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Guide for Developing Climate Risk Management Plans (CRMPs) in Small and Medium Sized Water and Wastewater Systems in Jordan

Systematic approach for developing climate risk plans for the water sector

CRMP – GIZ Disclaimer

This publication has been produced as a result of the project “Water and Wastewater Companies for Climate Mitigation”- WaCCliM activities in close cooperation with the Ministry of Water and Irrigation (MWI), Water Authority of Jordan (WAJ), Miyahuna Water Company (Miyahuna) and Aqaba Water Company (AWC). The WaCCliM project is a joint initiative between the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH and the International Water Association (IWA). This project is part of the International Climate Initiative (IKI). The German Federal Ministry for Economic Affairs and Climate Action (BMWK) supports this initiative on the basis of a decision adopted by the German Bundestag.

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List of Acronyms

AWC	Aqaba Water Company
CRMP	Climate Risk Management Plan
IPCC	Intergovernmental Panel on Climate Change
JVA	Jordan Valley Authority
MWI	Ministry of Water and Irrigation
PS	Pumping station
RCP	Representative Concentration Pathway
TNC	Third National Communication
WAJ	Water Authority of Jordan
WTP	Water Treatment Plant
WWTP	Waste Water Treatment Plant

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1 Overview and Context

Jordan is situated in the eastern Mediterranean region. Winters typically are associated with heavy rain from December– March, and are followed by hot, dry summer from April–November.

Jordan has three ecological zones (Jordan Second BUR, 2020):

– The Jordan Valley, which sits 200–400 meters below sea level, experiences warm winters (19°–22°C) and hot summers (38°–39°C), with average annual rainfall ranging between 102–300 mm.
– The Western Highlands experience the highest precipitation levels: rainfall averages 350–500 mm per year and temperatures range from 9°–13°C in the winter to 26°–29°C in the summer.
– The Badia, an arid and semi-arid area to the east, covers approximately 85 percent of the country. Average annual rainfall levels fall below 200 mm, and temperatures range from 14°–16°C in the winter to 35°–37°C in the summer.

Historical Climate

According to Jordan National Communications analysis, historical climate trends since the 1960s include the following observations:

– The mean, maximum and minimum air temperature tends to increase significantly by 0.02, 0.01, and 0.03 °C/year, respectively.
– Rise in annual maximum temperatures of 0.3°– 1.8°C and rise in annual minimum temperature of 0.4°–2.8°C across all regions (minimum temperatures rose at a faster pace than maximum temperatures).
– Increase in the average number of heat waves across the country, particularly in the desert.
– Increase in the number of consecutive dry days nationwide (highest in the desert, followed by the highlands and then the Jordan Valley).
– Decline in annual precipitation by 5–20 percent across the country, except Ras Muneef in the highlands and Ruwaished in the Badia, where rainfall has increased by 5–10 percent.

Future Climate

According to Jordan National Communications analysis, projected climate changes outcomes include:

– Rise in annual maximum temperature of up to 5.1°C and rise in annual minimum temperature of 3.8°C by 2085 (warming is stronger during the summer). Some models project temperatures to rise evenly across the country while others suggest the increase will be strongest in the eastern and southern regions.
– Increase in the frequency of heat waves.
– 10-day increase in the number of consecutive dry days from 2040–2070 (increase will be greatest in the southern Aqaba region).
– Precipitation projections are highly variable but all point to an overall decrease between 15–60 percent from 2011 to 2099.

Impact Assessments and Vulnerabilities in Water Sector

Jordan is suffering from water scarcity, with water availability levels far below the standard water poverty threshold of 500 m^3 per capita per year. Water levels per capita were 3600 m^3/year in 1946, but fell to 145 m^3/year by 2020 due to population growth and climate change. Climate change will continue to have significant impacts on water scarcity in Jordan as a result of lower precipitation levels and rising temperatures. Both trends decrease water availability and quality by reducing runoff and creating environments conducive for microorganism and bacterial growth. The realities of overexploitation and supply deficits have put pressure on groundwater aquifers (which provide 70 percent of potable water). Transboundary river systems also exacerbate the challenges, as long-standing agreements with neighbouring countries have not been observed, leaving Jordan with less than 10 percent of the total flow of the Upper Jordan and Yarmouk Rivers, potentially causing further destabilization and conflict in the region. (Climate change policy, 2013). Table 1 shows the potential stressors and associated climatic risks in the water sector.

Table 1: Climate Stressors and Climate Risks

Stressors	Risks
Rising temperatures **Drought and reduced rainfall**	Reduced surface water and groundwater resources and recharge rates
	Reduced water quality for industrial and household use
	Constrained agricultural and economic growth
	Increased regional tensions over water access

Water Sector institutional Arrangement: Jordan has set up a strong institutional structure for water resources management and delivery. This includes the Ministry of Water and Irrigation (MWI), the Water Authority of Jordan (WAJ), the Jordan Valley Authority (JVA) and water companies such as Miyahuna, the Aqaba Water Company and the Yarmouk Water Company.

MWI is the official body responsible for the overall monitoring of the water sector, water supply and wastewater system and the related projects, planning and management, the formulation of national water strategies and policies, research and development, information systems and procurement of financial resources. Its role also includes the provision of centralized water-related data, standardization and consolidation of data.

MWI is the lead government institution responsible for strategic planning and guiding the development of Jordan's water sector. MWI works closely with the regulatory body, WAJ, to align strategy and policy making with technical and regulatory oversight for water infrastructure across the country. MWI is also responsible for maintaining irrigation networks, and for liaising with major water users, except in certain areas, such as the Jordan Valley, where the JVA supports farmers to develop and maintain water networks.

WAJ and MWI work closely with the water utilities including Miyahuna, Yarmouk, and Aqaba water companies. Water Utilities cover operation and maintenance in nine of the Kingdom's 12 governorates and are thus important for ensuring a smooth delivery of water and wastewater service to the citizens of Jordan.

The Water Utilities are responsible for ensuring that this vital service, which is essential to developmental activities in the country, is offered in the most efficient and effective manner, and continues to be closely monitored and assessed.

2 Purpose and Scope of this Guides

This guide is intended to assist small and medium sized water and wastewater systems in Jordan in developing a climate risk management plan (CRMP).

The guide outlines the minimum requirements needed for developing a Climate Risk Management Plan for the water and wastewater systems and it identifies how the plan should be tailored to suit each system.

The guide includes *Climate Risk Management Plan templates and tables* along with the best management practices at utilities level.

The objectives of the CRMP are to assist the water and wastewater systems to achieve a proactive rather than reactive Climate Risk Management approach through the following:

– A common framework for managing increased climate change risks and potential impacts on water systems
– Support Water Utilities in carrying out needs assessment and prioritizing adaptation measures and improve climate finance readiness
– Integrating climate change impacts into risk management and strategic planning
– Maintain compliance with legislation
– Improved stakeholder confidence and trust.

This guide is primarily tailored for operators of water systems in Jordan, including:

– MWI and WAJ (particularly staff members who are involved in dams and water wells operation)
– Water treatment plants
– Water pumping stations
– Wastewater treatment plants.

3 Definitions

Throughout the guide the following terms are used with the below specific definitions according to the IPCC Fifth Assessment Report (IPCC- AR5, 2014)[1].

[1] AR5 Synthesis Report - Climate Change 2014 (ipcc.ch)

Climate change

Climate change refers to a change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forces such as modulations of the solar cycles, volcanic eruptions and persistent anthropogenic changes in the composition of the atmosphere or in land use.

Climate variability

Climate variability refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all spatial and temporal scales beyond that of individual weather events. Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability).

Adaptation

The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities.

Vulnerability

The tendency or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.

Climate sensitivity

Degree to which a system or species is affected, adversely or beneficially, directly or indirectly, by climate variability or change.

Adaptive capacity

Ability of systems, institutions, humans, and other organisms to adjust to potential damage, take advantage of opportunities, or respond to consequences”

Impact

Effect on a natural or human system… the interaction of climate changes or hazardous climate events occurring within a specific time-period and the vulnerability of an exposed society or system.

Hazard

The potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources.

Exposure

The presence of people, livelihoods, species or ecosystems, environmental functions, services, and resources, infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected.

Risk

The potential for consequences where something of value is at stake and where the outcome is uncertain, recognizing the diversity of values. Risk is often represented as probability of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur. Risk results from the interaction of vulnerability, exposure, and hazard. In this report, the term risk is used primarily to refer to the risks of climate-change impacts.

Likelihood

The chance of a specific outcome occurring, where this might be estimated probabilistically.

Risk management

Plans, actions, strategies or policies to reduce the likelihood and/or consequences of risks or to respond to consequences.

Monitoring is a continuous or periodic process, which allows for regular feedback of systematically collected data or information.

Evaluation is a systematic and objective feedback of a completed or ongoing action, aimed at determining its performance.

4 Developing the CRMP

This CRMP will provide a framework for managing increased climate change risks, which might affect water systems. The Plan seeks to identify risks related to climate change impacts as well as recognizing existing climate change events while establishing a process for ensuring that these risks are managed effectively as high priority and on timely manner.

The CRMP will be the final output, after having conducted the steps 1-5 (Fig.1) from this guide. Each step includes a number of tables and/or boxes to be filled.

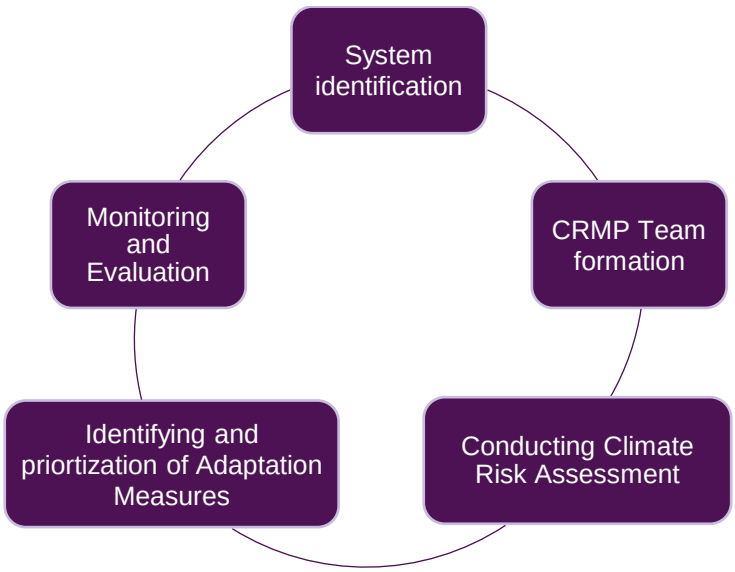


Figure 1: CRMP Cycle

CRMP Sections and Intended Outcomes

Table 2: sections and intended outcomes

Sections	Intended outcomes
Section 1: System identification	System boundaries are well identified and defined
Section 2: Staff roles, responsibilities, competencies and training requirements	Mobilised team with a clear vision of what the plan will achieve and how it will be achieved.
Section 3: Conducting risk assessment	The potential hazards and the associated risks are identified. Climate hazards might differ from one region to another according to the geographical location, and are usually defined in relation to the geographical region. As a result, a prioritized list of climate risks is identified with increased awareness of the threats and opportunities that climate change could bring
Section 4: Adaptation measures identification and prioritization	List of priority adaptation measures related to prioritised climate risks.
Section 5: Monitoring and Evaluation	Understanding of what is working well and what can be improved by also considering changes required to the plan in light of new science/evidence.

