

WATER AND SEWERAGE **EMERGENCY** PLANNING GUIDEBOOK



World Health
Organization
Maldives



Ministry of Tourism
and Environment



ESPLAN

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Lead Author

Ibrahim Miflal Fayaz

Co-Authors

Suma Khalid Mohamed
Mauman Abdul Rasheed
Ismail Ajmal
Saaif Mohamed Raheed
Aminath Nizar

Reviewed By

Mohamed Musthafa
Afsal Hussain
Haleemath Nahula
Hazlee Hameed
Mohamed Zaidhaan Ahmed
Aishath Enash
Shagiya Abdul Rasheed

Cover Page and Layout

Ufnoon Hussain Rasheed

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WATER AND SEWERAGE **EMERGENCY** PLANNING GUIDEBOOK



OVERVIEW

The Maldives, with its geographic dispersion and limited freshwater resources, faces unique challenges in ensuring the resilience of its water and sewerage utilities. This Water and Sewerage Emergency Planning (WSEP) Guidebook provides a framework for developing and implementing effective emergency plans for water and sewerage utilities in alignment with the mandate of Clause 25(b) of the Water and Sewerage Service Regulation (2021/R-23). It outlines essential steps, from hazard identification and risk assessment to preparedness, response, recovery, and continuous improvement. The guide incorporates best practices and industry standards to enhance the resilience of utility services and protect public health and safety.

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ACRONYMS

BCP	Business Continuity Plan
BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
EAS	Emergency Alert System
EOP	Emergency Operations Plan
EPA	Environmental Protection Agency
FRS	Fire and Rescue Service
GIS	Geographical Information System
HIRA	Hazard Identification and Risk Assessment
HPA	Health Protection Agency
MMS	Maldives Meteorological Services
MNDF	Maldives National Defense Force
MTE	Ministry of Tourism and Environment
MPS	Maldives Police Service
MRC	Maldives Red Crescent
NDMA	National Disaster Management Authority
NGO	Non-Governmental Organization
PWS	Public Work Services
RO	Reverse Osmosis
SCADA	Supervisory Control and Data Acquisition
SOP	Standard Operating Procedure
SSP	Sanitation Safety Plan
TDS	Total Dissolved Solids
URA	Utility Regulatory Authority
UV	Ultra-Violet
WSEP	Water and Sewerage Emergency Plan
WSP	Water Safety Plan

INTRODUCTION

1.1 Scope of Works and Legal Framework

This Water and Sewerage Emergency Planning Guidebook is designed to assist water and sewerage operators in developing Water and Sewer Emergency Plans (WSEPs) in alignment with the mandate of Clause 25(b) of the Water and Sewerage Service Regulation (2021/R-23). The guidebook specifically targets providing tailored guidance for developing WSEPs within their respective licensed areas for the operators. The scope of each WSEP is to be defined by the boundaries of the operating license issued by the Utility Regulatory Authority (URA) to the utility.

As such this guidebook is primarily intended for water and sewerage operators responsible for developing WSEPs within the boundaries of their individual operating licenses, typically encompassing individual islands.

The WSEPs should include the following minimum requirements as per the regulation:

Water Systems

1. How the service provider will respond if a situation arises where water services are interrupted for more than 1 (one) day due to a crisis or due to an issue in providing water services;
2. How to cater to the basic water needs of the citizens;
3. The most feasible way to provide water to individuals;
4. How water will be provided to the crucial service providers such as hospitals;
5. How the basic water requirement will be supplied to hotels, cafes, restaurants and such businesses;
6. Emergency procedures for restoring water quality in situations that could pose a public health risk, where the water may be contaminated with harmful microorganisms or hazardous substances that could endanger health if consumed.
7. How the arrangement will be made by the service provider to provide uninterrupted water services where the main electricity supplied to the island is interrupted.

Sewerage Systems

1. The action to be taken by the service provider if a circumstance arises in which there is difficulty in operating the system, causing leakage of sewage and sewage water through junctions and other such places on to the roads due to a burst sewage pipe or due to damage to the sewerage system or part of the sewerage system;
2. Steps which will be taken to remedy the injured parties and things where a situation such as that specified above arises, immediate, short-term and long-term measures which will be taken to remedy the damage caused to the environment, steps which will be taken to fix the damage to the system or part of the system;
3. How the arrangement will be made by the service provider to provide uninterrupted sewerage services where the main electricity supplied to the island is interrupted.

In addition to the above requirements the WSEP must comply with:

- The Water and Sewerage Service Regulation (2021/R-23)
- Utility Regulatory Authority Act (26/2020)
- Environment Protection and Preservation Act (4/93)
- The Disaster Management Act (28/2015)
- Decentralization Act (07/2010)
- Guidelines, plans, and Standard Operating Procedures (SOPs) endorsed by the National Disaster Management Authority (NDMA)

1.2 Institutional Framework

This framework provides an overview of the key institutions and their roles in supporting WSEP for water and sewerage utilities in the Maldives.

Table 1: Institutional Framework Defining the Roles and Responsibilities of Emergency Response Partners

ORGANIZATION	ROLES AND RESPONSIBILITIES
GOVERNMENT	
Ministry of Tourism and Environment (MTE)	<p>Ministry of Tourism and Environment is the lead government agency under the Water and Sewerage Act (08/2020) responsible to set out policies to ensure the provision of water and sewerage services in the Maldives.</p> <p>In the event of an emergency MTE will:</p> <p>Exercise its responsibilities set out in the Water and Sewerage Act and its relevant regulations and guidelines in assessing the situation, developing relevant policies, setting out plans for preparedness and monitoring execution.</p> <p>Liaising with other relevant government agencies and public to build situational awareness and analyzing the implications.</p> <p>MTE is also the regulatory body for tourism establishments. They develop policies to ensure safety and well being of tourists. MTE works to promote recovery of the tourism industry after emergencies.</p>
Utility Regulatory Authority (URA)	<p>URA is the regulatory body to oversee the utilities, including water and sewerage services in the Maldives.</p> <p>In an emergency that impacts the operation of water and sewerage services, URA would monitor and provide guidance on service provider operation and regulatory arrangement.</p>
Environmental Protection Agency (EPA)	<p>The Environment Protection Agency (EPA) is responsible for environmental legislation and may grant exemptions to environmental regulations in an emergency, if appropriate.</p>
Health Protection Agency (HPA)	<p>The Health Protection Agency (HPA) is responsible for health safety legislation and may grant exemptions to safety regulations in an emergency, if appropriate.</p>
Island, Atoll/City Council	<p>In an emergency, the island or atoll/city council would connect with central government agencies to address community needs and concerns.</p>

UTILITY SECTOR	
MWSC, FENAKA Corporation, MACL, STELCO, Altec Maldives, Villa Utilities Maamigili	<p>During peacetime:</p> <p>Proactive measures: Conduct hazard assessments, develop emergency plans, train staff, strengthen infrastructure, maintain emergency supplies, and engage with the community to enhance preparedness.</p> <p>In the event of an emergency:</p> <p>Work closely with relevant government departments to coordinate emergency response efforts and leverage their expertise and resources.</p> <p>Implement a unified response strategy across the organization, ensuring effective communication and coordination among all departments to minimize disruption and maximize efficiency.</p> <p>Create detailed plans outlining the steps to be taken in various emergency scenarios, including resource allocation, personnel deployment, and communication protocols.</p> <p>Keep responsible government agencies informed of the situation, progress made, and any challenges encountered.</p> <p>Identify and provide support to customers who may be particularly affected by the emergency.</p>
EMERGENCY RESPONSE AGENCIES	
National Disaster Management Authority (NDMA)	<p>NDMA serves as the lead national authority for disaster management, ensuring that emergency response efforts align with national strategies and are coordinated effectively with relevant stakeholders.</p> <p>Promote disaster risk reduction measures, such as early warning systems, land-use planning, etc., to minimize the impact of future disasters.</p> <p>Enhance the capacity of government agencies, communities, and individuals to prepare for and respond to emergencies.</p> <p>In the event of an emergency:</p> <p>Coordinate and manage emergency response efforts, ensuring the effective allocation of resources and assistance to those in need.</p> <p>Provide strategic direction and guidance, and facilitate coordination and collaboration among government agencies, NGOs, and other stakeholders involved in the emergency response.</p> <p>Support post-disaster recovery efforts, including rehabilitation, reconstruction, and community development.</p>
Maldives Police Service (MPS)	<p>In the event of an emergency:</p> <p>Assume primary responsibility for maintaining public safety and security during emergency situations.</p> <p>Deploy police officers and other resources to provide essential emergency services, such as search and rescue, crowd control, and traffic management.</p> <p>Safeguard essential infrastructure, such as power plants, water treatment facilities, and communication networks.</p>

Maldives National Defense Force (MNDF) and Fire and Rescue Service (FRS)	In a large-scale emergency situation, such as fire or flooding, MNDF officials will be deployed to respond and manage the emergency crisis.
Maldives Red Crescent (MRC)	Emergency response is a legal mandate for the Maldivian Red Crescent, which is designated as a First Response Agency. MRC's emergency response operations at national and local levels complement the national emergency response systems of the National Disaster Management Authority. MRC acts as a government auxiliary, providing humanitarian aid and supporting community recovery efforts.
Media	In an emergency crisis, media will play a critical role in disseminating accurate and timely information to the public about the emergency situation and response efforts, helping to alleviate anxiety and maintain public trust.

1.3 Water and Sewerage Systems in the Maldives

1.3.1 Overview

The Maldives, a nation composed of about 1200 low-lying islands, faces significant hurdles in managing its water and sewerage infrastructure. Despite an annual rainfall of approximately 2000 mm, freshwater resources are scarce. The primary sources are shallow groundwater aquifers and rainwater.

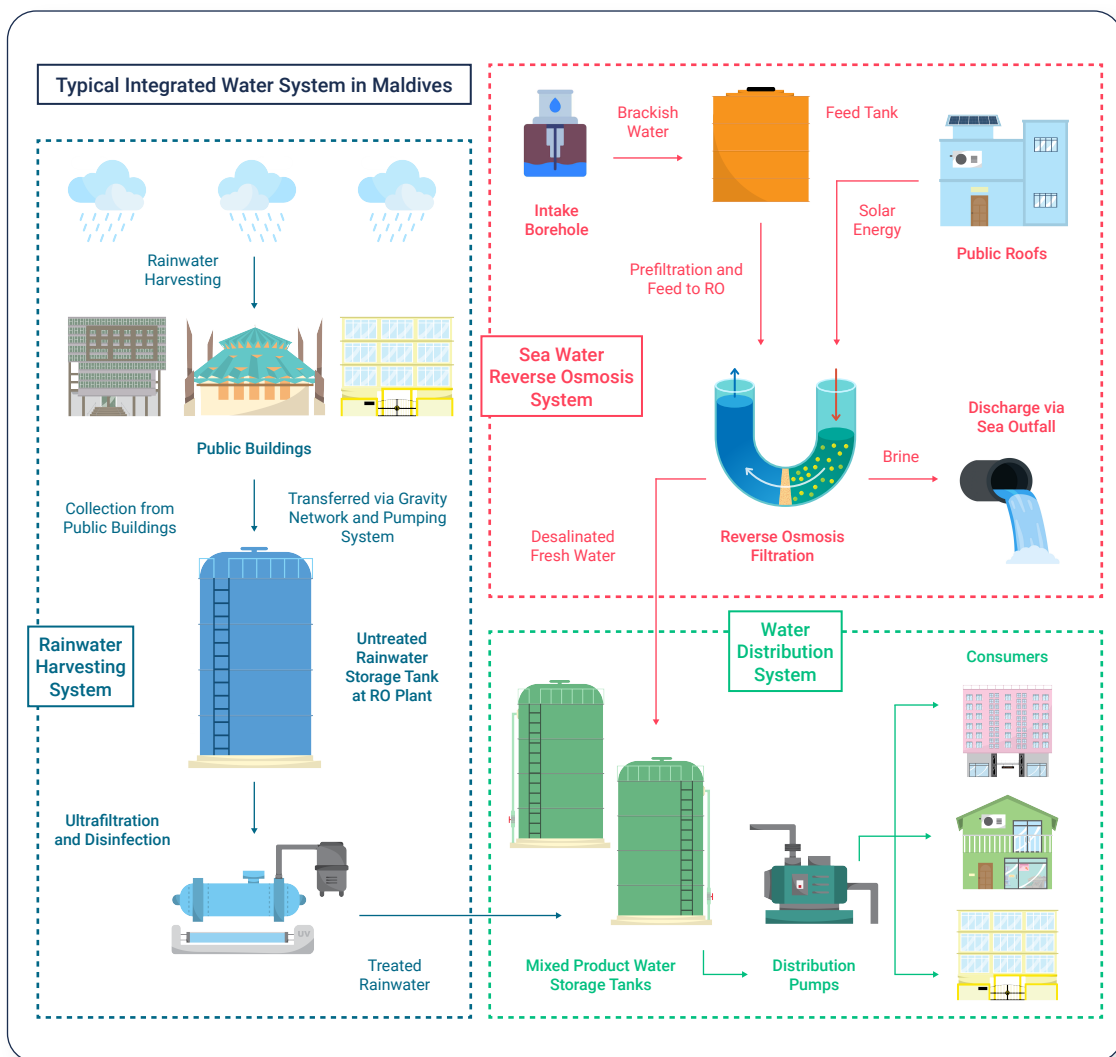
Historically, Maldivians relied heavily on groundwater. However, increasing population and urbanization have rendered groundwater in most islands unsuitable for consumption. To address this, the government has prioritized the development of centralized water and sewerage systems across the nation. Currently, rainwater harvesting is the predominant method for obtaining drinking and cooking water, particularly in rural areas. Groundwater remains essential for personal hygiene, washing, and agricultural activities on most islands, excluding Malé City. The government aims to complete the installation of water and sewerage systems in all inhabited islands by the end of the 2028 presidential term, ensuring water security and improved sewerage for the entire population (Presidents Office, 2024).

1.3.2 Typical Water System

A typical integrated water system in Maldives consists of 3 major components as seen in Figure 1:

1. Rainwater harvesting system
2. Sea water reverse osmosis system
3. Water distribution system

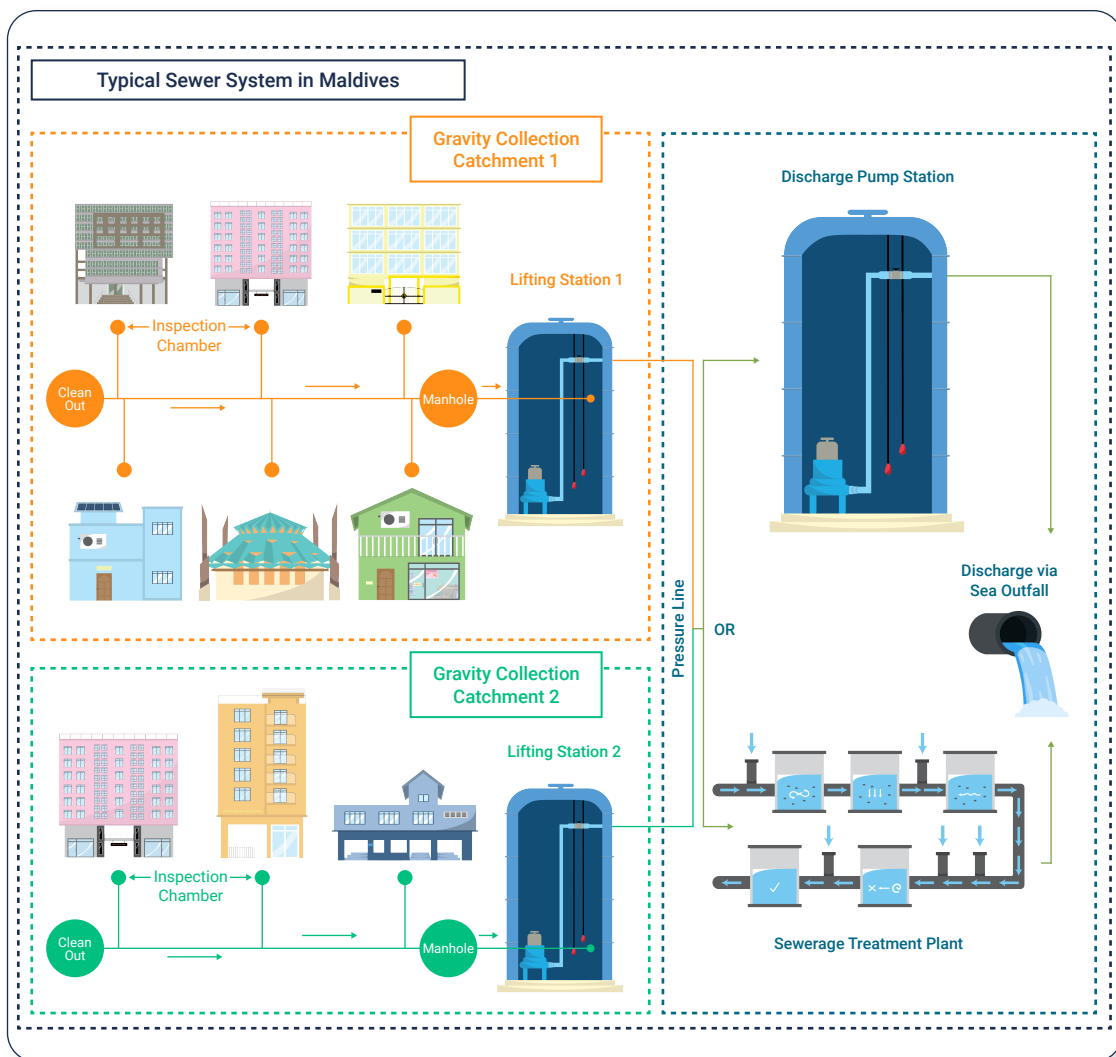
Figure 1: Schematic of a Typical Integrated Water System in Maldives



1.3.3 Typical Sewerage System

Conventional gravity sewerage systems are the most common sewerage system in Maldives, although vacuum sewerage systems and small-bore sewerage systems can also be found in some islands. A typical gravity sewer system in Maldives consists of the collection system and discharge system as seen in Figure 2. Some islands also have operational sewerage treatment facilities.

Figure 2: Schematic of a Typical Gravity Sewer System in Maldives



1.4 Importance of WSEP for Water and Sewerage Services

WSEPs are essential complements to Water Safety Plans (WSPs) and Sanitation Safety Plans (SSPs) for communities. These documents collectively prioritize proactive risk management to safeguard public health, ensure water quality, optimize resource allocation, comply with regulations, and foster public trust in water and sewerage services. By collaborating with stakeholders, these plans are instrumental in delivering reliable and safe water and sewerage services.

Incorporating a robust WSEP into WSPs and SSPs empowers water and sewerage utilities to effectively protect public health, minimize service disruptions, and build community trust.

