unicef

Global Water Partnership

WASH Climate Resilient Development

Guidance Note

Risk assessments for WASH

About UNICEF

UNICEF works in more than 100 countries around the world to improve water supplies and sanitation facilities in schools and communities, and to promote safe hygiene practices. We sponsor a wide range of activities and work with many partners, including families, communities, governments and like-minded organizations. In emergencies we provide urgent relief to communities and nations threatened by disrupted water supplies and disease. All UNICEF WASH programmes were designed to contribute to the Millennium Development Goal for water and sanitation.

About GWP

The Global Water Partnership is an intergovernmental organisation of 13 Regional Water Partnerships, 86 Country Water Partnerships and more than 3,000 Partner Organisations in 183 countries. Its vision is a water secure world. Its mission is to advance governance and management of water resources for sustainable and equitable development through integrated water resources management (IWRM). IWRM is a process that promotes the coordinated development and management of water, land and related resources in order to maximise economic and social welfare in an equitable manner, without compromising the sustainability of vital ecosystems and the environment.

© 2017 GWP and UNICEF

ISBN: 978-91-87823-39-8
Cover photo credit: © UNICEF/UN034855/Abassi
Design and layout by Strategic Agenda

Portions of the text may be reproduced for educational or non-commercial use without prior permission from UNICEF and GWP, provided that the source is acknowledged, with mention of the complete name of the report, and that the portions are not used in a misleading context. No use of this publication may be made for sale or other commercial purposes. The findings, interpretations and conclusions expressed are those of the author(s) and do not imply endorsement by UNICEF and GWP.

Prepared in cooperation with HR Wallingford and the Overseas Development Institute (ODI)

HR Wallingford
Working with water

ODI

Contents

Figures

Tables

1. Introduction

1.1 Understanding risk

Risk-based programming in the WASH sector is essential. WASH systems that are informed by risk assessments will be more resilient and more likely to withstand shocks and stresses. Acting now to identify, manage and minimise risks will offer benefits to long-term WASH programme performance.[1]

Risk results from the interaction of hazard, vulnerability and exposure. Capacity also influences risk: high capacity reduces risk while low capacity does not. Table 1.1 provides key definitions for hazard, exposure, vulnerability and capacity; and Figure 1.1 shows how scores for each can impact on the overall risk score.

Table 1.1: Key definitions

Hazard	Exposure	Vulnerability	Capacity
The term hazard can be defined as "a dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage".	The term exposure can be defined as "people, property, systems, or other elements in places or settings that could be adversely affected by hazards and that are thereby subject to potential losses".	The term vulnerability can be defined as "the characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard". There are many aspects of vulnerability, arising from various physical, social, economic and environmental factors.	The term capacity includes "infrastructure and physical means, institutions, societal coping abilities, as well as human knowledge, skills and collective attributes such as social relationships, leadership and management". Capacity is the ability to prepare, respond, recover and learn.

Source: UNISDR (2009)

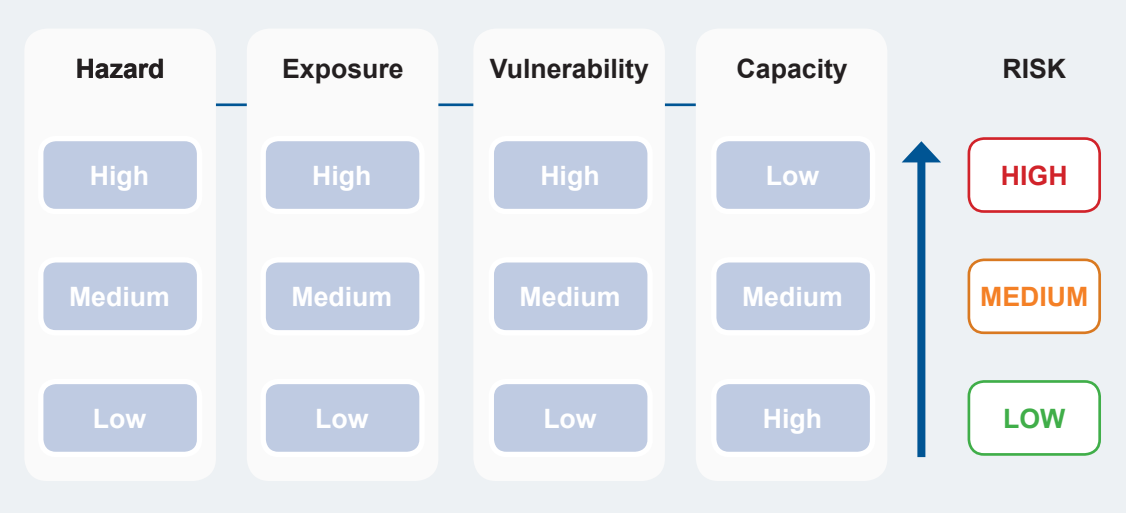

Figure 1.1: The impact of hazard, exposure, vulnerability and capacity scores on the overall risk score

[1] GWP and UNICEF (2014)

The WASH sector is at risk from a wide range of hazards. These hazards might be climate-related – for example, floods and droughts affect a large number of people and could affect more in the future (see Box 1). Other environmental hazards include geophysical events and trends, such as volcanic eruptions and earthquakes. The WASH sector can also be affected by: violent conflict; political/social unrest and instability; economic downturn and market instability; chemical hazards; and biological hazards. Some hazards can also be impacts that result from other hazards – for example, pollution can also be an impact if it was caused by flooding.

There is a need to broaden the understanding of risk to encompass all the different hazards that could affect the WASH sector.

Box 1: Climate variability and change

- Projections indicate warming by the end of the 21st century of between 0.3 and 5°C.[2]
- With a 2°C global temperature rise, up to 10 million more people could be affected by coastal flooding each year. With a 4°C temperature rise, a 50 percent decrease in water availability could occur in East Africa and the Middle East.[3]
- In developing countries, the incidence of diarrhoea is expected to increase by around 5 percent for every 1°C increase in temperature.[4]
- Since the original Rio Earth Summit in 1992, floods, droughts and storms have affected 4.2 billion people (95 percent of all people affected by disasters) and caused US$1.3 trillion of damage (63 percent of all damage).[5]

1.2. Risk assessment

Risk assessments usually relate to a particular exposure and aim to show who or what is most at risk: populations, communities, infrastructure, or the environment. Risk assessments are important because they provide valuable evidence for decision-making.

Risk assessment

A risk assessment can be defined as "a methodology to determine the nature and extent of risk by analysing potential hazards and evaluating existing conditions of vulnerability that together could potentially harm exposed people, including specific groups such as children, property, services, livelihoods and the environment on which they depend".[6]

By assessing risks, you can:

- identify any hazards that could have an impact
- identify who and what is exposed to these hazards
- identify the vulnerabilities of those exposed, which influences the damaging effects of a hazard;
- identify and consider capacity to understand how it influences risk
- consider how and to what extent the risks can be reduced or mitigated.

Many different risk assessment methods are available. They seek to determine the level of risk (such as high, medium or low), either quantitatively or qualitatively.[7]

It is important to identify and assess the impact of all possible risks, and given the scarcity of resources, prioritise those that require action. The type of action needed to reduce these risks and improve the resilience of the WASH sector is dependent on current capacity.

By identifying and assessing all the risks to the WASH sector, the case can be made to governments and their WASH sector partners to take effective action. It also enables disaster risk reduction (DRR) and adaptation agendas to be brought together more explicitly in tackling underlying issues and solutions.[8]

[2] IPCC (2013)
[3] Stern (2007)
[4] Campbell-Lendrum and Woodruff (2007)
[5] GWP and UNICEF (2014)
[6] Adapted from UNISDR (2009)
[7] AMCOW (2012)
[8] GWP and UNICEF (2014)

2. Introducing the Guidance Note

2.1. Setting in the Strategic Framework

The Strategic Framework for WASH Climate Resilient Development advances sector thinking around WASH and climate change, cutting across both development and emergency preparedness programmatic spheres, with climate resilience addressed as a cross-cutting issue encompassing elements of both DRR and climate change adaptation.[9] The Framework serves to set out the rationale and concepts for WASH climate resilient development, as well as improve understanding of how to ensure that climate resilience is considered in WASH strategies, plans and approaches.

The objective of the Strategic Framework is to support WASH service delivery that is resilient to the climate, both now and in the future. The Framework is centred around four quadrants of activity, and this Guidance Note sits under the 'Understand the problem' quadrant, which covers the various elements that help to understand the risks facing the WASH sector. The main tasks in this phase of the Framework are to:[10]

- Understand the priorities outlined in existing relevant strategies, plans and studies, and the risks posed by climate variability and change. This informs the argument for new investment strategies and guides the scope for further analysis.
- Carry out stakeholder analysis to identify who has an interest or influence over WASH outcomes, and ensure that their needs are taken into account. Engaging with stakeholders can help to better understand roles, responsibilities, risks and uncertainties, with stakeholders providing inputs on many different aspects of the process.
- Identify and understand hazards, exposure and vulnerabilities, and the existing capacities to respond.

The quadrants are shown in Figure 2.1.

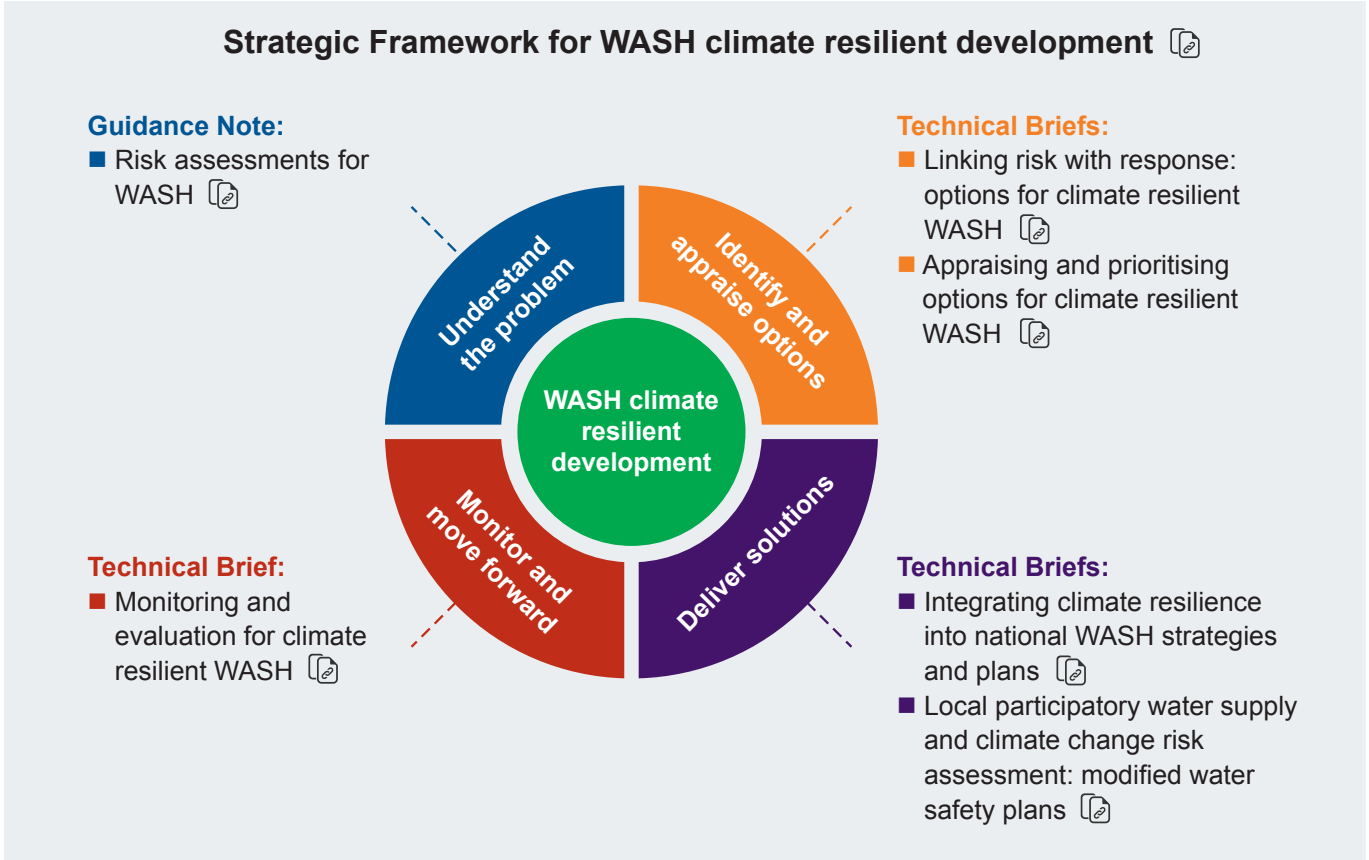

Figure 2.1: Strategic Framework quadrants and associated Guidance Note and Technical Briefs

[9] http://www.gwp.org/en/Our-approach/Thematic-Areas/Climate-Resilience-and-Water-Security/Global-Water-and-Climate-Programme/WASH-Climate-Resilient-Development--a-GWP-UNICEF-Collaboration/

[10] GWP and UNICEF (2014)

The Framework also complements the tools recommended by the GWP integrated water resources management (IWRM) Tool Box, specifically the tools on Risk Assessment and Vulnerability Assessment.[11]

2.2. Scope and target audience

This Guidance Note has been developed to support national workshops in developing draft programmes, strategies and plans. The Guidance Note:

- sets out an approach for conducting risk assessments for the WASH sector, to provide evidence to support the prioritisation of risks requiring action
- covers risks across a wide range of hazard groups that affect the WASH sector, as well as climate-related risks in more detail
- is a resource for the WASH sector as a whole
- focuses primarily on rural WASH services encompassing small-scale and community systems; however, the approach set out in this Guidance Note can be applied to both rural and urban settings.

