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TECHNICAL SPECIFICATION AND GUIDELINE FOR BOREHOLE DRILLING

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UTILITY REGULATORY
AUTHORITY

TECHNICAL SPECIFICATION AND GUIDELINE FOR BOREHOLE DRILLING

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1. Introduction

- 1.1. This guideline consists of drilling boreholes and installation of electric pumps for source water extraction for various water supply development projects including reverse osmosis desalination. The work includes drilling boreholes, installation of casings and screens; provision of gravel packing; development of the boreholes; test pumping, water sampling; water quality analysis and installation of pumps.
- 1.2. This guideline is formulated and implemented by Utility Regulatory Authority (URA) under the powers vested in it by Section 33 of Act Number 26/2020 (Utility Regulatory Act).

2. Drilling Site

The borehole drilling location shall be selected through the steps mentioned in section 6 of Regulation number: 2021/R-23 (General Regulation for Water and Sewerage Service).

3. Environmental Protection of the Site

Care must be taken in handling and storage of all drilling fluids, oils, greases and fuel on site to avoid any environmental pollution, damage and degradation. Any toxic materials, drilling fluids and other additives, cuttings and discharged water shall be disposed in a manner that do not cause damage to the environment, public and private property.

4. Equipment and Materials

All machinery, equipment and materials used to carry out the drilling work shall be handled, transported and stored in accordance with the manufacturers' recommendations to minimize damage to environment.

5. Drilling fluids

The volume of drilling fluids, drilling fluid additives, and lubricants used during drilling of a borehole should be recorded.

6. Supervision Work

The execution of drilling work shall be supervised by a qualified Hydro-Geologist/Civil Engineer/Environmental Engineer experienced with borehole drilling works.

7. Depth of Borehole

The in-land borehole depth shall not be less than 30 (thirty) meters and it should not impact the ground water lens of the island. If Electrical Conductivity of discharged water at 30 (thirty) meter depth is measured less than 50-60 (fifty to sixty) mS/cm, drilling must be continued until Electrical Conductivity reaches 50-60 (fifty to sixty) mS/cm.

8. Drilling Method

May use any rotary drilling technique that the client feels applicable to achieve the required depth and diameter, provided that the techniques used are specified in the environmental impact assessment report approved by Environmental Protection Agency (EPA). Please follow the Method Statement of Utility Regulatory Authority (URA) in Annex 1 for borehole drilling.

9. Borehole Design

The final design of the borehole shall confirm that pumped raw water does not interact with the fresh groundwater aquifer zone. For monitoring purpose, borehole drilled shall provide water sampling tubes at the interval of 5 (five) meters from top to bottom.

10. Yield Estimates During Drilling

Yield estimates shall be made during the course of drilling by applying an appropriate method agreed to make sure that drilled borehole will provide required volume of raw-water.

11. Pumping Test

Pumping test shall be performed to establish the performance and yield of the borehole using a suitable, self-contained, mobile test pumping unit. The method for varying the discharge rate of the pumps will depend on the type of pump used, but the contractor shall ensure the provision of a suitable means of achieving the range of constant flow rates specified by the supervisor.

12. Electrical Conductivity/Salinity

Electrical Conductivity or Salinity of discharged water during the process of drilling and test pumping shall be conducted and recorded.

13. Records and Reporting

During the process of borehole drilling, daily activity records as follows shall be recorded and maintained which must be provided to Utility Regulatory Authority (URA) upon completion of borehole drilling.

- 13.1. Name of the Island.
- 13.2. Date of drilling.
- 13.3. Reference number of borehole.
- 13.4. GPS Co-ordinates of borehole (latitude/longitude).
- 13.5. Method of drilling.
- 13.6. Diameter and depth of borehole.

- 13.7. Description of strata drilled.
- 13.8. Vertical water quality profile at 5 (five) meter intervals (Electrical Conductivity/Salinity).
- 13.9. Depth at which seawater was reached.
- 13.10. Records of components and quantities used or added to the drilling fluid or air.
- 13.11. Water level at the start of each working day.
- 13.12. Problems encountered during drilling.
- 13.13. Details of installations in the borehole (if any).
- 13.14. Depth, size and description of well casing.
- 13.15. Depth, size and description of well screens.
- 13.16. Aquifer depth after completion of well.
- 13.17. Borehole design and installation details (as built drawings).

14. Water Sampling and Quality Testing

Water samples shall be collected for testing the physico-chemical and bacteriological quality after completion of borehole. For this purpose, water samples shall be collected in standard sampling bottles including sterilized bottles for bacterial tests. Samples shall be tested from a certified laboratory, and the test results shall be part of the borehole completion report which shall be made available to Utility Regulatory Authority (URA) upon request.

