بسم الله الرحمن الرحيم

Ministry of National Planning Housing and Infrastructure
Republic of Maldives

TERMS OF REFERENCE

Consulting Services for Feasibility study and Conceptual Designs for Sewage Treatment Plant in Hulhumale Phase 2 and Male' City

(REF No: MV-MONPI-327457-CS-CQS*)*

MALDIVES URBAN DEVELOPMENT AND RESILIENCE PROJECT

Abbreviations

CAPEX	Capital Expenditure
DBO	Design, Build & Operate
HDC	Housing Development Corporation
IBRD	International Bank for Reconstruction and Development
ICB	International Competitive Bidding
IDA	International Development Association
MoE	Ministry of Environment
MoF	Ministry of Finance
MNPHI	Ministry of National Planning, Housing and Infrastructure
MUDRP	Maldives Urban Development and Resilience Project
MWSC	Malé Water and Sewerage Company
EPA	Environment Protection Agency
MCC	Male City Council
NDMA	National Disaster Management Authority
O&M	Operation and Maintenance
OPEX	Operational Expenditure
PPF	Project Preparation Fund
STP	Sewage Treatment Plant
ToR	Terms of References
USD	United States Dollar
WB	The World Bank

1. BACKGROUND

1. Introduction

The Government of Maldives in collaboration with the World Bank/ International Development Association (IDA) is implementing Maldives Uraban Development and Reslience Project (MUDRP) which is aimed to develop critical infrastructures such as sewerage treatment plant in Hulhumale' phase 1, storm water drainage improvement. In addition, some technical aspects are proposed in the project. These include development of urban regional master plan for Addu City, Faadhipolhu and Thiladhunmathi Region and establishment of an emergency operations coordination centre in National Disaster Management Authority (NDMA).

The Ministry of National Planning, Housing and Infrastructure (MNHPI) is seeking the service of a consultancy firm to conduct feasibility study for establishment of a Sewage Treatment Plant (STP) in Hulhumale' Phase 2 and Male' city and prepare conceptual design for the aforementioned STPs.

1.1 Beneficiary

The expected beneficiary of the project are the residents of Male' city and Hulhumale' phase 2. This will account for more than 40% of the population of the country. Currently, there is no existing STP for Male' city which is a city of approximately 150,000 people. The sewage generated in the city is dumped into sea via a sea outfall, hence this technical study is expected to be preliminary work for establishment of a STP which will bring significant environmental and social benefits for the residents of Male' city and Hulhumale'.

1.2 Existing condition of sewerage network in Male'

Information on the existing condition of the Male' sewerage network is included in the Annex One of this TOR.

2. OBJECTIVES & EXPECTED RESULTS

2.1. Objectives

The objectives of this consultancy assignment are to demonstrate feasible technical, propose cost effective solution and prepare conceptual design for the Hulhumale Phase 2 and Male

Sewage Treatment Plant (STP).

2.2. Scope of work

The scope of work for the assignment can be summarized as follows:

- **Source and estimate of wastewater generation:** Estimate the wastewater to be generated from Male' and Hulhumale' phase2 development considering household, commercial, institution and industrial, detailing the quantities to be generated from each source. A list of industries is detailed in Annex 3. The consultant would be required to sample industries representative of different industries to understand process and the quantity of wastewater generated from them.
- **Characterization of wastewater:** Carry out, as a minimum, two daily composite samples to characterize the domestic and industrial wastewater. For industrial wastewater it would be necessary to characterize wastewater from different type of industries (representative sample for each industries type). The following parameters will be analyzed for domestic wastewater (pH, Suspended solids, Dissolved solids, COD, BOD, Total Kjeldhal Nitrogen, Ammoniacal nitrogen and Total phosphorus). For industrial wastewater, in addition to the parameters detailed for domestic wastewater, heavy metals will have to be analyzed. With the flows and wastewater characteristics for different sources of wastewater, determine the characteristics of the combined wastewater.
- **Conceptual Design for the proposed STPs**: A complete review of technical options for wastewater treatment considering the land area available, meet the relevant discharge standards and reuse of treated wastewater. Included in the assessment is an evaluation of option for treatment of industrial wastewater (pre-treatment + co-treatment with domestic wastewater; direct discharge of industrial effluents to the sewer) and if the suggested option complies with the country's regulation. Estimate the capital and operating cost for all options and on life cycle costing recommend the most effective treatment option. Conceptual design would have to be developed for wastewater and sludge. Conceptual design to include process designs, process schemes, layout plans, and hydraulic longitudinal profiles.
- **Develop economically feasible and environment friendly sludge management strategy:** Currently there is no strategy to manage sludge in the Maldives. Sludge generated from the operational STPs are managed in an ad-hoc manner. The consultant

