom special provisions may have to be made, if affected, and in the context of developing mitigation measures;

f. Assess whether there will be any displacements as a result of the physical works;

g. Physical cultural property: Cultural heritage assets such as cultural, religious, historical or archaeological sites, including sacred sites, graveyards and burial places, that might be affected during proposed civil works;

h. Other data relevant to the project investments as required by the existing national environmental conservation laws, regulations and standards.

**Task 3 Brief review of the existing Legislative Framework, institutional assessment and capacity building** The Consultant will review existing legislation in Myanmar, decisions and/or guidance notes relevant to the environment quality, health and safety, waste management, water management, hazardous substance/pesticide storage and handling; noise emissions; protection of sensitive areas and endangered species, land-use planning, involuntary resettlement and expropriation; public information; environmental liability, etc. determining their relevance to the project. The Consultant will assess the institutional arrangements for project management including the mechanisms and responsibilities for environmental and social screening and the review of ESMP results. This includes a review of institutional capacity for the supervision and enforcement of ESMPs during construction and operation phases. The consultant will reference any international relevant legislation applicable to the project investments.

**Task 4 Brief assessments of potential environmental and social impacts and related mitigation measures** The Consultant will identify general significant positive and negative impacts, direct, indirect and associated impacts, and immediate and long-term effects related to the construction phase of the proposed works as well as once the works are finalized (operational phase).

**Task 5 Brief analysis of Alternatives to the Proposed Project** The Consultant will review the proposed project interventions and summarize any possible alternatives. Such alternatives could be related to different options in terms of design of structures and facilities, selection of technologies, construction techniques, and project phasing, operating and maintenance activities. The alternatives should also emphasize upstream analysis of cumulative and secondary/induced impacts and potential conflicts (e.g., with planned dams/hydropower schemes).

**Task 6 ESMF process** – The Consultant will describe the framework process to be followed once the location of the project investments will be identified during project implementation. The framework should have the following essential elements:

- Typology of subproject/investment types expected in the project
- Screening process for subproject types – based on potential size/scale of subproject in conjunction with potential environmental and social impacts and risks
- Screening of potential environmental and social impacts and risk mitigation approach, including determination of safeguards instruments; for example, ESMF will include screening procedure to (i) determine whether the subproject is in a critical or non-critical natural habitat, and (ii) avoid any significant conversion or degradation of any critical natural habitat as well as guidelines to develop mitigation measures to minimize or avoid

damage to the natural habitats; similarly, screening procedure will consider cultural resources. Also, it will include screening procedure for dams (small, medium or large);

- Development of appropriate safeguards documents; for example, in the case of small works on channel improvements or installation of hydromet meteorological stations, generic EMP or an EIA if necessary will be developed and followed during project implementation. For existing hydromet station, ECoP procedures would be sufficient to be followed during project implementation;
- Clear definition of roles and responsibilities of project staff and associated agencies in subproject implementation and application of environmental and social review, implementation of safeguard documents, monitoring and evaluation.

#### **Task 7 Preparation of Environmental and Social Management Plan Framework (ESMPF)**

The Consultant will prepare the project Framework ESMP including Mitigation Plan and a Monitoring Plan according to the Bank requirements on the OP 4.01. The Framework ESMP should include proposed mitigation and monitoring actions as well as the institutions responsible for the ESMP implementation. Also, the ESMPF should present proposed staffing and training requirements related to ESMP implementation, institutional needs (based on a capacity assessment, and other necessary support, and estimated costs for proper ESMP implementation.

- (a) The Mitigation Plan will include general mitigation measures related to preventing or reducing the possible project environmental and social impacts as well as the approximate costs for these measures;
- (b) The Monitoring Plan will propose a general plan of feasible actions to monitor the implementation of the mitigation measures and the impacts of the project during the construction and operation. The Monitoring Plan should include an estimate of costs required to successfully implement such plan as well as the parties responsible to carry out this plan.