Document Control Sheet

It is important to include a summary of the document history (who the plan was prepared by, who reviewed the plan).

Table 3: Document control sheet

Date of issue	Version	Prepared by	Approved by	Description of changes

Section 1: System Identification

In this section, a list of system elements will be included, ideally ranging from water sources (e.g. groundwater aquifer) to distribution infrastructure. The process starts with participatory work in which a team (including planners, operators, and other stakeholders) meet to identify tools, data, and models to be used.

The first step in any plan is to clearly define the system and its boundaries and the elements within these boundaries. The boundaries for a system depend on its type. For example, the system boundary for water treatment plant may extend from water resources (i.e. groundwater or surface water) to the abstraction (e.g. through wells), treatment units (i.e. sedimentation tank, Chlorination, UV) and until the storage reservoirs and distribution networks.

The system's boundaries may only include water treatment plant or may extend from the water sources to the storage units. Defining the system's boundaries depends on the system owner's control limits and circle of influence (Fig. 2). It is also important to consider elements *outside* of the defined system boundary (if relevant) that might indirectly affect or be affected by changes within the defined boundary. Therefore, coordination and communication with relevant stakeholders is vital for the success and sustainability of climate risk planning.

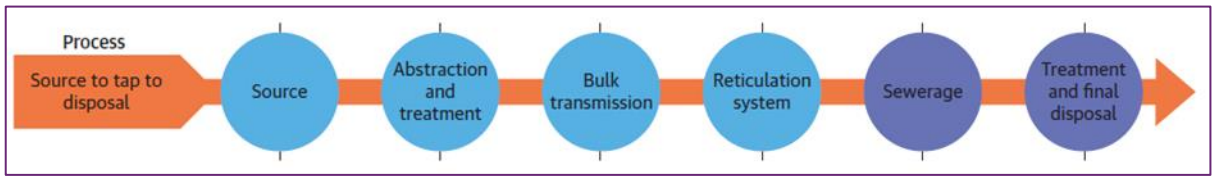


Figure 2: Scheme of a complete water and wastewater system, from source to disposal; World Bank 2018[2]

Identifying the system could consider the below information among others (**Annex 1**):

- System (Utility) Name
- System Type (WTP, WWTP, PS, Water reservoir, Water well, Water Resource…)
- Location of system
- Population served / Total flow / System Size (for water and WW treatment plants)
- Identify system boundary (i.e the Infrastructure from source -tap- disposal)
- Identify all elements within the system boundaries (elements: all assets and resources that lead to service delivery)
- All incoming water sources
- Treatment operations: Filtration steps, primary and secondary disinfection points and Automated chemical dosing points
- Automated monitoring points
- Sample points for water quality monitoring
- All on-site water storages

[2] Note: This diagram is limited only to the infrastructure side. It is advisable to include also the operational, institutional, and (for some utilities) financial aspects. WSS = water supply and sanitation.

– Backflow prevention devices
– Wastewater removal disposal point.
– Type of infrastructure (e.g. material used for pipes)
– Leakage/water or wastewater losses

Section 2: Staff Roles, Responsibilities, Competencies and Training Requirements

Based on system identification section, the CRMP team shall be formed taking into consideration all key persons involved in the identified system boundary (**Annex 2: Responsible Team**). This will require the following:

– Insert the role titles of staff and a brief description of their responsibilities in relation to this plan.
– Provide an overview of your current training management system and/or how you ensure training and development is provided.
– Include how you make sure all staff are aware of this plan and are trained on its implementation.
– Keep a detailed record of staff training.

Section 3: Conducting Climate Risk Assessment

This section is key in developing the management plan, where the potential hazards and the associated risks need to be well identified. It is highly important to note that climate hazards differ from one region to another according to the geographical location.

The Fifth IPCC Assessment Report (AR5) focus on risk more than focusing on vulnerability to focusing on risk of climate-related impacts that may harm a system. Figure 3 below is an overview of the risk assessment framework.

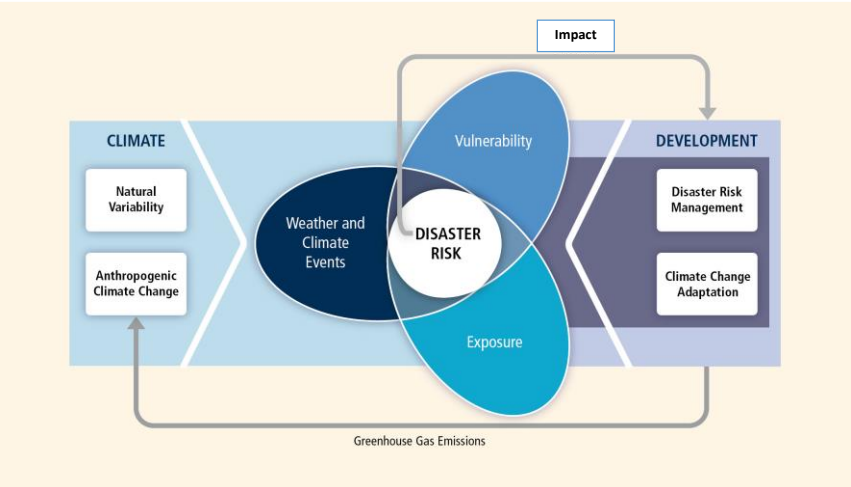


Figure 3: The figure indicates key concepts involved in risk management and climate change adaptation (Adopted from IPCC, 2018[3])

[3] Adopted from Working Group II, IPCC AR5, 2014

Identifying the system boundaries is the first step to outline the climate hazards taking in consideration the current and projected climate hazards within the area of the system boundaries.

IPCC's Fifth Assessment Report notes that more frequent hot temperature extremes are "*virtually certain*" as global mean surface temperature increases, and that it is "*very likely*" that heatwaves will be more frequent and last longer. However, it is important to note that confidence in projections of extreme events is generally weaker than for projections of long-term averages due to the limited number of relevant detection and attribution studies.

Climate variability and change, as well as environmental and social systems (independent or because of climate change), will result in changes in the risks associated with hazards.

The risk associated with a hazard is a combination of the **likelihood** of the hazard occurring **over a given period** and the **severity** of the consequences of the hazard "if" and "when" it occurs. Both the likelihood and the severity of the consequences arising from the hazard, as well as the effectiveness of existing control measures, are likely to change due to climate variability and change.

Climate-related hazards affecting water availability and reliability (quantity): In water resources context, drought-related hazardous events, exacerbated by future climate change, can lead to scarcity and reliability risks.

Climate-related hazards affecting water quality: The types of water quality hazards that are more likely to occur with increasing severity within existing water supplies as a result of climate change are those that are exacerbated by warmer, drier conditions or more intense precipitation events. Such as, pathogens, phytoplankton, opportunistic pathogens, and chemicals found in many groundwater systems. Also, one of the projected consequences of climate change is increased periods of water shortage in many parts of the world, and new water supplies are being tapped in many areas.

The major climate-related hazards affecting water supply systems relevant to Jordan can be grouped under three broad scenarios:

Increasing likelihood of flooding or increased run-off in some areas, which potentially overwhelms current sanitary protection measures, leading to damage or destruction of infrastructure and cross-contamination. Increased flooding is likely to derive from more intense rainfall events, from increased average rainfall, or from a combination of both.

Decreasing rainfall or longer periods of low rainfall in some areas, potentially resulting in declining surface and renewable groundwater availability or longer droughts. This is expected to increase challenges to meet demands for water for domestic use, which may lead to consumers finding alternative (and potentially unsafe) sources of water.

Decreasing total rainfall in some areas will reduce the capacity of surface water to dilute, attenuate and remove pollution, together with rising temperatures, will change the patterns of microbial growth in both source, and treated waters. Higher temperatures and evaporation will potentially lead to higher concentrations of biological and chemical contamination.

Examples of system information that will support climate-related hazard identification and risk assessment include:

– Reliability of source yields (considering seasonal variability and variability between years, for example due to droughts);
– Historical water quality data and relationship with source yields;
– History and trends of extreme weather events (for example flash floods and droughts);
– Future climate projections that could impact the water supply;
– Water quantity and quality implications of current and projected climatic conditions;
– Potential new or alternative sources;
– Trends in land use and population growth impacting water resources supply or demand;
– Other water abstracters in the catchment and their patterns of abstraction under normal and drought conditions.

The vulnerability and risk assessment and identified measures could be identified at the national level by referring to national reports and studies. However, noting that the national reports usually map out climatic related hazards at a wider level (i.e. country or sub-country); we need to consider climate hazards that pertain to the region in which the system is located.

Different possible climate change scenarios were taken in consideration while identifying climate related hazards. Table 2 presents a summary of mid-term (~2050) and long-term (~2100) climate projections for Jordan through a pessimistic (RCP 8.5) and an intermediate scenarios (RCP 4.5).

Table 4: Summary of mid-term (~2050) and long-term (~2100) climate projections for Jordan from two different regional climate scenarios.

Parameters	**RCP4.5**		**RCP8.5**	
	2050	**2100**	**2050**	**2100**
Temperature	+1.2 to 1.5ºC	+1.5 to 2.1ºC	+1.7 to 2.9ºC	+3.2 to 5.9ºC
Precipitation	-4 to -15%	- 7 to -25%	-7 to -15%	-13 to -22%
Drought	NA	+ 30 to 40 days	NA	+ >40 days
Flash floods	No significant change	No significant change	+ 4 days with precipitation >20mm	+ 8 days with precipitation >20mm
Heat Waves	NA	NA	75 days per year	200 days per year

* LTS Roadmap analysis, RICARDO, 2021 (unpublished): synthesis from Jordan TNC (2014) and RICCAR data sets (2017).

