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Maldives Tsunami Reconstruction Program

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**Environmental Assessment for the Installation of
Seawater Reverse Osmosis Facilities on Hinnavaru
and Naifaru Islands in the Lhaviyani Atoll
Maldives Tsunami Reconstruction Program**

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Prepared for
USAID Mission to Sri Lanka and Maldives
Colombo, Sri Lanka

Prepared by



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PN 350735

Executive Summary

USAID is providing assistance to the Government of the Maldives as part of a tsunami reconstruction program. One major component of the assistance is the installation of two 30-cubic meter per day seawater reverse osmosis desalination units on the islands of Naifaru and Hinnavaru.

This Environmental Assessment for the installation of the seawater desalination facilities on Naifaru and Hinnavaru islands in Lhaviyani Atoll in the Maldives has been carried out at the request of USAID in order to fulfill the requirement of the United States Environmental Regulation 22 CFR 216. The primary objective of the environmental assessment was to evaluate the potential impacts rendered by the construction of the components associated with the facility and recommend mitigation measures to minimize any adverse impacts. These components include: the intake and discharge pipelines in the sea; transmission and distribution pipelines on land; the building and associated facilities to contain the SWRO units and the operational phase of the facilities.

Sites for the construction of the facilities were selected by the Government of the Maldives in conjunction with the local Island Development Committees. The facilities will be constructed on sites that are about 500 square meters on Naifaru and 325 square meters on Hinnavaru. Storage for 30 cubic meters (a day's full production) will be provided on each island as will a 2 kilometer distribution system. The distribution system will serve about 10 community taps that will be located throughout the two communities.

Table ES.1 lists the major impacts and mitigation measures that are anticipated.

Environmental Impacts			Mitigation	
No.	Impact	Activity	Degree ¹	Measure
Impact on soil and terrestrial vegetation				
1	Loss of productive soil or vegetation by removal or erosion	Excavation for foundations and trenches for pipes. Most soil is only sand and there is almost no vegetation.	Low	Soil removed and piled should not be placed close to the shore to avoid erosion into the sea.
2	Loss of trees on the SWRO facility site on Hinnavaru	General construction activity within the boundary wall that has been constructed.	Moderate	A wall will be constructed on the eastern end of the site to separate the area with the trees from the rest of the site and no storage or construction activity will be allowed
Impact on freshwater resources				
3	Contamination of the freshwater lens by seawater discharges or dumping	Start-up and testing of the SWRO facility with seawater	Moderate	The brine discharge line and connecting drains in the SWRO facility site must be completed before any seawater is pumped to the settling tank so that there is a method to discharge it to sea.
4	Contamination of the freshwater lens by spillage of gasoline, oil	Storage of materials and servicing of mechanical equipment by the	Moderate	All lubricants and fuel must be stored in approved containers and servicing of equipment done in a

¹ Degree of impact without mitigation measures

Environmental Impacts			Mitigation	
No.	Impact	Activity	Degree ¹	Measure
	and other chemicals	contractor		manner to minimize spillage. Empty containers should be taken to the solid waste facility on each island.
Impact on marine environment				
5	Disturbance of aquatic habitats	Installation of the seawater intake and brine discharge lines	Low	The route and schedule of the placement of the pipelines will be coordinated with the local fishermen to insure that fisheries & anchorages are not disturbed. The concrete anchors and pipeline should be assembled on shore and floated into position to avoid dragging things on the sea bottom
6	Disturbance of aquatic habitats	Discharge of brine from the SWRO unit through the brine discharge pipeline	Low	Instead of the direct, end of pipe, discharge commonly used in Maldives, the last 10 meters of the discharge pipe will be perforated to spread the flow.
7	Disturbance of aquatic habitats	Intake of seawater by the seawater intake pipeline	Low	Flow into the 100-mm diameter pipe will be less than 20 gal/min, the intake will be a screen to keep out fish and it will be located off the sea bottom by about one meter.
General				
8	Increase in noise pollution	Construction	Low to Moderate	This will be limited in time as the actual construction activity will be less than about 4 months. The Naifaru site is far enough away from dwellings to have very limited affect but the Hinnavaru site will be more of a problem
9	Increase in noise pollution	Operating	Low to Moderate	The SWRO building and the boundary wall will reduce the noise level. Naifaru site is away from dwellings. Hinnavaru will be more of a problem as there are buildings immediately adjacent to the site
10	Spread of solid waste and other construction materials	Construction	Moderate	The contractor will be directed to move all construction debris to the solid waste disposal areas on each island at regular intervals
11	Discharge of disinfecting solution	The distribution main will be filled with a chlorine solution to disinfect it.	Moderate	The solution should be discharged into the harbor on Naifaru (Tap #1) and near the marine docking area on Hinnavaru (Tap #1). See Figures 2.5 and 2.7