**Task 8 Preliminary Social Assessment** As part of the preparation of the ESMF, the consultant will carry out a preliminary social assessment which, together with the social baseline to be collected through literature review and key stakeholder interviews, will provide basic social inputs to the development of ESMF. The preliminary social assessment will be conducted through free, prior and informed consultations with poor and vulnerable people including but not limited to ethnic groups. Key stakeholder interviews with local businesses and government officials will also be done to supplement stakeholder consultations. The preliminary social assessment will focus on the following: (i) the local people's use of and dependence on Ayeyarwady basin water resources for livelihoods; (ii) the current water resource management of the Ayeyarwady Basin and local people's participation in it; and (iii) aspects of Ayeyarwady basin management that may constrain the sustainable livelihood improvement of local people and possible steps that may enhance their participation in Ayeyarwady river basin management. Some social baseline such as existing grievance redress mechanisms available to local people, in particular poor, vulnerable and ethnic groups, and their effectiveness, should also be collected. Selection of site visits should take into account the distribution of ethnic groups and vulnerable population in the Ayeyarwady Basin.

During the consultation meetings, overall project scope and potential impacts, positive and negative, will be explained to participants and their broad community support to the project will be assessed and documented.

**Task 9 Resettlement Policy Framework (RPF)** It is unlikely that the project will result in permanent acquisition of private land, however, specific policies and procedures should be developed during project preparation to allow the project to address potential land acquisition should it prove to be necessary. Also, in case changes in water resource management mechanisms of Ayeyarwady river basin result in loss of access to livelihood activities, processes and procedures should be developed so that they can meaningfully participate in developing such mechanisms and that potential loss in livelihood will be mitigated. Policies and procedures to ensure that temporary occupation of land by contractors during civil works is allowed on a willing seller - willing buyer basis without any coercion or under duress should also be developed.

RPF will form a part of ESMF. Some common elements, such as project objectives and description, which are described in other parts of ESMF do not need to be repeated in RPF but they should be cross-referenced. Specifically, RPF should contain, at minimum, the following elements:

- (a) Description of potential, although unlikely, land acquisition or restriction of access to lands on a permanent basis, and measures to mitigate them including steps to allow meaningful participation of affected people in developing mitigation measures.
- (b) Description of processes and procedures to be followed in case private land has to be occupied temporarily during civil works.
- (c) Institutional arrangements and implementation procedures, with a clear description of roles and responsibilities of key stakeholders;
- (d) Monitoring and grievance mechanisms; and
- (e) Budget
- (f) Other elements as required under OP 4.12.

**Task 9 Community Participation Policy Framework (CPPF)** Improvements in Ayeyarwady river basin management will likely change the access of local poor and vulnerable groups to natural resources on which they depend for a significant part of their livelihood. Also, ethnic groups are present within the Ayeyarwady river basin, and any change in its management will affect their livelihood. CPPF will be developed that will provide detailed, step by step processes and procedures to allow a free, prior and informed consultation with and a meaningful participation of poor, vulnerable and ethnic groups in project implementation. CPPF should fully incorporate elements of Indigenous Peoples Planning Framework (IPPF). Among other aspects, CPPF should address the following:

- (a) Description of poor, vulnerable and ethnic groups who are present in the Ayeyarwady river basin. In particular, demographic, ethnic and socioeconomic characteristics of such groups of people should be described.
- (b) Description of the likely project impacts



- (c) Detailed, step by step description of full Social Assessment (SA) that will be carried out during implementation. SA will include free, prior, and informed consultation with effected local poor, vulnerable and ethnic groups.
- (d) Institutional arrangements with detailed description of the roles and responsibilities of stakeholders including the government agencies in charge of full SA to be developed during implementation
- (e) Description of mechanisms for Monitoring and Evaluation, and to address grievances.
- (f) Disclosure plan
- (g) Budget

**Task 10 Public Consultation** The Consultant will assist in carrying-out two minimum public consultations and the relevant disclosure process for the ESMF (with annexes) and Executive Summary reports to allow public awareness of the selected project investments and the envisaged related environmental and social impacts. The first Meeting will take place to seek guidance on these ToRs and a second Meeting will be hold when the draft ESMF will be available. Minutes including questions and answers from these meetings will be included in the final documents. The public meetings should be announced in mass-media at least one week ahead of the discussions. Active NGOs, potential community/farmers representatives as well as local authorities that may be affected by the project activities should be invited. The draft documents should be made publicly accessible by posting it on the website of the relevant institution in local languages before the date of the public meeting.