It is important to consider how the system boundaries are defined as “vulnerable” or “sensitive” to adverse climate change impacts. The defined CRMP Team must begin by considering how the system is exposed to specific hazards to navigate the potential impact or consequences on the system boundaries. As such, historical data as well as future projections and analysis of climate change are vital at this stage[4].

For sub- national and localized identification and trend analysis of the most common shock (s), or risks to those shock(s), that are experienced in Jordan; please visit: Jordan Maps floods and droughts- Integrated Context Analysis (https://geonode.wfp.org/imaps/ica/).

Choose Jordan in the field of ICA country then click on “6- Layers” tab.

Using the Risk Matrix of Annex 3 in this guide, the CRMP Team will be able to identify the hazards, existing control measures (plans, regulations, procedures, etc.), the indicators that could identify if/when the hazard may occur and finally the ability to categorize the risk magnitude – if this hazard occurs – using the Risk Matrix.

Section 4: Identification and Prioritization of Adaptation Measures

This section includes assessing available adaptation actions. Analysts can organize these options into potential robust matrix and examine the trade-offs among them in meeting the agreed objectives under the scenarios identified.

Also, the section includes a detailed methodology to prioritize measures to improve climate resilience (e.g. Cost-Effectiveness or Multi-Criteria Analysis), including stakeholder participation.

For each adaptation measure, it is crucial to link it to one of the climate risks or hazards identified above. For example: implementing green infrastructures in some sites will help in cases of flash floods events and thus helps in reducing financial loss caused by the damage in the water utilities.

Following are number of potential adaptation measures that are common in water systems:

Construct New Infrastructure[5]

– Build flood barriers to protect infrastructure
– Build infrastructure needed for aquifer storage and recovery
– Diversify options for water supply and expand current sources
– Increase water storage capacity
– Install low-head dam for saltwater wedge and freshwater pool separation
– Plan and establish alternative or on-site power supply

[4] Refering to national reports such as International reports and National Communication Reports and Cliamte Change models can be used to support the teams in identifying potential hazards due to climate change.
[5] The green infrastructure options are adopted from Climate Resilience Evaluation and Awareness tool (CREAT) which is a web-based tool developed by Environmental Protection Agency (EPA).

Increase System Efficiency

- Improve energy efficiency and optimization of operations
- Finance and facilitate systems to recycle water
- Practice conjunctive use

Section 5: Stakeholder Engagement and Coordination

Once the system boundaries are identified and a designed team is assembled, it is important to consider other relevant stakeholders that affect and are affected by measures or changes within a larger scope.

When it comes to water systems, it is rarely an isolate case, where the CRMP Team members should ensure clear and constructive coordination with various entities and authorities to implement possible adaptation measures on specific water systems. Therefore, a simple method of identifying relevant stakeholders should be in place.

An additional step to better define the expected roles from stakeholders, would be to consider a Responsibility Assignment Matrix through the highly acclaimed RACI Matrix - Responsible, Accountable, Consulted, and Informed. This Matrix, helps in defining the roles of involved stakeholders[6]:

- **Responsible**: Person who is completing the task
- **Accountable**: Person who is making decisions and taking actions on the task(s)
- **Consulted**: Person who will be communicated with regarding the decision-making process and specific tasks
- **Informed**: Person who will be updated on decisions and actions during the project

Refer to Annex 5 in this document for defining the relevant stakeholders that must be coordinated with to ensure efficient management of implementing proposed adaptation measures.

Section 6: Monitoring and Evaluation

Monitoring and evaluation (M&E) is critical to ensure the long-term success of climate adaptation initiatives, plans and actions. Monitoring should include outputs, immediate and short-term outcomes, and longer-term outcomes.

M&E can help to demonstrate accountability to stakeholders and communities. Monitoring, evaluation and review design is critical to ensure that information is used to inform decision-making, make appropriate adjustments, and report to stakeholders and decision makers.

Stakeholder feedback is essential. People or groups who have an interest in the plan, or who are responsible for delivering various actions, must be made aware of any changes that affect them. Importantly, consideration must be given to how the plan is being amended so that the planning cycle can be continued.

[6] RACI Matrix | Understanding Responsibility Assignment Matrix (project-management.com)

Monitoring and evaluation involve the development of indictors/ trigger points to measure the performance of adaptation efforts in terms of relevance, effectiveness, efficiency, results and sustainability of the results. Indicators/ Trigger points are things that we can measure.

Indicators/ Trigger points can be identified and monitored and, when reached, can stimulate the implementation of the next action in a sequence. In identifying trigger levels for response, it is important to consider the time required for the decision to be made and implemented. This should include acknowledging the time that may require for effective stakeholder engagement, or for any detailed investigation, design and development of actions that may be required.

Evaluation helps to learn from what was planned and what has been done. It helps with considering what changes need to be made to the plan and associated activities to get adaptation outcomes.

Monitoring and reviewing our adaptation plan is essential and it will necessarily include:

– Evaluation of effectiveness: Here it is important to set a goal that the adaption measure will achieve the indicator will be a**re we achieving our goals**?);
– Understand efficiency (**Are we implementing cost-effective and appropriate actions?**);
– Improve learning and future interventions (**What do we need to do differently?**); and
– Assess outcomes (**What impact has the plan had?**).

** Annex 5 includes sample templates that can be used.

Notes:

– Critical Success Factors are; accountability; evidence based reporting and continuous improvement.
– The plan should be monitored, reviewed and updated annually.
– The plan coordinator will be responsible for leading this review.
– The support team will ensure their own action plans are kept up to date and will report back at the annual team meeting – or sooner if they encounter difficulties.
– This exercise will be informed continuously by the latest technology, climate change science, policy and research, and ongoing changes in our operations. A major review of our adaptation plan will be conducted once every 5 years.

5 Case Studies

5.1. Case Study No. 1 (Site A – Water Utility)

1. System Identification

– Utility, source water and treatment systems

Utility Information

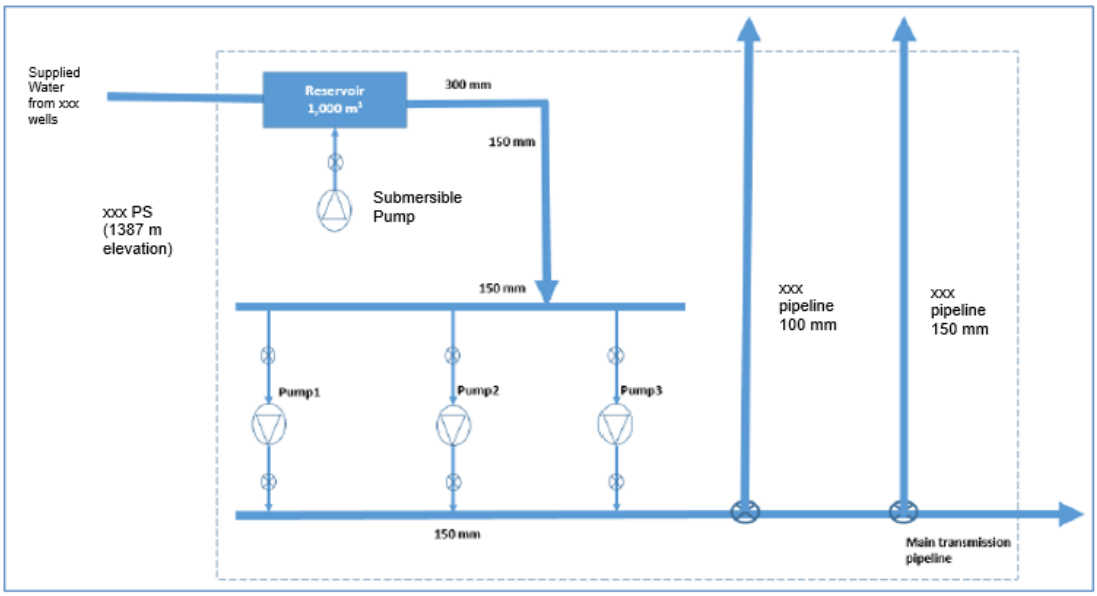
General information	
Name of utility	xxx pump station
System/utility type	Water Pump Station (PS)
Address of utility	South of Jordan
Age of utility	xxx
Name of operator	xxx
Address of operator	xxx
Contact details of operator	xxx
Utility category (No. of citizens served)	In 2020, the total number of households served by this network is approximately 3,135 with a total population of 17,611 persons.
Use this section for additional information	
xxx pumping station is located in xxx region about 25 km southwest of xxx city center at an elevation of about 1,387 m above sea level. The wells supply water almost 24-hrs per day to xxx reservoir with a capacity of 1,000 m3. The WaCCliM Project conducted an Energy Audit and Hydraulic Model for the Pump Station in 2021 and found that the wells deliver water with a total flow rate of 173 m3/hr and about 87% of the total flow received by xxx reservoir. Based on the energy audit, it was found that the pumping station consumed about 2,134,262 kWh in 2020 and emitted around 1,365.9 tons of CO2	

Utility Description

Source water	
Type of water source feeding the utility (e.g. rainwater, municipal supply)	Three water wells: xxx well (located in the PS) 30m3/h, xxx Well 30-35m3/h, and xxx No. 5 Well 55-60m3/h, 10.4km. fourth one Well No. 6 is in progress to be commissioned 50-60m3/h.
Water supplier	WAJ / AWC operate the abstraction pumps
Treatment process prior to entry to facility	No treatment prior to entry to facility, only chlorination at facility

Pumps	
Number and types of circulation pumps	A total of three (3) pumps are used to distribute water from the Pump Station to the receiving areas. All pumps operate at a flow of 150m3/hr, Head 350m, one is 400, One Pump use as a main supply and the other two are standby, due to scare water resources. Detailed measurements and analysis of the performance of existing pumps were performed and found that the overall efficiency for pump 1, pump 2 & pump 3 are 41%, 54% and 57%, respectively

Schematic and/or process flow diagram



2. CRMP Team

Role/title	Responsibilities	Special competencies	Training requirements for CRMP	Team member name
Head of xxx Water Affairs	Managing and directing all Water affairs operations of xxx boundaries in terms of water supply		Climate Risk Assessment	xxx
Head of Technical Affairs Department	Managing daily technical affairs operations of xxx boundaries in terms of water supply		Climate Risk Assessment	xxx
Head of Operations for xxx and xxx	Managing daily operations of areas in terms of water supply		Climate Risk Assessment	xxx
AWC – Focal Point	Focal point for climate risk planning in Aqaba Water Company		Climate Risk Assessment	xxx