The Guidance Note forms part of the Strategic Framework for WASH Climate Resilient Development, produced under a collaboration between GWP and UNICEF.[12]

The target audience is the same as the Strategic Framework. It includes government planners, decision-makers and practitioners responsible for WASH services provision at national, sub-national and local levels, and their associated WASH development partners. The Guidance Note is primarily aimed at the national level; however, the approach is flexible enough to use at sub-national levels if required.

Risk is driven by multiple factors. The WASH sector has a key role to play in this. This Guidance Note can be used either in support of a wider multi-sector analysis, or to produce a standalone assessment for the WASH sector.

The approach in this Guidance Note aligns with the UNICEF Risk-Informed Programming Guidance.[13] This outlines the method for UNICEF Country Offices to carry out programmes that are grounded in an understanding of the risk landscape. The ideas in this Note also bring together thinking from the Overseas Development Institute (ODI) report 'Adaptation to Climate Change in Water, Sanitation and Hygiene',[14] as well as a variety of other sources.

2.3. Using the Guidance Note

2.3.1. The approach

There are two parts to the assessment, shown in Figure 2.2. The first part is a high-level assessment for risks across all types of hazards. The second part is a detailed assessment for climate-specific risks only.

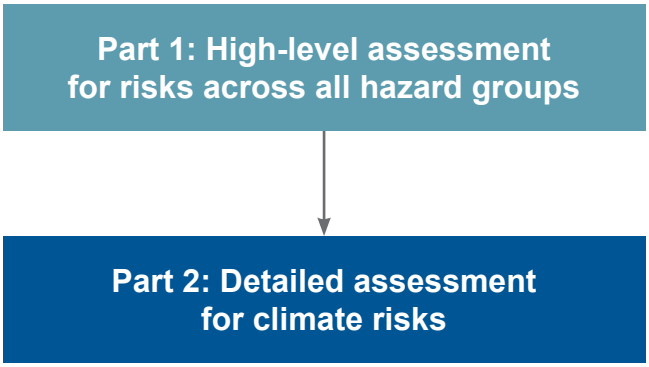

Figure 2.2: Assessment parts

Users of this Guidance Note will assess hazard, exposure, vulnerability and capacity and bring these together to provide an overall scoring of risks. The following risk formula is used:

Risk = Hazard x Exposure x Vulnerability

The risk formula includes scores for hazard, exposure and vulnerability. Capacity is not used in the equation, but assessed separately to help prioritise risks for identifying resilient options. While there are some national-level elements of capacity to consider – such as the effect of political views on the ability to adapt – capacity is something which is mainly specific to the regional or local level. Therefore, for a high-level assessment, it will be difficult to score capacity. It is not used to determine the overall risk score because if it is scored inaccurately there is a possibility that some key risks may be ignored as the capacity score might inappropriately cancel out the vulnerability score. More information on capacity is given in Section 7.

Figure 2.3 outlines the approach to be used in the assessment.

[11] http://www.gwp.org/en/ToolBox/
[12] GWP and UNICEF (2014)
[13] UNICEF (2015a) and UNICEF (2015b)
[14] Oates et al. (2014)

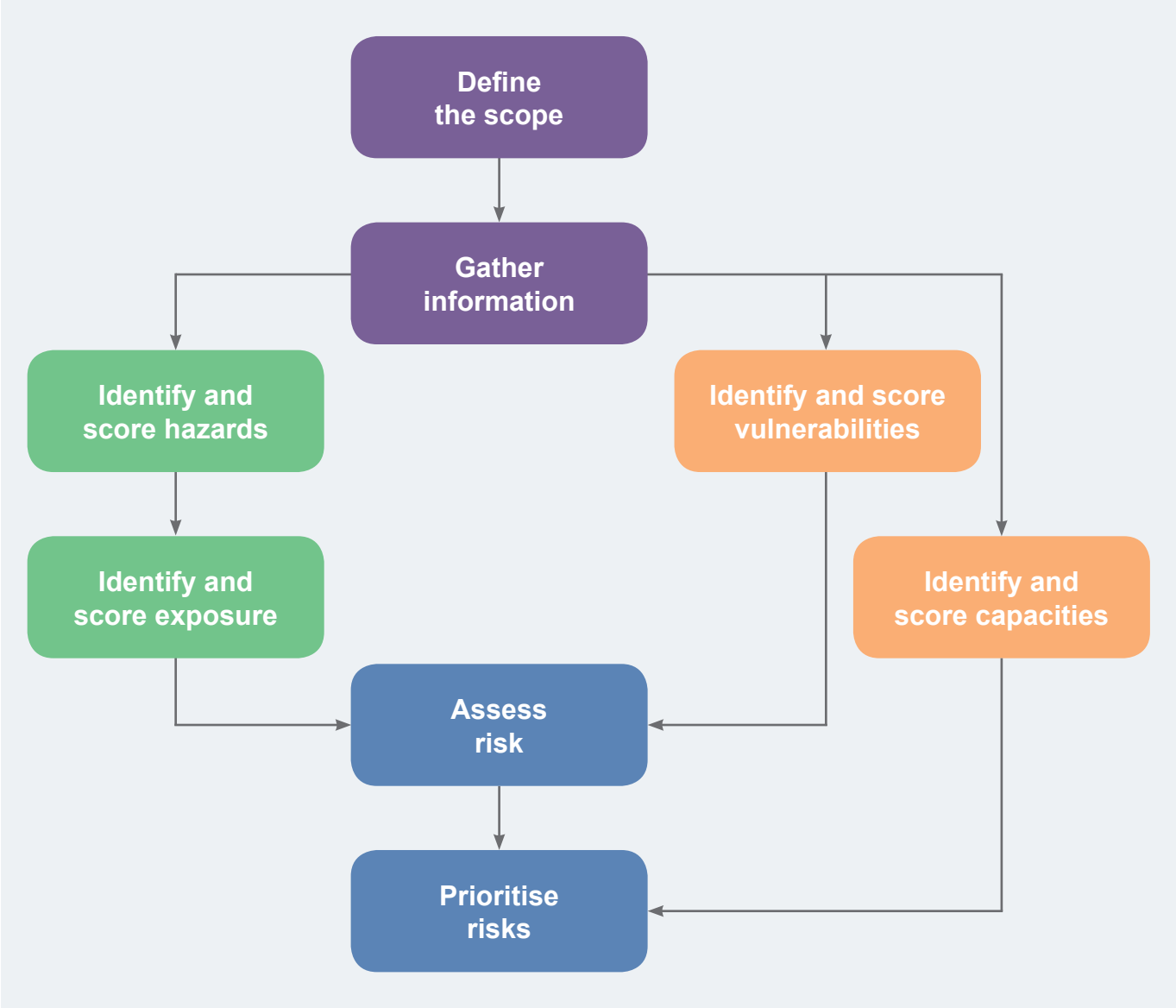

Figure 2.3: Assessment approach

The approach:

- includes a mix of literature reviews, data collection and stakeholder consultation
- is flexible, recognising that the level of information available across the different hazards will vary widely for different countries
- includes examples to guide users through the assessment process
- provides links to further information.

The approach given in Figure 2.3 is the same for both the high-level and detailed climate assessments. However, the method within each step may vary between the two assessments. At the beginning of each step, a summary is given which specifies where the method varies between the two assessments.

Box 2: Spreadsheet tool

To help you complete the assessments, a spreadsheet tool has been developed to accompany this Guidance Note. You can fill in each section as you progress through the assessments, and easily edit and update scores.

2.3.2. Consultation

The high-level assessment will use stakeholder workshops. The detailed climate assessment may then include expert elicitation. Box 3 explains the differences between the two types of consultation.

Box 3: Stakeholder engagement and expert elicitation

- Stakeholder engagement is more generalist than expert elicitation, higher-level and based on consensus forming workshops.
- Expert elicitation is more selective about who is involved, can go into more detail depending on the expertise of those involved, and is based on the judgements of individuals and comparisons with fellow experts. It does not necessarily require a workshop, as experts can give their opinions independently – although it is useful to have some form of follow-up where experts can review/compare results. It is not specifically aimed at forming a consensus and is often more time-consuming.

2.3.3. Components of exposure, vulnerability and capacity

Exposure, vulnerability and capacity are considered in six different components, given in Figure 2.4.

These components are used in this Guidance Note to help identify and score exposure, vulnerability and capacity. All the components are important and potentially measurable in the context of risks to safe and sustainable WASH services.

The source–pathway–receptor model is given in Figure 2.5. It is often used in environmental risk assessments to help understand the link between hazard and risk.

The components (from Figure 2.4) are used in assessing exposure, vulnerability and capacity, because these are all associated with the 'receptor' – i.e. something that could be affected such as population or infrastructure. The components are not used for

Figure 2.4: Components of exposure, vulnerability and capacity[15]

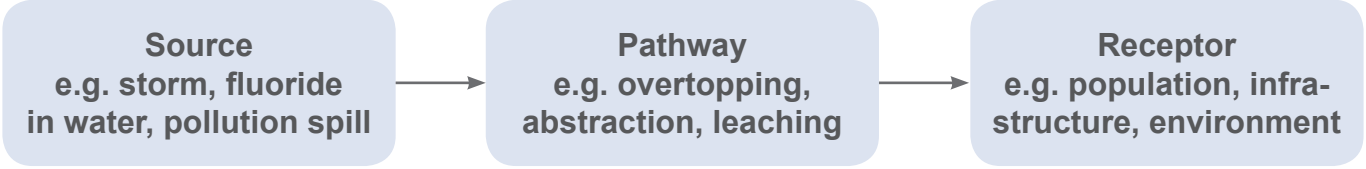

Figure 2.5: The source–pathway–receptor model

[15] Based on the vulnerability and capacity 'components' given in UNICEF (2015b). The physical component in the WASH sector refers to infrastructure, including technology and aspects of design. The environmental component covers water sources and land types, including land use change.

assessing hazards because these are associated with the 'source' and the 'pathway' (the way in which exposure might occur). The hazards also differ in that they are organised into more clearly-defined groups, given in Section 4. For the detailed climate assessment, all hazards sit within the same group.

2.4. Assessment approach in detail

The approach used for the assessments is shown in more detail in Figure 2.6. The numbers refer to the relevant sections in this Guidance Note.

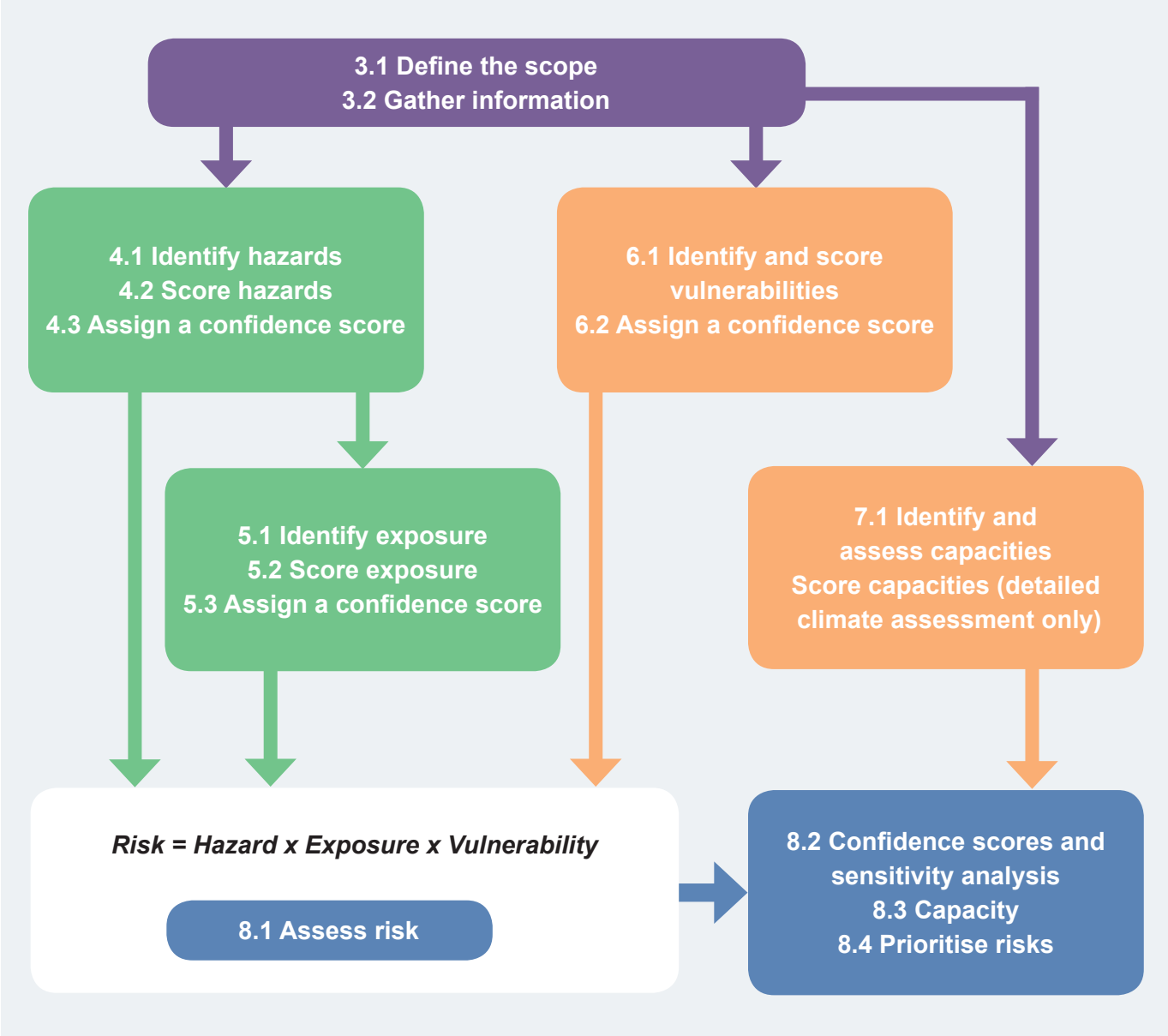

Figure 2.6: Assessment approach in detail

3. Initial steps

3.1. Define the scope

The first step of the risk assessment is to define the scope.