15. Parameters to be Tested

Upon completion of the borehole, pumped water shall be tested at a certified laboratory for Slit Density Index (SDI), pH, Electrical Conductivity ($\mu\text{S}/\text{cm}$), Total Dissolved Solids (mg/l), Chloride (mg/l), Calcium Hardness (mg/l), Magnesium Hardness (mg/l), Boron (mg/l), Phosphate (mg/l), Sulphate (mg/l), Iron (mg/l), Fluoride (mg/l), Ammonia (mg/l) and Lead (mg/l).

16. Code of Conduct

Drilling work should be conducted in an environmentally and socially sensitive and responsible manner making sure that all workers are aware of the potential impacts of their activities.

17. Penalties

Violation of this guideline or any of its provisions shall be accounted as a violation of section 8 of the Regulation number: 2021/R-23 (General Regulation for Water and Sewerage Service in Maldives) will be penalized under Section 48 of Act No: 26/2020 (Utility Regulatory Act).

18. Implementation Date

This guideline shall take effect from the date of its publication in the Government Gazette

19. Annex 1

Method Statement for Borehole Drilling

- 1.** The Reverse Rotary Drilling Method is preferred for all boreholes drilling works.
- 2.** Specification for well casings and pumping can be modified as per site requirement based upon information gathered during drilling.
- 3.** The Contractor will be responsible to collect formation samples at 10 feet intervals and at every change in geological formation at the borehole which shall be kept initially in a box called snake type of sampling box. Later these samples will be preserved in the plastic bags each of 1 liter capacity at least with proper marking for identification. Sieve analysis (5 samples) sampling depth shall be as instructed by the Engineer-in-charge.
- 4.** Grade and Space of Centralizer
 - a.** Mild Steel (M.S) Cage type
 - b.** Size shall fit in the drilling and casing diameter.
- 5.** Gravel packing material shall be to uniformity coefficient near 2.5 or as per actual design, based on the subsoil formation conditions.
- 6.** During pumping test, the Contractor shall provide equipment for the following water sample tests at site for water quality analyses of the borehole wells:
 - a.** pH
 - b.** Electrical Conductivity
 - c.** Temperature
 - d.** Taste
 - e.** Odour
 - f.** Colour
 - g.** Sand contents

7. Verticality and Straightness of the borehole to be checked at sites as per international specifications.

8. Development and Multi Step Tests

- a. Constant Discharge Test for 12 Hours @ 150% of design discharge.
- b. Recovery to the original level for 12 hours or up to 90% recovery.
- c. Aquifer Test of Production Well

Schedule of Measurement of Water Levels During Development, Step Test and Aquifer Test. This test will be carried out for 100 hours

Time	Elapsed	Interval
1 st Hour	0-10 Minutes 10-30 Minutes 30-60 Minutes 1 Hour	1 Minutes 2 Minutes 5 Minutes
2 nd Hour	60-120 Minutes 1 Hour	10 Minutes
3 rd Hour	120-180 Minutes 1 Hour	20 Minutes
4 th Hour to 7 th Hour	180 - 360 Minutes 3 Hours	30 Minutes
8 Hour and beyond	360 - 420 Minutes and Beyond	1 hour

- **Development**

Development will be carried out with raw hiding method for 18 hours using turbine pump till water is cleared of sand in 6 steps each of 3 hours, the table of development is given below:

Discharge	Hours
25% of design discharge	3
50% of design discharge	3
75% of design discharge	3
100% of design discharge	3
125% of design discharge	3
150% of design discharge	3

- **Step Test**

a) Step test will follow development of 12 hours in 6 steps each step of 2 hours.

Discharge	Hours
25% of design discharge	2
50% of design discharge	2
75% of design discharge	2
100% of design discharge	2
125% of design discharge	2
150% of design discharge	2

b) Same schedule given above shall be followed during the recovery period.

Supervision and Reporting

Part 1

- a. The drilling and testing shall be supervised properly by the Hydro-Geologist/Civil Engineer/Environment Engineer having 8 to 10 years of experience in similar field.
- b. The results of the drilling and testing shall be recorded and completed by the Contractor and submitted in the form of a report which will include:
 - i. Daily job record
 - ii. Drilling record, geological time log and casing program etc.

Part 2

- i. Pumping test report
 - ii. Water analysis report
 - iii. Water observation data
 - iv. Data analysis for aquifer parameters i.e. safe yield, co-efficient of permeability,
 - v. Co-efficient of transmissivity etc.
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