3. Risk Documentation

Step 1: Water Supply Hazard and Risk Identification

Hazard	Hazardous event	Future impact of climate change	Current controls (identified by responsible department)	Related Risks	Likelihood	Consequence	Risk*
Drought	– Rainfall reduction & delay of rainfall season – Electricity cuts – Reduced vegetation / farmland and livestock	Expected to further increase by 15-20% (RCP 4.5) to 18-35% (RCP 8.5) by 2100 in the region (World Bank CC Knowledge Portal)	– Existing Summer Emergency Plans – Emergency Unit Plans – Local crisis units	– Increased Electricity consumption and electricity cuts – Increased maintenance of equipment – Reduced water supply and increased water demand	Possible	Major	High
Flash floods	– Flooding / high flowing water streams and soil erosion	Expected to further increase by region + 4 days with precipitation >20mm by 2050 and + 8 days with precipitation >20mm by 2100 (RCP 8.5)	– Existing Winter Emergency Plans – Emergency Unit Plans – Local crisis units	– Destruction of infrastructure	Unlikely	Major	Medium

*The risk is ranked based on the Risk Matrix (Included in Annex 3)

Step 2: Risk Registry

Date of risk review			
Compiled by	xxx	**Date**	
Reviewed by	xxx	**Date**	

Risk ID	Risk category	Risk description	Risk assessment			Level of adequacy of existing controls	Mitigating response (Risk reduction measure)	Risk owner	Status	Risk priority
			Likelihood	Consequences	Level of risk					
1	Increased Electricity consumption	– Increased consumption from abstraction and distribution	Possible	Major	High	Existing plans are adequate (team implements Summer Emergency Plans with support from local authorities)	– Installing PV Units at Pump Station	Head of Operations for xxx	Open	High
2	Increased maintenance of equipment and infrastructure	– Pump maintenance due to overuse – Network maintenance to protect against heat waves/droughts	Possible	Major	High		– Rehabilitate Pump Station and Water Network to reduce NRW (with EE pumps and new pipelines)	Head of Operations for xxx	Open	High

Risk ID	Risk category	Risk description	Risk assessment			Level of adequacy of existing controls	Mitigating response (Risk reduction measure)	Risk owner	Status	Risk priority
			Likelihood	Consequences	Level of risk					
3	Reduced Water supply & increased water demand	– Increased use of Water Tankers to supply subscribers – Reduced vegetation / farmland and livestock	Possible	Major	High	Existing plans are adequate (team implements Summer Emergency Plans with support from local authorities)	– Increase water supply share from non-vulnerable/exposed sources – Increase Water Use efficiency awareness at subscriber level – Utilize grey water for irrigation	Head of xxx Water Affairs, Head of Technical Affairs Department	Open	High
4	Destruction of infrastructure due to floods	– Pump failure – Destruction of electric panels – Destruction of network pipes and manholes, etc.	Unlikely	Major	Medium	Existing plans are adequate (team implements Winter Emergency Plans with support from local authorities)	– Casing / Encasement of pipes of pipes (when needed)	Head of Operations for xxx	Open	Medium

Step 3: Risk Treatment Plan

Date of risk review			
Compiled by	xxx	**Date**	
Reviewed by	xxx	**Date**	

The risk in priority order from risk registry	**Possible risk treatment options**	**Risk rating after treatment**	**Result of cost-benefit analysis Accept/reject**	**Person responsible for implementation of option**	**Timetable for implementation**	**How will this risk and the treatment options be monitored?**
Increased Electricity consumption	Installing PV Units at Pump Station	-TBD-	-TBD-		Long term	Site visits/ Committees/Regular report/ Meetings
Increased maintenance of equipment	Rehabilitate Pump Station and Water Network to reduce NRW (with EE pumps and new pipelines)	-TBD-	-TBD-		Short – medium term	Site visits/ Committees/Regular report/ Meetings
Reduced Water supply & increased water demand	– Utilize alternative water sources (grey water for irrigation, water supply share from non-vulnerable/exposed sources – Increase Water Use efficiency awareness at subscriber level	-TBD-	-TBD-		Short – medium term	Site visits/ Committees/Regular report/ Meetings
Destruction of infrastructure due to flash floods	Casing / Encasement of pipes (when needed)	-TBD-	-TBD-		Medium – long term	Site visits/ Committees/Regular report/ Meetings

4. Adaptation Measures Template

Upon the documentation of the defined risks relevant to the system boundaries, it is important to focus analyzing the Cost benefit of suggested measures.in order to agree on the most applicable solution to the given conditions. The following template shall be used by the CRMP Team for further assessment.

– Action Identification

Action reference no.	1 - Installing PV Units at Pump Station
Owner (person)	Head of Operations for xxx
Other relevant parties	MWI, WAJ, MEMR, MoPWH
Department description	
Benefits	The construction of PV units at Pump Station would support the facility in managing increased electricity demand as well as reduce the impacts of electric network cut offs
Resources	Human - Financial
Implementation date	N/A
Measuring success (indicators)	Reduction of electricity cuts and its duration, reduction of GHG emissions due to the transition to clean energy.

Action reference no.	2 - Rehabilitate Pump Station and Water Network to reduce NRW (with EE pumps and new pipelines)
Owner (person)	Head of Operations for xxx
Other relevant parties	MWI, WAJ
Department description	
Benefits	The installation of new pumps and the rehabilitation of the water network will aim to improve efficiency of the supply system and conserve the lost water quantities to recover a percentage of water demand. The rehabilitation of the network will directly reduce the non-revenue water accounted for in the system. This will allow efficient allocation of water to subscribers and efficiently manage
Resources	Human - Financial
Implementation date	N/A
Measuring success (indicators)	Reduction of electricity requirement per 1 m^3 of pumped water, reduction in NRW quantities, increased efficiency in water supply system.

Action reference no.	3 - Utilize alternative water sources (grey water for irrigation, water supply share from non-vulnerable/exposed sources and increase Water Use efficiency awareness at subscriber level
Owner (person)	Head of xxx Water Affairs, Head of Technical Affairs Department
Other relevant parties	MWI, WAJ
Department description	
Benefits	Tapping into alternative sources of water including grey water for irrigation will allow improve allocation of fresh water for drinking purposes, thus resulting in a higher share per capita. Increasing water supply from non-vulnerable/exposed sources should be used in emergency cases. Moreover, the focus on water use efficiency will require extensive support in developing strong awareness campaigns resulting in a change of behaviour for improved water use patterns in the area.
Resources	Human - Financial
Implementation date	N/A
Measuring success (indicators)	Increased share of using grey water for irrigation purposes, increasing share per capita / number of capita that receives fresh water, implementing effective awareness campaigns to address water use efficiency

Action reference no.	4 –Casing / Encasement of pipes (when needed)
Owner (person)	Head of Operations for xxx
Other relevant parties	MWI, WAJ
Department description	
Benefits	The Casing of pipes will support the protection of pipeline conditions against damages from heat waves and droughts, as well as rare conditions of flash floods.
Resources	Human - Financial
Implementation date	N/A
Measuring success (indicators)	Existing Infrastructure have not been affected by events of flash floods compared to previous years.

– **Cost benefit Analysis for Adaptation Measures**

Table 1: Benefits' Scoring Table

Measures/ criteria weight	Benefits (B)					Benefits overall weight	Benefits rank
	Ensure sustainability water supply and water quality	Financial feasibility / potential savings	Autonomy in implementation	Co-benefits (air quality, GHG emission reduction, employment, better livelihood)	Urgency		
	20%	20%	20%	10%	30%	100	
1- Installing PV Units at Pump Station	13	15	10	9	15	62	2
2- Rehabilitate Pump Station and Water Network to reduce NRW (with EE pumps and new pipelines)	17	15	16	9	20	77	3
3- Utilize alternative water sources (grey water for irrigation, water supply share from non-vulnerable/exposed sources and increase Water Use efficiency awareness at subscriber level	20	15	10	9	25	79	4
4- Casing / Encasement of pipes	17	13	14	5	10	59	1

* Rank of benefits: scoring from 1-4 (where one is the least beneficial and four is the most beneficial).

Table 2: Cost Scoring Table

Measures	Estimated cost (USD)	Ranking of cost
1. Installing PV Units at Pump Station	760,000 – 1,000,000	4
2. Rehabilitate Pump Station and Water Network to reduce NRW (with EE pumps and new pipelines)	470,000	3
3. Utilize alternative water sources (grey water for irrigation, water supply share from non-vulnerable/exposed sources and increase Water Use efficiency awareness at subscriber level	75,000	1
4. Casing / Encasement of pipes	100,000	2

** Rank of Cost: 1-4 (where 1 is the least and 4 is the most expensive)

Table 3: Benefit/Cost Ratio Table

Measures	Benefits rank	Ranking of cost	Ratio (B/C)
1. Installing PV Units at Pump Station	2	4	0.5
2. Rehabilitate Pump Station and Water Network to reduce NRW (with EE pumps and new pipelines)	3	3	0.75
3. Utilize alternative water sources (grey water for irrigation, water supply share from non-vulnerable/exposed sources and increase Water Use efficiency awareness at subscriber level	4	1	4
4. Casing / Encasement of pipes of pipes (when needed)	1	2	0.5

* The benefit-cost ratio (BCR) is the ratio of benefits to costs (Ratio=B/C)

Any BCR above one makes sense from an economic point of view as this indicates that benefits are higher than the costs. The larger the BCR becomes, the better the adaptation option is judged to be.