Table 3.1 outlines the differences in scope and method between the two assessments.

Table 3.1: Differences in scope and method between the two assessments

	Part 1 – High-level assessment for risks across all hazard groups	Part 2 – Detailed assessment for climate risks
Scope	Provides a framework/method for a group to undertake a high-level qualitative risk assessment for WASH, for their particular geographic scope	Provides a framework/method for a group to undertake a detailed climate risk assessment for WASH, for their particular geographic scope
Method	A qualitative assessment that uses stakeholder engagement only	Uses more detailed analysis if available and may also make use of expert elicitation

3.2. Gather information

For the assessments, you will need to use information and data from existing sources and studies of relevance to the geographical area of interest. This will involve workshop leaders, who will collate the information prior to any workshops being held.

The existing information will vary widely by country. For example, in some countries assessments for some of the hazards may already have been completed, while in others, there may be limited data and literature to draw from. In some cases, anecdotal evidence, or very basic estimation methods may be required. Data availability is a common challenge and it is important that investments are made to help build the evidence base.

The confidence scoring system described in Section 4.3 is used to assign a level of confidence to each of the scores for the hazard, exposure and vulnerability steps of the process, and considers the information or data that has been used to come up with the score.

The approach is flexible enough to allow for differences in data availability. The high-level assessment is based on stakeholder workshops and qualitative assessments only. The detailed climate assessment can use more detailed information where available, but can still be based on stakeholder workshops or expert elicitation only, if existing data are limited.

Some key sources of information that can be used as the basis for the high-level and detailed climate risk assessments for WASH are given in Box 4.

Box 4: Key sources of information

Inter-Agency Standing Committee (IASC)[16]

The ERP approach has been developed with the aim of optimising 'the speed and volume of critical assistance delivered immediately after the onset of a humanitarian emergency'.

Conducted at a country level, one element of ERP is risk analysis and monitoring, and the guidelines help to develop a clear and common understanding of risks. This includes identifying the hazards that could trigger a crisis, and ranking them by impact and likelihood. The identified hazards cover five different threat categories.

The Index for Risk Management - INFORM[17]

INFORM is a method that can be used to quantitatively assess crisis and disaster risk. It brings together a number of different indicators that measure the dimensions of risk: hazard, exposure, vulnerability, and lack of capacity.

INFORM provides a way of simplifying lots of information about crisis and disaster risk so it can be used for decision-making. The source data used in INFORM comes from international organisations and academic institutes, and is considered the most reliable available. INFORM can be used at a global, regional or national level.

EM-DAT – the International Disaster Database[18]

EM-DAT, the Emergency Events Database, was launched in 1988 by the Centre for Research on the Epidemiology of Disasters.

EM-DAT contains data on the occurrence and effects of disasters around the world, including natural and technological disasters. The information is used for humanitarian action at national and international levels.

The database includes country profiles, which show a summary of disasters, as well as the top disasters that have occurred in the country.

Other sources of information

- National Adaptation Programmes of Action (NAPAs)
- National Adaptation Plans (NAPs)
- Nationally Appropriate Mitigation Actions (NAMAs)
- WASH sector strategies and plans
- Water resources management plans
- WFP/UNICEF Hazard calendar
- UNICEF's Climate Change Mapping
- National Communications produced for the United Nations Framework Convention on Climate Change (UNFCCC)
- Other national/sub-national/sectoral strategies and plans.

[16] IASC (2015)
[17] INFORM Index for Risk Management (n.d.)
[18] http://www.emdat.be/

4. Hazards

Hazard

The term hazard can be defined as “a dangerous phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage”.

Source: UNISDR (2009)

There are three main steps to hazard assessment. These are given in Figure 4.1.

Table 4.1 outlines the differences between the high-level and detailed climate assessments for the hazards steps of the process.

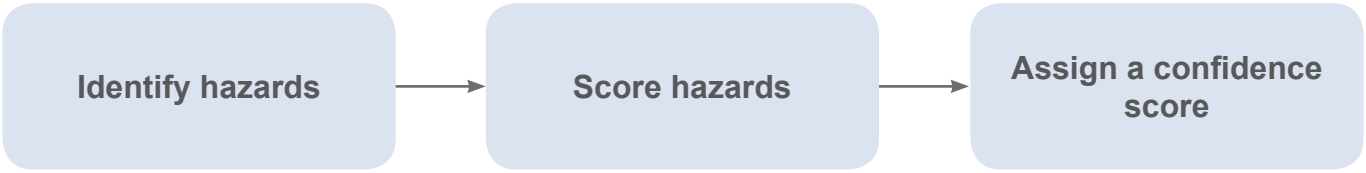

Figure 4.1: Steps to assess hazards

Table 4.1: Differences between assessment methods for identifying and scoring hazards

Step	High-level assessment	Detailed climate assessment
Identify hazards	This looks broadly across different hazard groups.	This looks at climate-related hazards only, building on those identified in the high-level assessment.
Score hazards	Users will consider the characteristics of the hazard to come up with a traffic light scoring system, with a score of 1 to 3 for each hazard. It is anticipated that this will be based on one main characteristic of the hazard but, if appropriate, more than one can be considered.	Users will consider the characteristics of the climate hazard to come up with a traffic light scoring system, with a score of 1 to 3 for each hazard. Greater consideration will be given to the range of characteristics of the hazard, which may result in more than one risk being identified.
Assign a confidence score	One confidence score is assigned for each hazard.	Two confidence scores are assigned, one for the hazard in the present day, and one for the hazard in the future.

4.1. Identify hazards

4.1.1. The approach

The purpose of this step is to identify the hazards that could impact on the WASH sector. A list of hazards, categorised into different groups, has been identified (see Figure 4.2 and Table 4.3). This list does not cover all possible hazards, only those which are of relevance to the WASH sector.

Using this list of hazards, a consideration will be whether:

- these hazards are of relevance to your situation
- there are any additional hazards, besides those included in the list, that you need to consider in the assessment.

Box 5 sets out some points to consider to ensure you have identified all the relevant hazards.

Once you have identified all the relevant hazards, you will then need to record any available information you have about them including:

- the frequency of the hazard
- any details on how the hazard is expected to change in the future
- the duration of the hazard – i.e. how long the hazard lasts
- the intensity or magnitude of the hazard – for example, if you have identified flooding as a hazard, is it shallow, slow moving flood water; or deep and/or fast-moving flood water?
- the extent of the geographical area affected by the hazard
- whether the hazard occurs at a particular time of year – for example, during the monsoon season.

This information will be used to score the hazards in the next step. The suggested format for recording this information is given in Table 4.2.

Box 5: Points to consider to ensure you have identified the relevant hazards:

- Have you collected and reviewed all the relevant literature?
- Have you identified and made use of any existing resources that have information on hazards?
- Have you engaged with all the relevant stakeholders for their input?
- Have you considered the full range of hazards irrespective of the available information? Remember that the information available for some hazards might be limited.

Tips for identifying hazards

- Make sure that you consider all the hazards and whether they are of relevance to your situation.
- If you feel that it would be useful to record specific locations affected by the hazard – for example, to produce a hazard map showing hotspots – then you can do so in the accompanying spreadsheet tool. However, this information will not be used to assess risk in the high-level or detailed climate assessments.

Table 4.2: Recording hazards

Hazard group	Hazard	Frequency	Duration	Intensity	Geographical extent	Time of year

4.1.2. The high-level assessment

For the high-level assessment, you will need to consider both climate and non-climate hazards. The hazard groups used here are given in Figure 4.2.

All these hazard groups are relevant to the WASH sector and are important to consider in the assessment.

Land use change is not included in these hazard groups because it is an external factor that could impact on any of the given hazards – deforestation, for example, could increase the number of landslides. Therefore, land use change is included as a factor that influences vulnerability; more details are given in Section 6. Table 4.3 provides examples of hazards for each of the hazard groups that are relevant to the WASH sector, to be considered in the high-level assessment.

4.1.3. The detailed climate assessment

Table 4.4 provides examples of climate-related hazards to be considered in the detailed climate assessment. Note that all of these are listed in Table 4.3; most are in the environmental events and environmental degradation group but some are in the biological hazards group.

Figure 4.2: Hazards and the WASH sector

Table 4.3: Examples of hazards to be considered in the high-level assessment

Environmental events (climate-related, meteorological, and geophysical events and trends) and environmental degradation (pollution, industrial hazards)			
■ Drought ■ Flooding ■ Heavy rainfall ■ Heatwave ■ Cold spell ■ Blizzard ■ Heavy snowfall ■ Melting of snow and ice	■ Storms – thunder, hail, dust, ice, wind ■ Tornado ■ Tropical cyclone ■ Salinisation (dryland) ■ Desertification ■ Wildfire ■ Landslide, mudslide	■ Avalanche ■ Rockfall ■ Subsidence ■ Soil erosion ■ River bank erosion ■ River siltation ■ Coastal erosion ■ Saline intrusion	■ Sea level rise (long-term) ■ Storm surge ■ Tsunami ■ Earthquake ■ Volcanic eruptions ■ Pollution ■ Other
Violent/potential violent conflict (ongoing conflict, socio-political tensions and possible triggers)		**Current and potential political/social unrest and instability**	
■ Violent conflict ■ Riots ■ Other		■ Social unrest and protests ■ Political instability ■ Other	
Biological hazards		**Chemical hazards**	
■ Potential viruses/diseases ■ Insect/animal infestation ■ Plant or animal contagion ■ Moulds and fungi ■ Algal growth ■ Other		■ Arsenic ■ Fluoride ■ Nitrate ■ Phosphate ■ Chemical spill ■ Other	
Cross-border dynamics (as a destabilising factor)		**Economic downturn/shocks and market instability**	
■ Displacement ■ Migration ■ Cross-border violence ■ Other		■ Economic downturn ■ Economic shock ■ Market instability for specific commodities ■ Other	

Table 4.4: Examples of climate-related hazards to be considered in the detailed climate assessment

Climate-related hazards			
■ Drought ■ Flooding ■ Heavy rainfall ■ Heatwave ■ Cold spell ■ Blizzard ■ Heavy snowfall ■ Melting of snow and ice	■ Storms – thunder, sand, hail, dust, ice, wind ■ Tornado ■ Tropical cyclone ■ Salinisation (drylands) ■ Desertification ■ Wildfire ■ Landslide, mudslide	■ Avalanche ■ Rockfall ■ Subsidence ■ Soil erosion ■ River bank erosion ■ River siltation ■ Coastal erosion ■ Saline intrusion	■ Storm surge ■ Pollution ■ Insect/animal infestation ■ Plant or animal contagion ■ Moulds and fungi ■ Disease ■ Algal growth ■ Other

4.2. Score hazards

4.2.1. The approach

In this step, you will score each of the hazards that you have identified as relevant. The way to do this is to consider the characteristics of the hazard so that each can be classified and assigned a score which corresponds to a traffic light system. Characteristics to consider include:

- the frequency with which the hazard occurs
- the intensity or magnitude of the hazard
- the geographical extent of the hazard
- the duration of the hazard – i.e. how long the hazard lasts.

Whether you consider only one characteristic or two will depend on the data that are available. If data are available for two characteristics, then you should use both to assign a score to the hazard.

To assess each hazard, you will need to consider what has happened in the recent past, as well as what is expected to occur in the future, based on the available information. The time horizon for looking at future risks is the near-term, over the next 15-20 years, rather than longer periods where uncertainty becomes greater. This approach also fits in with WASH programming timescales and development.

Remember that you will have a wide range of hazards to score and the approach used will likely vary for each. Depending on the hazard, it may be more appropriate to score the hazard using one of the characteristics over another. For example, you may feel that it is more appropriate to score flooding based only on its frequency, while it is more appropriate to score desertification based on its geographical extent. Or it may be that two of the characteristics are relevant, such as duration and geographical extent for drought.

You will also need to make sure that you do not score the hazard using a characteristic that might be inappropriate and would therefore result in a score that is too low. For example, a tornado should be scored based on its frequency and intensity, rather than its duration.

Box 6 provides some guiding questions that can be considered when scoring a hazard based on frequency.

Once you have decided which characteristic or characteristics to base your assessment on for each hazard, you will need to come up with categories so that you can assign a score. Table 4.5 provides an example of a scoring system to classify hazards according to frequency. This shows present-day and expected future frequency in separate columns. Both are assessed to give an overall score for the hazard.

Tips for scoring hazards

- The characteristics will not necessarily be of relevance to all the hazards.
- If you think that more than two of the characteristics are relevant to consider, you should still only choose two on which to base your assessment. This avoids the approach becoming overly complicated.
- If you are unsure that you have picked the two most relevant characteristics, then you can try out more than one combination to see whether the outcome is sensitive to this decision. For more details on sensitivity analysis, see Section 4.3.
- Remember that existing information may vary widely. For some hazards, there may be limited data and literature to draw from, and in some cases, it may be necessary to use anecdotal evidence or very basic estimation methods. This is where sensitivity analysis of the scoring is really useful and why use of a confidence score is so important. For more details on assigning a confidence score, see Section 4.3.