Key Components of a Water and Sewerage Emergency Plan:

- **Hazard Identification:** Recognizing potential threats such as waterborne diseases, infrastructure failures, and natural disasters.
- **Risk Assessment:** Evaluating the likelihood and potential impact of identified hazards.
- **Emergency Procedures:** Developing detailed step-by-step protocols for various emergency scenarios.
- **Communication Strategy:** Establishing clear communication channels for staff, customers, and emergency responders.
- **Roles and Responsibilities:** Defining roles and responsibilities for emergency situations.
- **Evacuation Planning:** Developing evacuation plans as needed for staff and the public.
- **Training and Exercises:** Conducting regular drills and training to enhance preparedness.

1.4.1 Case Studies: Maldives Water and Sewerage Emergencies

Understanding past water and sewerage crises is crucial for building resilience and improving emergency response capabilities. By analyzing case studies, we can identify patterns, lessons learned, and best practices for preventing and mitigating future disruptions. Some of the notable case studies are highlighted in Table 2.

Table 2: Some Case Studies of Emergencies in Water and Sewerage Services in the Maldives

CASE	SEGMENT	DATE	CAUSE OF INCIDENT	AGENCIES INVOLVED	DISRUPTION TIME	LESSONS LEARNED
Male' Water Crisis	Water	2014	Fire at Male Water and Sewerage Company	<ul style="list-style-type: none"> MWSC NDMA MNDF Local Authorities International Agencies 	Several days	Importance of redundancy in critical infrastructure, decentralized operation centers and need for effective WSEPs
Addu Water Disruption	Water	2024	Damage to borehole pump, insufficient RO plant capacity	<ul style="list-style-type: none"> Fenaka Corporation Limited Local Authorities 	Several weeks	Need for proper maintenance, increased water storage, and additional water sources
Dry Season Water Supply	Water	Annually	Reduced rainfall, increased demand	<ul style="list-style-type: none"> Ministry of Tourism and Environment Fenaka Corporation Limited Local Authorities 	Varying duration	Importance of rainwater harvesting, desalination, and water conservation
Fuvahmulah Sewerage System Issues	Sewer	2019 - 2021	Inadequate infrastructure, Rainfall Infiltration into sewerage system	<ul style="list-style-type: none"> Ministry of Tourism and Environment Fenaka Corporation Limited Local Authorities 	Three years	Need for proper technology selection design, planning and implementation

1.5 Guidebook Structure

The WSEP Guidebook is a ten-module resource designed to assist water and sewerage utilities in developing WSEPs. The stages cover Preparation, Prevention and Mitigation, Preparedness, Response, and Recovery, building sequentially to provide a comprehensive framework.

The guidebook begins by introducing WSEPs in the context of water and sewerage utilities, defining relevant emergencies, and identifying the target audience. It outlines the structure and content of each module, emphasizing their interconnectedness. Below is an outline of the guidebooks structure.

What is a Water and Sewerage Emergency Plan?

Water and Sewerage Emergency Plan

Stage 1: Preparation

- Module 1: Assemble WSEP Team
- Module 2: Describe the System

Stage 2: Prevention and Mitigation

- Module 3: Hazard Identification, Risk Assessment and Control Measures

Stage 3: Preparedness

- Module 4: Emergency Preparedness
- Module 5: Annual Action Plan for WSEP Activities

Stage 4: Response

- Module 6: Emergency Classification
- Module 7: Emergency Operations Plans
- Module 8: Crisis Communication Plan
- Module 9: Business Continuity Plan

Stage 5: Recovery

- Module 10: Emergency Recovery

WHAT IS A WATER AND SEWERAGE EMERGENCY PLAN?

WSEP is a document outlining procedures and strategies to be followed in case of a disruption or failure of water or sewerage services.

2.1 Definition and Purpose

The purpose of a WSEP is to enhance the preparedness of utilities, increase their resilience to major disasters and emergencies, ensure the sustainability of basic services for the entire community, and provide a framework for rapid response and service continuation during crises.

Given the unique challenges faced by the Maldives, such as its distributed geography and heavy reliance on desalination plants, a robust WSEP is essential. The nation's numerous islands, many of which are remote and have limited infrastructure, pose logistical challenges for transporting emergency supplies and personnel. Moreover, the dependence on desalination plants makes the Maldives particularly vulnerable to disruptions in power or infrastructure.

To address these challenges and improve emergency preparedness, the WSEP Guidebook aims to provide a standardized framework for developing WSEPs tailored to the specific needs of Maldivian utilities. By following this guide, utilities can enhance their ability to respond effectively to emergencies, ensure the continued provision of essential services, and protect public health and safety.

2.2 Definition

An emergency within the context of water and sewerage services is an event or series of events that disrupt the normal operation of these services.

Water Services Emergency:

A situation that results in:

1. Reduced water pressure below acceptable standards - 0.7 Bar (Ofwat, 2017)
2. Complete water supply interruption
3. Water quality deterioration exceeding URA regulations (URA, 2022)

Sewerage Services Emergency:

An event causing:

1. Sewage overflow from the sewerage network

2.3 Objectives

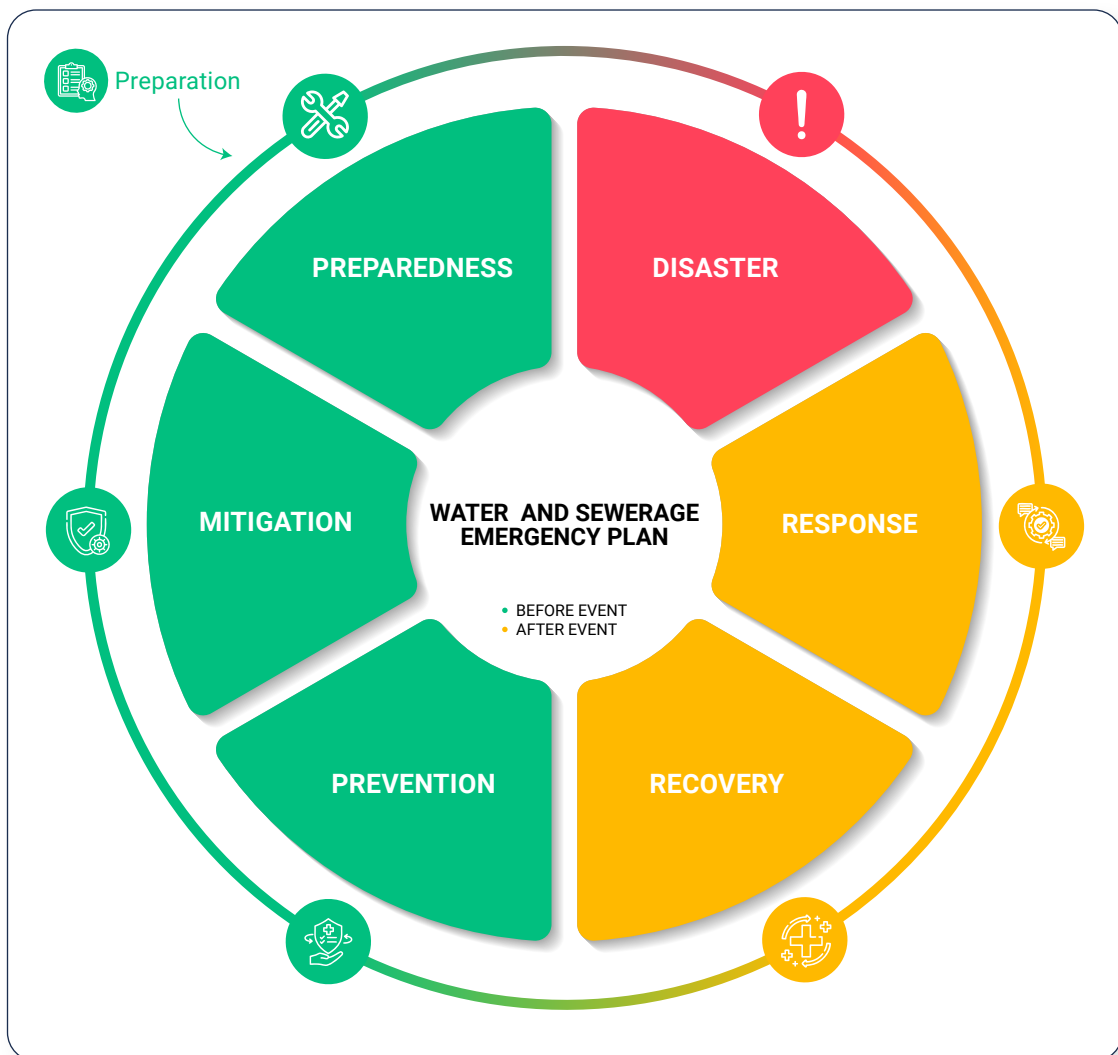
A WSEP is built upon five key objectives.

1. **Operational Continuity:** Maintaining uninterrupted water and sewage services during emergencies.
2. **Impact Mitigation:** Reducing the financial, environmental, and infrastructural consequences of emergencies.
3. **Effective Communication:** Establishing clear internal and external communication channels.
4. **Swift Restoration:** Implementing rapid service recovery strategies to minimize disruptions.
5. **Regulatory Compliance:** Adhering to all relevant emergency preparedness and response standards.

WATER AND SEWERAGE EMERGENCY PLAN

WSEP is a document that outlines strategies, resources, plans, and procedures to be followed during emergencies that threaten the water and sewerage system. This plan encompasses five key stages (Figure 3): Preparation, Mitigation, Preparedness, Response and Recovery.

Figure 3: Components of WSEP





STAGE 1

PREPARATION

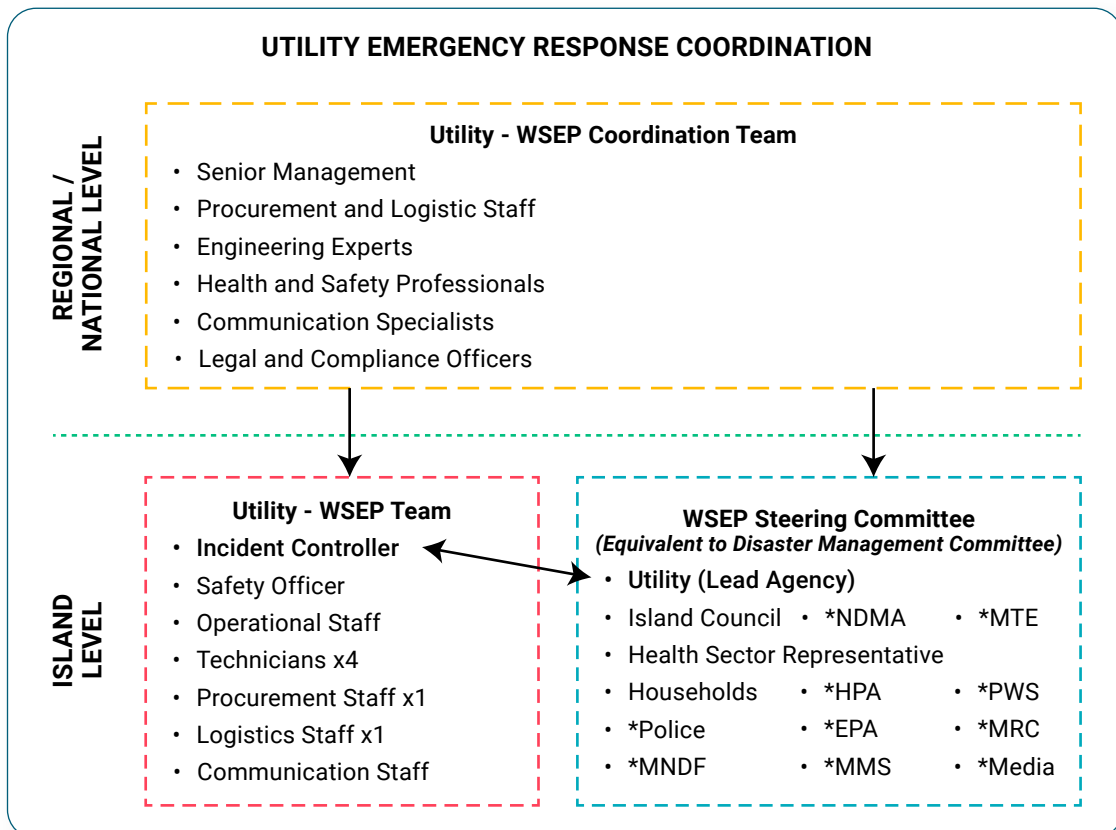
STAGE 1: PREPARATION

The WSEP is effective for a particular administrative area or service area for which URA has issued an operating license. To initiate an WSEP, the utility must first assemble the WSEP team. The objective of this step is to:

1. Obtain and allocate resources for the development and implementation of WSEP.
2. Form a multi-disciplinary planning team for emergency preparedness and response.
3. Involve key stakeholders, such as government agencies, community representatives, and NGOs, in the WSEP development process.

4.1 Module 1: Assemble WSEP Team

Figure 4: WSEP Response Coordination Flow Diagram



The response coordination teams will consist of three main components defined at a regional/national level and the island level.

1. **Utility-WSEP Coordination Team (Regional/National Level):** This team will be responsible for providing strategic direction, allocating resources, and ensuring organizational commitment.
2. **Utility-WSEP Team (Island Level):** This team will be responsible for implementing the WSEP at the island level.
3. **WSEP Steering Committee:** This committee is a high-level body responsible for overseeing the development and implementation of the WSEP. This committee can be integrated with any existing Disaster Management Committees (DMC) in the island. Based on the type of emergency, these committees will be co-led by the relevant government agency; for example; for health-related emergencies, the committee will be co-led by HPA.

4.1.1 Stakeholder Analysis and WSEP Steering Committee

Following a stakeholder analysis, an WSEP steering committee could be established.

The WSEP steering committee is a high-level body responsible for overseeing the development and implementation of the WSEP. This committee should comprise senior representatives from key organizations involved in water and sewerage services, including:

1. **Utility (Lead agency):** Responsible for overall operations and decision-making.
2. **Households connected to water and sewerage services:** Representing the interests of consumers and providing feedback on the impact of emergencies. This could be represented by active citizens in the community, by active NGOs on the island or by the Island Council.
3. **Island Council:** Representing local government and community interests, and coordinating with other stakeholders.
4. **Health Sector Representative:** Responsible for the medical response activities.
5. **Emergency management:** Responsible for overall emergency response coordination and resource allocation. This could include representatives from Maldives Police Service (MPS), Maldives National Defense Force (MNDF), Fire and Rescue Service (FRS), Maldives Red Crescent (MRC) or other active Non-Governmental Organizations (NGOs) in the service area.
6. **Law Enforcement:** Maintaining order and security during emergencies.

This committee could include representatives from other relevant organizations as needed depending on the scale of the operations, such as the National Disaster Management Authority (NDMA), Ministry of Tourism and Environment (MTE), Health Protection Agency (HPA), Environmental Protection Agency (EPA), Maldives Meteorological Services (MMS), Public Work Services (PWS), Maldives Red Crescent (MRC), and private sector partners.

A well-rounded WSEP Steering Committee, utilities can ensure effective collaboration, decision-making, and resource allocation for emergency response planning and execution. The steering committee is expected to be part of the WSEP formulation and endorsement process. The committee can also play a key role in communication with the public in case of emergency. The members of the steering committee should have a basic understanding of the water and sewerage services being provided by the utility.

4.1.2 Emergency Coordination and WSEP Team

To effectively develop and implement an WSEP, a dedicated WSEP team is essential. The team should comprise individuals representing various departments and roles within the utility (lead agency), each contributing unique expertise and perspectives.

Key members of the Emergency Coordination and WSEP team may include:

At a Regional/National Level

- 1. Senior management (Regional/National level):** To provide strategic direction, allocate resources, and ensure organizational commitment.
- 2. Engineering experts (Regional/National level):** For technical assessments and problem-solving.
- 3. Safety and health professionals (Regional/National level):** To address employee safety and well-being.
- 4. Communications specialists (Regional/National & Island level):** For internal and external communication during emergencies.
- 5. Legal and compliance officers (Regional/National):** To ensure adherence to regulations.
- 6. Procurement and logistic staff (Regional/National):** Manages the procurement and allocation of resources and supplies. Ensures that necessary equipment and materials are available.

At an Island Level

1. **Incident Controller (Island level):** Oversees the overall emergency response and makes critical decisions. The Incident Controller is responsible for the following but not limited to:
 - Leading and coordinating the team
 - Ensure team is trained and carrying out inspections
 - Communicating with headquarters
 - Activating the water and sewerage emergency plan
 - Assessing the situation
 - Allocating resources
 - Making decisions
 - Coordinating with stakeholders
2. **Safety Officer:** Ensure the safety of all personnel involved in the response effort.
3. **Operational staff (Island Level):** With firsthand knowledge of daily operations with understanding equipment, infrastructure, potential hazards and potential failure points.
4. **Procurement and logistic staff (Island Level):** Manages the procurement and allocation of resources and supplies from local sources.
5. **Public information officer:** Coordinates and disseminates information to the public.

4.1.3 Define roles and responsibilities

At the outset of the WSEP development process, clear roles and responsibilities should be assigned to each team member. This ensures efficient collaboration and avoids duplication of efforts. For larger teams, consider using a table to outline specific tasks and responsibilities as in Table 3, Table 4 and Table 5.

Table 3: Suggested Utility-WSEP Coordination Team (Regional/National Level) Members Recording Template

FOCAL POINT NAME	DESIGNATION (Examples)	CONTACT INFORMATION	ROLE IN WSEP
[Name]	[Designation]	[Contact no.]	Senior Management
[Name]	[Designation]	[Contact no.]	Engineering Experts
[Name]	[Designation]	[Contact no.]	Health and Safety Professional
[Name]	[Designation]	[Contact no.]	Communication Specialist
[Name]	[Designation]	[Contact no.]	Legal and Compliance Officer
[Name]	[Designation]	[Contact no.]	Procurement Staff
[Name]	[Designation]	[Contact no.]	Logistic Staff

Table 4: Suggested Utility-WSEP Coordination Team (Island Level) Members Recording Template

FOCAL POINT NAME	DESIGNATION (Examples)	CONTACT INFORMATION	ROLE IN WSEP
[Name]	[Designation]	[Contact no.]	Incident Controller
[Name]	[Designation]	[Contact no.]	Operational Staff
[Name]	[Designation]	[Contact no.]	Safety Officer
[Name]	[Designation]	[Contact no.]	Technician
[Name]	[Designation]	[Contact no.]	Procurement Staff
[Name]	[Designation]	[Contact no.]	Logistic Staff
[Name]	[Designation]	[Contact no.]	Public Information Officer

Table 5: Suggested WSEP Steering Committee Members Recording Template

STAKEHOLDER / AGENCY (Examples)	FOCAL POINT NAME / DESIGNATION	CONTACT INFORMATION	ROLE IN WSEP
Utility	[Name] / [Designation]	[Contact no.]	Lead Agency
Island Council	[Name] / [Designation]	[Contact no.]	Supporting Agency
Households	[Name] / [Designation]	[Contact no.]	Households
Maldives Police Service	[Name] / [Designation]	[Contact no.]	Supporting / Law Enforcement Agency
Health Center	[Name] / [Designation]	[Contact no.]	Supporting Agency
Fire and Rescue Service	[Name] / [Designation]	[Contact no.]	Supporting / Emergency Response Agency
Maldives National Defense Force	[Name] / [Designation]	[Contact no.]	Supporting / Emergency Response Agency
Maldives Red Crescent	[Name] / [Designation]	[Contact no.]	Supporting / Emergency Response Agency
Local NGO	[Name] / [Designation]	[Contact no.]	Supporting Agency
Ministry of Tourism and Environment (For Tourism Establishments)	[Name] / [Designation]	[Contact no.]	Supporting Agency

Table 6: Guidance Note for 4.1.3 - Defining the Roles and Responsibilities of WSEP Team

Checklist of Issues to Consider when Identifying the WSEP Team

- Are all stakeholders involved in every step of the water and sewerage sector represented?
- Are day-to-day technical operational skills included within the team?
- Do one or more members have an understanding of management systems and emergency procedures?
- Do one or more members understand natural hazard events and how it may influence them?
- Do members have the authority to implement recommendations stemming from the WSEP?
- How will the work be organized?
- How will specific stakeholders who are not represented on the team be engaged?
- How will documentation be organized?
- What external technical support can be brought in to support the team?