5. Stakeholder Engagement and Coordination

Table 1: Stakeholder Group Identification

Stakeholder	Main responsibility	Relevant communication for climate risk management	Contact details
Ministry of Water and Irrigation / Water Authority of Jordan	Define Sector strategies and policies of water use and climate change	Receive approvals of climate risk planning, and maintain communication on such topics	
Aqaba Water Company Board of directors	Manage the operations of xxx Regional Operating Unit	Receive approvals of climate risk plan and implementation of feasible measures. Maintain Communication with CRMP Focal Point	
Ministry of Energy and Mineral Resources	Defines and manages Energy sector strategies and policies	Receive approvals for implementing PV Systems	
Electricity Distribution Company	Manages approvals and implementation of electric networks in areas	Receive approvals for implementing PV Systems	
Ministry of Public Works and Housing	Defines and manages infrastructure sector strategies and policies	Receive approvals for implementing any construction measure	
Ministry of Local Administration	Manages municipal sector strategies and policies	Receive approvals for implementing any construction measure that fall within boundaries of a given municipality. Moreover, ensure clear communication in cases of emergency weather conditions	
Municipality of xxx	Manages and implements specific requirements of municipalities such as xxx and xxx, etc.		
Jordan Meteorological Department	Monitoring and Forecasting weather conditions in Jordan based on available meteorological stations	Communicates forecasted weather and climatic conditions and announces any impending emergency conditions	

Table 2: Stakeholder Engagement Using RACI Matrix

Measures	Entity A	Entity B	Entity C	Entity D
Suggested Measure (1)	This will be filled out once actions have been discussed and agreed upon for implementation			
Suggested Measure (2)				
Suggested Measure (3)				

6. Monitoring and Evaluation Templates

Title of project (1)	
Installing PV Units at xxx Pump Station	
Objective of the project	
Due to increasing water demand and reduced water supply, the pump station is continuously working 24/7 to ensure water is being supplied to its subscribers. Moreover, the area experiences frequent electricity cuts and requires a long time to have it reconnected. This in return reflects on high electricity bills and high costs of maintenance. Therefore, this proposed measure could support the utility in managing the consumption and electricity cuts as an additional clean source.	
Purpose of monitoring and evaluation	**Monitoring frequency**
The objective of monitoring and evaluation of this project will support the feasible implementation considering the availability of relevant staff as well as financial resources.	– Annual monitoring and evaluation for utility reports – Monitoring during and after an event. – Evaluation frequency
Evaluation frequency	
Evaluation occurs, every month after installation of PV to compare reduction in electricity consumption and thus bill, as well as the reduction of duration of potential electricity cuts in the area.	

Title of project (2)	
Rehabilitate Pump Station and Water Network to reduce NRW (with EE pumps and new pipelines)	
Objective of the project	
Improve the operational infrastructure of the xxx Water System in order to increase efficiency and reduce losses within the network.	
Purpose of monitoring and evaluation	**Monitoring frequency**
The objective of monitoring and evaluation of this project will support the feasible implementation considering the availability of relevant staff as well as financial resources.	Monitoring frequency can be defined depending on available resources, however, will be considered in these cases: – Annual monitoring and evaluation for utility reports – Monitoring during and after an event. – Evaluation frequency
Evaluation frequency	
Evaluate on quarterly basis to compare conditions of water supply system with baseline conditions by considering the efficiency of pumps, network conditions, and the billed water quantities (to determine NRW percentage)	

Title of project (3)	
Utilize alternative water sources (grey water for irrigation, water supply share from non-vulnerable/exposed sources and increase Water Use efficiency awareness at subscriber level	
Objective of the project	
Due to increased events of droughts, the xxx Water Affairs under the Aqaba Water Company, shall be able to navigate alternative water sources to provide to subscribers, as well as reuse options in order to efficiently use the scare water in the area. To ensure the sustainability of this project, suitable awareness campaigns must be implemented for the local community to highlight the importance of water use efficiency and available low-cost technology.	
Purpose of monitoring and evaluation	**Monitoring frequency**
The objective of monitoring and evaluation of this project will support the feasible implementation considering the availability of relevant staff as well as financial resources.	Monitoring frequency can be defined depending on available resources, however, will be considered in these cases: – Annual monitoring and evaluation for utility reports – Monitoring during and after an event. – Evaluation frequency
Evaluation frequency	
Evaluation of this project shall be conducted by designated personnel every quarter to ensure continuity of awareness and change of behaviour	

<table>
<tr><td colspan="2">Title of project (4)</td></tr>
<tr><td colspan="2">Casing / Encasement of pipes (when needed)</td></tr>
<tr><td colspan="2">Objective of the project</td></tr>
<tr><td colspan="2">Due to possible events of flash floods, this project aims to reduce the negative effects of these floods on existing infrastructure along the path of floods. Casing pipelines shall ensure that flash floods will not damage or sweep exposed pipelines.</td></tr>
<tr><td>Purpose of monitoring and evaluation</td><td>Monitoring frequency</td></tr>
<tr><td>The objective of monitoring and evaluation of this project will support the feasible implementation considering the availability of relevant staff as well as financial resources.</td><td>Monitoring frequency can be defined depending on available resources, however, will be considered in these cases:
– Annual monitoring and evaluation for utility reports
– Monitoring during and after an event.
– Evaluation frequency
– After a flash flood event</td></tr>
<tr><td colspan="2">Evaluation frequency</td></tr>
<tr><td colspan="2">Evaluation of this project shall be conducted by designated personnel after a flash flood event</td></tr>
</table>

Monitoring Sheet

Adaptation actions	Outcomes	Baseline conditions	Indicators Indicators should reflect the purpose of monitoring and evaluation	Roles & responsibilities of organisations Who monitors? Who evaluates?	Monitoring & evaluation requirements for financial and resource personnel (e.g. what data need to be collected?)
1. Installing PV Units at xxx Pump Station	Reduce electricity cuts and provide clean energy	Planned and unplanned electricity cuts affect the operations of the pump station and disrupt the normal water supply.			
2. Rehabilitate Pump Station and Water Network to reduce NRW (with EE pumps and new pipelines)	Improved conditions of equipment and machinery in pump station to deliver water. Improved water networks to reduce NRW and conserve the lost quantities of water	Poor performance of facility resulting in loss of energy and water quantities.			

Adaptation actions	Outcomes	Baseline conditions	Indicators Indicators should reflect the purpose of monitoring and evaluation	Roles & responsibilities of organisations Who monitors? Who evaluates?	Monitoring & evaluation requirements for financial and resource personnel (e.g. what data need to be collected?)
3. Utilize alternative water sources (grey water for irrigation, water supply share from non-vulnerable/exposed sources and increase Water Use efficiency awareness at subscriber level	Tap into reusing treated wastewater for irrigation purposes to provide other inhabitants with additional water quantities, whom otherwise would not get water	Subscribers use fresh water for other purposes, when in times of drought more care and awareness should be done to efficiently use water.			
4. Casing / Encasement of pipes (when needed)	Protecting the exposed pipes from flash flood events.	During events of flash floods, exposed pipes can be affected by the uncontrolled flow of water whereby pipes can be swept away resulting in the cut of water supply as operators are required to treat the situation	**Technical**: Pipeline has been stabilized and not affected by flash flood events, compared to previous years. **Personnel:** 1 -2 dedicated staff for monitoring and evaluation of measure **Financial:** available funding is secured	Infrastructure & operational Manager: for monitoring progress on technical scope of measure and evaluates success of measure	

5.2. Case Study No.2 (Site B – Water Utility)

1. System Identification

– Utility, source water and treatment systems

Utility Information

General information	
Name of Utility	xxx pump station
System/ utility type	WTP, PS, Water reservoir, Water well, Water Resource
Address of Utility	Middle of Jordan
Age of Utility	Since 1995
Name of operator	xxx
Address of operator	xxx
Contact details of operator	xxx
Utility category (No. of citizens served)	Customers served by this network is approximately 12,057 connections with an approximate number of 72,342 inhabitants
Use this section for additional information	
xxx pump station are major water supply units within the xxx system, given that the area is highly populated. The climate stressors on the area can be seen through the increased water demand (which is usually felt by subscriber complaints). This water system includes local wells, xxx, xxx and water distribution network of xxx to xxx reservoir as well as xxx & xxx Reservoirs. The xxx pumping station receives potable water from both xxx ground water wells and xxx. The xxx pumping station accommodates six pumps, five of them are in-service and one is out of service/ disassembled.	

Utility Description

Source water	
Type of water source feeding the utility (e.g., lakes, rivers, and underground aquifers)	xxx reservoir, wells, and xxx.
Name of water sources	Pumping from wells of xxx to xxx Pumping Station By Gravity From xxx Reservoirs
Treatment process prior to entry to facility	Yes, at xxx PS

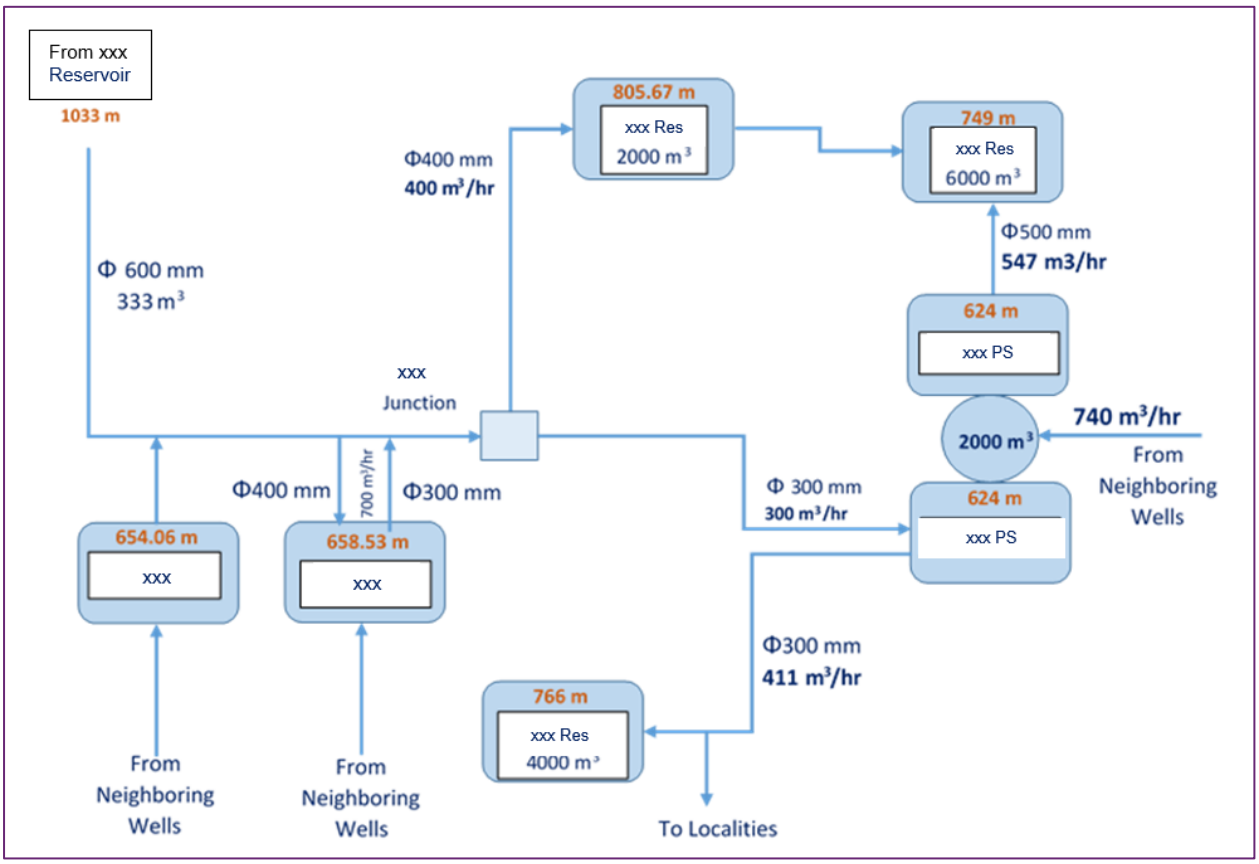
Pumps	
Number and types of circulation pumps	There are Six pumps at xxx Pump Station