Box 6: Questions to guide scoring of hazards based on frequency

- Is the hazard currently being experienced or expected to occur in the future?
- How often does the hazard occur? Is it annually or more regular? Does it occur only once every few years or is it rarely experienced?
- Is the hazard expected to increase in frequency in the future?

If the hazard is considered a high (H) hazard, then it would score 3, a medium (M) hazard would score 2 and a low (L) hazard would score 1.

Another way of classifying hazards is given in Table 4.6. This shows more than one medium category used in the scoring system. An example for present day and expected future geographical extent is given in Table 4.7.

You may feel that two different characteristics are considered relevant to the particular hazard. For

Table 4.5: Classifying hazards according to frequency

Class	Frequency		Score
	Present-day frequency	Expected future frequency	
High	Occurs frequently	Expected to continue to occur frequently	3
Medium	Occurs only occasionally	Expected to continue to occur either occasionally or more frequently	2
Low	Rarely occurs	Not expected to occur more frequently	1

Table 4.6: Classifying hazards – example for present day and expected future frequency

Class	Frequency		Score
	Present-day frequency	Expected future frequency	
High	An existing problem	Expected to increase in the future	3
Medium	An existing problem	Not expected to increase in the future	2
Medium	Currently rarely a problem	Expected to increase in the future	2
Low	Currently rarely a problem	Not expected to increase or occur in the future	1

Table 4.7: Classifying hazards – example for present day and expected future geographical extent

Class	Geographical extent		Score
	Present-day extent	Expected future extent	
High	Affects a large area	Expected to increase in the future	3
Medium	Affects a large area	Not expected to increase in the future	2
Medium	Affects a small area	Expected to increase in the future	2
Low	Affects a small area	Not expected to increase or occur in the future	1

example, for climate-related hazards, both the frequency and intensity of the hazard may be relevant, with available information and/or knowledge on both.

Figure 4.3 shows a scoring system based on frequency and intensity, while Figure 4.4 shows a scoring system based on intensity and geographical extent.

An example of a system for scoring a hazard based on frequency and intensity, for both the present day and the expected future, is given in Table 4.8.

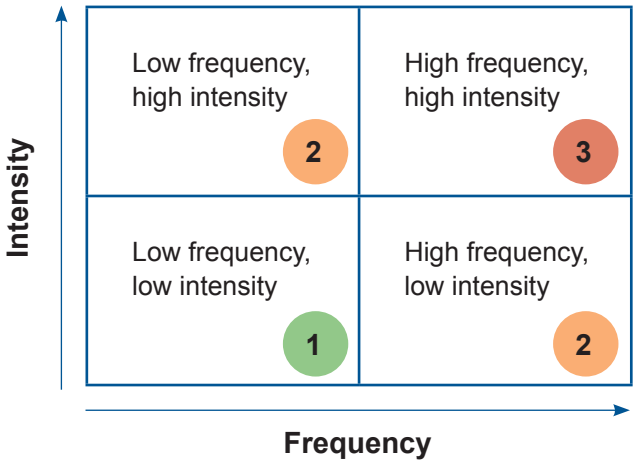

Figure 4.3: Scoring system based on frequency and intensity

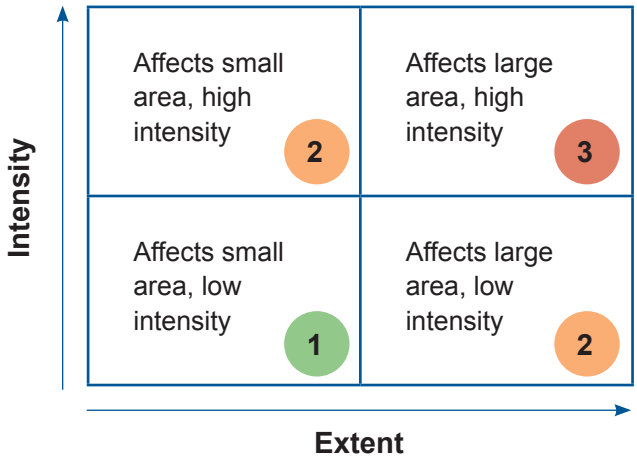

Figure 4.4: Scoring system based on intensity and geographical extent

Table 4.8: Classifying hazards according to frequency and intensity, for present day and expected future

Class	Frequency and intensity		Score
	Present-day frequency and intensity	Expected future frequency and intensity	
High	High frequency, high intensity	High frequency, high intensity	3
Medium	High frequency, low intensity	High frequency, low intensity or high frequency, expected to increase in intensity	2
Medium	Low frequency, high intensity	Low frequency, high intensity or expected to occur more frequently, high intensity	2
Low	Low frequency, low intensity	Low frequency, low intensity or not expected to occur in the future	1

Note that these systems are only a guide and classifying the hazards in this way would require expert moderation within the project team.

Make sure that you record details of the classification system that you used to assign the score to the hazard in the accompanying spreadsheet tool.

4.2.2. The high-level assessment

Table 4.9 shows an example of a high-level assessment where a country has identified a number of different hazards that are of relevance. It shows which characteristics were used to score some of the hazards (with the scores shown in bold).

Table 4.9: Examples of hazard scoring systems, high-level assessment

Fluoride	Political instability
■ High: an existing problem, expected to increase in frequency in the future ■ **Medium: an existing problem, not expected to increase in frequency in the future** ■ Medium: currently rarely a problem, expected to increase in frequency in the future ■ Low: currently rarely a problem, not expected to increase or occur in the future	■ **High: an existing problem, expected to increase in frequency in the future** ■ Medium: an existing problem, not expected to increase in frequency in the future ■ Medium: currently rarely a problem, expected to increase in frequency in the future ■ Low: currently rarely a problem, not expected to increase or occur in the future
Desertification	**Violent conflict**
■ High: affects a large area and is expected to increase in area in the future ■ Medium: affects a large area and is not expected to increase in area in the future ■ Medium: affects a small area and is expected to increase in area in the future ■ **Low: affects a small area and is not expected to increase in area or occur in the future**	■ High: occurs frequently and is expected to continue to occur frequently in the future ■ **Medium: occurs only occasionally and is expected to continue to occur occasionally in the future** ■ Low: rarely occurs and is not expected to occur more frequently in the future

Table 4.10 shows how these hazard scores would be recorded.

Table 4.10: Examples of how hazard scores would be recorded, high-level assessment

Hazard	Description	Score	
Fluoride	An existing problem, not expected to increase in frequency in the future	M	2
Political instability	An existing problem, expected to increase in frequency in the future	H	3
Desertification	Affects a small area and is not expected to increase in area or occur in the future	L	1
Violent conflict	Occurs only occasionally and is expected to continue to occur occasionally in the future	M	2

4.2.3. The detailed climate assessment

In the detailed climate assessment, you will need to give greater consideration to the range of characteristics (frequency, intensity, geographical extent, duration, speed of onset) of each hazard. This may mean that certain hazards branch out into two or more different hazards. For example, a flash flood might be recorded separately from other flooding hazards. Or you might record different types of drought, such as meteorological and hydrological drought, as separate entries.

4.3. Assign a confidence score

You will need to assign a confidence score of high, medium or low to each of the scores.

Box 7 provides details on the guidance for assigning a confidence score.

For the high-level assessment, a single confidence score will be assigned to the hazard.

The approach to assigning a confidence score will differ slightly for the detailed climate assessment. Sometimes, it is relatively easy to score the present-day hazard, but much more difficult to predict the hazard in the future. You will therefore need to assign two confidence scores, one for the hazard in the present day, and one for the hazard in the future. Some examples of how this can be done are given in Table 4.11.

The confidence scores will then be combined to give an overall score for the hazard. Table 4.12 shows overall confidence scores for each of the confidence score combinations. Note that the lowest confidence score is taken as the overall confidence score.

So, for the example hazards given in Table 4.11, the overall confidence scores would be:

- fluvial flooding: medium confidence
- soil erosion: low confidence
- landslide: high confidence
- tropical cyclone: medium confidence.

Those hazards with a low or medium confidence score but a medium or high hazard score can then, if necessary, be flagged for further investigation and sensitivity analysis. More details on sensitivity analysis are given in Box 8.

Box 7: Classification of confidence[19]

- High Confidence – Based on reliable information or analysis with a strong theoretical basis and widely accepted within the sector.
- Medium Confidence – Estimation of potential impacts or consequences, grounded in theory, using accepted methods and with some agreement across the sector.
- Low Confidence – View based on limited information such as anecdotal evidence, or very basic estimation methods.

Table 4.11: Example hazard confidence scores, detailed climate assessment

Hazard	Hazard score	Present day	Confi-dence	Future	Confi-dence
Fluvial flooding	H	An existing problem	H	Expected to increase in frequency	M
Soil erosion	M	Affects a small area	M	Expected to increase in area	L
Landslide	L	Rarely occurs	H	Not expected to occur more frequently in the future	H
Tropical cyclone	M	Low frequency, high intensity	H	Low frequency, high intensity	M

[19] Based on the classification of confidence from the UK's first Climate Change Risk Assessment (Defra, 2012).

Table 4.12: How to combine confidence scores for the detailed climate assessment

Confidence score A	Confidence score B	Overall confidence score
HIGH	HIGH	HIGH
HIGH	MEDIUM	MEDIUM
HIGH	LOW	LOW
MEDIUM	MEDIUM	MEDIUM
MEDIUM	LOW	LOW
LOW	LOW	LOW

Box 8: Sensitivity analysis

Sensitivity analysis can be completed for any hazards, exposures, or vulnerabilities where there is uncertainty or disagreement, by taking another look at the way they have been scored. This would be carried out where there is either a low or medium confidence score and you would like to know whether the outcome would change if scored differently.

Sensitivity analysis is useful because it enables further investigation of the scores and can be used to ensure that there is agreement across the group involved in the assessment. For example, you might score flooding based on its frequency and intensity, but may be unsure as to whether it would be best to score it based on the geographical extent instead. You could decide to take another look at this and score it again to see whether the outcome is sensitive to this decision.

Sensitivity analysis can be carried out when a specific step has been completed, or it can be done at the end of the process when you are compiling and prioritising the list of risks.

4.4. Checklist

In this step of the analysis, you should have completed the tasks given in Table 4.13.

Table 4.13: Hazard checklist

Task	Complete?
Considered whether the presented hazards are of relevance	
Identified any additional hazards not in the list that you need to consider in the assessment	
Scored each of the hazards	
Assigned a confidence score or scores to the hazards	
Recorded details of the classification system that you used to assign the score to the hazard, and the confidence score for each of the hazards	

4.5. Further information

- Climate Change Team Environment Department World Bank (2012) Climate Change Knowledge Portal: Brief User's Guidance Manual. http://sdwebx.worldbank.org/climateportal/index.cfm.
- Gassert, F. Landis, M. Luck, M. Reig, P. and Shiao, T. (2013) *Aqueduct Global Maps 2.0*, Working Paper. Washington, DC: World Resources Institute. http://www.wri.org/publication/aqueduct-metadata-global.
- Global WASH Cluster. (2011) *Disaster Risk Reduction and Water, Sanitation and Hygiene… Comprehensive Guidance. A Guideline for Field Practitioners Planning and Implementing WASH Interventions*. Global WASH Cluster, UNICEF New York.
- Intergovernmental Panel on Climate Change. (2014) Climate Change 2014: Synthesis Report. Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, R.K. Pachauri and L.A. Meyer (Eds.)], p. 151. IPCC, Geneva, Switzerland.
- UK Department for Environment, Food and Rural Affairs (Defra). (2012) *Climate Change Risk Assessment Methodology Report*, UK 2012 Climate Change Risk Assessment, Defra, London, UK.
- UNICEF ROSA. (2014) *Child-Centred Risk Assessment: Regional Synthesis of UNICEF Assessments in Asia*. UNICEF ROSA, Kathmandu, Nepal
- United Nations International Strategy for Disaster Reduction (UNISDR). (2004) *Living with Risk. A global review of disaster reduction initiatives* – Volume I.
- Willows, R.I. and Connell, R.K. (Eds.). (2003) *Climate adaptation: Risk, uncertainty and decision-making*. UKCIP Technical Report. UKCIP, Oxford, UK.

5. Exposure

Exposure

The term exposure can be defined as “people, property, systems, or other elements in places or settings that could be adversely affected by hazards and that are thereby subject to potential losses”.

Source: Adapted from UNISDR (2009)

There are three main steps to assess exposure. These are given in Figure 5.1.

Table 5.1 outlines the differences between the high-level and detailed climate assessments for the exposure step of the process.

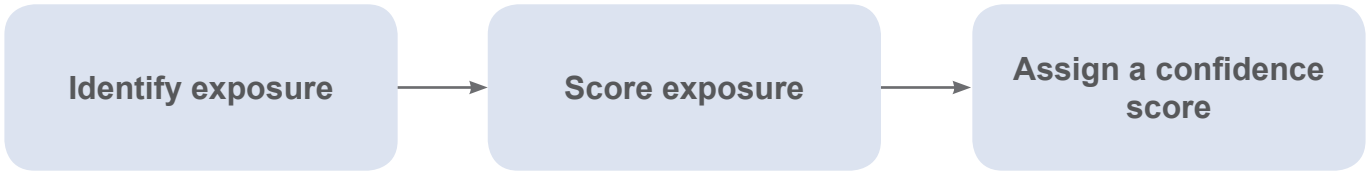

Figure 5.1: Steps to assess exposure

Table 5.1: Differences between assessment methods for identifying and scoring exposure

Step	High-level assessment	Detailed climate assessment
Identify and score exposure	Uses stakeholder engagement to identify and score exposure	Supported by more evidence and may use expert elicitation

5.1. Identify exposure

In this step, you will need to relate the identified hazards to exposure.