4.2 Module 2: Describe the System

Module 2 focuses on developing a comprehensive understanding of the water and sewerage system to identify potential vulnerabilities and hazards. This in-depth assessment will inform subsequent risk assessment and mitigation strategies.

1. **System Mapping:** Create a detailed representation of the water and sewerage infrastructure, including sources, treatment facilities, distribution networks, and disposal points.
2. **System Performance Evaluation:** Collect quantitative baseline data on system performance, such as flow rates, water quality parameters, and treatment efficiency.
3. **Gap Analysis:** Identify deficiencies in the system, such as inadequate capacity, outdated infrastructure, or insufficient emergency response procedures.

4.2.1 Map the System

A comprehensive understanding of the water and sewerage system is essential for effective emergency planning. This involves mapping the entire system from water sources to water treatment, distribution and disposal for water services and excreta flow from source to treatment and/or disposal for sewerage services.

Water Services

1. **Water Sources:** Identify all raw water sources, including surface water bodies, groundwater (borewells, aquifers).
2. **Water Treatment Facilities:** Detail treatment processes (pretreatment, filtration, RO etc., capacity, and disinfection methods (chlorination, UV, ozonation).
3. **Water Distribution Network:** Map pipelines, zonal isolation valves, storage tanks, pumping stations, and booster stations.
4. **Consumption Points:** Identify type of water users based on residential, commercial, public industrial, and agricultural water users. To identify critical infrastructure like hospitals and other critical consumption points.

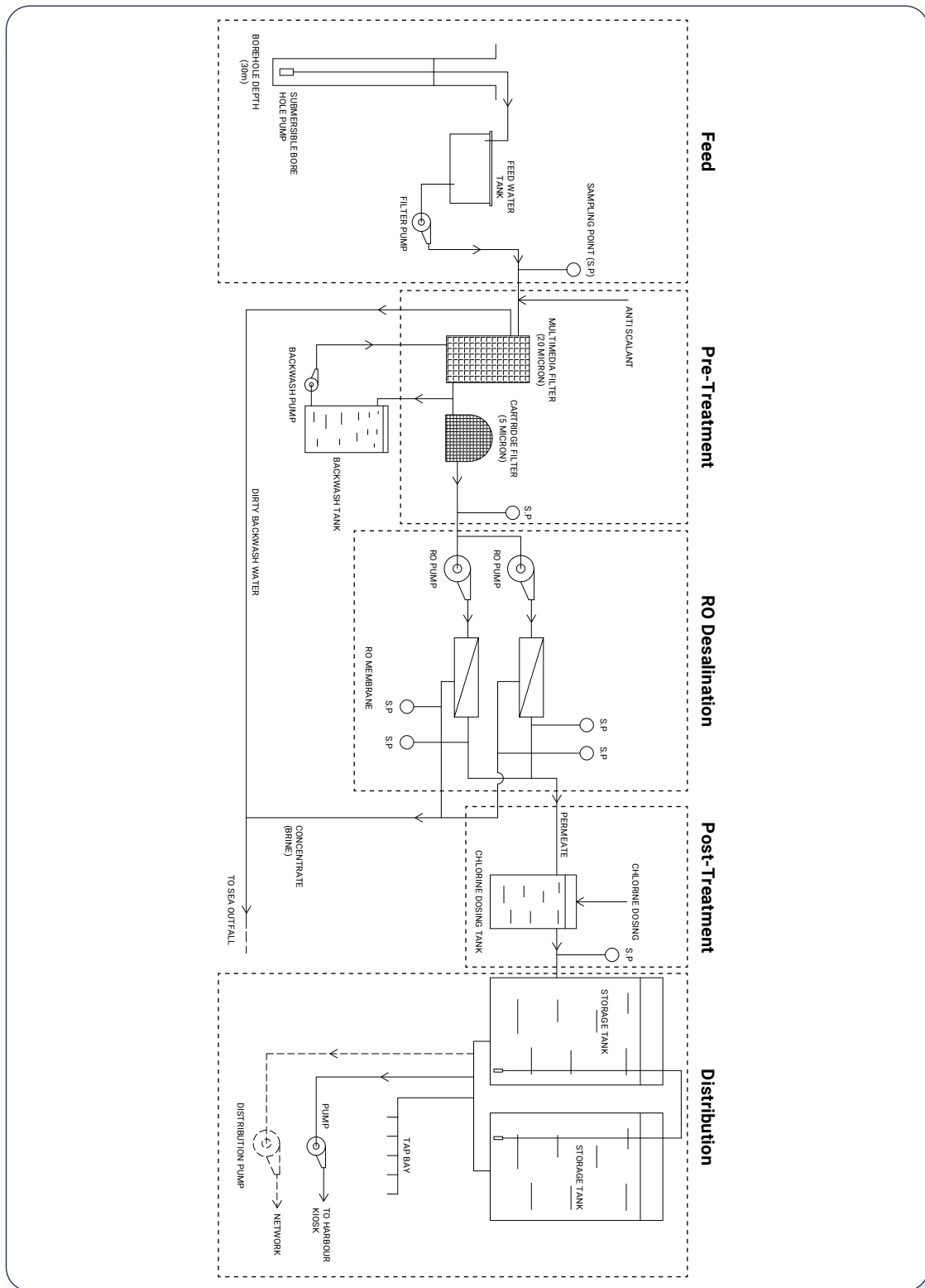
Sewerage Services

1. **Sewerage Collection System:** Outline the network of sanitary sewers, pumping stations, and manholes.
2. **Wastewater Treatment Facilities:** Describe treatment processes (primary, secondary, tertiary), capacity, and effluent disposal methods (discharge to water bodies, land application, reuse).
3. **Disposal Points:** Identify final discharge locations for effluent.
4. **Sludge Management:** Describe sludge handling, treatment, and disposal practices.

Table 7: Guidance Note for 4.2.1 - Map the System

Checklist of Issues to Consider When Mapping the Systems		
CHECK LIST ITEM	DESCRIPTION	TYPICAL DATA SOURCE
WATER SYSTEMS		
1	Identify the source water location and quality from available documentation of the system, this will typically be provided by the contractor/developer/ministry. Process flow diagrams are encouraged for simpler understanding.	Contractor / Developer / Ministry
2	Collect visual representations of the water infrastructure, including sources, treatment facilities, distribution networks, zonal isolation valves, and disposal points, this will typically be provided by the contractor/developer/ministry or be included among the operational license documentation.	Contractor / Developer / Ministry / Operating License Documents
3	Incase maps and drawings of the system are not available, conduct surveys and mapping if necessary, digitizing data and using GIS for analysis.	Field Surveys
4	Confirm the accuracy of system mapping via desktop reviews, interviews and physical surveys.	Contractor / Developer / Ministry, Interviews, Physical Surveys
SEWER SYSTEMS		
1	Identify all sources and disposal points of system flows including typical flow and quality. Process flow diagrams are encouraged for simpler understanding.	Contractor / Developer / Ministry / Operating License Documents / Measurements / Water Quality Testing
2	Collect visual representations of the sewerage infrastructure (collection network, treatment facilities, disposal points) from existing documentation.	Field Surveys
3	Incase maps and drawings of the system are not available, conduct surveys and mapping if necessary, digitizing data and using GIS for analysis.	Contractor / Developer / Ministry, Interviews, Physical Surveys

Figure 5: Sample Process Flow Diagram of Water Treatment Plant



4.2.2 Baseline Performance of the System

Understanding the baseline performance of the water and sewerage system is crucial for effective emergency planning. This involves collecting and analyzing quantitative data on various system parameters.

Water Supply System

1. **Flow Rates:** Measure water production, distribution, and consumption at key points within the system (e.g., treatment plants, pumping stations, distribution networks).
2. **Water Quality Parameters:** Monitor water quality at source, treatment plants, distribution points, and consumer taps for parameters such as turbidity, pH, chlorine residual, coliform bacteria, and other relevant contaminants.
3. **Pressure Levels:** Record water pressure at different points within the distribution network to identify areas with low pressure or pressure fluctuations.

Sewerage System

1. **Flow Rates:** Measure wastewater flows at various points within the collection system (e.g., pumping stations, treatment plants).
2. **Wastewater Quality Parameters:** Monitor wastewater quality for parameters such as suspended solids, biochemical oxygen demand (BOD), chemical oxygen demand (COD), nutrients, and pathogens.
3. **System Capacity:** Assess the capacity of the sewerage system to handle peak flows and rainfall events.

Table 8: Guidance Note for 4.2.2 - Baseline Performance of the System

Checklist of Issues to Consider when Assessing the Baseline Performance of the Systems		
CHECK LIST ITEM	DESCRIPTION	TYPICAL DATA SOURCE
WATER SYSTEMS		
1	Measure flowrates at key points (e.g., feed, permeate, reject, storage, distribution).	Totalizing flow meter or instantaneous flow meter.
2	Measure water quality at key points (e.g., feed, permeate, reject, storage, distribution, consumer taps).	Existing monitoring data, water quality labs, in-situ water quality testing equipment.
3	Measure water pressure at key points (e.g., feed, permeate, reject, storage, distribution, water network)	Pressure gauges, SCADA systems, physical surveys.
SEWER SYSTEMS		
1	Measure flowrates at key points (e.g., lift stations, treatment plant stages).	Totalizing flow meter, instantaneous flow meter, calculations from running hours based on pump duty points.
2	Measure water quality at key points (e.g., pump stations, different stages of the wastewater treatment and final discharge location).	Existing monitoring data, water quality labs, in-situ water quality testing equipment.
3	Assess system capacity (retention volume): Calculate retention time based on pump running hours or outfall flow rates.	Pump station data, flow meters.

4.2.3 Gap Analysis

A gap analysis is a critical step in identifying vulnerabilities within the water and sewerage system. By comparing the system's current state to desired performance levels or industry best practices, operators can pinpoint areas where improvements are needed to enhance overall system resilience and emergency preparedness.

Identifying Deficiencies and Vulnerabilities in the System

1. **Capacity Shortfalls:** Assess whether the system has adequate capacity to meet peak demands, handle increased flows during emergencies, or accommodate future growth.
2. **Infrastructure Deterioration:** Evaluate the condition of water and sewerage infrastructure, including pipelines, pumps, treatment plants, and storage facilities. Identify components that are aging, undersized, or in need of repair or replacement.
3. **Operational Shortcomings:** Analyze operational procedures, maintenance practices, and staffing levels to identify areas where improvements can be made to optimize system performance and response times.
4. **Regulatory Compliance Issues:** Evaluate the system's compliance with relevant regulations and standards.

Table 9: Guidance Note for 4.2.3 - Gap Analysis

Checklist of Issues to Consider when Assessing the Gap Analysis of the Systems		
CHECK LIST ITEM	DESCRIPTION	TYPICAL DATA SOURCE
WATER SYSTEMS		
1	Assess the system's ability to meet peak demands, handle increased flows, and accommodate future growth.	Check whether operational demand is catered by the operational production and discharge. Use historical data and population projections to estimate current and future demand.
2	Evaluate the condition of water and sewerage infrastructure components.	<ul style="list-style-type: none"> • Infrastructure inspections reports, • Maintenance records (Focusing on preventative maintenance)
3	Analyze operational procedures, maintenance practices, and staffing levels.	<ul style="list-style-type: none"> • Standard operating procedures • Staff interviews • Performance data
4	Assess compliance with relevant regulations and standards.	Check water production, water quality, wastewater discharge flow and quality with regulatory requirements of URA. Obtain historical data from compliance reports sent to URA.

Table 10: Suggested List of Data/Information to be Collected for Water Services

WATER SYSTEM COMPONENT	INFORMATION TO BE COLLECTED
Water Source	Source type (surface water, groundwater), location, water quality parameters, extraction capacity
Water Treatment Plant	Year established, treatment processes, capacity, disinfection methods, chemical use, effluent quality parameters, maintenance activities, monitoring frequency, operational records
Water Distribution Network	Pipe material, diameter, age, length, network map, pressure zones, hydrant locations, leak detection records, maintenance activities
Water Storage Facilities	Type (ground, elevated), capacity, age, location, water quality monitoring
Pumping Stations	Location, capacity, pump type, energy consumption, maintenance records
Consumer Information	Number of connections, consumption patterns, water quality complaints

Table 11: Suggested List of Data/Information to be Collected for Sewerage Services

SEWERAGE SYSTEM COMPONENT	INFORMATION TO BE COLLECTED
Sewer Networks	Year established, number of households connected, number of manholes, length and diameter of sewer pipes, material of sewer pipes, location of lifting stations, maintenance activities, frequency of inspection, sewer network map, issues and problems encountered (e.g., leaks)
Wastewater Treatment Plant	Year established, treatment capacity, daily flow rate, treatment process, list of components (equipment, tanks), process flow diagram, design capacity of tanks, maintenance activities, monitoring of effluent quality (e.g., frequency, parameters), frequency of inspection, issues and problems encountered (e.g., malfunction, overflow), emergency bypass procedures
Effluent Outfall	Location of effluent outfall, distance from shoreline, depth and condition of outfall
Solid Waste from Sewer Network	Volume of solid wastes collected, location of disposal, pre-treatment applied (e.g., disinfection), if any



STAGE 2

PREVENTION AND MITIGATION

STAGE 2: PREVENTION AND MITIGATION

5.1 Module 3: Hazard Identification, Risk Assessment and Control Measures

This module focuses on identifying potential hazards, assessing associated risks, and evaluating existing control measures within the water and sewerage system. The goal is to prioritize high-risk areas and develop targeted mitigation and prevention strategies.

1. **Identify Potential Hazards:** Determine potential threats to the water and sewerage system, including natural disasters, equipment failures, human errors, and external factors (e.g., contamination, vandalism etc.)
2. **Assess Risk Severity and Likelihood:** Evaluate the potential consequences of each hazard and the likelihood of occurrence.
3. **Prioritize Risks:** Rank hazards based on their overall risk level, considering both severity and likelihood.
4. **Control measures:** Describe measures that are essential for preventing or mitigating the impact of hazards on water and sewerage systems.

5.1.1 Hazard Identification

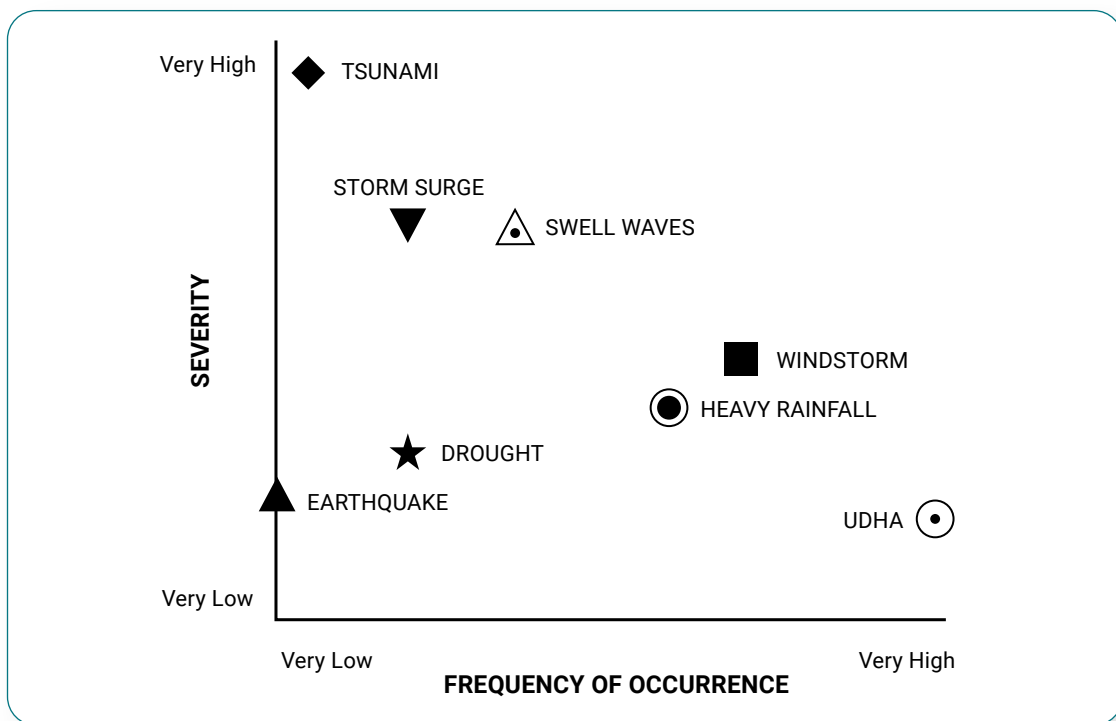
A hazard is any biological, chemical, physical, or radiological agent that has the potential to cause harm to public health, property, or the environment. It can be a natural phenomenon, such as a hurricane or earthquake, or a human-induced event, such as a chemical spill or infrastructure failure. Hazards can lead to a variety of negative consequences, including loss of life, injury, property damage, economic disruption, and environmental degradation.

Hazard identification is the critical first step in developing a robust Emergency Plan (WSEP). Hazards can originate from various sources, including but not limited to:

1. **Natural hazards:** Cyclones, Floods due to heavy rainfall, swell wave, storm surges, tsunami, earthquakes, droughts (water shortages), extreme temperatures, (Figure 6). Utilities can determine the hazard classification of their service area from established hazard maps for each natural hazard from sources such as Multihazard Risk Atlas of Maldives (Asian Development Bank, 2020).
2. **Human-made hazards:** Equipment failures, chemical spills, fires, explosions, power outages, cyberattacks, vandalism, lack of PPE, terrorism, etc.
3. **Biological hazards:** Microbial contamination leading to waterborne diseases.

A thorough understanding of potential hazards including the components of the system most vulnerable to these hazards is fundamental to building a resilient organization capable of responding effectively to emergencies.

Figure 6: Hazard Patterns of Maldives (NDMA, 2024)



Methodologies for Hazard Identification

1. **Walk-through inspections:** Conducting physical inspections of facilities and workplaces to identify potential hazards.