Primary disinfection	
Primary treatment – chlorine or bromine	Chlorine
Chemical used	Cl_2
Average storage time	7 days Maximum
Supplier	Chlorine Supplier company
Disinfectant set point	The Disinfection is being conducted by the inlet water pipe of reservoir
Contact time	10 minutes
Continuous dosing system	Continuous
Online monitoring system	Local monitoring system

Schematic and/or Process Flow Diagram

Provide a drawing that shows the layout of the system within the utility. If the system is complex, use multiple flow diagrams. At a minimum, the schematic should include:

– All incoming water sources
– Filtration steps
– Primary and secondary disinfection points
– Automated chemical dosing points
– Automated monitoring points
– Sample points for water quality monitoring
– All on-site water storages
– Backflow prevention devices
– Wastewater removal disposal point



2. CRMP Team

Role/title	Responsibilities	Special competencies	Training requirements for CRMP	Team member name
Head of Energy Unit	O&M of Energy Unit Define high consuming	-	Climate Risk Assessment	xxx
Water Distribution	O&M	-	Climate Risk Assessment	xxx
Maintenance Engineer	O&M	-	Climate Risk Assessment	xxx
Head of Planning Department	Planning	-	Climate Risk Assessment	xxx
Head of wells and station Directorate	O&M	-	Climate Risk Assessment	xxx
Head of Technical services directorate	To ensure that the PS is operating according to the design	-	Climate Risk Assessment	xxx
Maintenance Engineer	Maintenance	-	Climate Risk Assessment	xxx
Head of water Distribution section	Water Distribution	-	Climate Risk Assessment	xxx

3. Risk Documentation

Step 1: Water Supply Hazard and Risk Identification

Hazard	Hazardous event	Future impact of climate change	Current controls (identified by responsible department)	Related Risks	Likelihood	Consequence	Risk*
Flash floods	Flooding / high flowing water streams and soil erosion	Expected to further increase by region + 4 days with precipitation >20mm by 2050 and + 8 days with precipitation >20mm by 2100 (RCP 8.5)	-	Destruction of infrastructure	Rare	Major (destruction on infrastructure and requires many corrective action)	**Medium**
			– Water quality operational control plan – National standard – Operational safety plans	Deterioration of water quality (biological and turbidity)	Possible	Major (deterioration of water quality and requires many corrective action)	**High**
Drought	Water scarcity	Expected to further increase by 15-20% (RCP 4.5) to 18-35% (RCP 8.5) by 2100 in the region (World Bank CC Knowledge Portal)	– Operational safety plans – Alternative sources	– Increased water demand – Increased maintenance requirements – Reduced water sources	Rare	Major	**Medium**

** The risk is ranked based on Risk Matrix (Included in Annex 3)*

Step 2: Risk Registry

Date of risk review			
Compiled by	xxx	**Date**	
Reviewed by	xxx	**Date**	

Risk ID	Risk category	Risk description	Risk assessment			Level of adequacy of existing controls	Mitigating response (risk reduction measure)	Risk owner	Status	Risk priority
			Likelihood	Consequences	Level of risk					
1	Destruction of infrastructure	– Pump failure – Destruction of electric panels – Network pipes and manholes, etc.	Rare	Major	Medium	Existing plans are adequate (preventive and emergency plans are in place)	– Cementing of well (casing) – Construction of managed water stream pathway	Infrastructure & operational Manager	Open	High
2	Deterioration of water quality (biological and turbidity)	– Turbidity increased – Contamination of water due to mixing of wastewater – Reduced water supply to subscribers	Possible	Major	High	Existing plans are adequate (team takes grab samples and they stop the abstraction as preventive action)	– Construction of managed water stream pathway Increase water supply share from non-vulnerable/exposed sources – Construct a water treatment plant – Increased preventive maintenance (e.g., future chlorine scrubber)	Quality Operational manager – xxx	Open	High
3	Affected water supply and demand	– Depreciation and increased cost of maintenance of electric equipment	Possible	Major	High	Existing plans are adequate (preventive and emergency plans are in place)	– Cooling systems	Infrastructure & operational Manager	Open	Possible

Step 3: Risk Treatment Plan

Date of risk review			
Compiled by	xxx	**Date**	
Reviewed by	xxx	**Date**	

The risk in priority order from risk registry	**Possible risk treatment options**	**Risk rating after treatment**	**Result of cost-benefit analysis accept/reject**	**Person responsible for implementation of option**	**Timetable for implementation**	**How will this risk and the treatment options be monitored?**
Water Quality – Turbidity increased – Contamination of water due to mixing of wastewater – Reduced water supply to subscribers	– Construction of managed water stream pathway (تبطين) – Increase water supply share from non-vulnerable/exposed sources – Construct a water treatment plant – Increased preventive maintenance (e.g., future chlorine scrubber)	-TBD-	-TBD-	Infrastructure & operational Manager	Short – medium – long term (all levels)	Site visits/ Committees/Regular report/ Meetings

The risk in priority order from risk registry	Possible risk treatment options	Risk rating after treatment	Result of cost-benefit analysis accept/reject	Person responsible for implementation of option	Timetable for implementation	How will this risk and the treatment options be monitored?
Destruction of infrastructure – Pump failure – Destruction of electric panels – Network pipes and manholes, etc.	– Cementing of well (casing) – Construction of managed water stream pathway (تبطين)	-TBD-	-TBD-	Infrastructure & operational Manager	Medium – long term	Site visits/ Committees/Regular report/ Meetings
Depreciation and increased cost of maintenance of electric equipment	– Cooling systems installation – Increase water supply share from non-vulnerable/exposed sources – Increased preventive maintenance (assess distribution / operational plan for more optimization and increase capacity of operators)	-TBD-	-TBD-	Infrastructure & operational Manager	Short – medium – long term	Site visits/ Committees/Regular report/ Meetings

4. Adaptation measures template

Action Identification

Action reference no.	**1 - Construction of managed water stream pathway (تبطين)**
Owner (person)	Quality Operational manager
Other relevant parties	MWI, MoPWH, MoLA,
Department description	
Benefits	The construction of managed water stream pathway or (تبطين) supports the water utility in controlling anticipated flash floods that would harm the water quality of wells in terms of turbidity as well as increase chances of biological contamination which will ultimately affect the water supply system. Therefore, this proposed action would prevent the flash flood stream to affect wells and reduce chances of adversely affecting the water quality. Moreover, this action would support the water utility operators in collecting the water of the flood in a more controlled manner, where it could be further treated and reused in the water cycle. Finally, this action would control the flow of the flash flood and thus avoid damaging existing infrastructure along the flood path.
Resources	Human - Financial
Implementation date	N/A
Measuring success (indicators)	Water quality of wells has been stabilized and not affected by flash flood events, compared to previous years. Additional water quality has been collected from flash floods events. Existing Infrastructure have not been affected by events of flash floods compared to previous years.

Action reference no.	**2 - Cementing of well (casing)**
Owner (person)	Infrastructure & operational Manager
Other relevant parties	MWI, WAJ
Department description	
Benefits	This particular action would support the water utility in protecting individual wells from flash floods events, as it cases the upper part of the well with cement, thus reducing the chances of undesired material from entering the well during flash flood events.
Resources	Human - Financial
Implementation date	N/A
Measuring success (indicators)	Water quality of wells has been stabilized and not affected by flash flood events, compared to previous years.

Action Reference No.	**3 - Constructing new treatment plant**
Owner (person)	Infrastructure & operational Manager
Other Relevant parties	MWI, WAJ, MoEnv, MoPWH, MoLA
Department Description	
Benefits	The construction and implementation of a water treatment plant will support the utility and its operators in treating the low-quality water after flash flood events, thus reducing the chances of cutting off supply during these events and utilizing all water quantities from wells.
Resources	Human - Financial
Implementation date	N/A
Measuring Success (indicators)	Number and duration of water supply cuts have been reduced during flash flood events, compared to previous years.

Action Reference No.	**4 - Cooling Systems**
Owner (person)	Infrastructure & operational Manager
Other Relevant parties	MWI, WAJ
Department Description	
Benefits	The installation of cooling systems at electric hotspots in facilities will allow the designed zone to be cooled at optimum temperatures that would reduce chances of overheating equipment that would eventually affect its efficiency and lifetime.
Resources	Human - Financial
Implementation date	N/A
Measuring Success (indicators)	Number and duration of water supply cuts have been reduced during droughts and heat wave events.

Action Reference No.	**5 – Increased preventive maintenance (assess distribution / operational plan for more optimization and increase capacity of operators)**
Owner (person)	Infrastructure & operational Manager
Other Relevant parties	MWI, WAJ
Department Description	
Benefits	Such activities focus on the capacities of current staff of utility to ensure their ability to manage and handle predicted and unpredicted events.
Resources	Human - Financial
Implementation date	N/A
Measuring Success (indicators)	Number of qualified and certified personnel for climate risk management has increased, as well as the increase in effective climate risk plans are available in the utility.

– **Cost benefit Analysis for Adaptation measures**

Table 1: Benefits' Scoring Table

Measures/ criteria weight	Benefits (B)					Benefits overall weight	Benefits Rank
	Ensure sustainable water supply and water quality	Financial feasibility / potential savings	Institutional support for implementation / autonomy in implementation	Co-benefits (air quality, GHG emission reduction, employment, better livelihood)	Urgency		
	20%	20%	20%	10%	30%	100	
Construction of managed water stream pathway	20	13	10	6	20	69	1
Cementing of well (casing)	17	20	20	10	20	87	5
Constructing new treatment plant	20	15	17	8	15	75	4
Cooling Systems	17	15	20	5	15	72	3
Increased preventive maintenance	17	13	20	5	15	70	2

* Rank of benefits: scoring from 1-5 (where One is the least beneficial and Five is the most beneficial).