To determine what the exposure for a particular hazard might be, consider whether the hazard will affect:

- any people (if so, any specific groups such as children)
- critical infrastructure
- water sources (if so, are these primary water sources?)
- any other types of assets in the area.

Remember that there may be other types of exposure that you will need to consider.

Carefully consider what you mean by different exposures. Will you be considering all water sources or only primary sources in your assessment? What is considered critical infrastructure? You may want to specify different types of critical infrastructure as separate entries for certain hazards. For example, flooding may affect latrines, but not protected wells. You can record these additional details in the ‘comments’ column in the accompanying spreadsheet tool.

Definitions may vary from one risk assessment to another, but you need to make sure that you are being consistent for your risk assessment.

You will need to identify the exposure for the full list of hazards that you have identified, considering all the indicators of exposure that relate to a particular hazard. Record this information by including the different types of exposure as individual entries.

Table 5.2 shows how five example hazards have different exposures in two different countries:

- Flooding affects population and critical infrastructure (latrines) in country A; in country B, it affects critical infrastructure (latrines).
- Fluoride affects population and water sources in both countries. However, it only affects primary water sources in country B.
- Political instability affects populations in both countries.
- Cryptosporidium affects water sources and populations in both countries.
- Desertification only affects country B, specifically population and water sources.

Table 5.2: Examples of hazards and their exposures for two countries

Country A		Country B	
Hazard	**Exposure**	**Hazard**	**Exposure**
Flooding	Population	Flooding	Critical infrastructure – latrines
Flooding	Critical infrastructure – latrines	Fluoride	Population
Fluoride	Population	Fluoride	Water sources, including primary
Fluoride	Water sources, not primary	Political instability	Population
Political instability	Population	Cryptosporidium	Water sources
Cryptosporidium	Water sources	Cryptosporidium	Population
Cryptosporidium	Population	Desertification	Population
		Desertification	Water sources

5.2. Score exposure

In this part of the assessment you will score exposure. Exposure can be considered in six different components, given in Figure 5.2.

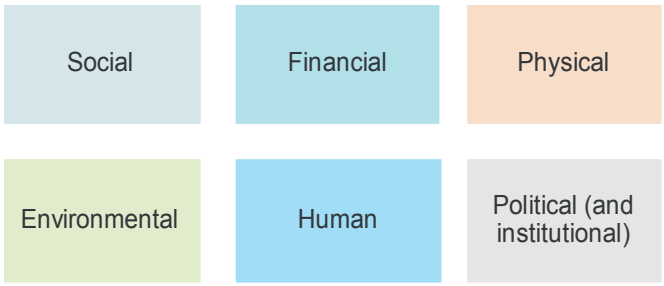

Figure 5.2: Components of exposure

Table 5.3 shows which of the components correspond to the exposures identified for country A (given in Table 5.2).

To help you to score exposure, some suggested indicators of exposure have been identified for four of the components. These are given in Table 5.4.

You will need to come up with a score for each exposure.

Table 5.5 provides suggestions for scoring the components of exposure. Note that these are suggestions only. It may be that you have identified other indicators of exposure that are not included in this table, or you wish to be more (or less) precise with the descriptions. These indicators of exposure may cover all six components, or they may only cover one or two of the components. For example, a hazard may affect water sources only, so will therefore only cover the environmental component.

Table 5.3: Example of combining exposures with the components

Exposure	Component
Population	Human
Critical infrastructure – latrines	Physical
Water sources	Environmental

For both the high-level assessment and detailed climate assessment, you need to consider the exposures across all the different components, and come up with a score for each one.

Table 5.4: Possible indicators of exposure to help scoring

Component	Possible indicators of exposure
Physical	Percentage of critical infrastructure affected
Environmental	Number of water sources affected Percentage of a certain land type affected
Human	Percentage of population affected Number/percentage of communities disrupted/affected
Financial	Percentage of GDP Income from livelihoods according to sector, e.g. agriculture, fishing, etc.

Table 5.5: Possible classification of exposure

Component	High	Medium	Low
Physical	>20% of critical infrastructure affected	5–20% of critical infrastructure affected	0–5% of critical infrastructure affected
Environmental	>20% of water sources affected	5–20% of water sources affected	0–5% of water sources affected
Human	>5% of population affected	0.5–5% of population affected	<0.5% of population affected
Financial	Costs – major damage and disruption	Costs – moderate damage and disruption	Costs – minor damage and disruption

Source: Based on the guidance on classification of relative magnitude from the UK's first Climate Change Risk Assessment (Defra, 2012)

Tips for scoring exposure

- Remember that you do not need to consider intensity or frequency here, as this comes under the 'score hazards' step. In this step, you need to think about who or what is exposed to the hazard.
- When scoring exposure, think about whether the exposure is going to change during the time period that you are considering. For example, might people move into the area affected by the hazard during that time? The scores will need to reflect this, projecting what will happen over the next 15–20 years.
- If you feel that it would be useful to record specific local observations – for example, about how people might move into areas affected by hazards – then you can do so in the accompanying spreadsheet. However, this information will not be used to assess risk in either the high-level or detailed climate assessments.

Table 5.6 provides an example of how exposure could be scored, based on the classification of exposure given in Table 5.5. The table also provides the corresponding hazards, identified in the earlier step. It shows that there is more than one exposure for some of the hazards. These are recorded separately. Other hazards may have the same exposure, but these would also be recorded and scored separately. For example, in Table 5.6, population is recorded as an exposure for both fluoride and political instability.

The scores for exposure are kept separate to make the approach more explicit and traceable. You can add the identified exposures and their scores to the accompanying spreadsheet.

5.3. Assign a confidence score

You will need to assign a confidence score (high, medium or low) for each of the exposures. To do this, follow the guidance given in Section 4.3. The method used to score confidence is the same for the high-level assessment and detailed climate assessment.

Those exposures with a low or medium confidence score, but a medium or high exposure score can then be flagged for further work and sensitivity analysis to investigate them in more detail, if considered necessary. More details on sensitivity analysis are given in Box 8 in Section 4.3.

Table 5.6: Example of how exposure would be scored

Hazard	Exposure	High	Medium	Low
Flooding	Critical infrastructure – latrines	3		
Flooding	Critical infrastructure – wells			1
Fluoride	Population		2	
Fluoride	Water sources, including primary		2	
Political instability	Population	3		
Cryptosporidium	Water sources			1
Cryptosporidium	Population			1
Desertification	Water sources		2	

5.4. Checklist

In this step of the analysis, you should have completed the tasks given in Table 5.7.

Table 5.7: Exposure checklist

Task	Complete?
Identified the exposure for the full list of hazards	
Recorded this information by including the different types of exposure as individual entries	
Assigned a score to exposure by considering specific indicators of exposure	
Assigned a confidence score to each exposure	
Recorded the exposure scores	
Recorded the confidence scores	

5.5. Further information

- Chen, C., Noble, I., Hellmann, J., Coffee, J., Murillo, M. and Chawla, N. (2015) *University of Notre Dame Global Adaptation Index: Country Index Technical Report*. http://index.gain.org/about/methodology#
- Intergovernmental Panel on Climate Change. (2012) *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change, p. 582 [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (eds.)] Cambridge University Press, Cambridge, UK, and New York, USA.

6. Vulnerability

Vulnerability

The term vulnerability can be defined as "the characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard". There are many aspects of vulnerability, arising from various physical, social, economic and environmental factors.

Source: UNISDR (2009)

There are three main steps to assess vulnerability. These are given in Figure 6.1.

Table 6.1 outlines the differences between the high-level and detailed climate assessments for the vulnerability steps of the process.

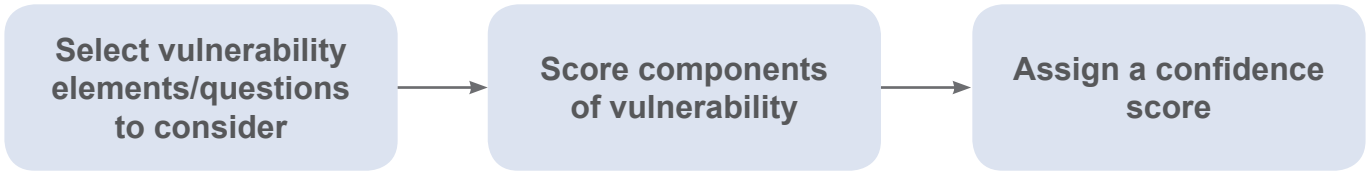

Figure 6.1: Steps to assess vulnerability

Table 6.1: Differences between assessment methods for identifying and scoring vulnerability

Step	High-level assessment	Detailed climate assessment
Identify and score vulnerability.	For the high-level assessment, the aim is to get a single score for each component (see Figure 6.2).	Factors are scored for each component. This means that, depending on the study, there could be more than one score for each of the six components, depending on the exposures you have identified in the previous step of the assessment.

6.1. Identify and score vulnerabilities

6.1.1. The approach

In this step, you will identify the different vulnerabilities with respect to the WASH sector.

Vulnerability can be considered in six different components, given in Figure 6.2.

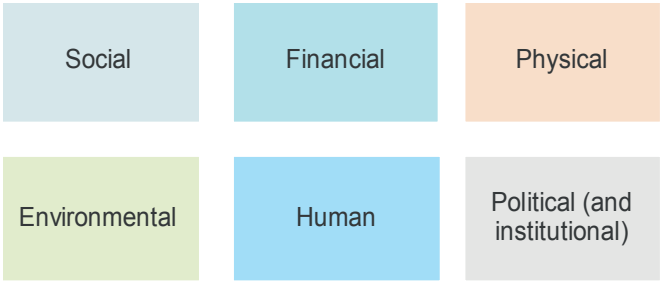

Figure 6.2: Components of vulnerability

Table 6.2 sets out the six components with respect to the WASH sector, together with different vulnerability factors for each of these components.[20] You can use this table to help you consider and score the areas of vulnerability for both the high-level and detailed climate assessments.

Tip for identifying and scoring vulnerability

You should not necessarily consider more factors, elements or questions in the climate assessment simply because it is more detailed. These factors are also of relevance to the high-level assessment, they are just assessed and scored in a different way.

For each of the factors in each component, there are a number of elements and questions to consider, given in Table 6.2. These are provided as examples to guide your assessment of vulnerability; you do not have to consider all of them. You may also think of other elements or questions that you want to use for the assessment.

Make sure that you record details of what has been considered together with the scores.

Box 9: Role of inequity in shaping vulnerability and resilience

Those who are in the most vulnerable groups are more likely to be adversely affected because they are more sensitive, are susceptible to harm, and have a lack of capacity to cope or adapt to hazards. Inequity plays a key role in shaping vulnerability and resilience. For example, the ability to access important information affects the level of knowledge and awareness of potential risks; a lack of access increases vulnerability because it means people are less able to make and act on informed decisions. It is important, therefore, that WASH programming is informed by an understanding of who or what is most vulnerable to hazards and why.

Table 6.2: Examples of elements and questions to consider when assessing vulnerability

Social		
Factor	**Element**	**Question**
Social networks (access to social networks such as informal social safety nets)	Access to social networks	Is there adequate access to social support networks such as informal social safety nets?
Community-wide knowledge and understanding of risks and WASH benefits	Community-based risk assessments	Are there any community-based risk assessments?
	Engagement in early warning systems	Is there sufficient engagement in early warning systems?
Norms/practice	Open defecation	What is the level of open defecation/ use of improved toilets?
	HWTS	What is the level of safe household water treatment and safe storage?
	Community awareness of protection of water sources	Is there good awareness in communities of the need to protect water sources?
Social cohesion	Conflict	Are there (strong) conflicts between different groups / community members?
	Marginalised groups	Are there marginalised groups / population?

Continued on next page

[20] Based on the information provided in the ODI report, Adaptation to Climate Change in Water, Sanitation and Hygiene Oates et al. (2014).

Financial		
Factor	**Element**	**Question**
Routine WASH sector budget allocations, including recurrent budgets (sufficient routine investments are an obvious pre-requisite for resilience)	WASH public investment as % of GDP	How much investment is there in the WASH sector?
	Adequacy of WASH recurrent budget	Is the WASH recurrent budget adequate?
Budget disaggregation	Budget lines	Are there clear WASH budget lines?
	Budget for mitigation, prevention, preparedness and response, and adaptation	Is there separate budget for mitigation, prevention, preparedness and response, and adaptation?
Ability to draw on emergency funds	Contingencies	Are there contingencies in budgets, and how quickly can they be released?
	Decentralised funding	Is there a practice of channelling spending and accounting for decentralised funding?
Service provider vulnerability	Cash reserves/insurance	Can service providers draw on cash reserves or insurance to rehabilitate services?
	Mitigate emergencies	Have service providers taken steps to mitigate emergency water supply? Do they have funds? Are they incentivised?

Physical		
Factor	**Element**	**Question**
Resilience of WASH infrastructure – e.g. designing for appropriate levels of climate variability (design and construction standards confer resilience on WASH physical infrastructure: reliability/yield, water quality protection, infrastructure damage)	Technology	What technology is available/used for WASH infrastructure? For example, which latrine types are predominantly used? Are they resilient?
	Existence of sound design/ construction standards	What are the design/construction standards? Do any sound standards exist?
	Standards observed in implementation	Are the design and construction standards observed in implementation?
	Water storage infrastructure	Is water supply held in storage infrastructure? What is the storage capacity (in days)? How does this vary for different uses, e.g. domestic?
	Geographic conditions	Is the technology designed based on existing hazards (e.g. earthquakes, floods, etc.)