2. **Hazard hunting:** Encouraging employees to report any potential hazards they observe.
3. **Incident analysis:** Reviewing past accidents and incidents to identify common causes and prevent future occurrences.
4. **Expert opinion:** Consulting with experts in relevant fields to identify potential hazards.

Exposure Group: An exposure group is a defined population that may be exposed to a specific hazard.

Exposure Route: An exposure route is the pathway through which a hazard can impact an exposure group.

Table 12: Example of Hazard Identification

Example of Hazard Identification				
HAZARD	EXPOSURE GROUP	EXPOSURE ROUTE	POTENTIAL IMPACT	EXISTING CONTROL MEASURES
Chemical Spill	Operators and general public in the vicinity of the chemical spill	Inhalation, skin contact, eye contact	Respiratory, eye and skin irritation. Environmental damage due to contamination of the soil, water and air.	Personal Protection Equipment (PPE) provided. Spill kits available.
Tsunami	General population, Critical Infrastructure, Equipment and Machinery	Direct impact of the tsunami wave, flooding, and debris	Property damage, environmental damage, infrastructure damages, service disruption, economic disruption and loss of life.	Coastal land use planning restrictions such as building setbacks. Evacuation plans and routes.
Defective Consumables or Chemicals	Operators and general public who rely on treated water	Indirect exposure through contaminated water	Reduced water production and quality, equipment damage and public health risks.	Quality control checks on incoming components.

5.1.2 Risk Assessment

Once potential hazards have been identified, the next step is to assess the associated risks. This involves evaluating the likelihood of each hazard occurring and the potential severity of its consequences.

Risk assessment is a systematic process to determine the level of risk posed by each hazard. It typically involves:

1. **Risk analysis:** Evaluate the potential consequences of each hazard in terms of likelihood and severity.
2. **Risk evaluation:** Determine the overall risk level by combining likelihood and severity.

A risk matrix is used to arrive at a risk score which determines the overall risk level.

Likelihood

1. **Define likelihood:** The probability of a hazard occurring, expressed as a qualitative or quantitative value.
2. **Qualitative assessment:** Use descriptive terms such as high, medium, or low to categorize likelihood based on historical data, expert judgment, or industry benchmarks.
3. **Quantitative assessment:** Assign numerical values to likelihood using probability scales or statistical analysis when data is available.
4. **Factors influencing likelihood:** Consider frequency of occurrence, trends, and contributing factors (e.g., weather patterns, equipment age).

Table 13: Suggested Definition of Likelihood

LIKELIHOOD SCORE (L)	DESCRIPTOR	DESCRIPTION
1	Very Unlikely	Has not happened in the past 15 years and is highly improbable it will happen in the next 12 months (or another reasonable period)
2	Unlikely	Has not happened in the past 15 years but may occur in exceptional circumstances in the next 12 months (or another reasonable period)
3	Possible	May have happened in the past 15 years and/or may occur under regular circumstances in the next 12 months (or another reasonable period)
4	Likely	Has been observed in the past 15 years and/or is likely to occur in the next 12 months (or another reasonable period)
5	Almost Certain	Has often been observed in the past 15 years and/or will almost certainly occur in most circumstances in the next 12 months (or another reasonable period)

Severity

1. **Define severity:** The potential impact of a hazard if it occurs, expressed in terms of consequences.
2. **Qualitative assessment:** Use descriptive terms such as catastrophic, major, moderate, minor, or negligible to categorize severity based on potential loss or damage. This could include assessments of economic loss such as loss to agricultural output, tourist arrival or industrial outputs due to the emergency.
3. **Quantitative assessment:** Assign numerical values to severity based on financial loss, environmental impact, or human health consequences.
4. **Factors influencing severity:** Consider the potential impact on people, property, the environment, and operations.

Table 14: Suggested Definition of Severity

SEVERITY SCORE (S)	DESCRIPTOR	DESCRIPTION
1	Insignificant	Hazard or hazardous event resulting in negligible health effects, minimal property damage, minimal economic loss, and negligible environmental impact.
2	Minor	Hazard or hazardous events potentially resulting in minor health effects, minor property damage, minimal economic loss, and minor environmental impact (e.g., localized pollution, temporary stoppage of equipment, temporary disruption of ecosystems).
4	Moderate	Hazard or hazardous event potentially resulting in self-limiting health effects or minor illness, moderate property damage, significant economic loss, and moderate environmental impact (e.g., significant pollution, repairable damage to equipment, habitat loss, biodiversity loss).
8	Major	Hazard or hazardous event potentially resulting in illness or injury, substantial property damage, major economic loss, and major environmental impact (e.g., widespread pollution, damage to equipment beyond repair, long-term environmental consequences).
16	Catastrophic	Hazard or hazardous event potentially resulting in serious illness, injury, or loss of life, extensive property damage, catastrophic economic loss, and catastrophic environmental impact (e.g., widespread ecological disaster, damage to equipment beyond repair, long-term environmental consequences).

Once the likelihood and severity are determined, the risk level of the hazardous event can be computed. The table below shows the risk assessment matrix to be used in determining the risk level of each hazardous event.

The formula on how risk level is calculated is presented below:

$$\text{RISK} = \text{LIKELIHOOD} \times \text{SEVERITY}$$

RISK SCORE (R)	RISK LEVEL
<6	Low Risk
7-12	Medium Risk
13-32	High Risk
>32	Very High Risk

Table 15: Suggested Risk Assessment Matrix

			SEVERITY (S)				
			Insignificant	Minor	Moderate	Major	Catastrophic
			1	2	4	8	16
LIKELIHOOD (L)	Very Unlikely	1	1	2	4	8	16
	Unlikely	2	2	4	8	16	32
	Possible	3	3	6	12	24	48
	Likely	4	4	8	16	32	64
	Almost Certain	5	5	10	20	40	80

Table 16: Example of Risk Assessment

Example of Risk Assessment				
HAZARD	LIKELIHOOD	SEVERITY	RISK VALUE	RISK LEVEL
Chemical Spill	3	2	6	Low Risk
Tsunami	2	16	32	High Risk
Defective Consumables or Chemicals	1	4	4	Low Risk

5.1.3 Risk Prioritization

The risk assessment assists in determining the overall risk level and appropriate response strategies. Table 17 provides a framework for categorizing risks based on their likelihood and severity.

Table 17: Definition of Risk Levels

RISK LEVEL	NOTES
Very High and High Risk	Actions need to be taken to minimize the risk. Possible options (short, medium and long-term options) should be documented and implemented based on priorities and available resources.
Medium Risk	Currently low or very unlikely impact on exposure groups. The situation can be improved with operational changes or system improvement over the medium to long term.
Low Risk	Actions may be taken but not a priority, or no action is needed at this time. The risk should be revisited in the future as part of the review process.
Unknown Priority	Further data is needed to categorize the risk. Some action can be taken to reduce risk while more data is gathered.

5.1.4 Control Measures

Control measures are essential for preventing or mitigating the impact of hazards on water and sewerage systems. These measures can be categorized into preventive and reactive strategies.

Preventive Control Measures - Prevention

Preventive controls aim to reduce the likelihood of emergencies occurring. They can be, but not limited to:

1. **Infrastructure maintenance:** Regular inspections, repairs, and upgrades to water and sewer infrastructure.
2. **Incident reporting mechanisms:** Can be a critical preventative control measure involving timely and accurate documentation of incidents or near-misses that occur, allowing for continuous learning from past events and enhance effectiveness of emergency response strategies.
3. **Staff training and education:** Comprehensive training programs for employees on emergency response procedures, hazard identification, and equipment operation.
4. **Emergency preparedness planning:** Development and implementation of detailed emergency response plans, including evacuation procedures, communication protocols, and resource allocation.
5. **Public awareness:** Education of the public on water conservation, water quality, and emergency response procedures.
6. **Early warning systems:** Implementation of systems to detect potential hazards early, such as water quality monitoring, weather forecasting, and leak detection.
7. **Redundancy and backup systems:** Installation of backup power generators, equipment to improve redundancy, and alternative water sources.

Reactive Control Measures - Mitigation

Reactive controls focus on minimizing the impact of emergencies once they occur. They can be, but not limited to:

1. **Containment:** Implementation of measures to control spills, leaks, or overflows, such as containment booms, sandbags, and diversion channels.
2. **Damage control:** Protection of critical infrastructure and equipment during emergencies.

3. **Emergency repairs:** Availability of equipment and personnel for immediate repairs and restoration of services.
4. **Alternative water supplies:** Provision of alternative water sources for essential needs during emergencies.
5. **Wastewater management:** Safe management and treatment of wastewater during and after emergencies.
6. **Public health protection:** Implementation of measures to protect public health, such as water quality testing, proper maintenance of RO plants, maintenance of networks and disinfection.
7. **Communication and coordination:** Establishment of effective communication channels with stakeholders, including government agencies, emergency responders, and the public.

Evacuation Plan and Assembly Points

In addition to the reactive control measures outlined, it is crucial to have a well-developed evacuation plan and designated assembly points in place.

Evacuation Plan

- **Identify vulnerable areas:** Determine areas that may be at risk of fires, flooding, contamination, or other hazards.
- **Develop evacuation routes:** Establish clear evacuation routes and signage to guide individuals to safe areas.
- **Communicate evacuation procedures:** Inform staff, customers, and the public about evacuation procedures and assembly points.
- **Coordinate with local authorities:** Work with local government agencies and emergency responders to ensure a coordinated evacuation effort.

Assembly Points

- **Select suitable locations:** Identify safe and accessible locations for assembly points, such as schools, community centers, or public parks.
- **Provide necessary amenities:** Ensure that assembly points have adequate facilities, such as restrooms, drinking water, and first aid supplies.
- **Communicate assembly point locations:** Inform the public of the designated assembly points through various communication channels.

5.1.5 Residual Risk and Risk Acceptance

Residual risk is the level of risk that remains after control measures have been implemented to reduce the potential impact of identified hazards. It is important to reassess risks periodically to ensure that control measures remain effective, to identify emerging risks and implement additional control measures.

Table 18: Example of Residual Risk and Risk Acceptance

Example of Residual Risk and Risk Acceptance			
HAZARD	ADDITIONAL CONTROL MEASURES	RESIDUAL RISK LEVEL	RISK ACCEPTANCE
Chemical Spill	Conduct regular inspections of storage containers and secondary containment.	L: 2 S: 2 R: 4 (Low)	Accepted
Tsunami	Develop and practice procedures for safely shutting down equipment and infrastructure in the event of a tsunami warning.	L: 2 S: 4 R: 8 (Medium)	Accepted
Defective consumables or chemicals	Provide workers with enhanced safety training on identifying and responding to potential defects.	L: 1 S: 2 R: 2 (Low)	Accepted

Risk acceptance is the decision to tolerate a level of residual risk because the cost or effort to reduce it further is not justified. This should be a conscious decision based on a thorough risk assessment and consideration of the potential consequences.

Factors to Consider when Accepting Risk:

1. **Cost-benefit analysis:** Weighing the cost of implementing additional control measures against the potential benefits.
2. **Regulatory requirements:** Adhering to legal and regulatory obligations.
3. **Risk tolerance:** The organization's willingness to accept a certain level of risk.

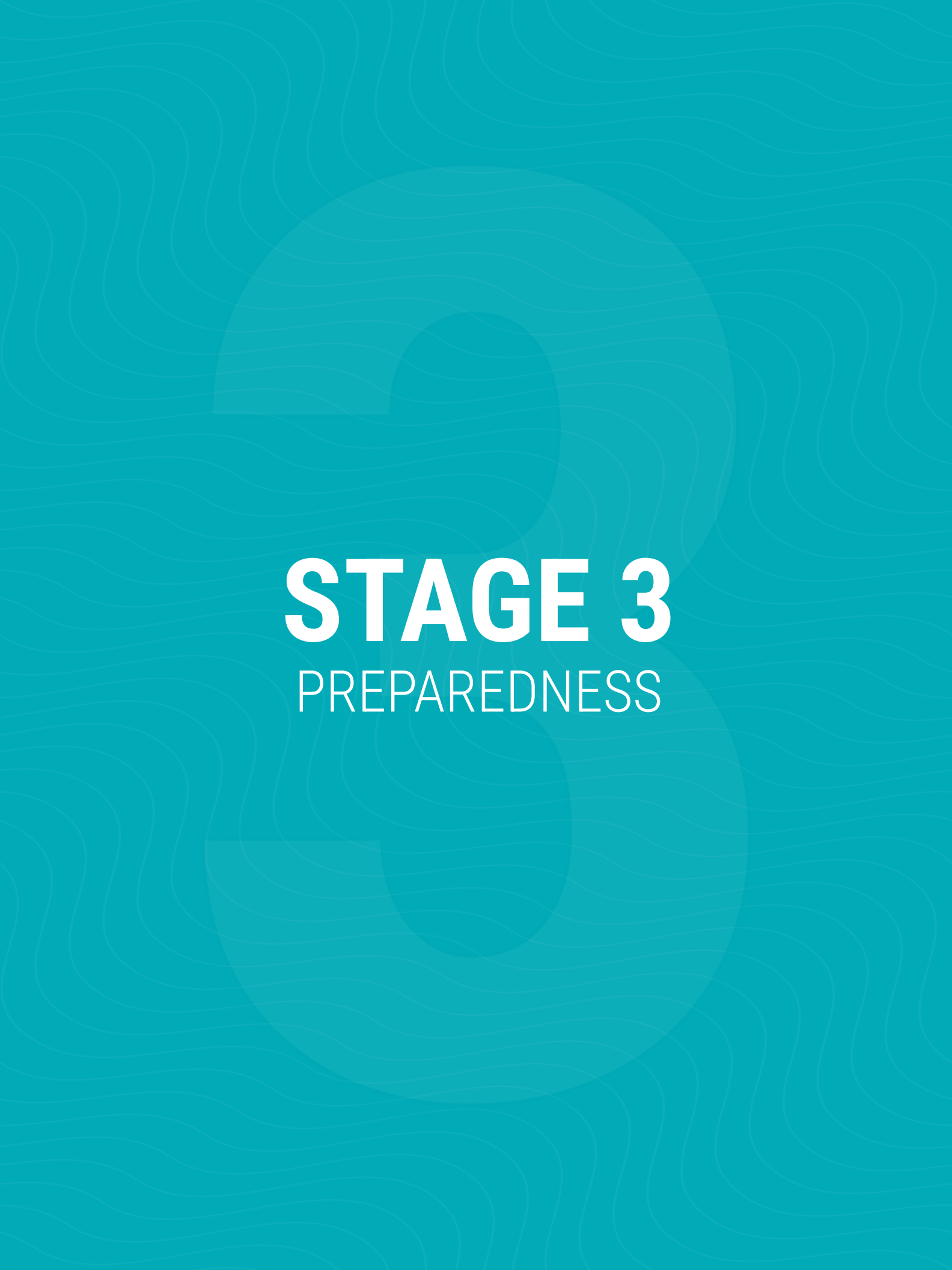
It is important to document the rationale for accepting residual risk and to regularly review these decisions. Risk acceptance does not imply negligence. It is a deliberate decision based on careful consideration of all relevant factors.

5.2 Hazard Identification and Risk Assessment (HIRA) Register

Based on the outlined hazard identification, risk assessment, and control measure framework, a sample HIRA register format is provided in Table 18. This template can be adapted by water and sewerage utilities to suit their specific operational context and requirements. By systematically documenting hazards, assessing risks, and identifying control measures, utilities can effectively manage potential threats to their systems and services.

Table 19: Suggested HIRA Register Template

HAZARD	EXPOSURE GROUP	EXPOSURE ROUTE	POTENTIAL IMPACT	EXISTING CONTROL MEASURES	LIKELIHOOD	SEVERITY	RISK VALUE	RISK LEVEL	ADDITIONAL CONTROL MEASURES	RESIDUAL RISK LEVEL	RISK ACCEPTANCE



STAGE 3

PREPAREDNESS

STAGE 3: PREPAREDNESS

6.1 Module 4: Emergency Preparedness

This module focuses on proactive measures to enhance an organization's capacity to respond effectively to emergencies.

1. **Resource Management:** Acquiring, maintaining, and utilizing essential resources for effective emergency response.
2. **Training, Drills and Exercises:** Developing staff competencies through training and simulated emergency scenarios. The level of training, drills and exercises can be defined by the utility based on their requirements.
3. **Communication and Coordination:** Establishing clear communication channels and collaborating with external agencies.
4. **Continuous Improvement:** Regularly reviewing and enhancing emergency preparedness plans. It is recommended that the WSEP be reviewed annually.

6.1.1 Resource Management

1. **Inventory Assessment:** Conduct a comprehensive assessment of available human, physical, and financial resources. This includes:
 - **Human resources:** Identify the number and qualifications of staff available for emergency response, including their skills, experience, and certifications.
 - **Physical resources:** Inventory all equipment, machinery, tools, spares, and consumables that are available for emergency response, including their location, condition, and maintenance status. This can include, but not limited to, personal protective equipment, bag filters, cartridge filters, membranes, vessels, lubricants, seal kits, pressure switches, sensors, gauges, dosing chemicals, float switches, electrical spares, water and sewerage network pipes and fittings. This can include both internal and external resources available to be used by the utility in case of an emergency. This can also be done at a regional (atoll) level.

- **Financial resources:** Evaluate the financial resources available for emergency preparedness, response, and recovery activities, including any external funding sources or partnerships.

Table 20: Example for Inventory Assessment

Example for Inventory Assessment			
HUMAN RESOURCES			
NAME	DESIGNATION	QUALIFICATION	EXPERIENCE / CERTIFICATIONS
Ahmed Ibrahim	Technician	Electrical Engineering	Pump maintenance, First Aid Certificate
PHYSICAL RESOURCES			
ITEM DESCRIPTION	QUANTITY	CONDITION	LOCATION
Backup Generator	1	Good, Maintenance completed	Water Treatment Plant
Diesel Pump	1	Good, In working condition	Island Council

2. **Resource Acquisition:** Identify and procure additional resources required for emergency response, such as equipment, supplies, and personnel. This may involve:
 - **Purchasing new equipment:** Identifying and purchasing necessary equipment that is not currently available.
 - **Entering into contracts:** Establishing agreements with suppliers or service providers to ensure a reliable supply of essential materials.
 - **Mobilizing external resources:** Coordinating with neighbouring utilities, government agencies, or other organizations for mutual aid assistance.
3. **Equipment Maintenance:** Ensure regular maintenance and calibration of emergency equipment, including generators, pumps, and communication devices. This includes:
 - **Developing a maintenance schedule:** Creating a schedule for routine maintenance and inspections of all emergency equipment.