## **Annex 1 Detailed Project Components Description**

### **Component 1: Water Resource Management Institutions, Decision Support Systems & Capacity Building.**

1. This component seeks to provide the information, capacity and institutions required to enable government to identify, appraise and manage appropriate development opportunities in the Ayeyarwady. At this moment of rapid reform and rapid investment it is important to ensure that a vision for integrated river basin management guides new investment in the Ayeyarwady, rather than defaulting to ad hoc investments that can undermine one another and irreversibly compromise the river's full sustainable economic, social and environmental potential.
2. To guide sustainable development in the Ayeyarwady, the Government of Myanmar is promoting greater coordination across agencies involved in water resources management as well as strengthened institutions, laws and regulations, capacity and decision support tools. A 2013 Presidential Decree was therefore issued creating the National Water Resources Committee (NWRC). The NWRC will have three pillars: (i) a Secretariat, (ii) a Hydro-Informatics Center (HIC) and (iii) an Expert Group. This component will help to build these three new entities.
3. The NWRC Secretariat and HIC will initially be established at the Yangon Technological University, at least for the period 2014-2015. The HIC will be the host and operations center for a decision support system, and will have access to the repository of IWRM data held in DMH, and be a knowledge hub for the analysis of water matters in Myanmar. [The activities below assume that significant investments will need to be made at the University to support the HIC and to support the Secretariat, but that funding will also be allocated to build/refurbish permanent facilities at Yangon Technical University or elsewhere.]

#### **1.1 Institutional Development**

4. Support will be provided to develop the institutional capacity necessary to deliver the NWRC's mandate and develop the necessary legal and institutional frameworks. A clear focus of the project will be a broadly based capacity building program integrated into the main knowledge and development activities. This sub-component will help to:
  - (a) Launch the newly created NWRC Secretariat, Hydro-Informatics Center and Expert Group This may include the purchase of office equipment, construction or refurbishment of facilities, incremental running costs, technical assistance for development of the NWRC institutions, mandates, business plans, staffing strategies and operational procedures.
  - (b) Undertake institutional, legal and regulatory reviews and reforms This sub-component will support (i) development of the new Water Resources Strategy and Law together with a Water Framework Directive and associated regulations, implementation arrangements and enforcement mechanisms, (ii) a review of water management functions across the government and relevant environmental and social safeguards regulations and capacity strengthening to screen, review and monitor water-related investments for environment and social impacts, and (iii) rationalization of the institutional structure

governing the management of water in Myanmar including support for the foreshadowed move to a River Basin Organization (RBO) for the Ayeyarwady by assisting with the design of the Organization and the preparation of any necessary laws, regulations and guidelines.

(c) Create a stakeholder forum and promote communications and outreach Stakeholder communications and outreach is essential given the importance, sensitivity and reach of impacts associated with water management decisions. In particular it will be important to have a robust consultation mechanism in place to engage civil society in the development of the Water Law, River Basin Planning exercise and design of the future Ayeyarwady RBO.

(d) Support capacity building Capacity building for water resources management in Myanmar is needed at all levels. Tailored professional trainings in country and out of country, MSc, PhD, secondary school curricula, workshops, exchanges/study tours, etc. Opportunities should be provided across the government and for Myanmar youth. This capacity building sub-component could also support study tours by senior government officials as they work to design the proposed RBO. The Government of The Netherlands is currently undertaking a Needs Assessment for integrated water resources management training in Myanmar which can be drawn on to prioritize activities for funding.