2.4 Construction Activities

The major construction activities are listed in Table 2.2.

Activity	Description
Intake and discharge lines	These lines are installed in the sea. They are 100-mm (in diameter) plastic pipes that will be laid on the sea floor using specially constructed concrete blocks to hold them in place. The intake line is anticipated to be about 100 m in length while the discharge line would be about 50 m
Intake pump station	This is a small building with a footprint of less than 2-m ² which would be located on the shore and would pump feedwater from the intake line to the SWRO unit.
Transmission mains	Since the SWRO facility is located some distance from the shore, pipelines must be installed to connect the intake (via the pump station) and the discharge lines to the SWRO unit. These are HDPE lines that are 100-mm in diameter.
SWRO facility	The facility is located in a walled area of about 550 m ² and contains: a single story building (for the SWRO unit and an office); a settling tank for feed water; storage tanks for product water; and a small shed for an emergency generator.
Distribution system	This will be a 50-mm in diameter HDPE pipe about 2 kilometers (km) long that will distribute water to various public taps and users in the community.

2.5 Operational Activities

The major operational activities are listed in Table 2.3.

Activity	Description
Start-up and operation of the SWRO units	Seawater will be pumped into the facility, have some pretreatment in the settling tank and then, after further treatment passed through the reverse osmosis membranes. Both freshwater and brine will be produced. The fresh water will be pumped into the storage tanks and the brine returned to the sea.
Operation of the distribution system	Water pumped into the storage tanks will be disinfected using a chlorine solution. The water will then be pumped into the distribution system where it can be collected from the community taps or by direct connections rtro selected consumers.
Maintenance	The pumps and electrical equipment will need to be properly serviced and cleaned at regular intervals
SWRO shutdown	Special care will need to be followed to ensure that the reverse osmosis membranes are stored so that they are safeguarded from microbial and other deterioration.

discharge lines that will go from the shoreline to the site of the SWRO. The location of the intake and discharge lines that transfer saline water between the sea and the SWRO facility has been made so as to minimize this distance.

The use of HDPE pipe means that there will be very few joints along the run. The pipes will be buried about 500-mm below ground surface (bgs) to reduce the potential for damage by foot or vehicular traffic.

6.2.5 Site Disturbance

The area provided by the IDC for this site includes a small rove of trees at the western end. It is the intention of the project to not touch these trees. A wall will be built to separate the trees from the facility site and the IDC will be requested to construct a non-gated entrance on the western end of the boundary wall so that people can have easy access to this green area.

6.2.6 Construction Activity

The location of the construction on this small island will mean that there will be little vehicular traffic. There are less than ten vehicles on Hinnavaru and, due to the cost of landing machinery, the contractor is expected to add very few to this. There is little major excavation involved in building the buildings and it is possible that part of the distribution mains will be installed by hand excavating the trenches.

An impact could be the disposal of petroleum products and other undesirable materials on the ground which could affect the freshwater lens.

Activity	Possible Impacts
Intake and discharge lines	Disturbance of the sea bottom and corals when placing the pipelines and concrete anchors
Intake pump station	Disturbance to the shoreline during the installation of the pump station .
Transmission mains	Some minor soil disturbance in constructing the trenches to hold the pipelines and then backfilling the trenches.
SWRO facility	Minor excavation and then compacting soil; mixing concrete; trenching to install field piping and electrical service; noise during construction.
Distribution system	Some minor soil disturbance in constructing the trenches to hold the pipelines and then backfilling the trenches.