- **Training staff:** Providing training to staff on how to properly maintain and operate emergency equipment.
 - **Maintaining spare parts:** Ensuring that adequate spare parts are available for all critical equipment.
4. **Supply Chain Management:** Establish reliable supply chains for essential materials and supplies to minimize disruptions. This includes:
- **Identifying reliable suppliers:** Identifying and selecting reputable suppliers with a proven track record of delivering goods and services on time.
 - **Negotiating contracts:** Negotiating favorable terms and conditions with suppliers to ensure a reliable supply of materials.
 - **Maintaining inventory levels:** Ensuring that adequate inventory levels of essential supplies are maintained at all times.
5. **Financial Planning:** Allocate adequate financial resources for emergency preparedness, response, and recovery activities. This includes:
- **Developing a budget:** Creating a detailed budget that outlines the expected costs of emergency preparedness, response, and recovery activities. This should include a contingency budget for unforeseen circumstances.
 - **Securing funding:** Identifying and securing funding sources to support the budget, such as government grants, donations, or internal allocations.
 - **Monitoring expenditures:** Tracking and monitoring expenditures to ensure that they align with the approved budget.

6.1.2 Training, Drills and Exercises

These trainings shall be conducted at least once a year.

1. **Staff Training:** Develop and implement comprehensive training programs covering hazard identification, emergency response procedures, first aid, and equipment operation.
2. **Tabletop Exercises:** Conduct simulated emergency scenarios to test response plans and identify weaknesses.
3. **Functional Exercises:** Simulate specific emergency response functions, such as evacuation or equipment deployment.

4. **Full-Scale Exercises:** Conduct large-scale simulations involving multiple agencies to test overall preparedness. For example; Organize an annual island-wide drill simulating a storm, involving the utility, local council, and hospital. The exercise will test the entire emergency response system, from early warning to recovery operations.

Involving Stakeholders in Training and Exercises

To enhance the effectiveness of the WSEP and foster stronger relationships and improved coordination among stakeholders, it is essential to involve them actively in training and exercises. This can include:

- **Inviting stakeholders to participate in drills:** Invite representatives from government agencies, NGOs, and other relevant organizations to participate in tabletop and functional exercises.
- **Conducting joint training sessions:** Organize joint training sessions with other agencies to improve interagency coordination and communication.
- **Sharing best practices:** Share best practices and lessons learned from training and exercises with other stakeholders to improve their preparedness.

Specific examples of stakeholders that can be involved include:

- **National Disaster Management Authority (NDMA):** The NDMA can provide overall leadership and coordination for emergency response efforts.
- **Maldives Red Crescent (MRC):** The MRC can provide expertise in first aid, disaster relief, and community mobilization.
- **Other government agencies:** Relevant government agencies, such as the police and fire and rescue, can participate in training and exercises to improve interagency coordination.
- **NGOs:** Local NGOs can provide support and assistance during emergencies, and can also participate in training and exercises to build their capacity.

6.1.3 Communication and Coordination

1. **Communication Plans:** Develop clear communication protocols for internal and external stakeholders.
2. **Public Information:** Establish procedures for informing the public during emergencies.

3. **Interagency Collaboration:** Build strong relationships with other agencies involved in emergency response, such as public health, fire, and police departments.
4. **Participating in Industry Forums:** Engaging in discussions with other utilities to share best practices, challenges, and lessons learned.
5. **Assistance Agreements:** Developing agreements with neighbouring utilities to provide or receive assistance during emergencies.

6.1.4 Continuous Improvement

1. **Benchmarking Programs:** Comparing the utility's emergency plans and procedures with those of leading utilities to identify areas for improvement.
2. **Plan Updates:** Regularly review and update emergency plans based on new information and changing conditions.
3. **Performance Measurement:** Track key performance indicators to assess the effectiveness of preparedness efforts.

6.2 Module 5: Annual Action Plan for WSEP Activities

Building a strong emergency response starts with a well-defined action plan for the upcoming year. To achieve this, integrate specific Emergency Response Preparedness activities into the utility's action plan. This plan should prioritize activities based on their potential impact and urgency, such as conducting drills, acquiring essential equipment, and updating emergency response protocols. Allocating appropriate budget resources for these activities ensures that the utility has the tools, training, and infrastructure necessary to effectively respond to any emergency, safeguarding public health and minimizing disruption during critical situations.

6.2.1 Task Identification and Prioritization

- **Brainstorm WSEP Activities:** List all potential activities that contribute to the utility's emergency preparedness. This could include:
 - Updating and revising EOPs and Crisis Communication Plans based on lessons learned from past events or changes in regulations.

- Conducting emergency drills to test response procedures and identify areas for improvement.
- Organizing training programs for personnel on various emergency response protocols (e.g., water quality testing, leak detection, communication strategies).
- Upgrading or acquiring new equipment to enhance response capabilities (e.g., mobile water treatment units, communication tools).
- Conducting vulnerability assessments to identify weaknesses in infrastructure and develop mitigation strategies.
- **Prioritize Activities:** Evaluate each activity based on its urgency, potential impact on emergency response, and resource requirements. Prioritize high-impact, time-sensitive activities for the upcoming year.

6.2.2 Develop a Detailed Action Plan

- For each prioritized activity, create a detailed plan outlining:
 - **Specific Tasks:** Break down the activity into smaller, actionable steps.
 - **Timeline:** Set realistic deadlines for completing each task.
 - **Resource Allocation:** Identify the personnel, equipment, and budget needed for each task.
 - **Accountability:** Assign clear ownership for completing each task.

6.2.3 Budgeting

- **Essential Equipment:** Develop a budget for acquiring essential equipment, machinery, tools, spares and consumables identified during task prioritization. Consider:
 - **Replacement Needs:** Budget for replacing outdated or malfunctioning equipment crucial for emergency response.
 - **New Technology:** Allocate funds for acquiring new technologies that could enhance your response capabilities.
 - **Cost-Effectiveness:** Evaluate the long-term cost-effectiveness of potential equipment purchases.

- **Training Programs:** Allocate resources for training programs that equip your personnel with the necessary skills and knowledge to respond effectively during emergencies.
- **Infrastructure Upgrades:** Budget for any necessary infrastructure upgrades identified during vulnerability assessments. This may include:
 - **System Redundancies:** Investing in backup systems to minimize service disruptions during emergencies.
- **External Human Resource Allocation:** Consider the need for external human resources during emergencies. This may include:
 - Hiring temporary staff to supplement existing workforce.
 - Contracting with specialized consultants or experts.
 - Coordinating with neighbouring utilities or government agencies for mutual aid assistance.
- **Logistics Costs:** Allocate funds for logistics costs associated with emergency response activities. This may include:
 - Transportation of equipment, supplies, and personnel.
 - Fuel costs.
 - Storage and warehousing fees.
 - Communication costs.

6.2.4 Plan Review and Updates

Regularly review and update the action plan throughout the year to reflect changing needs, budget adjustments, and lessons learned from drills or real-world events.

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STAGE 4

RESPONSE

STAGE 4: RESPONSE

7.1 Module 6: Emergency Classification

This module outlines the criteria for categorizing emergencies and response protocols.

1. **Emergency Levels:** Define different levels of emergencies based on severity, potential impact, and required response.
2. **Triggers for Escalation:** Establish clear criteria for escalating an incident to a higher level.

7.1.1 Emergency Identification

It is crucial to identify and classify emergencies to ensure a prompt and appropriate response based on the severity of the incident.

The following factors can indicate an impending emergency.

- **Deviations in Water Quality**
 - **Contamination Events:** Sudden spikes in contaminant levels can signal a breach in treatment protocols or a source water contamination event. This necessitates immediate investigation and corrective actions.
 - **Physical or Chemical Changes:** Significant changes in readily available parameter readings of conductivity, TDS and free chlorine can indicate malfunctioning treatment equipment or disruptions in the water source. These deviations require prompt investigation to ensure water quality meets safety standards.
- **Issues in Infrastructure**
 - **Leaks and Breaks:** Reports of leaks, pipe bursts, or unusual noises from facilities can indicate structural problems that, if left unaddressed, could lead to service disruptions or contamination events.
 - **Cross Connections:** Unauthorized cross connections in the water network by consumers can compromise water quality and pose health risks to all the users of the water network.

- **System Pressure Fluctuations:** Sudden drops or surges in water pressure can signify infrastructure failures or problems with pumps and storage tanks. These require immediate attention to prevent disruptions and potential damage.
- **Environmental Threats**
 - **Wastewater Leakage Events:** Reports on wastewater leakage may indicate contamination of the environment considering the location and size of the leak.
 - **Alerts about Natural Disasters:** Alerts from Early warning systems about heavy rainfall, earthquakes, or droughts can pose significant risks to water sources and infrastructure.
- **Customer Complaints**
 - **Water Quality Concerns:** A rise in customer complaints about discolored water, unusual odors, or taste issues can indicate potential contamination or treatment problems.
 - **Service Disruptions:** Reports of low water pressure or complete service outages require immediate investigation to identify the cause and restore service as quickly as possible.

7.1.2 Emergency Levels / Triggers for Escalation

The criteria used to define the emergency levels must be based on the following factors.

- Level of damage to equipment and infrastructure.
- Resource requirements and their availability.
- Size of the area and population affected.
- Anticipated duration of service disruption.
- Cascading effects and potential for quick escalation of the situation.
- Potential for environmental contamination and ecological damage.
- Risk to public health and safety.
- Regulatory violations such as exceeding permitted levels.
- Need for external assistance.

Table 21: Suggested Emergency Level Identification System

COLOUR	NAME	CRITERIA	AGENCIES RESPONSIBLE
	Level 1: Minor	<ul style="list-style-type: none"> Minor equipment failure or small-scale disruptions Limited impact on service delivery Can be managed by on-duty staff without external assistance Less than 1% of the population effected and/or lasts for a period shorter than 12 hours 	<ul style="list-style-type: none"> Utility
	Level 2: Moderate	<ul style="list-style-type: none"> Moderate equipment failure or localized service disruptions Potential for service interruption Requires mobilization of additional internal resources Less than 25% of the population effected and/or lasts for a period longer than 12 hours 	<ul style="list-style-type: none"> Utility Island Council
	Level 3: Major	<ul style="list-style-type: none"> Significant equipment failure or widespread service disruptions Immediate risk to public health or safety Requires external assistance and activation of Emergency Operations Plan More than 50% of the population affected and/or lasts for a period longer than 24 hours 	<ul style="list-style-type: none"> Utility Island Council NDMA, MNDF, FRS, Police, MRC EPA HPA
	Level 4: Disaster	<ul style="list-style-type: none"> Extensive equipment failure or complete service disruption Severe and prolonged impact on public health and safety No alternative water and sanitation options available Full activation of emergency operations and coordination with national emergency services All of the population affected and/or lasts for a period longer than 7 days. 	<ul style="list-style-type: none"> Utility Island Council NDMA, MNDF, FRS, Police, MRC Ministry of Tourism and Environment EPA HPA
	Level 0: All Clear	<ul style="list-style-type: none"> All Clear. Cancellation of warning 	<ul style="list-style-type: none"> Utility

7.2 Module 7: Emergency Operations Plans

An Emergency Operations Plan (EOP) is a vital document that outlines a response strategy to various emergencies. It serves as a roadmap for swift and coordinated action to minimize disruptions, protect public health, and ensure a rapid recovery. EOPs will be further aided by new or existing Standard Operating Procedures (SOPs) detailing the procedures to address disruptions. These SOPs will outline specific procedures for addressing disruptions, such as pipe repair, panel repair, pump repair, and other relevant scenarios.

An EOP is important for:

- **Preparedness:** EOP ensures that the utility is prepared to handle a wide range of emergencies, from natural disasters to infrastructure failures and contamination events.
- **Effective Response:** A well-defined plan outlines clear roles and responsibilities for personnel, communication protocols, and procedures for containment, mitigation, and restoration. This fosters a coordinated and efficient response during emergencies.
- **Minimize Disruptions:** A proactive EOP helps minimize service disruptions and potential health risks associated with emergencies.
- **Faster Recovery:** By outlining clear recovery steps, an EOP facilitates a quicker return to normal operations after an emergency.

Table 22: Suggested Contents of an Emergency Operations Plan

COMPONENT	OUTLINE
Triggers	The specific events or conditions that will initiate an emergency response, with reference to Section 7.1.
Initial Response	The immediate actions taken upon recognizing a trigger event. This includes: <ul style="list-style-type: none">• Activating the Emergency Response Team: Assembling a designated team of personnel with expertise in operations, maintenance, and public communication.• Situational Assessment: Gathering information about the nature and extent of the emergency to determine the appropriate response strategy.• Securing the Water Source: If there's a risk of contamination, isolating the affected area to prevent further spread of contaminants.

Public Notification	<p>The protocol for informing the public about the emergency. This includes:</p> <ul style="list-style-type: none"> • Developing Public Messages: Crafting clear, concise, and accurate information about the situation, potential health risks, and any necessary precautions. • Dissemination Channels: Identifying various communication channels to reach the public, such as local media outlets, social media platforms, emergency alert systems, and a designated public information hotline.
Communication with Stakeholders	<p>The communication plan for coordinating with key stakeholders during an emergency. This includes:</p> <ul style="list-style-type: none"> • Internal Communication: Maintaining open communication channels within the utility/WSEP Team, ensuring everyone is informed and understands their roles. • External Communication: Coordinating with public officials, emergency response agencies, and other utilities for support and resource sharing, if necessary.
Corrective Actions	<p>The specific actions taken to address the emergency and mitigate its impact. This includes:</p> <ul style="list-style-type: none"> • Containment Measures: Implementing procedures to isolate the problem and prevent further contamination or damage. • Repair and Restoration: Mobilizing resources and personnel to repair damaged infrastructure or treatment equipment. • Water Quality Testing: Increasing the frequency and scope of water quality testing to ensure safety standards are met before resuming normal operations. • Infrastructure Monitoring: Closely monitoring critical infrastructure (pipes, pumps) for any signs of further problems.
Recovery Plan	<p>The roadmap for restoring normal operations after an emergency. This includes:</p> <ul style="list-style-type: none"> • Infrastructure Repairs: Prioritizing and repairing damaged infrastructure. • Water Quality Testing: Conducting extensive water quality testing to ensure safety before resuming normal operations. • Public Communication: Providing the community with updates on the recovery progress and rescinding any precautions (e.g., boil water advisories) once the water is safe to consume.

Proactive planning is key to ensuring the smooth operation of the utility and the safety of the community it serves. From fires and droughts to water disruptions and infrastructure failures, a well-crafted EOP outlines clear steps for a coordinated response. By outlining these procedures beforehand, the utility can minimize service interruptions, protect public health, and ensure a swift recovery from any emergency.

The following sections provide a general framework, focusing on key considerations for each emergency type. This provides an overview for the utilities to develop their EOPs, but the actual EOP document will be much more detailed and specific to each utility's geographical location, size, infrastructure, resources, etc. The overview provided are examples of emergency types and actual types may not only be limited to these.

Fires

- **Triggers:** Fire alarms, reports of a fire at a critical facility (treatment plant, pumping station).
- **Initial Response:** Evacuate personnel, if necessary, activate fire suppression systems, and call emergency services.
- **Public Notification:** Inform the public about the situation and potential service disruptions through established channels (media, social media).
- **Communication:** Maintain clear communication within the team and with emergency responders such as Fire and Rescue, for coordinated action.
- **Corrective Actions:** Extinguish the fire, assess damage, and initiate repairs to restore service as quickly as possible.
- **Recovery Plan:** Evaluate infrastructure damage, prioritize repairs, and develop a timeline for resuming normal operations.

Dry Season

- **Triggers:** Low water levels in drinking water reservoirs, extended periods of low rainfall, government-issued water restrictions.
- **Initial Response:** Implement water conservation measures within the utility and encourage public water conservation efforts.
- **Public Notification:** Inform the public about the drought situation, water conservation tips, and potential restrictions.
- **Communication:** Coordinate with local authorities and public officials to share updates and plan water allocation strategies.
- **Corrective Actions:** Explore alternative water sources (e.g., desalination plants, inter-system transfers) if necessary.
- **Recovery Plan:** Monitor water levels, adjust conservation measures based on changing conditions, and develop a long-term drought mitigation plan.

Flooding

- **Triggers:** Weather forecasts predicting heavy rainfall, flood warnings issued by authorities, reports of rising water levels near critical infrastructure.
- **Initial Response:** Secure and relocate equipment at risk of flooding, activate backup power systems if available.
- **Public Notification:** Warn the public about potential flooding risks and advise them to take necessary precautions.
- **Communication:** Coordinate with emergency responders and monitor flood waters to assess potential threats to infrastructure.
- **Corrective Actions:** If necessary, shut down treatment plants or pumping stations to prevent damage.
- **Recovery Plan:** Inspect and repair flood damage to infrastructure, conduct water quality testing before resuming operations.

Water Disruption for More Than 24 Hours

- **Triggers:** Major pipe breaks, equipment malfunctions affecting essential systems.
- **Initial Response:** Identify the cause of the disruption, isolate the affected area if possible, and assess repair needs.
- **Public Notification:** Inform the public about the water disruption, estimated duration, and alternative water sources (e.g., bottled water distribution points).
- **Communication:** Coordinate with relevant authorities and public officials to manage the situation.
- **Corrective Actions:** Mobilize technicians to repair the issue and restore service as quickly as possible.
- **Recovery Plan:** Investigate the cause of the disruption, implement preventative measures to minimize future occurrences, and communicate service restoration to the public.

Drinking Water Contamination

- **Triggers:** Detection of harmful bacteria or chemicals, exceeding contaminant levels, reports of potential contamination events.
- **Initial Response:** Immediately isolate the affected area, initiate increased water quality testing, and activate the emergency response team.
- **Public Notification:** Issue a boil water advisory or other public health warnings as needed, advising the public on necessary precautions.
- **Communication:** Coordinate with public health officials to investigate the source of contamination and develop a remediation plan.
- **Corrective Actions:** Identify and address the source of contamination, implement treatment measures to ensure water safety.
- **Recovery Plan:** Conduct extensive water quality testing until safety standards are met, lift boil water advisories, and communicate clear information to the public.

Leakage of Wastewater

- **Triggers:** Reports of sewage spills, overflows from sewerage systems, detection of leaks in wastewater collection lines.
- **Initial Response:** Contain the leak to minimize environmental impact, notify relevant authorities, and mobilize cleanup crews.
- **Public Notification:** Inform the public about the situation, potential health risks, and any necessary precautions (e.g., avoiding contact with contaminated areas).
- **Communication:** Coordinate with public health officials to assess the extent of contamination and develop a containment plan.
- **Corrective Actions:** Repair the leak in the wastewater system as quickly and safely as possible.
- **Recovery Plan:** Monitor the affected area for any lingering contamination, implement disinfection procedures as needed, and ensure proper disposal of collected wastewater.

Power Outage Disrupting Water and Sewerage Services

- **Triggers:** Widespread power outages impacting critical utility infrastructure (treatment plants, pumping stations).
- **Initial Response:** Assess the extent of the power outage and activate backup power systems if available.
- **Public Notification:** Inform the public about the power outage, potential service disruptions (water pressure, sewer backups), and estimated restoration timeline.
- **Communication:** Coordinate with local authorities and power companies to get updates on the outage situation.
- **Corrective Actions:** Implement alternative measures to maintain water pressure (e.g., gravity flow in certain areas) and prioritize critical sewer system functions.
- **Recovery Plan:** Monitor power restoration efforts, adjust operations accordingly, and ensure a smooth transition back to normal operations.