## **1.2 Ayeyarwady Integrated River Basin Planning Framework and Feasibility Studies:**

(a) Ayeyarwady Integrated River Basin Planning Framework To ensure the government has ongoing capacity to plan and manage its water resources, an integrated river basin planning and management exercise will be undertaken. The exercise is envisaged to provide immediate guidance on investment options, but also to put in place the arrangements for strategic planning of the Basin's water related developments and to enable the GoM to select development pathways for the Basin rather than being captured by the current incremental and uncoordinated approaches. The exercise will be managed by the HIC, based in the Yangon Technical University (YTU) to provide an important link to the university sector. The Planning Framework exercise will include:

- (i) Basinwide diagnostic studies including scoping level analyses of hydropower potential, a basinwide Strategic Environmental and Social Assessment, and the creation of a knowledge base for use in the report and future use by the HIC, the future RBO and by line management Agencies
- (ii) Development of a set of models and analytic tools for use in the final report and future use by the HIC, the future RBO and by line management agencies

(iii) Stakeholder consultations to define planning scenarios [and establishment of a Panel of Experts to advise the work], and

(iv) An integrated basin master plan report that will include inter alia (i) a range of investment scenarios and recommendations developed in consultation with stakeholders and (ii) proposed institutional arrangements for ongoing basin planning and management in Myanmar (i.e., how basin investments should be identified, appraised, consulted with stakeholders, approved by government and implemented)

(b) An Ayeyarwady Basin Groundwater Survey: The Ayeyarwady has a rich groundwater endowment. This analytical work will seek to understand the quantity, quality and distribution of groundwater in the Basin. It would also look to establish the sustainable yield of the groundwater system in a few critical areas (where development currently exists or is foreshadowed) and provide advice on the legal and administrative frameworks necessary for the future management of these resources. It would provide advice on a long-term monitoring program and on areas where further detailed studies are required before groundwater resources in those areas are critically over-allocated. The study may include: (a) a detailed groundwater study to determine the extent, location, recharge and quality of groundwater available, particularly in the Dry Zone, (b) targeted investigations to understand aquifer characteristics and likely sustainable yields to support the GOM as it makes strategic choices about development pathways, and (c) groundwater quality assessment particularly related to arsenic contamination.

(c) A Sediment Transport and Management Strategy. The Ayeyarwady River has the 5th highest sediment load of any river worldwide. Sediment and its management will be a key element of any development pathway. The study will address two issues. The first will be an assessment of the past sediment loads in the river and an evaluation of whether the sediment load is increasing or not. It will also determine where sediment is generated from and rank sub-catchment areas in term of the sediment export loads. The second will be an evaluation of a number of high sediment load sub-catchments to determine what the mechanisms for sediment release are and what intervention strategies might be available to manage it.

(d) Resources to prepare potential investments. It is expected that as the Planning Framework evolves it will identify “no regrets” projects that could move to feasibility evaluation. It is important that these projects are progressively evaluated as they are likely to be a financed in future phases of this program. The GoM has given a high priority to the evaluation of projects in order to progress development in the country in an orderly and well informed way.

### **1.3 Implementation Support:**

5. This sub-component will include (i) for the PDU, incremental running costs and consultant and advisory services for overall project management, financial management, procurement,

safeguards and monitoring and evaluation, and (ii) for the Component 1 CMPU (CMPU-1), incremental running costs and consultant support [to be specified] to facilitate management and monitoring of the component.

## **Component 2. Hydromet Observation and Information Systems Modernization**

6. Hydrological and meteorological (hydromet) observation systems and services provide crucial agricultural advisories (for planting, harvesting and crop mixes) and disaster warnings (for floods, droughts, storms and sea surges), as well as the primary data upon which water management decisions are taken. Hydromet data is also important for transportation safety, energy production, public health, environmental protection, tourism and other weather-dependent sectors.

7. The proposed hydromet component supports priority modernization needs in order to improve the quality of water, weather, and climate information and services provided by DMH to the society. The quality of hydro-meteorological data in Myanmar is inadequate due to poor and obsolete equipment, poor status and limited number of observation sites and lack of quality assurance and quality control protocols.