6.2.7 Operational Impact

The operation of the SWRO facility will result in the production of new source of potable water for the inhabitants of the island. While the capacity of the unit is insufficient to provide for all the water needs of the people, it will provide a basic supplement supply that can be used to augment the supply normally available in their rainwater tanks. In general it should improve the quality of life.

The additional impact to the environment due to the discharge of brine project should be minimal, especially when compared to the numerous sewage outfalls on the island.

6.3 Mitigation

Table 6.3 lists impacts and mitigation measures.

TABLE 6.3 Major impacts and mitigation measures				
Environmental Impacts			Mitigation	
No.	Impact	Activity	Degree ¹⁴	Measure
Impact on soil and terrestrial vegetation				
1	Loss of productive soil or vegetation by removal or erosion	Excavation for foundations and trenches for pipes. Most soil is only sand and there is almost no vegetation.	Low	Soil removed and piled should not be placed close to the shore to avoid erosion into the sea.
2	Loss of trees on the SWRO facility site on Hinnavaru	General construction activity within the boundary wall that has been constructed.	Moderate	A wall will be constructed on the eastern end of the site to separate the area with the trees from the rest of the site and no storage or construction activity will be allowed
Impact on freshwater resources				
3	Contamination of the freshwater lens by seawater discharges or dumping	Start-up and testing of the SWRO facility with seawater	Moderate	The brine discharge line and connecting drains in the SWRO facility site must be completed before any seawater is pumped to the settling tank so that there is a method to discharge it to sea.
4	Contamination of the freshwater lens by spillage of gasoline, oil and other chemicals	Storage of materials and servicing of mechanical equipment by the contractor	Moderate	All lubricants and fuel must be stored in approved containers and servicing of equipment done in a manner to minimize spillage. Empty containers should be taken to the solid waste facility on each island.
Impact on marine environment				
5	Disturbance of aquatic habitats	Installation of the seawater intake and brine discharge lines	Low	The route and schedule of the placement of the pipelines will be coordinated with the local fishermen to insure that fisheries & anchorages are not disturbed. The concrete anchors and pipeline should be assembled on shore and floated into position to avoid dragging things on the sea bottom
6	Disturbance of aquatic habitats	Discharge of brine from the SWRO unit through the brine discharge pipeline	Low	Instead of the direct, end of pipe, discharge commonly used in Maldives, the last 10 meters of the discharge pipe will be perforated to spread the flow.
7	Disturbance of aquatic habitats	Intake of seawater by the seawater intake pipeline	Low	Flow into the 100-mm diameter pipe will be less than 20 gal/min, the intake will be a screen to keep out fish and it will be located off the sea bottom by about one meter.

¹⁴ Degree of impact without mitigation measures

TABLE 6.3 Major impacts and mitigation measures

Environmental Impacts			Mitigation	
No.	Impact	Activity	Degree ¹⁴	Measure
General				
8	Increase in noise pollution	Construction	Low to Moderate	This will be limited in time as the actual construction activity will be less than about 4 months. The Naifaru site is far enough away from dwellings to have very limited affect but the Hinnavaru site will be more of a problem
9	Increase in noise pollution	Operating	Low to Moderate	The SWRO building and the boundary wall will reduce the noise level. Naifaru site is away from dwellings. Hinnavaru will be more of a problem as there are buildings immediately adjacent to the site
10	Spread of solid waste and other construction materials	Construction	Moderate	The contractor will be directed to move all construction debris to the solid waste disposal areas on each island at regular intervals
11	Discharge of disinfecting solution	The distribution main will be filled with a chlorine solution to disinfect it.	Moderate	The solution should be discharged into the harbor on Naifaru (Tap #1) and near the marine docking area on Hinnavaru (Tap #1). See Figures 2.5 and 2.7

Section 7 – Environmental Management and Monitoring Plan

7.1 Management

Table 7.1 presents a plan that will minimize adverse environmental and social impacts for the installation of the SWRO facilities on both Naifaru and Hinnavaru.