is required to evaluate and propose all possible methods of disposing sludge while estimating the capital and operating cost for all options and on life cycle costing recommend the most effective treatment option. The proposed strategy shall be most suitable to the urban context of Male' and Hulhumale' Phase 2.

- **Conceptual Design for the proposed STP:** A complete review of technical options for wastewater treatment considering the land area available, meet the relevant discharge standards and reuse of treated wastewater. Included in the assessment is an evaluation of option for treatment of industrial wastewater (pre-treatment + co-treatment with domestic wastewater; direct discharge of industrial effluents to the sewer) and if the suggested option complies with the country's regulation. Estimate the capital and operating cost for all options and on life cycle costing recommend the most effective treatment option. Conceptual design would have to be developed for wastewater and sludge. Conceptual design to include process designs, process schemes, layout plans, and hydraulic longitudinal profiles. Conduct a survey to estimate the quantity of sewerage which would be collected in the sewerage treatment plant.
- **Propose odor control mechanism and energy recovery system for the proposed STP:** Explore the various odor control mechanisms available during operation of STP. A special consideration shall be given to the highly urbanized and densely populated nature of the island.
- **Explore the various options for reuse potential for wastewater:** This includes but not limited to the various industries which are potential users of treated wastewater. The desired treated wastewater quality is given in the Annex 02 of this TOR.
- **Estimate the land requirement for the STP:** Explore the available land for STP construction in consultation with relevant stakeholders such as Ministry of National Planning, Housing and Infrastructure, Male' city council.
- **Explore efficient energy options including solar hybridization:** Electricity consumption is the most significant challenge faced in operation of an STP in Maldives. The electricity is solely generated by diesel generators which make the electricity cost extremely high. The consultant is to explore options including solar hybridization why by the operations cost of STPs can be reduced in the Maldives.
- **Recommend the level of treatment that would be feasible:** Since wastewater is not charged, all operational costs have to be bared by the operator. Operational costs hugely depend on the level of treatment, and injecting treated waste water into different sources

of water needs to be strategically planned, and public needs to be given time to accept such trends. If waste water is to be treated and reused, primary treatment would not be sufficient, and if waste water is to be discharged to sea, secondary treatment may not the best approach. Consultant should recommend based on these scenarios.

- **Propose sea outfall point:** Based on the ocean currents, and the surrounding geography, environment and ecology, suggest the best point and way of disposing treated water.
- **Flow diversion**: Diverting the flows to STP, modification to the existing network.
- Propose a financially sustainable model for operation and maintenance of STP including tariff and/or subsidization approach.

3. TEAM COMPOSITION AND ESTIMATED TIME INPUT

General personnel requirements

MNPHI intends to engage a consultancy firm with ample experience in feasibility studies, engineering design of wastewater treatment infrastructure. The Consultant shall ensure that a team of experts and professional staff with necessary education, skill and experience will be deployed for all tasks required for this assignment.

Key Experts

A list of the key professional staff/ experts, who will be evaluated for this assignment, is given in Table below. The estimated staff-months are indicative only. The Consultant is free to propose their own estimate of professional input required to deliver the services in line with the present Terms of Reference.

Key Staff		
Sl. No.	**Position**	**Time (Months)**
1.	Wastewater treatment process engineer (Team Leader)	12
2.	Sludge Management Expert	6
3	Structural Engineer	4
5	Economic and Financial Specialist	4
Total		**12**

In addition to above listed positions of non-key professionals, the Consultant should have adequate support professionals to assist the key staff deliver this assignment.