Table 2: Cost Scoring Table

Measures	Cost (USD)	Ranking of cost
Construction of managed water stream pathway	11,000,000	3
Cementing of well (casing)	50,000 per well	1
Constructing new treatment plant	500,000	2
Cooling Systems	TBD	TBD
Increased preventive maintenance	TBD	TBD

** Rank of Cost: 1-5 (where 1 is the least and 5 is the most expensive)

Table 3: Benefit/Cost Ratio Table

Measures	Benefits rank	Ranking of cost	Ratio (B/C)
Construction of managed water stream pathway	1	3	0.33
Cementing of well (casing)	5	1	5
Constructing new treatment plant	4	2	2
Cooling Systems	3	TBD	TBD
Increased preventive maintenance	2	TBD	TBD

* The benefit-cost ratio (BCR) is the ratio of benefits to costs (Ratio=B/C)

Any BCR above one makes sense from an economic point of view as this indicates that benefits are higher than the costs. The larger the BCR becomes, the better the adaptation option is judged to be.

5. Monitoring and Evaluation Templates

Title of project (1)	
Construction of managed water stream pathway (تبطين) Project	
Objective of the project	
Due to increased events of flash floods, this project aims to reduce the negative effects of these floods on the quality of water in water wells and existing infrastructure along the path of floods. The Water Stream Pathway will allow a more controlled flow of water thus reducing negative effects on resources.	
Purpose of monitoring and evaluation	**Monitoring frequency**
The objective of monitoring and evaluation of this project will support the feasible implementation considering the availability of relevant staff as well as financial resources.	Monitoring frequency can be defined depending on available resources, however, will be considered in these cases: – Annual monitoring and evaluation for utility reports – Monitoring during and after an event. – Evaluation frequency – After a flash flood event
Evaluation frequency	
Evaluation of this project shall be conducted by designated personnel after a flash flood event	

Title of project (2)	
Cementing of well (casing) for xxx Water System Project	
Objective of the project	
Due to increased events of flash floods, this project aims to reduce the negative effects of these floods on the quality of water in water wells, since these water wells are usually downstream of floods. Therefore, the casing of these wells will reduce the chances of polluting events either from increase turbidity or increase chances of biological contamination.	
Purpose of monitoring and evaluation	**Monitoring frequency**
The objective of monitoring and evaluation of this project will support the feasible implementation considering the availability of relevant staff as well as financial resources.	Monitoring frequency can be defined depending on available resources, however, will be considered in these cases: – Testing of cement casing prior to installation at well, and as a test trial once installed to ensure that no leakages are witnessed – Annual monitoring and evaluation for utility reports – Monitoring during and after an event. – Evaluation frequency – After a flash flood event
Evaluation frequency	
Evaluation of this project shall be conducted by designated personnel after a flash flood event	

Title of project (3)	
Implement Treatment Plant	
Objective of the project	
Due to increased events of flash floods, this project aims to reduce the negative effects of these floods on the continuous operational of water system, by aiming to reduce the number and duration of cut offs during flash floods events, by providing the opportunity of treating the contaminated water in due time.	
Purpose of monitoring and evaluation	**Monitoring frequency**
The objective of monitoring and evaluation of this project will support the feasible implementation considering the availability of relevant staff as well as financial resources.	Monitoring frequency can be defined depending on available resources, however, will be considered in these cases: – Annual monitoring and evaluation for utility reports – Monitoring during and after an event. – Evaluation frequency – After a flash flood event
Evaluation frequency	
Evaluation of this project shall be conducted by designated personnel after a flash flood event	

Title of project (4)	
Installing Cooling Systems at xxx Pump Station	
Objective of the project	
Due to increased events of droughts and heat waves, this project aims to ensure that electric hotspots in facilities are well ventilated and suitable cooling systems are in place to avoid over-heating of equipment, thus extending the lifetime of equipment.	
Purpose of monitoring and evaluation	**Monitoring frequency**
The objective of monitoring and evaluation of this project will support the feasible implementation considering the availability of relevant staff as well as financial resources.	Monitoring frequency can be defined depending on available resources, however, will be considered in these cases: – Annual monitoring and evaluation for utility reports – Monitoring during and after an event. – Evaluation frequency – After a flash flood event
Evaluation frequency	
Evaluation of this project shall be conducted by designated personnel on quarterly basis, especially after major heat waves.	

<table>
<tr><th colspan="2">Title of project (5)</th></tr>
<tr><td colspan="2">Increased preventive maintenance</td></tr>
<tr><th colspan="2">Objective of the project</th></tr>
<tr><td colspan="2">Due to increased impacts of climate change and increased hazardous events, it is vital that operators are equipment with suitable measures and preventative actions that protect water sources and existing infrastructure.</td></tr>
<tr><th>Purpose of monitoring and evaluation</th><th>Monitoring frequency</th></tr>
<tr><td>The objective of monitoring and evaluation of this project will support the feasible implementation considering the availability of relevant staff as well as financial resources.</td><td>Monitoring frequency can be defined depending on available resources, however, will be considered in these cases:
– Annual monitoring and evaluation for utility reports
– Monitoring during and after an event.
– Evaluation frequency
– After a flash flood event</td></tr>
<tr><th colspan="2">Evaluation frequency</th></tr>
<tr><td colspan="2">Evaluation of this project shall be conducted by designated personnel on quarterly basis, especially after hazardous events.</td></tr>
</table>

Adaptation actions	Outcomes	Baseline conditions	Indicators Indicators should reflect the purpose of monitoring and evaluation	Roles & responsibilities of organisations Who monitors? Who evaluates?	Monitoring & evaluation requirements for financial and resource personnel (e.g. what data need to be collected?)
Construction of managed water stream pathway (تبطين)	Protecting water sources and infrastructure downstream of floods to protect against water contamination and destruction of infrastructure.	During events of flash floods, water pathways are not controlled, thus affecting any water source or infrastructure downstream, resulting in the cut of water supply as operators are required to treat the well prior to resuming its operation	**Technical**: Water quality of wells has been stabilized and infrastructure is intact and not affected by flash flood events, compared to previous years. **Personnel:** 1 -2 dedicated staff for monitoring and evaluation of measure **Financial:** available funding is secured	Infrastructure & operational Manager: for monitoring progress on technical scope of measure and evaluates success of measure	
Cementing of well (casing)	Protecting the water wells from flash flood events, by casing the wells and preventing polluted water from entering the well.	During events of flash floods, xxx wells are affected by the uncontrolled flow of water whereby the highly turbid and polluted water can infiltrate the well, thus affecting the groundwater quality, resulting in the cut of water supply as operators are required to treat	**Technical**: Water quality of wells has been stabilized and not affected by flash flood events, compared to previous years. **Personnel:** 1 -2 dedicated staff for	Infrastructure & operational Manager: for monitoring progress on technical scope of measure and evaluates success of measure	

		the well prior to resuming its operation	monitoring and evaluation of measure **Financial:** available funding is secured		
Implement Treatment Plant	Reduced number and duration of water supply cuts during flash flood events, by treating water in due time.	During flash flood events, operators are prone to cut off water supply for a long time in order to manage and treat the contaminated water. This usually takes time thus putting pressure on subscribers and operators in looking for alternative sources of water	**Technical**: Number and duration of water supply cuts have been reduced during flash flood events, compared to previous years. **Personnel:** 1 -2 dedicated staff for monitoring and evaluation of measure **Financial:** available funding is secured	Infrastructure & operational Manager: for monitoring progress on technical scope of measure and evaluates success of measure	
Cooling Systems	TBD				
Increased preventive maintenance	TBD				

References

Finding climate information

- IPCC Fifth Assessment Report (AR5), contributions of Working Group I, 2014. (https://www.ipcc.ch/site/assets/uploads/2018/02/WG1AR5_all_final.pdf)
- IPCC Fifth Assessment Report (AR5), contributions of Working Group II, 2014 (https://www.ipcc.ch/site/assets/uploads/2018/02/WGIIAR5-PartA_FINAL.pdf)
- Jordan's Second and Third National Communication on Climate Change (submitted to the UNFCCC on 2009 and 2014 respectively). (http://unfccc.int/resource/docs/natc/jornc2.pdf) (https://unfccc.int/resource/docs/natc/jornc3.pdf)
- Jordan's Second Biennial Update report, 2020 (https://unfccc.int/sites/default/files/resource/Jordan%E2%80%99s%20Second%20Biennial%20Update%20Report%20for%20web%2010-5.pdf)
- Jordan's National Adaptation plans (NAPs), 2020. (http://www.moenv.gov.jo/ebv4.0/root_storage/ar/eb_list_page/final_draft_nap-2021.pdf)
- Jordan Updated Nationally Determined Contributions (NDCs), 2021. (https://www4.unfccc.int/sites/ndcstaging/PublishedDocuments/Jordan%20First/UPDATED%20SUBMISSION%20OF%20JORDANS.pdf)
- Climate change Jordan's country profiles, USAID: (https://pdf.usaid.gov/pdf_docs/pa00mtz6.pdf)
- Climate change Jordan's country profiles, World Bank website: (https://climateknowledgeportal.worldbank.org/country/jordan)
- Climate change Jordan's country profiles, Climate Watch Data: (https://www.climatewatchdata.org/countries/JOR?end_year=2018&start_year=1990#climate-vulnerability)
- Jordan Maps floods and droughts- Integrated Context Analysis, 2019 https://geonode.wfp.org/imaps/ica/
- Jordan's National Climate Change Policy (2013-2020) (http://www.moenv.gov.jo/ebv4.0/root_storage/ar/eb_list_page/final_draft_nap-2021.pdf)

Further Reading References

– National Strategy and Action Plan to Combat Desertification (2015-2020) (https://knowledge.unccd.int/sites/default/files/naps/Jordan%2520-%2520eng%25202015-2020.pdf)
– Program “Adaptation to Climate Change to Sustain Jordan’s MDG Achievements”
– A National Green Growth Plan for Jordan (https://www.greengrowthknowledge.org/sites/default/files/A%20National%20Green%20Growth%20Plan%20for%20Jordan.pdf)