Continued on next page

Environmental		
Factor	**Element**	**Question**
Environmental degradation (land use change is a major cause of vulnerability)	Rate of deforestation	What is the rate of deforestation?
	Soil degradation	Is there any soil degradation resulting from human activities? How extensive is this?
	Water quality	Does water quality meet national standards? Is it particularly poor and are there any issues surrounding this? Are there any known dangerous spills entering water sources, or any detected leakages?
Resilience of water sources (poor siting and protection of WASH sources make systems vulnerable, leading to outages and reduced services)	Siting of water sources	Are water points poorly sited, e.g. outside of areas that can provide reliable and safe supply? Are hydrogeological investigations carried out to site water sources?
	Protection of water sources	Are water sources adequately protected? Are some better protected than others?
	Sustainability of abstractions	Are abstractions sustainable? Are groundwater resources being replenished (naturally or artificially)?
Alternative water sources (the use of alternative water sources if necessary and plans in place to use these)	Alternative water sources	Are there alternative water sources to use if necessary? Are the water supply systems relying on a single source?
Waste disposal (poorly managed waste disposal – domestic and industrial)	Landfill sites	Are landfill sites inappropriately sited or used? Are landfill sites poorly managed?
	Sewage disposal	Is sewage being disposed of safely? What about industrial waste?
Degradation of sub-surface and groundwater sources	Sub-surface and groundwater source degradation	Is there any degradation of sub-surface and groundwater sources? If so, how extensive is this/how many sources are affected?

Continued on next page

Human		
Factor	**Element**	**Question**
Demographic characteristics (age, levels of education, health and poverty)	Human Development Index (HDI)[21]	What is the HDI? Are there other similar factors that are relevant?
	Age of population	Is there a large population of very old or young people?
Knowledge and understanding (lack of knowledge reduces efficacy of behavioural change and can lessen the demand for WASH services)	Knowledge and understanding of local hazards	How knowledgeable are people about local hazards and how to protect latrines and water supply systems?
	Knowledge and understanding of WASH benefits	How knowledgeable are people about WASH benefits?
Population growth/ urbanisation (rapid population growth and urbanisation are major causes of vulnerability)	National population growth	What is the population growth rate?
	Urban population growth	What is the rate of urbanisation?
	Demand for water	What is the expected change in the demand for water?

Political (and institutional)		
Factor	**Element**	**Question**
WASH policies (incl. for climate), public institutions and governance (public policy and public institutions provide the necessary national guidance for dealing with vulnerabilities and risks)	Government effectiveness	Is there public policy to provide the necessary guidance for identifying and addressing vulnerabilities and risks?
	WASH and other policies	Are there appropriate WASH policies in place? Are there policies in place that specifically include climate resilience?

Source: Adapted from Oates et al. (2014)

6.1.2. The high-level assessment

For the high-level assessment, the aim is to get a single score of 1, 2 or 3 for each component, depending on whether the vulnerability is low, medium or high. Having one score for each component ensures that the method does not become overly complicated.

Table 6.3 provides an example of how vulnerability might be scored for the different components for the high-level assessment, together with notes on which elements and questions have been considered in the assessment.

[21] Data available here http://hdr.undp.org/en/data

Table 6.3: An example of how vulnerability might be scored for the high-level assessment

Component	Elements or questions considered	Notes	Score		
			H	M	L
Social	Access to social networks. Are there any community-based risk assessments?	There is limited access to social networks. There are only a few community-based risk assessments.	3		
Financial	How much investment is there in the WASH sector? Is there effective development partner support for WASH service delivery?	There is some investment; however, partner support for WASH service delivery could be more effective.		2	
Physical	What are the design/ construction standards? Do any sound standards exist? Are the design and construction standards observed in implementation?	Standards do exist and they are generally observed in implementation for water supply and sanitation.			1
Environmental	What is the rate of environmental damage? Does water quality meet national standards? Are water sources adequately protected?	Environmental damage is high and the quality of the water is poor and does not meet national standards; water sources are not adequately protected.	3		
Human	What is the population growth rate? How knowledgeable are people about local hazards? What is the Human Development Index (HDI).	Population growth is expected to increase. There is some knowledge on local hazards and wider knowledge on WASH benefits. HDI is medium.		2	
Political (and institutional)	Is there public policy to provide the necessary guidance for identifying and addressing vulnerabilities and risks? Are there appropriate WASH policies in place?	Policies are not very effective. There are insufficient WASH policies in place.	3		

6.1.3. The detailed climate assessment

For the detailed climate assessment, the method is to score factors for each component. This means that, depending on the study, there could be more than one score for each of the six components. However, it is not necessary to have a score for each of the factors. You may decide that one of the factors is not relevant to your assessment. This will depend on the different exposures you have identified in the previous step of the assessment.

To decide what the scores should be, a scoring system can be used for the elements or questions used for each of the factors. Examples of scoring systems are given in Table 6.4. For some of the factors it may be possible to assign quantitative thresholds that define the ranges of high, medium and low; however, this will depend on the context.

Table 6.4: Examples of vulnerability scoring systems

Social: social networks such as informal social safety nets	**Social: community-wide knowledge and understanding of risks and WASH benefits**	**Social: community-wide knowledge and understanding of risks and WASH benefits**
Is there adequate access to informal social safety nets? ■ High: there is limited access to social networks ■ Medium: there is some access to social networks ■ Low: there is good access to social networks	Are there any community-based risk assessments? ■ High: there are very few or no community-based risk assessments ■ Medium: there are some community-based risk assessments ■ Low: there are many community-based risk assessments	Is there sufficient engagement in early warning systems? ■ High: there is limited engagement in early warning systems ■ Medium: there is some engagement in early warning systems but this could be improved ■ Low: there is sufficient engagement in early warning systems
Financial: routine WASH sector budget allocations, including recurrent budgets	**Financial: routine WASH sector budget allocations, including recurrent budgets**	**Physical: resilience of WASH infrastructure – sanitation**
How much investment is there in the WASH sector? ■ High: there is limited/ inadequate investment in the WASH sector ■ Medium: there is some investment in the WASH sector but this could be improved ■ Low: there is plenty/adequate investment in the WASH sector	Adequacy of WASH recurrent budget ■ High: the WASH recurrent budget is inadequate and needs to be greatly improved ■ Medium: there need to be some improvements to the WASH recurrent budget ■ Low: the WASH recurrent budget is adequate	What technology is available/used for WASH infrastructure? ■ High: only poor or basic technology is available/used ■ Medium: some more advanced technology is available/used ■ Low: more advanced technology is widely used
Physical: resilience of WASH infrastructure – water supply	**Physical: resilience of WASH infrastructure – sanitation**	**Physical: resilience of WASH infrastructure – water supply**
Do sound design/construction standards exist? ■ High: no or very few standards exist ■ Medium: some design/ construction standards exist but they could be improved ■ Low: there are sound design/ construction standards	Are the design and construction standards observed in implementation? ■ High: standards are rarely or never observed in implementation ■ Medium: standards are sometimes observed in implementation ■ Low: standards are always or almost always observed in implementation	Is water supply held in storage infrastructure? ■ High: supply is rarely held in storage infrastructure ■ Medium: only some supply is held in storage infrastructure ■ Low: it is common for supplies to be held in storage infrastructure

Continued on next page

Environmental: environmental degradation	**Environmental: environmental degradation**	**Environmental: environmental degradation**
Rate of deforestation ■ High: the rate of deforestation is high ■ Medium: there is some deforestation ■ Low: the rate of deforestation is low	Is there any soil degradation resulting from human activities? ■ High: there is widespread soil degradation ■ Medium: there is some soil degradation ■ Low: there is no or very little soil degradation	Water quality ■ High: water quality is generally poor ■ Medium: water quality is poor in some areas but generally adequate ■ Low: water quality is adequate or good in most or all areas
Environmental: resilience of water sources	**Environmental: resilience of water sources**	**Environmental: alternative water sources**
Protection of water sources ■ High: the majority of water sources have little protection ■ Medium: some water sources are adequately protected ■ Low: most or all water sources are adequately protected	Are abstractions sustainable? ■ High: all or most abstractions are unsustainable ■ Medium: some abstractions are unsustainable ■ Low: only a few abstractions are unsustainable	Are there alternative protected water sources to use if necessary? ■ High: there are no or very limited alternative water sources ■ Medium: there are some alternative water sources available to use ■ Low: there are plenty of alternative water sources/ alternative water sources in most or all locations
Human: demographic characteristics	**Human: demographic characteristics**	**Human: knowledge and understanding**
Human Development Index (HDI) ■ High: in low human development group based on HDI rank ■ Medium: in medium human development group based on HDI rank ■ Low: in high or very high human development group based on HDI rank	Is there a large population of young people – i.e. is more than 50% of the population under the age of 18? ■ High: yes ■ Medium: yes, in some areas ■ Low: no	Knowledge and understanding of local hazards ■ High: there is poor or limited understanding of local hazards ■ Medium: there is some understanding of local hazards ■ Low: there is good understanding of local hazards

Continued on next page

Human: knowledge and understanding	**Human: population growth/ urbanisation**	**Human: population growth/ urbanisation**
Knowledge and understanding of WASH benefits ■ High: there is poor or limited understanding of WASH benefits ■ Medium: there is some understanding of WASH benefits ■ Low: there is good understanding of WASH benefits	National population growth ■ High: population growth rate is high ■ Medium: population growth is stable ■ Low: population is declining	Urban population growth ■ High: urban population is increasing ■ Medium: urban population is stable ■ Low: urban population is declining
Political (and institutional): WASH policies, public institutions and governance	**Political (and institutional): WASH policies, public institutions and governance**	
Is there public policy to provide the necessary guidance for dealing with vulnerabilities and risks? ■ High: no policies or insufficient policies in place ■ Medium: some policies are in place ■ Low: sufficient policies are in place	Are there appropriate national WASH policies in place that include climate resilience? ■ High: no WASH policies or insufficient policies in place ■ Medium: some appropriate WASH policies are in place ■ High: sufficient WASH policies are in place	

If you would like to consider more than one element or question for a factor in your assessment, assess each of the relevant elements and/or questions equally to decide on an overall score for the factor. The vulnerability scores for each factor should be kept separate, which means that a hazard and exposure combination may branch out to accommodate two or more vulnerability scores. Table 6.5 provides an example of how a hazard and exposure combination may do this, so as to accommodate more than one vulnerability score.

Table 6.5: Examples of how hazard and exposure combinations may branch out with vulnerability

Hazard	Exposure	Vulnerability
Heatwave	Population	Poor knowledge of local hazards and WASH benefits (knowledge and understanding factor)
Heatwave	Population	HDI score is medium (demographic characteristics factor)

6.2. Assign a confidence score

You will need to assign a confidence score of high, medium or low for each vulnerability. To do this, follow the guidance given in Section 4.3.

Those vulnerabilities with a low or medium confidence score, but a medium or high vulnerability score can then be flagged for further work and sensitivity analysis to investigate them in more detail, if considered necessary. More details on sensitivity analysis are given in Box 8 in Section 4.3.

In the high-level assessment, a confidence score of high, medium or low will need to be assigned for each of the components of vulnerability.

In the detailed climate assessment, a confidence score will need to be assigned to each vulnerability factor assessed. For example, if both the 'environmental degradation' and 'resilience and protection of water sources' factors in the environmental component have been assessed, then each will need to have a confidence score. Some more examples are given in Table 6.6.

Table 6.6: Example confidence scores for vulnerability – detailed climate assessment

Component	Factor	Vulnerability score	Confidence
Social	Knowledge and understanding	2	LOW
Financial	Routine WASH sector budget allocations, including recurrent budgets	1	MEDIUM
Physical	Resilience of WASH infrastructure	3	MEDIUM
Environmental	Environmental degradation	3	HIGH
	Resilience and protection of water sources	2	HIGH
Human	Population growth/urbanisation	3	HIGH
	Demographic characteristics	2	HIGH
	Knowledge and understanding	1	LOW
Political (and institutional)	WASH policies (incl. climate), public institutions, good governance	2	MEDIUM

6.3. Checklist

In this step of the analysis, you should have completed the tasks given in Table 6.7.

Table 6.7: Vulnerability checklist

Task	Complete?
Carefully selected the vulnerability elements and/or questions to consider	
Scored the six components and factors of vulnerability based on the selected elements and questions	
Assigned a confidence score to each of the components of vulnerability in the high-level assessment and each of the factors assessed in the detailed climate assessment	
Recorded the vulnerability scores and confidence scores, along with details of the vulnerability elements and questions that were considered	

6.4. Further information

- Chen, C., Noble, I., Hellmann, J., Coffee, J., Murillo, M. and Chawla, N. (2015) *University of Notre Dame Global Adaptation Index: Country Index Technical Report*. http://index.gain.org/about/methodology#.
- Climate Change Team Environment Department World Bank. (2012) *Climate Change Knowledge Portal: Brief User's Guidance Manual*. http://sdwebx.worldbank.org/climateportal/index.cfm.
- Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, *India Project on Climate Change Adaptation in Rural Areas of India* (CCA RAI). (2014) A Framework for Climate Change Vulnerability Assessments.
- Fritzsche, K., Schneiderbauer, S., Bubeck, P., Kienberger, S., Buth, M., Zebisch, M. and Kahlenborn, W. (2014) *The Vulnerability Sourcebook: Concept and guidelines for standardised vulnerability assessments*. Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Bonn and Eschborn.
- INFORM Index for Risk Management (n.d.) INFORM Global Model – interpreting and applying. Guidance Note. http://www.inform-index.org/
- Intergovernmental Panel on Climate Change. (2012) *Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change, p. 582 [Field, C.B., V. Barros, T.F. Stocker, D. Qin, D.J. Dokken, K.L. Ebi, M.D. Mastrandrea, K.J. Mach, G.-K. Plattner, S.K. Allen, M. Tignor, and P.M. Midgley (Eds.)]. Cambridge University Press, Cambridge, UK, and New York, USA.
- Oates, N., Ross, I., Calow, R., Carter, R. and Doczi, J. (2014) *Adaptation to Climate Change in Water, Sanitation and Hygiene: Assessing Risks and Appraising Options in Africa*. Overseas Development Institute, London, UK.
- Oppenheimer, M., Campos, M., Warren, R., Birkmann, J., Luber, G., O'Neill, B., and Takahashi, K. (2014) *Emergent risks and key vulnerabilities*. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change, pp. 1039-1099 [Field, C.B., V.R. Barros, D.J. Dokken, K.J. Mach, M.D. Mastrandrea, T.E. Bilir, M. Chatterjee, K.L. Ebi, Y.O. Estrada, R.C. Genova, B. Girma, E.S. Kissel, A.N. Levy, S. MacCracken, P.R. Mastrandrea, and L.L. White (eds.)]. Cambridge University Press, Cambridge, UK and New York, USA.
- United Nations International Strategy for Disaster Reduction. (2004) *Living with Risk. A global review of disaster reduction initiatives* – Volume I.