### **2.1 Institutional and Regulatory Strengthening, Capacity Building and Implementation Support for DMH**

8. The DMH is an authorized national body responsible for provision of weather, climate and hydrological data and information. DMH is responsible for the operation of a small network of manual meteorological, hydrological, climate and agro-meteorological stations and development of limited range of products such as basic weather forecasts, warnings of severe weather and floods. DMH staff are dedicated and committed to the improvement of their services, but they need significant support in capacity building and training, and there are several specialized areas that require additional qualified staff, such as weather forecasters, hydrologists, modelers, information and communications technology (ICT) specialists and engineers. This sub-components may finance:

(a) Institutional strengthening and development of a legal and regulatory framework  
In Myanmar, the new Water Law will be a pivotal piece of legislation. Associated water information standards and regulations should also be developed. It will be important for the future integration of systems that these laws and regulations are in place together with agreed data access agreements; otherwise the system design will become very complex and interagency data transfers will be non-trivial. Open sharing of data within the MoT at minimum should be an early consideration for implementation.

(b) DMH capacity building and training To manage and operate a modernized system capacity building of staff will be needed, including degree programs, short courses, participation in trainings with WMO and major users of hydromet information, and possibly “twinning” arrangements with advanced national hydro-meteorological services.

(c) Implementation support, systems design and integration Consultant support [to be specified] and incremental running costs will be provided to the Component 2 CPMU (CPMU-2) to facilitate management and monitoring of this component. Importantly, due to the complexity of designing a modern integrated hydro-meteorological system and the lack of such experience in Myanmar, a consulting company (a Systems Integrator) will be selected to provide support to DMH throughout the implementation period of the project. The main functions of this Systems Integrator will include (a) development of the detailed design of the future DMH system taking into account its affordability; (b) technical procurement support including developing technical specifications and bid documents; (c) assistance to DMH in the development and operationalization of the main information products and services; (d) assistance to DMH in the integration of various component activities into a unified observing, forecasting and delivery system and support for effective functioning of this system; and (e) assistance to DMH in the provision of data services and connectivity with HIC and other external client systems.

## **2.2 Modernization of the Observation Infrastructure, Data Management Systems and Forecasting**

9. The weather and hydrologic observing network is very small and has no operational automatic stations. The number of observation stations is significantly below WMO recommendations for all types of observations. Use of modern observation systems is very limited or non-existent. Communication and data management systems are in general rudimentary, unreliable and fragmented. The sub-component will therefore finance:

- (a) Technical modernization of the observation networks This will include expansion, rehabilitation and technical re-equipment of the hydrological network, improvement of the environment of the hydrological stations, upgrading surface meteorological detection network, expansion of agrometeorological network, establishment of a climate reference network, establishment DMH calibration laboratories and vehicles to support DMH field operations, maintenance and inspections.
- (b) Modernization of DMH operational centers and facilities, data management, communication and IT system Core ICT infrastructure investments will likely include file servers, generators, uninterrupted power supply, upgrade/installation of high speed interoffice communications links and internet upgrades. A complete network upgrade will be required to establish a local area network connecting all operational systems as well as administrative systems which should be segmented from each other for security.
- (c) Improvement of numerical hydro-meteorological prediction system Numerical Weather Prediction (NWP) is the foundation of modern forecasting systems. It is therefore essential that DMH has access to NWPs from leading meteorological centers and develops its own capabilities including associated hydrological

modeling frameworks.

- (d) Design and pilot operation of surface water quality monitoring system This will include a needs assessment, a preliminary evaluation of water quality, and the design of a water quality monitoring network for possible future investment. A pilot program will be undertaken in key geographic locations which will be selected during the needs assessment and design phase.
- (e) Reconstruction and refurbishment of DMH offices and facilities Modernization of the observation and ICT systems may require significant refurbishment, reconstruction and/or upgrading of DMH's facilities.