TABLE 7.1 Environmental management plan		
Environmental Issue		Mitigation Measures
1. Protection of soil and terrestrial vegetation		
1.1	Disposal of excess soil	Excess soil (generally sand) should be used to build up the road grade where needed or disposed of as the CH2M HILL Resident Engineer (CHRE) on the site directs
1.2	Protection of major vegetation	The contractor may not remove any major vegetation without the written consent of the CHRE. The trees at the Hinnavaru site are to be protected from damage by constructing a small wall to separate them from the remainder of the site within the boundary wall
1.3	Erosion of soil	While working adjacent to the sea, care must be taken to avoid placing excess soil in a place where it could be washed away into the sea.
2. Protection of the freshwater lens		
2.1	Contamination of the freshwater lens from seawater	Before any testing of any of the units with seawater, the brine line and relevant drains connected to it must be completed. No testing with seawater can occur without the consent of the CHRE
2.2	Contamination of the freshwater lens by other materials	All storage of lubricants, chemicals and fuel and their use to service equipment must be approved by the CHRE. All used containers must be disposed of in a manner approved by the CHRE
3. Protection of the marine environment		
3.1	Disturbance of corals and vegetation during the installation of the brine and seawater intake pipelines in the sea.	A written plan for the installation of the pipelines must be approved by the Engineer. This plan needs to include consultation with the various island IDCs so as not to create a problem with the fisheries. The goal of the activity is to minimize the disturbance of the sea bottom, marine vegetation and corals.
4. General protection		
4.1	Noise during construction and start-up	The contractor should schedule activities which generate excessive noise to be done during the daylight hours. Activities that will generate excessive noise that may take place after dark must be scheduled and approved by the CHRE.
4.2	Disposal of construction debris, sanitary, and solid waste	The contractor is to have a written plan that is approved by the Engineer on how he plans to dispose of these wastes in a safe and environmentally sensitive manner as is appropriate for the islands..
4.3	Disposal of disinfecting solutions	The contractor is to have a written plan that is approved by the Engineer on how to dispose of this solution in a safe and environmentally sensitive manner.

7.2 Monitoring

Table 7.2 presents an initial monitoring plan that CH2M HILL will use to monitor the compliance of the construction contractor for this project. A number of factors, including methods and frequency of reporting will be determined after the award of the construction contract. At this time the means and methods will be finalized. At this time we believe that this will be handled most efficiently as part of the monthly status report.

TABLE 7.2 Preliminary monitoring plan						
Indicator	Indicator Definition	Data Source	Data Collection Method	Frequency	Frequency & Mode of Reporting to USAID	Primary Responsibility
Objective #1 – Construction contractor compliance with requirements stipulated in Table 7.1						
Establish reporting mechanism	Mechanism to monitor contractor compliance	Field construction manager	Discussion – this is to be incorporated in the CCM ¹⁵	Prior to finalizing the construction contract	To be covered in the monthly status report	CH2M HILL Resident Engineer (CHRE)
Compliance with the EMP in Table 7.1	Fulfill all requirements	Construction contractor & CHCM	Spot checks and review of compliance issues	Monthly or as needed if problem arises	In the monthly status report	CHRE
Objective #2 – Protection of the freshwater lens						
Completion of the brine discharge line from the SWRO facility to the sea and associated drains	Observation	Construction contractor & CHRE	Observation	Before any seawater is pumped to the SWRO facility	In the monthly status report	CHRE
Storage and use of lubricants and chemicals	Observation	Construction contractor & CHRE	Observation	Monthly or as needed if problem arises	In the monthly status report	CHRE
Objective #3 – Protection of the marine environment						
Care in the planning and installation of the intake and discharge pipelines in the sea	Observation	Construction contractor & CHRE	Observation including snorkeling to observe finished work	At the time of the installation	In the monthly status report	CHRE
Objective #4 – Protection of the environment						
Noise during construction	Listening and discussions with residents	Construction contractor & CHRE	Observation	Monthly or as needed if problem arises	In the monthly status report	CHRE
Disposal of construction debris, sanitary and solid waste	Observation	Construction contractor & CHRE	Observation	Monthly or as needed if problem arises	In the monthly status report	CHRE
Disposal of disinfecting solutions	Observation	Construction contractor & CHRE	Observation	Monthly or as needed if problem arises	In the monthly status report	CHRE

¹⁵ CCM – Contractor's Construction Manual