7. Capacity

Capacity

The term capacity includes “infrastructure and physical means, institutions, societal coping abilities, as well as human knowledge, skills and collective attributes such as social relationships, leadership and management”.

Source: UNISDR (2009)

Capacity is the ability to prepare, respond, recover and learn. The resilience of people, infrastructure, the environment, or anything else that is exposed to a hazard therefore depends on its level of capacity. Capacity can be influenced by awareness, knowledge, data, monitoring and whether appropriate plans and policies are in place. It is really important to consider capacity as it influences risk; a high capacity reduces risk while a low capacity does not. As a result, capacity can be used to help prioritise risks.

There are two main steps to assess capacity, given in Figure 7.1. The components of capacity referred to in this figure are provided in Figure 7.2.

Table 7.1 outlines the differences between the high-level and detailed climate assessments for the capacity steps of the process.

Tip for scoring capacity in the detailed climate assessment

You do not need to assess confidence for capacity, because the capacity scores will not be used to determine the overall risk score.

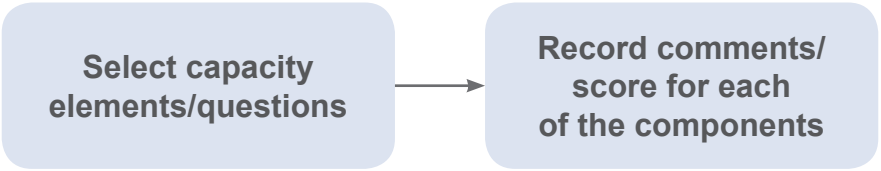

Figure 7.1: Steps to assess capacity

Table 7.1: Differences between assessment methods for identifying and scoring capacity

Step	High-level assessment	Detailed climate assessment
Identify and score capacity	The method involves considering the elements and questions for each of the components of capacity. Capacity is not assigned a score like the other components of risk.	Capacity will be scored; however, these scores will be used only to help prioritise risks for identifying climate-resilient WASH options. They will not be used to determine the overall risk score. Factors for each component will be scored so there could be more than one score for each of the components.

7.1. Identify and assess/score capacities

7.1.1. The approach

The next step is to identify capacity with respect to the WASH sector.

Capacity can be considered in six different components, given in Figure 7.2.

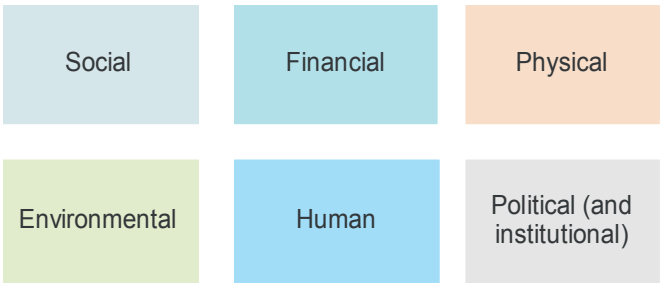

Figure 7.2: Components of capacity

Table 7.2 sets out the six components with respect to the WASH sector, together with different capacity factors, elements and questions.[22] You can use this table to help you consider and score different areas of capacity for both the high-level and detailed climate assessments.

You will notice that a couple of the factors are also provided as examples to consider when assessing vulnerability. These include:

- Knowledge and understanding can influence the capacity to prepare, respond, recover and learn, but can also increase the vulnerability of the population or a community if the threat from a hazard is underestimated.
- A lack of social networks can increase vulnerability by, for example, reducing access to alternative water supplies and informal social safety nets; reducing the ability to move elsewhere temporarily, or by making evacuation more difficult; but it can also reduce the ability to communicate and work with others, affecting capacity.

Tip for identifying and scoring capacity

You should not necessarily consider more factors, elements or questions in the climate assessment simply because it is more detailed. These factors are also of relevance to the high-level assessment, they are just assessed and scored in a different way.

Table 7.2: Examples of elements and questions to consider when assessing capacity

Social		
Factor	**Element**	**Question**
Planning, knowledge and tools. Communities may and often do have significant capacities to mitigate and respond to hazards.	Community preparedness plans	Are there any community preparedness plans? How detailed are the plans? What was the level of community participation? How often are plans revised? Is there a designated individual or group responsible for coordinating the response to a hazard?
	Knowledge and tools for prevention activities	What knowledge and tools are there in the community to mitigate and respond to hazards?
Social networks and communications tools.[23]	Access to social networks and communications tools	Are social networks in place? Is there access to communications tools such as radios and megaphones?
Civil society and civil society representation. The ability of civil society organisations including the media to speak out on public issues.	Strength of environmental/ governance and accountability civil society organisations (CSOs) and media	What is the strength of environmental/ governance and accountability CSOs and media?

Continued on next page

[22] Based on the information provided in the ODI report 'Adaptation to Climate Change in Water, Sanitation and Hygiene' Oates et al. (2014).
[23] Also included in Table 6.2 as it influences both vulnerability and capacity.

Financial		
Factor	**Element**	**Question**
Adequate mitigation, prevention, preparedness and response WASH sector budget allocations. This includes sufficient reserves for dealing with emergencies.	Emergency processes and procedures	Are there adequate emergency processes and procedures in place?
	Emergency budgets and residual risk coverage (e.g. insurance)	Are there sufficient emergency WASH sector budget allocations?
Effective development partner support for WASH service financing and sustainability. The level and effectiveness of support from development partners can increase capacity to withstand the effects of shocks and stresses.	Development partner support and resources for WASH service delivery	Is there effective development partner support and resources for WASH service delivery?
	Emergency aid	Can development partners convert their funding for development projects to emergency aid?
	Mitigation and preparedness	Do partners support mitigation and preparedness?
Budget disaggregation.	Budget for mitigation, prevention, preparedness and response	Is there separate budget for mitigation, prevention, preparedness and response?

Physical		
Factor	**Element**	**Question**
Aspects of physical infrastructure design. Aspects of design which mean that infrastructure can respond to hazards.	Technology	Is technology available that would help improve capacity, e.g. rainwater harvesting, water reclamation and reuse
	Aspects of design	Has infrastructure been designed to give it the capacity to better respond to hazards, e.g. flexible design
	Maintenance of infrastructure	Are plans in place to maintain infrastructure? Is infrastructure in an accessible location for maintenance?
Human capacity/resources for operation and maintenance.	Supply chain for replacement parts	Is there a supply chain for parts (replacements/spare parts)?
	Skills to operate and maintain infrastructure	Do people have the necessary skills to operate and maintain toilets and water supply systems?

Continued on next page

Environmental		
Factor	**Element**	**Question**
Effective environmental (weather, groundwater, surface water, land use) monitoring networks and institutions. Given the immense uncertainty over direction and magnitude of environmental change, monitoring is a clear pre-requisite for observing and understanding such change.	Monitoring agencies	Do monitoring agencies exist? How effective are they?
	Monitoring networks	Are there monitoring networks in place? Are these adequate?
	Environmental data	Are any environmental data available? Are these of sufficient quality, e.g. are they accurate and have they been collected on a regular basis?
Alternative water sources.	Sub-surface and groundwater source degradation	Is there any degradation of sub-surface and groundwater sources? If so, how extensive is this/how many sources are affected?
	Plans to use alternative water sources	Are there plans in place to use alternative protected water sources where available?

Human		
Factor	**Element**	**Question**
Knowledge and understanding. To prepare, respond, recover and learn.	Level of knowledge and understanding	Do people have adequate knowledge to prepare, respond, recover and learn?
Adequate socio-economic stability. Capacity to respond to shocks and stresses through appropriate self-protection capabilities and coping capacities.	Human Development Index (HDI)[24] Multidimensional Poverty Index (MPI) (if available)[25]	What is the HDI? Is there a high or a low MPI? If these are unavailable consider the individual components that make up the HDI and MPI, e.g. health, education, income. Are there other similar factors that are relevant?
Diversification of livelihoods. Livelihood diversification to enhance capacity to respond to hazards.	Livelihood diversification strategies	Is livelihood diversification possible? Are there plans in place to support this?

Continued on next page

[24] Also included in Table 6.2 as it influences both vulnerability and capacity.
[25] Data available here http://hdr.undp.org/en/data.

Political (and institutional)		
Factor	**Element**	**Question**
Capacity of (institutional) systems for preparedness, response and recovery.	Response plans for WASH emergencies	Are there response plans in place? Are these plans adequate?
	Coordination mechanisms for emergencies	Are there any coordination mechanisms in place for emergencies? Are these regularly reviewed, and if so, are they effective?
	Training and equipment	Is there sufficient staff, training and adequate equipment?
	Collaboration between departments	Does any collaboration exist between the departments responsible for WASH, DRR, environment and climate? Is this collaboration sufficient or could it improve?
	Political will to assess and mitigate risk and adapt	What is the political view on climate change? Does this affect the assessment and mitigation of risks and the ability to adapt?

Source: Adapted from Oates et al. (2014)

7.1.2. The high-level assessment

In this step of the high-level assessment, capacity is not assigned a score like the other components of risk. While there are some national-level elements of capacity to consider – such as the effect of political views on the ability to adapt – capacity is something which is mainly specific to a regional or local level. Therefore, for a high-level assessment, it will be difficult to score capacity. There would be less confidence in the scores, and if capacity is scored inaccurately there is a possibility that some key risks may be ignored as the capacity score might inappropriately cancel out the vulnerability score.

Therefore, for capacity you should consider the elements and questions given in Table 7.2. and record the findings. You can use this information to help prioritise risks for identifying resilient options.

Table 7.3 provides an example of how capacity might be assessed for the different components, together with notes on which elements and questions have been considered in the assessment. Note that you do not have to consider all of the elements and questions that are given in Table 7.2; these are provided as examples to guide your assessment of capacity. You may also think of other elements or questions that you want to base the assessment on. Record details of what has been considered together with your comments.

7.1.3. The detailed climate assessment

For the detailed climate assessment, capacity will be scored. However, these scores will be used only to help prioritise risks for identifying climate-resilient options. They will not be used to determine the overall risk score, because if capacity is scored inaccurately there

is a possibility that some key risks may be ignored as the capacity score might inappropriately cancel out the vulnerability score.

The method is the same as that used for vulnerability: factors for each component will be scored. This means that, depending on the study, there could be more than one score for each of the six components. However, it is not necessary to have a score for each of the factors. You may decide that some of the factors are not relevant to your assessment.

You will need to carefully select the elements and questions to consider to come up with the scores. The elements and questions in Table 7.2 are provided as examples to guide your assessment of capacity; you do not have to consider all of them. You may also think of other elements or questions that you want to base the assessment on. Record details of what has been considered together with the different scores. Note that high capacity would have a score of 3, medium capacity a score of 2, and low capacity a score of 1.

Table 7.4 provides an example of how capacity might be scored.

Table 7.3: An example of how capacity might be assessed for the high-level assessment

Component	Element or question considered	Notes on assessment
Social	Are there any community preparedness plans? How detailed are the plans? Are any social networks in place?	There are plans, however some do not go into enough detail. There are lots of social networks in place that improve capacity to respond to hazards.
Financial	Are there adequate emergency processes and procedures in place?	No – there needs to be more in place.
Physical	Is technology available that would help improve capacity? Has infrastructure been designed to better respond to hazards?	There is limited technology available to improve capacity. Some infrastructure has been well-designed but most needs to be improved.
Environmental	Do monitoring agencies exist? How effective are they? Are any environmental data available?	There is a monitoring agency but the effectiveness could be improved. Environmental data are sparse and more needs to be done to collect data.
Human	Knowledge and understanding and Multidimensional Poverty Index (MPI)	There is poor knowledge and understanding, and a high MPI.
Political (and institutional)	Are there response plans in place? Are these plans adequate? Is there sufficient training and adequate equipment?	There are some response plans in place but these need to be improved. There is currently not enough training available or adequate equipment.