Vandalism

- **Triggers:** Vandalism to utility infrastructure (pipes, pumping stations, treatment facilities).
- **Initial Response:** Secure the area, contact law enforcement, and assess the extent of the damage.
- **Public Notification:** Inform the public about the vandalism incident, potential service disruptions, and the ongoing investigation.
- **Communication:** Coordinate with law enforcement to investigate the vandalism and apprehend the perpetrators.
- **Corrective Actions:** Mobilize crews to repair the damage and restore service as quickly as possible.
- **Recovery Plan:** Evaluate the vulnerability of infrastructure to vandalism, consider security measures (fencing, alarms), and report the incident to relevant authorities.

7.3 Module 8: Crisis Communication Plan

This module outlines key components of a crisis communication plan. An effective crisis communication defines clear protocols for communication before, during, and after emergencies. To formulate this plan:

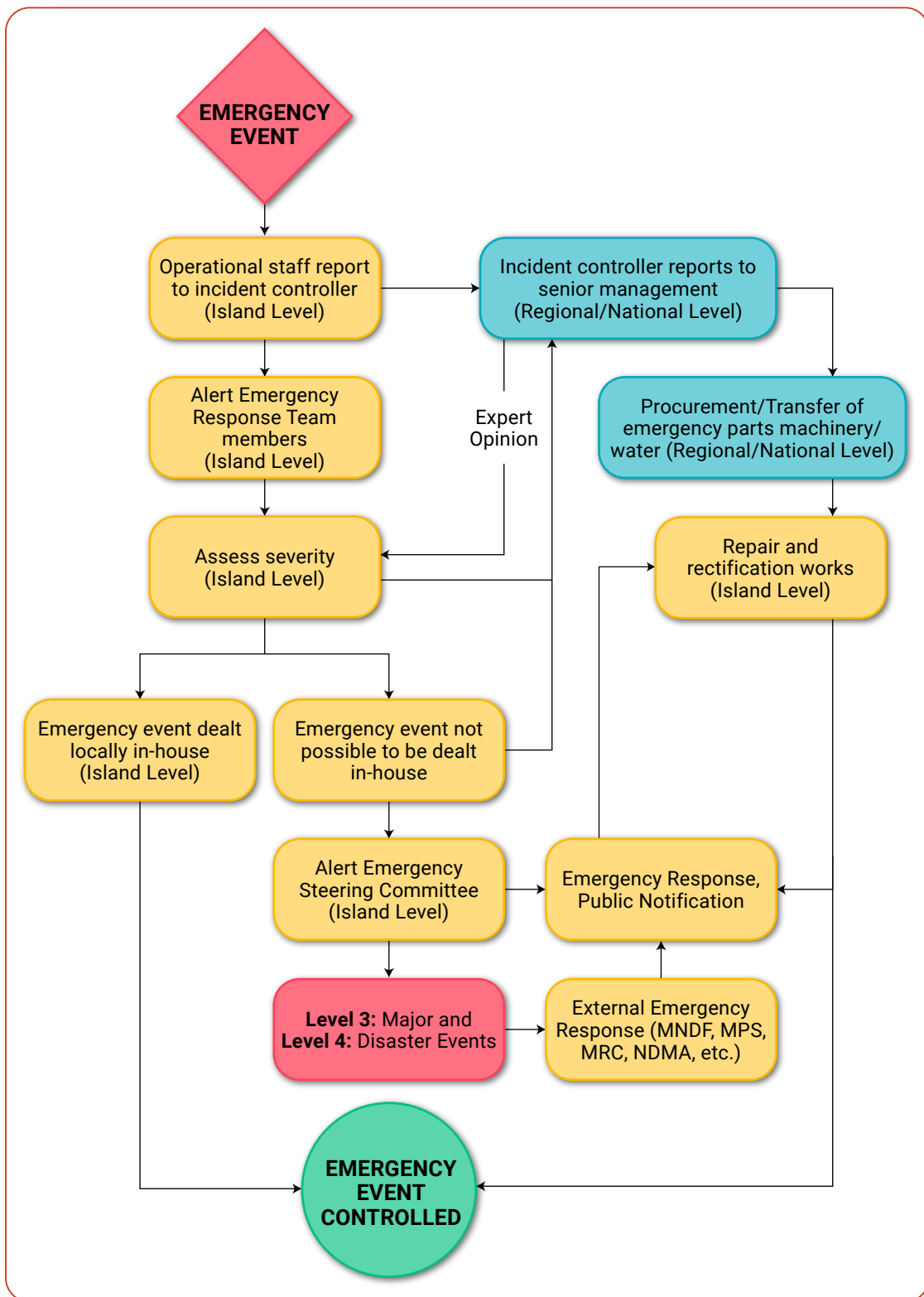
- **Before an Emergency:** Develop pre-written press releases and social media messaging templates to facilitate a swift response.
- **During an Emergency:** Establish a chain of command for the flow of information within an organization during a crisis.
- **After an Emergency:** Develop a communication strategy to keep the public informed about recovery efforts and timelines including the declaration after the end of an emergency.

7.3.1 Communication Flow Chart

The communication flow chart shall cover the following protocols:

- **Incident Identification and Assessment:** Procedures for identifying and assessing the nature, severity, and potential impact of a crisis. Certain stakeholders may need to be informed based on the emergency. Such as in case of oil spills or pollution related cases, EPA should be informed.
- **Response Team Activation:** Guidelines for assembling Emergency Response Team, which should include representatives from key departments and external response partners depending on the severity of the emergency (e.g., operations, procurement, logistics, etc.).
- **Media Relations:** Procedures for engaging with media outlets, conducting media briefings, and providing timely and accurate information.
- **Public Information:** Guidelines for disseminating information to the public through various channels, such as social media, emergency alert systems, and traditional media.

Figure 7: Sample Crisis Communication Plan



7.3.2 Public Notification

It is crucial to establish preferred methods for public notification during emergencies, considering factors like:

- **Accessibility:** Reach a broad audience through a mix of channels (e.g., local media outlets, social media platforms) to ensure everyone receives critical information.
- **Severity of the Emergency:** Utilize the most effective channels for the specific situation. For widespread emergencies, emergency alert systems may be necessary, while social media updates may suffice for localized issues.
- **Timeliness:** Choose channels that allow for quick dissemination of information during critical situations.

Table 23: Example for Modalities for Public Notification

Example for Modalities for Communication and Public Notification

- **Emergency Alert Systems:** For widespread emergencies, consider using emergency alert systems (EAS) or similar technologies to broadcast urgent messages directly to mobile devices and other electronic devices. These systems can provide immediate notifications to a large portion of the population. This can be an integration of existing billing messaging systems of some utilities.
- **Media Outlets:** Partner with radio and television stations to disseminate emergency information through news broadcasts and public service announcements. These outlets have a wide reach and can provide detailed updates and instructions.
- **Social Media Platforms:** Utilize popular social media platforms (e.g., Facebook, X, Viber) to share information and updates in real-time. These platforms can be effective for providing targeted messages.
- **Community Bulletin Boards:** Post important information on community bulletin boards and public notice boards to reach those who may not have access to electronic communication.
- **Direct Contact:** Develop strategies to reach users, through direct contact via community meetings or partnerships with community organizations.

7.4 Module 9: Business Continuity Plan

A Business Continuity Plan (BCP) is essential for any utility, going beyond the immediate response actions outlined in the WSEP. While the WSEP focuses on the technical aspects of managing a specific emergency (e.g., infrastructure repair, contamination mitigation), the BCP ensures the continued operation of all essential business functions across the entire utility during any disruptive event. This comprehensive approach minimizes disruptions and maintains service to the community regardless of the location or nature of the incident.

The BCP addresses the continuity of core business activities, such as payroll, customer service, critical system maintenance, and administrative functions. It is a complete, standalone document developed and implemented at the utility-wide level, not for individual island branches. This contrasts with the WSEP, which may address specific incidents and could have localized components.

For example, a power outage impacting a treatment plant on one island would trigger the WSEP, guiding the local team in restoring power or implementing alternative water flow measures. However, the utility-wide BCP would simultaneously ensure that critical business functions like billing, customer communication, and regulatory reporting continue uninterrupted, regardless of the outage's location. The BCP provides a framework for maintaining these essential services even if specific branches or facilities are directly affected by the emergency.

By implementing both a utility-wide BCP and an WSEP that may have localized components, the utility creates a comprehensive emergency preparedness strategy. This strategy safeguards public health through the WSEP's focus on emergency response, while the BCP ensures the utility's continued ability to function effectively and serve its customers during any crisis, regardless of scale or location.

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STAGE 5

RECOVERY

STAGE 5: RECOVERY

8.1 Module 10: Emergency Recovery

Following an emergency, the focus shifts towards restoring normal water and sewerage services as swiftly and safely as possible. This module outlines key recovery procedures and highlights the importance of post-emergency reporting and evaluation for continuous improvement.

8.1.1 Development of Recovery Procedures

Establish clear procedures for restoring water and sewerage services after various emergency scenarios (e.g., power outages, equipment failures, contamination events). These procedures should outline:

- **Damage Assessment:** Protocols for evaluating the extent of damage to infrastructure and identifying priority areas for restoration.
- **Restoration Measures:** Detailed steps for repairing or replacing damaged equipment, restoring power to treatment plants, and resuming normal operations.
- **Water Quality Testing:** Procedures for ensuring water quality meets safety standards before resuming service.

8.2 Post-Emergency Reporting

Thorough post-emergency reporting is vital for several reasons:

- **Documentation:** Creates a clear record of the event, including its nature, impact, and response actions taken.
- **Response Effectiveness Assessment:** Allows for evaluation of the utility's response, identifying areas where procedures were effective and areas for improvement.
- **Regulatory Compliance:** May be required by regulatory agencies to ensure adherence to safety protocols and reporting standards.

Table 24: Suggested Template for Incident Report

INCIDENT DETAILS	Date of Incident: [Date]
	Time of Incident: [Time]
	Location: [Specific location of incident]
	Type of Incident: [e.g., water main break, sewage overflow, power outage]
	Incident Number: [Unique identifier]
INVOLVED PARTIES	Reporting Personnel: [Name and position]
	Responding Personnel: [Name and positions]
	External Agencies Involved: [e.g., Police, Fire Department, Health Department]
INCIDENT DESCRIPTION	Detailed Description of the Incident: A clear and concise account of what happened.
	Affected Areas: Specify the geographic area impacted by the incident.
	Number of People Affected: Estimate the number of individuals affected.
	Environmental Impact: Assess potential environmental damage.
RESPONSE ACTIONS	Initial Response: Describe the immediate actions taken upon incident detection.
	Emergency Procedures Activated: Specify which emergency procedures were implemented.
	Resources Deployed: List equipment, personnel and other resources utilized.
	Coordination with External Agencies: Outline communication and collaboration with external parties.
IMPACT ASSESSMENT	Infrastructure Damage: Assess damage to water or sewerage infrastructure.
	Service Disruptions: Describe the extent and duration of service interruptions.
	Public Health Impact: Evaluate potential health risks to the public.
	Economic Impact: Estimate financial losses due to the incident.

LESSONS LEARNED	Identify Areas for Improvement: Highlight weaknesses in response procedures.
	Recommended Corrective Actions: Suggest changes to prevent similar incidents.
ATTACHMENTS	Photographs, diagrams or other relevant documentation.

8.3 Lessons Learnt and Response Evaluation

Following an emergency, a structured evaluation process should be undertaken to identify lessons learned and assess the effectiveness of the WSEP. This may involve:

- **Debriefing Sessions:** Conducting facilitated discussions with personnel involved in the response to gather first-hand accounts and identify areas for improvement.
- **Data Analysis:** Evaluating data collected during the emergency, such as response times, resource allocation, and communication effectiveness.
- **Reviewing Reports:** Analyzing post-emergency reports to identify trends and areas where procedures or training need to be revised.

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ANNEX

Water and Sewerage Emergency Plan Template

WATER AND SEWERAGE EMERGENCY PLAN TEMPLATE



World Health
Organization
Maldives



Ministry of Tourism
and Environment



ESPLAN

Table 1: Details of WSEP Updates Overtime

VERSION	DATE	CHANGES	AUTHOR(S)
1	[Date]	Initial Draft	[Your Name]

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1 Company Profile

- **Description:** A brief overview of the utility's operations, including its services, customers, and geographic coverage.
- **Organizational Structure:** The hierarchical structure of the utility, outlining the roles and responsibilities of different departments and personnel.
- **Geographical Location:** The specific areas served by the utility, including the number of islands and the population served. Details of the particular area being focused in this Water and Sewerage Emergency Plan (WSEP).

2 Objectives

The primary objectives of this WSEP are to:

1. **Operational Continuity:** Maintaining uninterrupted water and sewage services during emergencies.
2. **Impact Mitigation:** Reducing the financial, environmental, and infrastructural consequences of emergencies.
3. **Effective Communication:** Establishing clear internal and external communication channels.
4. **Swift Restoration:** Implementing rapid service recovery strategies to minimize disruptions.
5. **Regulatory Compliance:** Adhering to all relevant emergency preparedness and response standards.

3 Scope

This WSEP aims to address the potential impacts of various hazards on the water and sewerage system, including:

- **Disruption of water and sewerage services:** Interruptions in water supply or sewage service.
- **Contamination of water and sewage:** Introduction of harmful substances into the water or sewage systems.
- **Damage to infrastructure:** Physical damage to water and sewerage facilities.

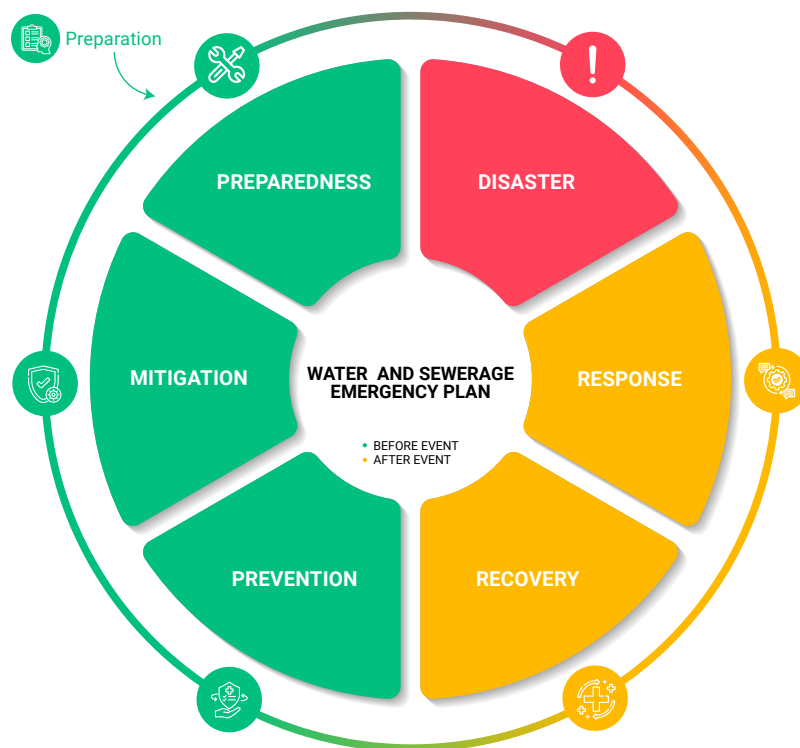
The WSEP covers a wide range of emergencies, including:

- **Natural disasters:** Cyclones, floods, tsunamis, earthquakes, droughts, and other climate-related events.
- **Infrastructure failures:** Equipment failures, power outages, water shortages, and communication disruptions.
- **Human-made hazards:** Chemical spills, fires, explosions, vandalism, terrorism, and other intentional or accidental acts.
- **Biological hazards:** Waterborne diseases, infectious diseases, and biological contamination.

4 Water and Sewerage Emergency Plan

This is a document that outlines strategies, resources, plans, and procedures for responding to emergencies that threaten the water and sewerage system. This plan encompasses five key stages (Figure 1): Prevention, Mitigation, Preparedness, Response and Recovery.

Figure 1: Components of WSEP



5 Stage 1: Preparation

The objective of this step is to:

1. Obtain and allocate resources for the development and implementation of WSEP.
2. Form a multi-disciplinary planning team for emergency preparedness and response.
3. Involve key stakeholders, such as government agencies, community representatives, and NGOs, in the WSEP development process.

5.1 WSEP Team

The response coordination teams will consist of three main components defined at a regional/national level and the island level.

1. **Utility-WSEP Coordination Team (Regional/National Level):** This team will be responsible for providing strategic direction, allocating resources, and ensuring organizational commitment.
2. **Utility-WSEP Team (Island Level):** This team will be responsible for implementing the WSEP at the island level.
3. **WSEP Steering Committee:** This committee is a high-level body responsible to oversee the development and implementation of the WSEP.

Figure 2: WSEP Response Coordination Flow Diagram

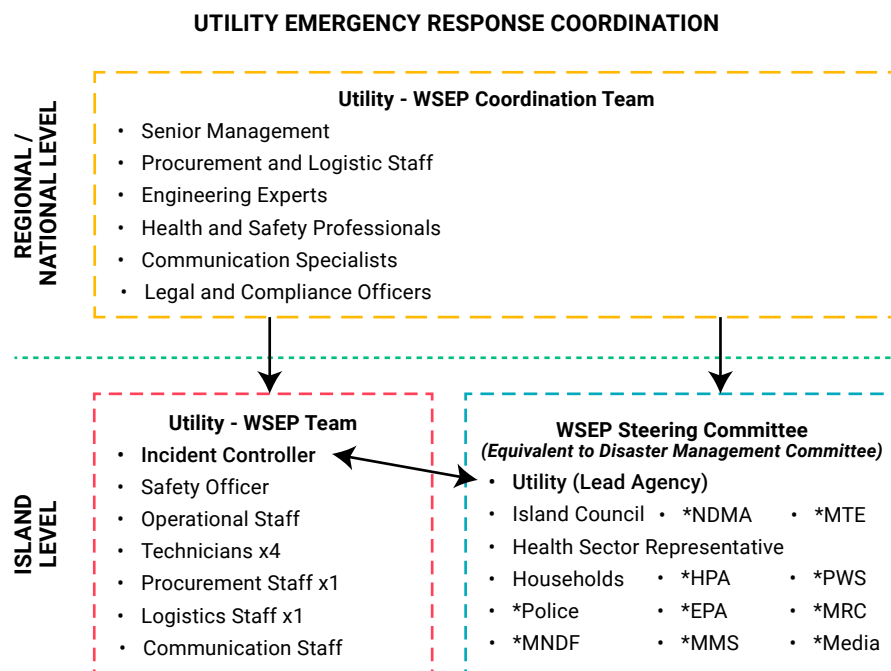


Table 2: Utility-WSEP Coordination Team (Regional/National Level) Members

FOCAL POINT NAME	DESIGNATION	CONTACT INFORMATION	ROLE IN WSEP (Examples)
[Name]	[Designation]	[Contact no.]	Senior Management
[Name]	[Designation]	[Contact no.]	Engineering Experts
[Name]	[Designation]	[Contact no.]	Health and Safety Professionals
[Name]	[Designation]	[Contact no.]	Communication Specialist
[Name]	[Designation]	[Contact no.]	Legal and Compliance Officer
[Name]	[Designation]	[Contact no.]	Procurement Staff
[Name]	[Designation]	[Contact no.]	Logistic Staff

Table 3: Utility-WSEP Coordination Team (Island Level) Members

FOCAL POINT NAME	DESIGNATION	CONTACT INFORMATION	ROLE IN WSEP (Examples)
[Name]	[Designation]	[Contact no.]	Incident Controller
[Name]	[Designation]	[Contact no.]	Safety Officer
[Name]	[Designation]	[Contact no.]	Operational Staff
[Name]	[Designation]	[Contact no.]	Technician
[Name]	[Designation]	[Contact no.]	Procurement Staff
[Name]	[Designation]	[Contact no.]	Logistic Staff
[Name]	[Designation]	[Contact no.]	Public Information Officer

Table 4: WSEP Steering Committee Members

STAKEHOLDER / AGENCY (Examples)	FOCAL POINT NAME / DESIGNATION	CONTACT INFORMATION	ROLE IN WSEP
Utility	[Name] / [Designation]	[Contact no.]	[Lead Agency]
Island Councils	[Name] / [Designation]	[Contact no.]	[Supporting Agency]
Households	[Name] / [Designation]	[Contact no.]	[Users]
Maldives Police Service	[Name] / [Designation]	[Contact no.]	[Supporting/Law Enforcement Agency]
Health Center	[Name] / [Designation]	[Contact no.]	[Supporting Agency]
Fire and Rescue Service	[Name] / [Designation]	[Contact no.]	[Supporting/Response Agency]
Maldives National Defense Force	[Name] / [Designation]	[Contact no.]	[Supporting/Response Agency]
Maldives Red Crescent	[Name] / [Designation]	[Contact no.]	[Supporting/Response Agency]
Local NGO	[Name] / [Designation]	[Contact no.]	[Supporting Agency]
Ministry of Tourism and Environment	[Name] / [Designation]	[Contact no.]	[Supporting Agency]

**Include organization chart of Emergency Response Team*

5.2 System Description

This step is an in-depth assessment which will inform subsequent risk assessment and mitigation strategies.