Required qualification of Key Experts

The qualification, experience and competency requirements of the key staffs, whose CVs will be considered for evaluation of Consultant bids, are as follows:

Sl. No	Type of staff	Education	Overall Experience	Specific Experience & responsibilities.
1.	Wastewater treatment Process Engineer	Graduate - Environmental Engineering.	Working experience minimum 10 yrs.	This professional staff should have proven experience in sewage/wastewater treatment process selection and design with a wide variety of different modern technologies. He/she must be experienced in designing large municipal STPs.
2.	Sludge management expert	Graduate - Environmental Engineering.	Working experience minimum 10 yrs.	This professional staff should have proven experience in the area of sludge management. He/she must be experienced in the various options of sludge management and its economic and environmental benefits.
3	Structural engineer	Graduate - Structural engineering	Working experience minimum 5 yrs.	This professional staff should have proven experience in structural design and estimate of civil structures of sewage/wastewater treatment plants.
4	Economic and Financial Analyst	Graduate in Economics or Finance/Business Management	At least 8 yrs of experience in financial and economic analysis of infrastructure and/or	Responsible for financial assessment and economic analysis of STPs.

			municipal projects	

All key staffs must be fluent in English, both in speaking and in writing.

4. Data, services and facilities to be provided by Client

MNPHI, HDC, MWSC and Ministry of Environment will provide, free of charge, to the Consultant the following assistances:

(i) Studies, reports, plans etc. as available, preferably in electronic format;

(ii) Assistance in the preparation and implementation of the surveys;

(iii) Coordination assistance with respect to introduction to relevant authorities, professionals etc.;

(iv) Assistance in obtaining other relevant information and materials from government institutions and state authorities;

Notwithstanding this assistance, the final responsibility of all those activities stays exclusively with the Consultant.

5. DELIVERY AND PAYMENT SCHEDULE

Output	**Months from Commencement of Contract**	**Payment (% of contract)**
Inception Report	1	20
Draft STP feasibility report Hulhumale Phase 2 and Male'	6	40
Final STP Feasibility report with concept design	12	40

List of Annexures

Annex 1: Background information on existing sewerage network in Male'

Annex 2: Information on the Raw Sewage Quality and desired quality of treated wastewater (STP Effluent)

ANNEX 1: BACKGROUND INFORMATION ON EXISTING SEWERAGE NETWORK IN MALE'

Aspect	Details
Initial Design Population	100,000 (approximately)
Current Population	227,486[1]
Project completion year and operation commencement year	Project completion year: 1988 Operation commencement year: 1988
Total house connection	33,363 households
Number of pumping stations	10
Total length of sewer network	46,184
Total number of sea outfalls	7 sea outfall
Commercial and industries served by sewer network	- Restaurants and Cafes – Total 121 (Hota, Café & Restaurants). - Vehicles repair garages who are connected to sewer network in Male' – Total 21

Annex 2: Information on the Raw Sewage Quality and desired quality of treated wastewater (STP Effluent)

Anticipated Raw Sewage Quality

Feasibility study conducted for Hulhumale' Phase 1 STP suggest the following raw sewage quality. It can be inferred that the raw sewage quality will be similar in Male'.

Parameter	Value
pH	6.5 – 8.0
Biochemical Oxygen Demand (BOD) (mg/L)	400
Chemical Oxygen Demand (COD) (mg/L)	800
Total Suspended Solids (TSS) (mg/L)	300

[1] UNFPA Population Projection For Male'

Total Nitrogen (mg/L)	75

The desired quality of the treated wastewater (STP Effluent).

Parameter	Value
pH	5.0 – 9.5
Biochemical Oxygen Demand (BOD) (mg/L)	< 5
Chemical Oxygen Demand (COD) (mg/L)	< 50
Total Suspended Solids (TSS) (mg/L)	< 5
Total Nitrogen (mg/L)	< 10
Oil and Grease	< 10
Escherichia Coli (E. Coli)	1 Organism / 100 ml
Fecal Coliforms	< 10 Organism / 100 ml