Table 7.4: An example of how capacity might be scored for the detailed climate assessment

Component	Factor	Elements or questions considered	Notes	Score		
				H	M	L
Social	Social networks	Is there adequate access to social networks and communications tools?	Access to networks and tools varies. It needs to be improved in some areas.		2	
	Planning, knowledge and tools	What knowledge and tools are there in the community to mitigate and respond to hazards?	Generally, there is good knowledge and available tools to mitigate and respond to hazards.	3		
Financial	Effective development partner support for WASH service delivery	Is there effective development partner support for WASH service delivery?	Yes – effective development partner support is widely available.	3		
Physical	Technology	Is technology available that would help improve capacity?	The technology used is basic; improvements to technology are needed to help improve capacity.			1
	Aspects of design	Has infrastructure been designed to better respond to hazards?	Some types of infrastructure have factored this into their design; however, most have not.			1
Environmental	Effective environmental monitoring networks and institutions	Are there monitoring networks in place? Are these adequate? Are any environmental data available?	There are a few monitoring networks in place, although some are inadequate. There are some environmental data available.		2	
	Alternative water sources	Are there plans to use alternative protected water sources where available?	There are plans to use alternative water sources only in some locations.		2	
Human	Adequate socio-economic stability	Multidimensional Poverty Index (MPI).	The MPI is high.			1
	Diversification of livelihoods	Is livelihood diversification possible? Are there plans in place to support this?	Yes – some livelihood diversification is possible, with plans in place to support this.		2	
Political (and institutional)	Capacity of systems for preparedness, response and recovery	Are there response plans in place? Are these plans adequate?	Yes – there are adequate response plans in place.	3		

7.2. Checklist

In this step of the analysis, you should have completed the tasks given in Table 7.5.

Table 7.5: Capacity checklist

Task	Complete?
Carefully selected the capacity elements and/or questions to consider.	
Recorded your comments (and assigned scores for the detailed climate assessment) for each of the components for the selected capacity elements and/or questions.	

7.3. Further information

- Chen, C., Noble, I., Hellmann, J., Coffee, J., Murillo, M. and Chawla, N. (2015) *University of Notre Dame Global Adaptation Index: Country Index Technical Report*. http://index.gain.org/about/methodology#.
- INFORM Index for Risk Management (n.d.) *INFORM Global Model – interpreting and applying*. Guidance Note. http://www.inform-index.org/
- Oates, N., Ross, I., Calow, R., Carter, R. and Doczi, J. (2014) *Adaptation to Climate Change in Water, Sanitation and Hygiene: Assessing Risks and Appraising Options in Africa*. Overseas Development Institute, London, UK.
- United Nations Development Programme (2015) *Human Development Report 2015: Work for Human Development*. United Nations Development Programme, New York, USA.
- United Nations International Strategy for Disaster Reduction (2004) *Living with Risk. A global review of disaster reduction initiatives* – Volume I.

8. Risk prioritisation

8.1. Assess risk

In this step, you will combine the individual scores for hazard, exposure and vulnerability to come up with an overall score for risks. These scores can then be used to rank the risks to determine priorities. You may want to use a threshold to decide which of the risks you should take forward to the next quadrant of the Framework *'Identify and appraise options.'*

The following risk formula is used in this Guidance Note:

Risk = Hazard x Exposure x Vulnerability

Capacity is not used in the equation, but assessed separately to help prioritise risks for identifying resilient options.

Tip for assessing risk

You can combine scores across different components of exposure and vulnerability. For example, latrines (critical infrastructure) as an exposure might have a corresponding physical vulnerability score and a financial vulnerability score – both of which are important to consider. There would then be two different entries in the list of risks for critical infrastructure – latrines, with separate overall scores, as shown in Table 8.1 (the hazard is flooding).

However, you may decide to combine exposure with its corresponding vulnerability score only, if you feel that the other components of vulnerability are not important for that particular exposure.

Some examples of risk for the high-level assessment are provided in Table 8.1. The risk column shows the overall score of country X, while the rank column can be used to order the risks. In this example, the top scoring risks are:

- flooding of latrines, considering the financial vulnerability component
- fluoride affecting water sources, considering the environmental vulnerability component
- political instability affecting the population, considering the human vulnerability component
- cryptosporidium in water sources, considering the environmental vulnerability component.

The risks have been reordered (according to rank) and a threshold applied to determine which should be taken forward to the next step: identifying and appraising options. The threshold used in this example is rank four – i.e. all of those that fall within ranks one to four. You may decide that you want to use the same threshold, or you may choose a different one; this depends on the resources available.

Tip for assessing risk

A similar table will be produced for the detailed climate assessment. Remember that hazard and exposure combinations may branch out further with the different vulnerability factors.

8.2. Confidence scores and sensitivity analysis

Separate confidence scores have been assigned throughout the assessment. When looking at the overall risk, it will be important to have an understanding of what the confidence is for each individual component. This will help you to identify where you may need to do sensitivity testing for some of the risks, to ensure you are happy with the overall scores.

Some examples of confidence scores are given in Table 8.2. It shows that the exposure of population to fluoride has low confidence, so may need to be investigated in more detail. You may also decide to look at some of the hazards, exposures or vulnerabilities that have a medium confidence score.

Sensitivity analysis can also be particularly useful if a risk has not made it to the prioritised list of risks and there is disagreement over whether it should be included.

Table 8.1 shows that desertification has low scores for hazard and exposure, so this risk has not been taken forward to the prioritised list; but Table 8.2 shows that the scores for confidence for both of these are also low. You might therefore decide to carry out sensitivity analysis for desertification, to be sure that it should not be in the prioritised list.

Table 8.1: Examples of scoring risk – high-level assessment, country X

Hazard		Exposure		Vulnerability		Risk score	Rank
Description	Score	Description	Score	Description	Score		
Flooding	3	Critical infrastructure – latrines*	3	Financial	2	18	1
Fluoride	2	Water sources, including primary	3	Environmental	3	18	1
Political instability	3	Population	3	Human	2	18	1
Cryptosporidium	2	Water sources	3	Environmental	3	18	1
Cryptosporidium	2	Population	3	Human	2	12	2
Flooding	3	Critical infrastructure – latrines*	3	Physical	1	9	3
Fluoride	2	Population	2	Human	2	8	4
Flooding	3	Critical infrastructure – wells	1	Financial	2	6	5
Flooding	3	Critical infrastructure – wells	1	Physical	1	3	6
Desertification	1	Water sources	1	Environmental	3	3	6

**Exposure has more than one vulnerability component to consider*

Table 8.2: Examples of confidence scores, high-level assessment

Hazard	Confidence	Exposure	Confidence	Vulnerability	Confidence
Flooding	HIGH	Critical infrastructure – latrines	HIGH	Physical	MEDIUM
Flooding	HIGH	Critical infrastructure – wells	MEDIUM	Physical	MEDIUM
Fluoride	MEDIUM	Population	LOW	Human	HIGH
Desertification	LOW	Water sources	LOW	Environmental	HIGH

8.3. Capacity

The capacity assessment can help you to identify what types of actions are needed. Where capacity is high, limited interventions may be needed. Where capacity is low, the intervention needs to be much bigger.

You can also use your assessment of capacity to help in prioritising risks, if you have a lot of risks with the same score or rank. One way of doing this is to look at your assessment of capacity for your top risks to determine whether this would influence its inclusion in the next steps of the process. For example, if you have used a threshold that includes ranks one to four, and you have a lot of risks that have a rank of four, then you might want to look at the capacity assessments for these to determine whether they should be included in the final list of prioritised risks or not. Where capacity is better for one risk than another, then you might only want to include the risk where capacity is poorer.

For the detailed climate assessment, you will be able to use the capacity scores to help compile the final list of prioritised risks. If capacity is low (or very low), then you may want to include that risk in the list, even if you have not scored the risk as high (especially if confidence is low). On the other hand, if capacity is high, you might decide that you do not need to take that risk forward to the next steps of the process.

8.4. Prioritise risks

Consider the following questions to make sure that you are satisfied with the list of prioritised risks:

- Are you satisfied with the total number of risks to take forward for further analysis?
- Are there any risks in the prioritised list that you think should not be included?
- Are there any risks not in the prioritised list that you think should be included?

9. Next steps

By following this guidance, you will have completed a high-level assessment or a detailed climate assessment. The assessments will have resulted in a list of key risks to consider and will hopefully have improved your understanding of the hazards, exposures, vulnerabilities and capacities.

The next steps would be to complete some more detailed analysis of the risks, or to try and begin the process of identifying options that would improve resilience in the WASH sector. Risk management is an iterative process. Therefore, as long as decisions can be made with due regard to the uncertainties, then it is possible to move on to the next steps of the Strategic Framework having only completed a high-level assessment, even with medium or low confidence risks.

The list of prioritised risks that you have identified can be taken forward to the next quadrants in the Strategic Framework. These are:

- Identify and appraise options: this covers the identification and appraisal of options to improve climate resilience.
- Deliver solutions: this covers the integration of options into existing strategies and plans, and their implementation.
- Monitor and move forward: this covers monitoring and the lessons learned from the implementation of climate resilient development activities.

The next step is to identify and appraise climate-resilient options for each of your prioritised risks. There are two Technical Briefs that provide guidance on how to support this. The first sets out a long list of potential climate-resilient options for dealing with the climate-related risks and pressures identified by following this Guidance Note; and the second shows how these options can be appraised and evaluated against set performance criteria.

10. References

African Ministers' Council on Water (AMCOW). (2012) *Water Security and Climate Resilient Development*. Technical background document.

Campbell-Lendrum, D. and Woodruff, R. (2007) *Climate Change: Quantifying the Health Impact at National and Local Levels*. Editors, Prüss-Üstün, A., Corvalán, C. (WHO Environmental Burden of Disease Series No.14). World Health Organization, Geneva.

Global Water Partnership (GWP) and UNICEF. (2014) WASH Climate Resilient Development. Strategic Framework.

INFORM Index for Risk Management (n.d.) INFORM Global Model – interpreting and applying. Guidance Note. http://www.inform-index.org/.

Inter-Agency Standing Committee. (2015) *Emergency Response Preparedness (ERP): Risk analysis and monitoring, minimum preparedness, advanced preparedness and contingency planning - draft for field testing*. https://interagencystandingcommittee.org/files/emergency-response-preparedness-0.

Intergovernmental Panel on Climate Change. (2013) Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change [Stocker, T.F., D. Qin, G.-K. Plattner, M. Tignor, S.K. Allen, J. Boschung, A. Nauels, Y. Xia, V. Bex and P.M. Midgley (eds.)]. Cambridge University Press, Cambridge and New York, 1535 pp, doi:10.1017/CBO9781107415324.

Oates, N., Ross, I., Calow, R., Carter, R. and Doczi, J. (2014) *Adaptation to Climate Change in Water, Sanitation and Hygiene: Assessing Risks and Appraising Options in Africa*. Overseas Development Institute, London.

Stern, N. (2007) *The Economics of Climate Change: The Stern Review*. Cambridge University Press, Cambridge and New York.

UK Department for Environment, Food & Rural Affairs (2012) *Climate Change Risk Assessment Methodology Report*, UK 2012 Climate Change Risk Assessment, Defra, London.

UNICEF. (2015a) Risk-informed Programming Guidance – Summary. Module 1 – Introduction.

UNICEF. (2015b) Risk-informed Programming Guidance – Substance. Module 2 – Risk analysis.

UNISDR, Geneva, Switzerland.
United Nations International Strategy for Disaster Reduction. (2012) *Impacts of Disasters since the 1992 Rio de Janeiro Earth Summit*. UNISDR. http://www.preventionweb.net/files/27162_infographic.pdf

United Nations International Strategy for Disaster Reduction. (2009) *UNISDR terminology on Disaster Risk Reduction*.

Acknowledgements

Preparation of the *Strategic Framework for WASH Climate Resilient Development* was led by a joint Global Water Partnership-United Nations Children's Fund (GWP-UNICEF) team including Cecilia Scharp, Jose Gesti Canuto and Emily Bamford UNICEF; and Jacques Rey, Alex Simalabwi, Susanne Skyllerstedt, Armand Houanye, and Sara Oppenheimer Global Water Partnership (GWP). The Framework documents were prepared by HR Wallingford in collaboration with the Overseas Development Institute (ODI) and Peter Bury on behalf of GWP and UNICEF. The lead authors for the Guidance Note *Risk assessments for WASH*, which supports implementation of the Framework, were Jemima Kennedy, Helen Udale-Clarke and Nigel Walmsley (HR Wallingford).

We are grateful for the valuable input from regional and country-based experts, and practitioners from UNICEF, GWP, WaterAid and others who took part in our consultation exercises and also reviewed drafts of the Framework documents. These included: Arinita Maskey Shrestha and Overtoun Mgemezulu, UNICEF Nepal; Kelly Ann Naylor and Anne-Cecile Vialle, UNICEF Democratic Republic of the Congo (DRC); Peter Harvey, UNICEF Eastern and Southern Africa Regional Office (ESARO) Nairobi; Chander Badloe, Erik Kjaergaard, Maya Igarashi-Wood and Guy Mbayo Kakumbi, UNICEF East Asia & Pacific Regional Office (EAPRO); Pierre Fourcassie, UNICEF Regional Office for the Middle East & North Africa; Hendrik van Norden, UNICEF Regional Office for South Asia (ROSA); Michael Emerson Gnilo and Simone Klawitter, UNICEF Philippines; Alex Heikens, Climate Change Advisor, UNICEF Division of Policy; Antony Spalton, UNICEF Programme Division; Kalanithy Vairavamoorthy, GWP TEC; Frederik Pischke, Francois Brikké, Danka Thalmeneirova, Kenge James Gunya and Ralph Philip, Maika Mueller GWPO; Priyanka Dissanayake, GWP South Asia; Andrew Takawira, GWP Water, Climate and Development Programme (WACDEP) Coordination Unit; and Vincent Casey, WaterAid West Africa. We are also indebted to the panel of experts who have reviewed and commented on our draft reports. These were: Alan Hall, GWP Senior Advisor; Merylyn Hedger, GWP Senior Advisor; Michele Messina, independent; Belynda Petrie, OneWorld; and Melvin Woodhouse, independent. Thanks also to Monika Ericson, GWPO, for coordinating the production of the publications.

UNICEF
3 United Nations Plaza
New York, NY
United States
www.unicef.org

Global Water Partnership
Global Secretariat
PO Box 24177, SE-104 51 Stockholm
Sweden
www.gwp.org, www.gwptoolbox.org