### **2.3 Enhancement of the Service Delivery System of DMH**

10. Traditionally, departments of meteorology and hydrology have focused on data gathering rather than delivering information services to users. This sub-component will support DMH in strengthening its service orientation in order to ensure the benefits of the project's investment are realized across the range of stakeholders. This will likely include :

- (a) Introduction of a Public Weather and Hydrological Service The Public Weather Service (PWS), as defined by the WMO, is the primary means by which a National Meteorological Service forecasts and communicates weather information and warnings to the general public. The PWS is responsible for liaising with the public, media and weather, climate and water-sensitive sectors. It is the principal interface between the technical provider of products and the users. Pilot efforts will be undertaken in this activity to improve service delivery to communities. Myanmar is rapidly expanding access to mobile telecommunications. This should soon become the quickest and easiest way to communicate warning information and presents an opportunity for DMH to mainstream the use of mobile telephone-based applications (mobile applications or m-apps) across its programs to improve service delivery to a variety of users.
- (b) Support for DRM operations This sub-component focuses on strengthening the institutional and technical capacity of the DMH in enhancing its short- to medium-term forecasting capacity. Reliable and frequent real-time data for precipitation, river flow, temperature and wind speeds along with climate forecast modeling capabilities will allow the DMH to issue early warning bulletins for hydro-meteorological disasters with sufficient lead time. This will include expansion of "end-to-end" early warning systems in two or three medium size river basins with flash floods.
- (c) Development of Agriculture and Climate Advisory Service (ACAS) The objective of this sub-component is to provide critical, timely and reliable agro-climate and weather information to farmers in order to increase productivity and reduce losses from meteorological and hydrological hazards. This will include the design and pilot operation of an ACAS Portal, development of agriculture monitoring products such as the mapping of climate-vulnerable farming communities and the establishment of a

crop monitoring system, dissemination of information products and capacity building.

(d) Creation of the National Framework of Climate Services A National Climate Service will transform the traditional climatological role of a National Meteorological Service, which focuses on the collection and mapping of meteorological data, to a full user-oriented service. This effort will be undertaken in line with the WMO Global Framework for Climate Services (GFCS). A digital library will be created with climate-relevant information from all sectors, designed to deliver climate information in forms that can be easily understood and utilized by end-users.

### **Component 3. Navigation Enhancement on the Ayeyarwady River:**

11. The Ayeyarwady River has historically been the main transport artery of the nation but the river's navigability is deteriorating. This deterioration appears to be caused primarily by heavy sediment loads. The annual estimated sediment load in the Ayeyarwady/Chindwin system is roughly 400 million tons making it the fifth most sediment laden river in the world. Sedimentation is perceived to be increasing as a consequence of natural processes as well as human activities such as mining and deforestation in the upstream watersheds. Impacts are seen in increasingly braided channels, sand bars that affect river morphology and present hazards to inland transport particularly at night when visibility is compromised, insufficient water depths for navigation in low water season (15 November to 15 May) and flooding in high flow seasons. The government is currently managing 46 points of constriction along the river.

12. This sub-component is designed to improve inland water transport safety, ease navigation constraints in the priority stretches of the Ayeyarwady River and design a cost-effective and environmentally and socially acceptable strategy for managing the full length of the navigation channel.

#### **3.1 Navigation Aids (Mandalay to Yangon)**

13. Existing navigation aids are useful only for daytime navigation and need to be modernized to better indicate the navigation channel. Most navigation aids are currently of a temporary nature, such as bamboo rods, and need to be upgraded to more permanent equipment such as metal buoys, some of which should be lighted. Providing modern navigation aids and night navigation aids from Mandalay to Yangon will enhance income generating opportunities for both inland water transport and green/river tourism businesses. These activities will include:

(a) Design of navigation aids A design [consultancy] for navigation aids on the stretch of the river from Mandalay to Yangon will be developed, along with the documentation necessary for tendering goods and any associated installation and training required. Aids may include signage, buoys, lighting, mapping, a system of government river-pilots and a hopper-dredger (operated by the government or private sector) for immediate response to river obstructions.