Annexes

Annex 1: System Identification

Utility, source water and treatment systems

– Utility Information

General information	
Name of utility	
System/utility type	
Address of utility	
Age of utility	
Name of operator	
Address of operator	
Contact details of operator	
Utility category (no. of citizens served)	
Use this section for additional information	

– Utility description

Source water	
Type of water source feeding the utility (e.g. rainwater, municipal supply)	
Water supplier	
Treatment process prior to entry to facility	

Pumps	
Number and types of circulation pumps	

Primary disinfection	
Primary treatment – chlorine or bromine	
Chemical used	
Average storage time	
Supplier	
Disinfectant set point	
Contact time	
Continuous dosing system	
Online monitoring system	
Secondary disinfection – e.g. ultraviolet (UV) disinfection	
Is UV disinfection installed?	
Date of installation	
Brand/make/model	
Online monitoring system	
UV operational monitoring parameters as per the validated operating conditions (e.g. flow rate, UV lamp age, UV Transmittance (UVT), UV Intensity (UVI), UV dose)	
Alkalinity	
Chemical used to increase alkalinity	
Chemical used to decrease alkalinity	
Supplier	
Average storage time	
Operating range in mg/L	

Backflow prevention	
Location	

Calcium hardness	
Method of managing calcium hardness levels	
Supplier	
Average storage time	

Schematic and/or process flow diagram

Provide a drawing that shows the layout of the system within the utility. If the system is complex, use multiple flow diagrams. At a minimum, the schematic should include:

- All incoming water sources
- Filtration steps
- Primary and secondary disinfection points
- Automated chemical dosing points
- Automated monitoring points
- Sample points for water quality monitoring
- All on-site water storages
- Backflow prevention devices
- Wastewater removal disposal point

Annex 2: CRMP Team

Role/title	Responsibilities	Special competencies	Training requirements for CRMP	Team member name

Annex 3: Risk Documentation

In order to be able to adequately document and identify relevant hazards, risks and potential risk management measures the following steps must be followed:

Step 1: Risk identification

- Refer to international and national reports on climate change to define the vulnerability and exposure of the system boundary to hazards, as well referring to and climate projections to define future hazards (i.e., Integrated Context Analysis (https://geonode.wfp.org/imaps/ica/)).
- Brainstorm with relevant CRMP Team members for defining the control systems in place as well as indicators to identify if or when a hazard might occur
- Utilize the Risk Matrix to define the qualitative rating of risks based on the level of likelihood and consequences. In order to define the level of likeliness and consequences, the CRMP shall use the matrix of “Qualitative measures of consequence” to better define the magnitude of the impact or consequence

Step 2: Risk Registry

- Based on the risk identification matrix, the CRMP Team shall register the **medium to high** risks identified in step 1
- Brainstorm with relevant CRMP Team members for possible risk reduction measures, the responsible risk owner, the status, and the priority of managing the risk

Step 3: Risk Treatment Plan

- Upon completion of Step 1 and 2, the CRMP Team shall devote their efforts into planning how the risk reduction measure would be managed and how the risks after implementing such measures will be monitored

Once the Risk documentation is complete, the CRMP Team shall continue to further develop the Adaptation measures and Monitoring and evaluation plans.

Step 1: Water supply hazard and risk identification[7]

Hazard	Hazardous event	Future impact of climate change	Current controls (identified by responsible department)	Related Risks	Likelihood	Consequence	Risk*

** The risk shall be ranked based on the below Risk Matrix*

[7] This table was adopted from the Australian Water quality risk management plan, Department of Health and Human Services Water Unit

Risk Matrix

Likelihood	Consequence				
	Insignificant	Minor	Moderate	Major	Severe
Almost certain	Medium	High	High	Extreme	Extreme
Likely	Medium	Medium	High	Extreme	Extreme
Possible	Low	Medium	Medium	High	High
Unlikely	Low	Low	Medium	Medium	High
Rare	Low	Low	Low	Medium	Medium

* Adopted from the Australian Water quality risk management plan, Department of Health and Human Services Water Unit

Qualitative Descriptions – Likelihood and Risk

The below are suggestions only. Utilities can use their own qualitative measures of risk and likelihood.

Descriptor	Description
Almost certain	Is expected to occur quarterly to monthly (8-24 times per year)
Likely	May occur quarterly to monthly (4-12 times per year)
Possible	May occur seasonally (2–12 times per year)
Unlikely	Expected to occur annually (once per year)
Rare	May occur less than annually

Qualitative Measures of Consequence

For the purposes of this plan, you are only required to assess a hazard based on the public health consequence. You may concentrate on the impacts in one area only (public health) or on several possible areas of impact. Sample areas such as legal, financial and service delivery have been included. Facilities can also use their own qualitative measures of consequence to determine risk.

Severity level	Public health	Legal/regulation	Financial/profit reduction	Service delivery
Insignificant	For water quality – a water quality incident/event that has no public health impact	Legal issues managed by internal manuals or practices Breach of internal policies or manuals without the need for formal investigation	Loss < JD Xk Net cash flow < 1% Budget overrun < 1%	No loss of service Issues rectified with corrective action
Minor	Minor health-related issue such as skin/eye irritation or isolated water quality issue For water quality – localised illness (diarrhoea) that does not require medical attention	Minor legal issues, non-compliances and breaches of regulation or Matter requires legal advice to address issues; internal breach of policies or manuals requiring a formal investigation	Loss JD Xk–Xk Net cash flow 1–X% Budget overrun 1–3%	Service restored within expected timeframes (e.g. ≤ 2 hours)
Moderate	Acute health impact such as a faecal incident or water quality repeatedly non-compliant with regulations For water quality – localised illness (diarrhoea) requiring medical attention	Serious breach of regulation with investigation or report to authority with prosecution and/or moderate fine possible or Required to operate under limited regulatory restrictions or orders; serious incident that requires legal representation	Loss JD Xk–Xk Net cash flow 4–20% Budget overrun 3–5%	Short-term disruption to service outside of expected timeframes (e.g. ≤ 12 hours)

Severity level	Public health	Legal/regulation	Financial/profit reduction	Service delivery
Major	Probable health impact such as a diarrhoeal incident or pathogens detected, or facility impacted For water quality – widespread illness (more than three confirmed cases) requiring hospitalisation	Major breach of regulation; major litigation or Significant prosecution and fines; required to operate under significant regulatory restrictions or orders; government inquiry/intervention	Loss JD10m–JD40m Net cash flow 20–80% Budget overrun 5–10%	Long-term disruption to service with extended resources required to remedy (> 12 hours < 24 hours)
Severe	A fatality, or long-term or permanent disabling effects on human health (more than one person) For water quality – fatality, disease secondary to water-borne illness	Significant prosecution and fines; very serious ligation including class actions or Criminal charges or civil litigation against the facility and/or personnel; registration revoked	Loss > JD40m Net cash flow > 80% Budget overrun > 10%	Complete and indefinite disruption to service (≥ 24 hours)

* Adopted from the Australian Water quality risk management plan- Department of Health and Human Services Water Unit.

Go to Step 2 to transfer resulting risks to the risk registry

Step 2: Risk Registry

Date of risk review			
Compiled by		**Date**	
Reviewed by		**Date**	

Risk ID	Risk category	Risk description	Risk assessment			Level of adequacy of existing controls	Mitigating response (risk reduction measure)	Risk owner	Status	Risk priority
			Likelihood	Consequences	Level of risk					

Go to Step 3 to transfer high-priority risks to the risk treatment plan

Step 3: Risk Treatment Plan

Date of risk review			
Compiled by		**Date**	
Reviewed by		**Date**	

The risk in priority order from risk registry	Possible risk treatment options	Risk rating after treatment	Result of cost-benefit analysis accept/reject	Person responsible for implementation of option	Timetable for implementation	How will this risk and the treatment options be monitored?

* Adopted from the Australian Water quality risk management plan, Department of Health and Human Services Water Unit

Annex 4: Adaptation Measures Template

Upon the documentation of the defined risks relevant to the system boundaries, it is important to focus analyzing the Cost benefit of suggested measures.in order to agree on the most applicable solution to the given conditions. The following template shall be used by the CRMP Team for further assessment.

- **Action Identification**

Action reference no.	
Owner (person)	
Other relevant parties	
Department description	
Benefits	
Resources	
Implementation date	
Measuring success (indicators)	

- Cost benefit Analysis for Adaptation measures
  Develop a Matrix with scores and seek feedback from CRMP team/ operators/managers (experts' judgement)

  Examples of criteria:

  - Human life/ health saved/Arable land, water supply etc. saved
  - Infrastructure and monuments saved
  - Co- benefits (air quality, GHG emission reduction, employment, better livelihood, etc)
  - Urgency of implementation
  - Practicability of implementation

Table 1: Benefits' Scoring Example Table

Measures/ criteria weight	Benefits (B)					Benefits overall weight	Benefits Rank
	Ensure sustainability Water Supply and Water Quality	Financial Feasibility / potential savings	Autonomy in implementation	Co-Benefits (air quality, GHG emission reduction, employment, better livelihood)	Urgency		
	20%	20%	20%	10%	30%	100	

* Rank of benefits: scoring from 1-X (where one is the least beneficial and X is the most beneficial).

Table 2: Cost Scoring Example Table

Measures	Estimated cost (JOD)	Ranking of cost

** Rank of Cost: 1-X (where 1 is the least and X is the most expensive)

Table 3: Benefit/Cost Ratio Example Table

Measures	Benefits rank	Ranking of cost	Ratio (B/C)

* The benefit-cost ratio (BCR) is the ratio of benefits to costs (Ratio=B/C)

Any BCR above one makes sense from an economic point of view as this indicates that benefits are higher than the costs.

The larger the BCR becomes, the better the adaptation option is judged to be.

Annex 5: Stakeholder Engagement and Coordination

Table 1: Stakeholder Group Identification

Stakeholder	Main responsibility	Relevant communication for climate risk management	Contact details

Table 2: Stakeholder Engagement using RACI Matrix

Measures	Entity A	Entity B	Entity C	Entity D
Suggested Measure (1)				
Suggested Measure (2)				
Suggested Measure (3)				

Annex 6: Monitoring and Evaluation Templates

Title of project (1)	
Objective of the project	
Purpose of monitoring and evaluation	**Monitoring frequency**
Evaluation frequency	

Monitoring Sheet

Adaptation actions	Outcomes	Baseline conditions	Indicators Indicators should reflect the purpose of monitoring and evaluation	Roles & responsibilities of organisations Who monitors? Who evaluates?	Monitoring & evaluation requirements for financial and resource personnel (e.g. what data need to be collected?)