- 1. System Mapping:** Create a detailed representation of the water and sewerage infrastructure, including sources, treatment facilities, distribution networks, and disposal points.
- 2. System Performance Evaluation:** Collect quantitative baseline data on system performance, such as flow rates, water quality parameters, and treatment efficiency.
- 3. Gap Analysis:** Identify deficiencies in the system, such as inadequate capacity, outdated infrastructure, or insufficient emergency response procedures.

5.2.1 System Mapping - Water Service

The water treatment plant has the following specifications.

Table 5: Water Treatment Plant Specifications

DESCRIPTION	TREATMENT PLANT ONE	TREATMENT PLANT TWO
Date Established	[Date]	[Date]
Make / Model	[Brand / Model/ Contractor]	[Brand / Model/ Contractor]
Capacity (m ³ /day)	[Production in 20 Hours]	[Production in 20 Hours]
Feed Tank (m ³)	[m ³ / NA]	[m ³ / NA]
Pretreatment Method	[Sand Filter / Multimedia Filter] [Cartridge Filter / Bag Filter]	[Sand Filter / Multimedia Filter] [Cartridge Filter / Bag Filter]
Number of RO Vessels	[Value]	[Value]
Number of RO Membranes	[Value]	[Value]
Disinfection Method	[UV / Chlorine / Ozone]	[UV / Chlorine / Ozone]
Distribution Method	[Overhead Tanks / Booster Pumps]	[Overhead Tanks / Booster Pumps]

Water Source

The raw/feed water used for the water service has the following properties.

Number of sources: *[Number of sources]*

Table 6: Raw/Feed Water Properties (URA, 2021)

DESCRIPTION	SOURCE ONE	SOURCE TWO
Intake Method	[Borehole / Seawater]	[Borehole / Seawater]
Depth of Source (m)	[Depth]	[Depth]
Diameter of Borewell / Intake (mm)	[Diameter]	[Diameter]

Date of Drilling	[Date]	[Date]
GPS Coordinates	[Coordinates]	[Coordinates]
WATER QUALITY - PHYSICAL PARAMETERS		
Visual Appearance - Colour if any	[Observation]	[Observation]
Turbidity (NTU)	[Value]	[Value]
Temperature (°C)	[Value]	[Value]
pH	[Value]	[Value]
WATER QUALITY - CHEMICAL PARAMETERS		
Total Dissolved Solids (mg / L)	[Value]	[Value]
E. Conductivity (µS / cm)	[Value]	[Value]
Calcium Hardness (mg / L)	[Value]	[Value]
Magnesium Hardness (mg / L)	[Value]	[Value]
Boron (mg / L)	[Value]	[Value]
Phosphate (mg / L)	[Value]	[Value]
Sulphate (mg / L)	[Value]	[Value]
Iron (mg / L)	[Value]	[Value]
Chloride (mg / L)	[Value]	[Value]
Fluoride (mg / L)	[Value]	[Value]
Nitrates (mg / L)	[Value]	[Value]
Ammonia (mg / L)	[Value]	[Value]
Sulfate (mg / L)	[Value]	[Value]
Lead (mg / L)	[Value]	[Value]

Water Treatment

The following treatment processes are carried out in the water treatment with the provided baseline pressure and flow measurements.

Table 7: Baseline Flow Rate and Pressure of Water Treatment Stages (Edit as per Actual Process)

STAGE <i>(Measured / Read from Flow Meters and Pressure Gauges in the Plant)</i>	TREATMENT PLANT ONE		TREATMENT PLANT TWO	
	FLOW (m ³ /hr)	PRESSURE (BAR)	FLOW (m ³ /hr)	PRESSURE (BAR)
Feed	[Value]	[Value]	[Value]	[Value]
Sand Filter / Multi-media Filter Inlet	[Value]	[Value]	[Value]	[Value]
Sand Filter / Multi-media Filter Outlet	[Value]	[Value]	[Value]	[Value]
Bag Filter / Cartridge Filter Inlet	[Value]	[Value]	[Value]	[Value]
Bag Filter / Cartridge Filter Outlet	[Value]	[Value]	[Value]	[Value]
High Pressure Pump Inlet	[Value]	[Value]	[Value]	[Value]
Permeate	[Value]	[Value]	[Value]	[Value]
Reject	[Value]	[Value]	[Value]	[Value]
Chemical Dosing (Chlorine / Acid / Base / Antiscalant)	[Value]	[Value]	[Value]	[Value]
OTHER INDICATORS <i>(Read from Panel)</i>				
Grid Energy Consumption (kWh)	[Value]		[Value]	
Solar Energy Consumption (kWh)	[Value]		[Value]	
Running Hours (hr)	[Value]		[Value]	

Table 8: Baseline Performance of Water Treatment Stages

INDICATOR	TREATMENT PLANT ONE	TREATMENT PLANT TWO
Recovery (%)	[Flow Rate of Permeate / Flow Rate of Feed Water]	[Flow Rate of Permeate / Flow Rate of Feed Water]
Salt Rejection (%)	[Conductivity of Feed Water / Conductivity of Permeate]	[Conductivity of Feed Water / Conductivity of Permeate]
Sand Filter / Multi-media Pressure Drop (Bar)	[Sand Filter / Multi-media Filter Outlet - Inlet]	[Sand Filter / Multi-media Filter Outlet - Inlet]
Bag Filter / Cartridge Filter Pressure Drop (Bar)	[Bag Filter / Cartridge Filter Outlet - Inlet]	[Bag Filter / Cartridge Filter Outlet - Inlet]
Specific Energy Consumption - SEC (kWh/m ³)	[Energy Consumption (kWh/hr) / Permeate Flow Rate (m ³ /hr)]	[Energy Consumption (kWh/hr) / Permeate Flow Rate (m ³ /hr)]

Baseline water quality of permeate should be measured and recorded in Table 9.

Table 9: Permeate Baseline Quality (URA, 2022)

DESCRIPTION	TREATMENT PLANT ONE	TREATMENT PLANT TWO	URA STANDARD
WATER QUALITY - PHYSICAL PARAMETERS			
Visual Appearance - Colour if any	[Observation]	[Observation]	Clear
Turbidity (NTU)	[Value]	[Value]	<1 NTU
Temperature (°C)	[Value]	[Value]	NA
pH	[Value]	[Value]	6.5 - 8.5
WATER QUALITY - BIOLOGICAL PARAMETERS			
Total Coliform (CFU / 100ml)	[Value]	[Value]	0
Fecal Coliform (CFU / 100ml)	[Value]	[Value]	0
E.Coli (CFU / 100ml)	[Value]	[Value]	0
Total Viable Count at 22°C (CFU / 100ml)	[Value]	[Value]	100

Total Viable Count at 37°C (CFU / 100ml)	[Value]	[Value]	20
Enterococci (CFU / 100ml)	[Value]	[Value]	0
Salmonella Typhi (CFU / 100ml)	[Value]	[Value]	0
Shigella spp. (CFU / 100ml)	[Value]	[Value]	0
Vibrio Cholerae (CFU / 100ml)	[Value]	[Value]	0
WATER QUALITY - CHEMICAL PARAMETERS			
Free Chlorine (mg / L)	[Value]	[Value]	0.04 - 0.2
Total Dissolved Solids (mg / L)	[Value]	[Value]	<500
E. Conductivity (µS / cm)	[Value]	[Value]	<1000
Total Hardness (mg / L)	[Value]	[Value]	<75
Chlorides (mg / L)	[Value]	[Value]	<200
Nitrates (mg / L)	[Value]	[Value]	<50
Ammonia (mg / L)	[Value]	[Value]	<0.02 - 2.50
Iron (mg / L)	[Value]	[Value]	<0.3
Hydrogen Sulphide (mg / L)	[Value]	[Value]	0.05
Suspended Solids (mg / L)	[Value]	[Value]	5 - 750
Anionic Detergents (mg / L)	[Value]	[Value]	0.002 - 0.275
Arsenic (mg / L)	[Value]	[Value]	<0.01
Boron (mg / L)	[Value]	[Value]	<0.3
Bromine (mg / L)	[Value]	[Value]	0.05 - 4.50
Cadmium (mg / L)	[Value]	[Value]	<0.003
Calcium Hardness (mg / L)	[Value]	[Value]	<60

Chromium (mg / L)	[Value]	[Value]	<0.05
Copper (mg / L)	[Value]	[Value]	<2
Cyanide (mg / L)	[Value]	[Value]	<0.07
Fluoride (mg / L)	[Value]	[Value]	<1.5
Lead (mg / L)	[Value]	[Value]	<0.01
Manganese (mg / L)	[Value]	[Value]	0.1
Mercury (mg / L)	[Value]	[Value]	<0.001
Phenolic Compounds (mg / L)	[Value]	[Value]	0.002 - 0.2
Phosphate (mg / L)	[Value]	[Value]	<5
Potassium (mg / L)	[Value]	[Value]	0 - 50
Sodium (mg / L)	[Value]	[Value]	<200
Sulphate (mg / L)	[Value]	[Value]	<250
Total Petroleum Hydrocarbon (mg / L)	[Value]	[Value]	0

In addition to the above detail's critical components of the treatment plant can be listed and tabulated for easy troubleshooting and replacement works in case of emergency. These details are provided in Table 10 below.

Table 10: Critical Components in the Treatment Plant and Their Specifications (Edit as per Actual Process)

COMPONENT	BRAND	MODEL	SIZE (kW)	CONDITION
Borehole Pump	[Brand]	[Model]	[kW]	[Good / Damaged]
Feed Pump	[Brand]	[Model]	[kW]	[Good / Damaged]
RO High Pressure Pump 1	[Brand]	[Model]	[kW]	[Good / Damaged]

RO High Pressure Pump 2	[Brand]	[Model]	[kW]	[Good / Damaged]
Energy Recovery Pump	[Brand]	[Model]	[kW]	[Good / Damaged]
Transfer Pump	[Brand]	[Model]	[kW]	[Good / Damaged]
Dosing Pump	[Brand]	[Model]	[kW]	[Good / Damaged]
CIP Pump	[Brand]	[Model]	[kW]	[Good / Damaged]
Washing Pump	[Brand]	[Model]	[kW]	[Good / Damaged]
Degasifier Blower	[Brand]	[Model]	[kW]	[Good / Damaged]
Distribution Pump	[Brand]	[Model]	[kW]	[Good / Damaged]
Outfall Pump	[Brand]	[Model]	[kW]	[Good / Damaged]

Water Distribution Network

Insert or Annex detailed drawings of water distribution network. This should include maps of the pipeline, zonal isolation valve locations, washout valve locations, location of storage tanks, pumps and booster stations. Pipe material, diameter, age, length, network map, pressure zones, hydrant locations should be included.

(These drawings are normally provided by contractors or developers of the system. In case they are unavailable, it is important to prepare them for emergency preparedness, troubleshooting, operation and maintenance.)

Table 11: Storage Tank Details

TANK DETAILS	TANK CAPACITY (m³)	LOCATION	TYPE / BRAND	DATE INSTALLED	CONDITION
Storage Tank 1	[Value]	[Location]	[Type / Brand]	[Date]	[Condition]
Storage Tank 2	[Value]	[Location]	[Type / Brand]	[Date]	[Condition]
Rainwater Storage Tank 1	[Value]	[Location]	[Type / Brand]	[Date]	[Condition]
Rainwater Storage Tank 2	[Value]	[Location]	[Type / Brand]	[Date]	[Condition]

Table 12: Daily Water Distribution and Demand Data

PARAMETER	AVERAGE DAILY VALUE
Daily Water Production (m³/day)	[Value]
Daily Water Distribution (m³/day)	[Value]
Estimated Peak Demand (m³/hour)	[Value]
Non-Revenue Water (NRW) Volume (m³/day)	[Value]
Non-Revenue Water (NRW) %	[Value]
Average Distribution Pressure (Bar)	[Value]

Consumer Details

Identify type of water users based on residential, commercial, public industrial, and agricultural water users. To identify critical infrastructure like hospitals and other critical consumption points.

Table 13: Details of Consumers in the Water Network

CONSUMER TYPE	NUMBER OF CONNECTIONS	NETWORK ZONE
Residential	[Value]	[Zone]
Commercial	[Value]	[Zone]
Harbour	[Value]	[Zone]
Industrial	[Value]	[Zone]
Agriculture	[Value]	[Zone]
PUBLIC / GOVERNMENT		
Schools	[Value]	[Zone]
Health Centers / Hospitals	[Value]	[Zone]
Offices	[Value]	[Zone]

5.2.2 System Mapping - Sewerage Service

The sewerage system has the following specifications. The sewerage system has [value] catchments.

Table 14: Sewerage System Specifications

DESCRIPTION	CATCHMENT ONE	CATCHMENT TWO
Date Established	[Date]	[Date]
Type	[Conventional Gravity / Vacuum / Smallbore]	[Conventional Gravity / Vacuum / Smallbore]
Number of Pump Stations	[Value]	[Value]
Number of Manholes	[Value]	[Value]

The sewerage waste has the following baseline characteristics based on water quality testing.

Number of sources: 2

Table 15: Wastewater Discharge Properties (URA, 2023)

DESCRIPTION	RAW WASTEWATER	TREATED WASTEWATER <i>(If Treatment is Available)</i>
Discharge Type	[Outfall / Groundwater Recharge / Reuse]	
Depth of Discharge (m)	[Depth]	
Diameter of Outfall (mm)	[Diameter]	
Date of Installation	[Date]	
Discharge Condition	[Good / Damaged]	
GPS Coordinates	[Coordinates]	
WATER QUALITY - PHYSICAL PARAMETERS		
Visual Appearance - Colour if Any	[Observation]	[Observation]
Turbidity (NTU)	[Value]	[Value]
Temperature	[Value]	[Value]
pH	[Value]	[Value]
WATER QUALITY - CHEMICAL PARAMETERS		
Fecal Coliforms (100 CFU / 100ml)	[Value]	[Value]
E. Coli 1 FCU / 100ml	[Value]	[Value]
Suspended Solids (mg / L)	[Value]	[Value]
Residual Chlorine (mg / L)	[Value]	[Value]

Nitrates as N (mg / L)	[Value]	[Value]
Free and Saline Ammonia as N (mg / L)	[Value]	[Value]
Ortho-phosphate as P (mg / L)	[Value]	[Value]
Surfactants (mg / L)	[Value]	[Value]
Total Dissolved Solids (mg / L)	[Value]	[Value]
E. Conductivity (µS / cm)	[Value]	[Value]
Soaps, Oils and Grease (Food Related) (mg / L)	[Value]	[Value]
Oil, Grease and Waxes (mg / L)	[Value]	[Value]
Chemical Oxygen Demand (mg / L)	[Value]	[Value]
Biological Oxygen Demand (mg / L)	[Value]	[Value]
Phenolic Compounds as Phenol (mg / L)	[Value]	[Value]
Sum of Metals (mg / L)	[Value]	[Value]

Sewerage Collection System

Insert or Annex detailed drawings of sewerage collection system. This should include maps of the gravity and pressure mains, pump stations, manholes, clean outs, location of treatment plants and discharge pump stations.

(These drawings are normally provided by contractors or developers of the system. In case they are unavailable, it is important to prepare them for emergency preparedness, troubleshooting, operation and maintenance.)

Table 16: Baseline Performance of Sewerage System (Calculated from Table 7 Values)

INDICATOR	CATCHMENT ONE	CATCHMENT TWO
Grid Energy Consumption (kWh)	[Value]	[Value]
Solar Energy Consumption (kWh)	[Value]	[Value]
Running Hours (hr)	[Value]	[Value]
Running Counter (nos)	[Value]	[Value]
Pump Flow Rate (m ³ /hr)	[Pump Flow Rate]	[Pump Flow Rate]
Average Wastewater Generation (m ³ /hr)	[(Pump Flow Rate * Pump Running Hours) / 24 Hours]	[(Pump Flow Rate * Pump Running Hours) / 24 Hours]
Retention Volume (m ³)	[Volume of Network (Pipes, Manholes, Catchpits) + Volume of Pump Stations]	[Volume of Network (Pipes, Manholes, Catchpits) + Volume of Pump Stations]
Retention Time	[Retention Volume / Wastewater Generation (m ³ /hr)]	[Retention Volume / Wastewater Generation (m ³ /hr)]

Wastewater Treatment Facilities

The wastewater treatment process is described in the Table 17 below.

Table 17: Wastewater Treatment Process

TREATMENT PROCESS	TREATMENT PLANT 1	TREATMENT PLANT 2
Primary Treatment	[Describe Process, e.g., Screening, Grit Removal]	[Describe Process]
Secondary Treatment	[Describe Process, e.g., Biological Treatment]	[Describe Process]
Tertiary Treatment	[Describe Process, e.g., Disinfection, Nutrient Removal]	[Describe Process]
Capacity	[Flow Rate in m ³ /day or Other Suitable Unit]	[Flow Rate]
Sludge Management	[Method, e.g., Sludge Thickening, Dewatering, Disposal]	[Method]
Effluent Disposal	[Method, e.g., Discharge to Sea, Groundwater Recharge, Reuse]	[Method]
Outfall Depth (m)	[Depth Value]	[Depth Value]

In addition to the above detail's critical components of the treatment plant can be listed and tabulated for easy troubleshooting and replacement works in case of emergency. These details are provided in Table 18 below.