(b) Navigation aids The design developed above (3.1.a) will be implemented [by government force account -- tbc]. Installation of and training for specialized



equipment, i.e., lighted buoys or patrol boats, should be contracted by vendors as appropriate. Night navigation aids will be installed in the Mandalay to Nyaung Oo reach as a priority.

### **3.2 Channel Improvements (Mandalay to Nyaung Oo)**

14. Channel improvements will be undertaken to ensure transport safety and efficiency along the busiest stretch of the Ayeyarwady system which lies between Mandalay and Nyaung Oo (Bagan). This is also the stretch where the project's night navigation enhancements will be focused. It is a first priority for both passenger and cargo transport. The present draft restriction for the Mandalay to Nyaung Oo stretch during the dry seasons is just 1.5 meters. Draft improvements will allow vessels to be loaded more heavily during dry seasons, increasing the efficiency of passenger and cargo transport. Activities will include:

(a) Design & feasibility study of Mandalay to Nyaung Oo channel enhancements

The first phase of channel enhancements will focus on the Mandalay to Nyaung Oo stretch of the Ayeyarwady. Enhancements will likely include a series of groins, gabions and other minor river works not anticipated to have 'over-bank' impacts. A design and feasibility consultancy will be carried out that will: (a) build a one-dimensional model for the pilot section, and within this section focus on the two stretches of 30 km that are known bottlenecks using two-dimensional models to predict morphological changes and navigation channel dynamics, (b) propose a design for channel enhancement works including siting and materials specifications, (c) provide a feasibility assessment including technical and economic analyses, and (d) conduct an ESIA.

(b) River training The design developed above (3.2.a) will be implemented.

### **3.3 Ayeyarwady River Navigation Strategy (Mandalay to Yangon)**

15. A channel design study will be undertaken to design a comprehensive river training strategy for the full Mandalay to Yangon stretch of the river. The study will model the morphology and sediment transport dynamics of the full Ayeyarwady basin with an emphasis on the key navigation reach Mandalay to Yangon. Any models that are produced will be provided to the HIC once they are developed to ensure GoM has the capacity to manage and monitor its navigation assets. This sub-component will also finance channel enhancement works on a second priority<sup>1</sup> stretch of the Ayeyarwady River.

(a) Ayeyarwady Navigation Strategy Building on the feasibility study of the Mandalay to Nyaung Oo pilot reach (activity 3.2.a), the river modeling effort will be extended to obtain a 2-dimensional model of the entire Mandalay to Yangon reach. This model will then be used to generate a channel enhancement strategy for the full Mandalay to Yangon reach. The activity will include a feasibility study (recommendations for design, materials and siting, as well as an economic analysis)

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<sup>1</sup> Here the term 'second priority' is with reference to the 'first priority' Mandalay to Nyaung Oo stretch where channel enhancements will be carried out under activity 3.2.

and ESIA. The stretch remains to be identified, but the area surrounding Yangon Port is a likely priority. The models developed in this exercise will be given to the HIC and training will be provided to HIC staff to enable their usage.

(b) River training River works will be undertaken on the second priority reach identified by the Ayeyarwady Navigation Strategy (activity 3.3.a), following the design and ESIA recommendations of the Strategy report.

### **3.4 Institutional Strengthening and Implementation Support**

(a) Implementation Support Consultant support [to be specified] and incremental running costs will be provided to the Component 3 CMPU (CMPU-3) to facilitate management and monitoring of this component.

(b) Capacity building, training and awareness raising Training will be provided to government staff and river users where new signs, regulations and services are introduced. Communications and outreach to river users groups will be undertaken to raise awareness of the improvements made under this component.

### **Component 4. Emergency Contingency Response**

16. This provisional zero allocation component is added under the project to allow for the rapid reallocation of funds from other components in order to provide preparedness and rapid response support to disaster, emergency and/or catastrophic events, as needed.

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