Table 18: Critical Components in the Sewerage System and Their Specifications (Edit as per Actual Process)

COMPONENT	BRAND	MODEL	SIZE (kW)	CONDITION
Lifting Submersible Pump	[Brand]	[Model]	[kW]	[Good / Damaged]
Outfall Discharge Pump	[Brand]	[Model]	[kW]	[Good / Damaged]
Vacuum Pump	[Brand]	[Model]	[kW]	[Good / Damaged]
Transfer Pump	[Brand]	[Model]	[kW]	[Good / Damaged]
Sludge Pump	[Brand]	[Model]	[kW]	[Good / Damaged]

5.3 Gap Analysis

Identify the following in this section:

- **Capacity shortfalls:** Assess if the system can handle peak demand, future growth, and emergencies.
- **Infrastructure deterioration:** Evaluate the condition of pipes, pumps, and treatment plants.
- **Operational shortcomings:** Analyze procedures, maintenance, and staffing.
- **Regulatory compliance issues:** Ensure adherence to relevant standards.

This section can include long term historical demand of water of the island. Comparisons with current demand and current production of water for water systems. Also, comparison of running hours and running count overtime for sewerage systems and reports of overflows or sewer leaks to determine if there are any operational shortcomings in the sewer system operations.

6 Stage 2: Prevention and Mitigation

6.1 Hazard Identification, Risk Assessment and Control Measures

(This section focuses on identifying potential hazards, assessing associated risks, and evaluating existing control measures within the water and sewerage system. The goal is to prioritize high-risk areas and develop targeted mitigation and prevention strategies.)

6.1.1 Hazard Identification

(Identify and record the potential hazards in the water/sewerage system along with their exposure groups and routes. For each hazard, list down the potential impacts that maybe caused due to the hazard or hazardous event.)

Table 19: Hazard Identification

HAZARD	EXPOSURE GROUP	EXPOSURE ROUTE	POTENTIAL IMPACT

6.1.2 Risk Assessment

(For the above-mentioned hazards, use a risk assessment and evaluation tool to determine the risk posed by each hazard. You may use the method described in the Water and Sewerage Emergency Planning Guidebook. If another tool is utilized, describe the methodology including the assessment criteria in detail. Regardless of which methodology is followed, it is important to determine the likelihood and severity of each hazard and determine a risk score/level based on the evaluation.)

Table 20: Risk Assessment

HAZARD	LIKELIHOOD	SEVERITY	RISK VALUE	RISK LEVEL

6.1.3 Risk Prioritization

(Based on the risk levels determined from the risk assessment, highlight and rank the hazards that must be prioritized to ensure short-, medium- and long-term response strategies are planned and implemented to address them.)

6.1.4 Control Measures

(It is important to implement control measures for all identified tasks, but prioritize those with the highest overall risk.

Tailor control measures to the specific nature of each hazard and the unique circumstances of your utility. While it may not be feasible to completely eliminate all risks, focusing on high-risk hazards can help you allocate resources effectively and minimize potential damage. Hence, apply the following approach while determining preventive and mitigative control measures for the identified hazards.

- **High-risk hazards:** *Implement comprehensive control measures to reduce the likelihood and impact of these hazards.*
- **Medium-risk hazards:** *Implement reasonable control measures to mitigate risks and prevent them from escalating.*
- **Low-risk hazards:** *Implement basic control measures or monitor them closely to ensure they don't become more significant.*

Review your current practices and procedures to determine which control measures are already in place. This will assist in determining where additional control measures are needed to address identified hazards.)

Evacuation Plan and Assembly Points

(Include a map of the water/sewerage system identifying areas that may be at high risk during emergencies, such as areas near water sources, or areas with critical infrastructure. Identify safe and accessible evacuation routes from these vulnerable areas to designated assembly points.)

6.1.5 Residual Risk and Risk Acceptance

(Based on the risk assessment, the potential impacts and the existing control measures, determine the residual risk levels and the decision to accept the risk or not.)

Hazard Identification and Risk Assessment Register

(The HIRA register is a centralized repository for documenting all identified hazards, their associated risks, and the control measures implemented to mitigate them. This register is essential for effective risk management and emergency preparedness.)

Table 21: HIRA Register

HAZARD	EXPOSURE GROUP	EXPOSURE ROUTE	POTENTIAL IMPACT	EXISTING CONTROL MEASURES	LIKELIHOOD	SEVERITY	RISK VALUE	RISK LEVEL	ADDITIONAL CONTROL MEASURES	RESIDUAL RISK LEVEL	RISK ACCEPTANCE

Attach the completed HIRA register to the Appendix of the WSEP. This will serve as a valuable reference for emergency response teams and other stakeholders, providing a comprehensive overview of identified hazards, risks, and control measures.)

7 Stage 3: Preparedness

(This section focuses on proactive measures to enhance an organization's capacity to respond effectively to emergencies.)

7.1 Emergency Preparedness

7.1.1 Resource Management

- **Inventory Assessment**

(Attach the inventory of human, physical and financial resources available for emergency preparedness.)

- **Resource Acquisition**

(Record the additional resources that are required for emergency response and how they will be acquired.)

- **Equipment Maintenance**

(Describe how the emergency equipment is maintained by the utility.)

- **Supply Chain Management**

(Identify key suppliers and distribution channels and procurement methods to obtain essential materials and equipment to minimize service disruptions.)

- **Financial Planning**

(Describe how financial resources will be allocated for emergency preparedness including how funding will be secured.)

7.1.2 Training, Drills and Exercises

(Attach the annual training plan in the following format.)

Table 22: Emergency Preparedness and Response Trainings

PROGRAM	OBJECTIVES	TRAINERS	PARTICIPANTS	DURATION	FREQUENCY

7.1.3 Communication and Coordination

Communication Protocols

(Internal Stakeholders:

- **Emergency Response Team:** Outline the frequency of meetings, communication channels (e.g., phone, email, instant messaging), and procedures for decision-making and information sharing.
- **Employees:** Specify how employees will be notified of emergencies, the channels for receiving updates, and procedures for reporting incidents.
- **Management:** Define communication channels for management to receive updates and make critical decisions.

External Stakeholders:

- **Critical Customers:** Develop specific communication plans for hospitals, schools, and other key institutions, including emergency contact information, communication channels, and protocols for providing updates and assistance.
- **Community:** Outline how the public will be notified, such as through local media, social media, or public address systems.
- **Government Agencies:** Describe the procedures for coordinating with relevant government agencies, including communication channels, joint response plans, and mutual aid agreements.
- **Other Utilities:** Explain how the organization will coordinate with other utilities (e.g., electricity, gas) to ensure a coordinated response.)

Public Notification

- **(Channels:** Specify the communication channels to be used, such as local media, social media, emergency alert systems, and public address systems.
- **Key Messages:** Develop a list of key messages to be communicated during emergencies, including instructions, safety tips, and updates on the situation.
- **Frequency:** Determine the frequency of updates to the public based on the severity of the emergency.)

Emergency Contact Numbers

- **(Internal Stakeholders:** Provide a list of emergency contact numbers for key personnel within the organization, including the Emergency Response Team, department heads, and management.
- **External Stakeholders:** Include contact numbers for government agencies, hospitals, schools, commercial and industrial facilities, community leaders, and emergency responders.
- **Office Hours:** Specify whether contact numbers are available during office hours only or 24/7.
- **Emergency Hotlines:** If applicable, provide the phone numbers for dedicated emergency hotlines.)

7.1.4 Continuous Improvement

(Describe how the Emergency Response Plan will be reviewed and updated for improvement. The WSEP guidebook and template should be updated by the utilities on a timely manner, or when a major change is brought to a water or sewerage system.)

7.2 Annual Action Plan for WSEP Activities

(For all the control measures for the prioritized risks, and other WSEP activities that contribute to the emergency preparedness of the utility, prepare and attach the annual Action Plan in the following format.)

Table 23: Annual Action Plan for WSEP Activities

ACTIVITY / MEASURES	SPECIFIC TASKS	TIMELINE	RESOURCE REQUIREMENT	BUDGET	RESPONSIBLE PARTY

8 Stage 4: Response

(This section outlines the criteria for categorizing emergencies and the corresponding response protocols.)

8.1 Emergency Classification

Table 24: Emergency Level Identification System

COLOUR	NAME	CRITERIA	AGENCIES RESPONSIBLE
	Level 1: Minor	<ul style="list-style-type: none"> Minor equipment failure or small-scale disruptions Limited impact on service delivery Can be managed by on-duty staff without external assistance Less than 1% of the population effected and/or lasts for a period shorter than 12 hours 	<ul style="list-style-type: none"> Utility
	Level 2: Moderate	<ul style="list-style-type: none"> Moderate equipment failure or localized service disruptions Potential for service interruption Requires mobilization of additional internal resources Less than 25% of the population effected and/or lasts for a period longer than 12 hours 	<ul style="list-style-type: none"> Utility Island Council
	Level 3: Major	<ul style="list-style-type: none"> Significant equipment failure or widespread service disruptions Immediate risk to public health or safety Requires external assistance and activation of Emergency Operations Plan More than 50% of the population affected and/or or lasts for a period longer than 24 hours 	<ul style="list-style-type: none"> Utility Island Council NDMA, MNDF, FRS, Police, MRC EPA HPA
	Level 4: Disaster	<ul style="list-style-type: none"> Extensive equipment failure or complete service disruption Severe and prolonged impact on public health and safety No alternative water and sanitation options available Full activation of emergency operations and coordination with national emergency services All of the population affected and/or or lasts for a period longer than 7 days 	<ul style="list-style-type: none"> Utility Island Council NDMA, MNDF, FRS, Police, MRC Ministry of Tourism and Environment EPA HPA
	Level 0: All Clear	<ul style="list-style-type: none"> All Clear. Cancellation of warning 	<ul style="list-style-type: none"> Utility

8.2 Emergency Operation Plans

(For every potential emergency type, prepare an EOP in the following format.)

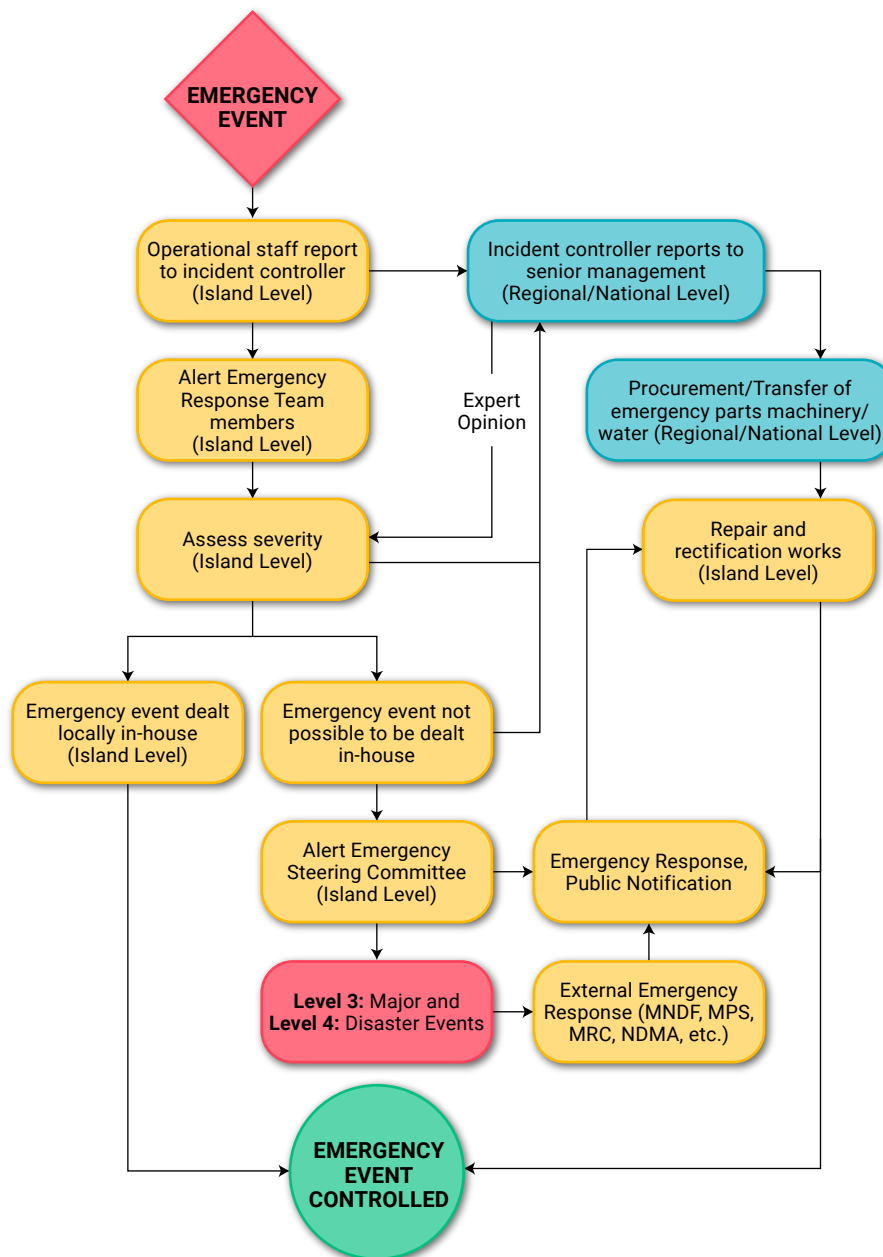
TYPE OF EMERGENCY
TRIGGERS
<i>(What will initiate an emergency response?)</i>
INITIAL RESPONSE
<i>(What are the immediate actions that needs to be taken?)</i>
PUBLIC NOTIFICATION
<i>(What and how will the public be notified?)</i>
COMMUNICATION WITH STAKEHOLDERS / EMERGENCY RESPONDERS
<i>(Which stakeholders and emergency responders will be communicated with to coordinate the response?)</i>
CORRECTIVE ACTIONS
<i>(What are the specific actions that will be taken to mitigate the impacts of the emergency?)</i>
RECOVERY PLAN
<i>(How will the normal operations be restored?)</i>

8.3 Crisis Communication Plan

8.3.1 Communication Flow Chart and Protocols

(Describe the crisis communication protocols that will be adopted during an emergency beginning from the notification of the emergency until the situation is under control.)

Figure 3: Crisis Communication Plan



8.3.2 Public Notification

(Attach emergency messages that have been prepared to be disseminated during an emergency. These messages shall provide clear and concise description of the emergency that has occurred, specific instruction and guidance, and contact information of the emergency services. Following is a sample of water advisory to be used in case of an emergency (CDC, 2022). These notifications must be provided in multiple languages.

BOIL WATER ADVISORY FOR (WATER SYSTEM LOCATION)
<p>[Date]</p> <p>FOR IMMEDIATE RELEASE</p> <p>Contact: [Name, Title, Phone, E-mail]</p> <p>[Water System] issues a boil water advisory for all customers in [location]</p> <p>[Water System] advises all customers to boil their drinking water. The boil water advisory is in effect until further notice.</p> <p>Customers should:</p> <ul style="list-style-type: none">• Fill a pot with water.• Heat the water until bubbles come quickly from the bottom of the pot to the top.• Keep heating the water for one more minute.• Turn off the heat source and let the water cool.• Pour water into a clean, sanitized container with a cover for storage. <p>Use bottled water or boiled water that has cooled for:</p> <ul style="list-style-type: none">• Drinking• Brushing teeth• Washing fruits and vegetables• Preparing food and baby formula• Making ice• Giving to pets <p>The advisory is in effect until [Water System] and [other agencies] are confident there is no longer a public health concern. We will provide the next update at [date or timeframe]. Customers will be notified immediately when the advisory is lifted.</p>

Tests results from [date] showed [contaminant] at [levels/amount]. The [primacy agency/health department] is working closely with [Water System] to find the contamination source and fix the problem.

To correct the problem, we are [what is being done (e.g., chlorine was applied to the entire system)].

[Give dates or time estimate for duration of the advisory, if possible]. [Number or No] illnesses related to the community's drinking water are reported.

If you are concerned about your health or your family, call your healthcare provider or the [local health department]. People at increased risk should seek advice about drinking water from their healthcare provider.]

Please share this information with all the other people who drink this water, especially those who may not have received this notice directly (for example, people in apartments, schools, and businesses).

For more information, residents should call the (Water System) office at _____, or the (other responsible agencies) _____.

Prepare similar templates for the scenarios including but not limited to:

- *DO NOT USE WATER advisory after contamination events*
- *Loss of pressure or disruptions due to water shortages*
- *Sewer overflow warnings*
- *Water/sewerage system infrastructure failure warnings.*
- *Natural disaster warnings*

8.4 Business Continuity Plan

(Attach the BCP of the utility.)

9 Stage 5: Recovery

(This section outlines key recovery procedures and highlights the importance of post-emergency reporting and evaluation for continuous improvement.)

9.1 Recovery Procedures

(Provide the key recovery procedures that will be followed to restore and resume operations after interruptions to water/sewerage services. These procedures are to be explained in detail in the EOPs specific for each emergency type in Section 8.2.)

9.2 Post-Emergency Reporting

(Explain the use of the Incident Report to document the emergency response and recovery efforts.)

Table 25: Incident Report

INCIDENT DETAILS	Date of Incident: [Date]
	Time of Incident: [Time]
	Location: [Specific location of incident]
	Type of Incident: [e.g., water main break, sewage overflow, power outage]
	Incident Number: [Unique identifier]
INVOLVED PARTIES	Reporting Personnel: [Name and position]
	Responding Personnel: [Name and positions]
	External Agencies Involved: [e.g., Police, Fire Department, Health Department]
INCIDENT DESCRIPTION	Detailed Description of the Incident: A clear and concise account of what happened.
	Affected Areas: Specify the geographic area impacted by the incident.
	Number of People Affected: Estimate the number of individuals affected.
	Environmental Impact: Assess potential environmental damage.

RESPONSE ACTIONS	Initial Response: Describe the immediate actions taken upon incident detection.
	Emergency Procedures Activated: Specify which emergency procedures were implemented.
	Resources Deployed: List equipment, personnel and other resources utilized.
	Coordination with External Agencies: Outline communication and collaboration with external parties.
IMPACT ASSESSMENT	Infrastructure Damage: Assess damage to water or sewerage infrastructure.
	Service Disruptions: Describe the extent and duration of service interruptions.
	Public Health Impact: Evaluate potential health risks to the public.
	Economic Impact: Estimate financial losses due to the incident.
LESSONS LEARNED	Identify Areas for Improvement: Highlight weaknesses in response procedures.
	Recommended Corrective Actions: Suggest changes to prevent similar incidents.
ATTACHMENTS	Photographs, diagrams or other relevant documentation.

9.3 Response Evaluation

(Explain the procedures for evaluating the effectiveness of the Water and Sewerage Emergency Plan and its implementation during emergencies.)

