National Institute for Public Health
and the Environment
*Ministry of Health, Welfare and Sport*

# Towards integrated climate resilient water and sanitation safety planning

Summary report of the pan European Symposium on Water and Sanitation Safety Planning and Extreme Weather Events, April 6-7, 2017, Bilthoven, Netherlands

RIVM Letter report 2018-0169
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# Colophon



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# Synopsis

**Towards integrated climate resilient water and sanitation safety planning**
Summary report of the pan European Symposium
on Water and Sanitation Safety Planning and Extreme
Weather Events, April 6-7, 2017, Bilthoven, Netherlands

Climate change induces exterme weather events which lead to droughts and floods. These climate change effects have an impact on the management of water and waste water systems and make their management more complicated. This has been one of the main finding of the symposium RIVM organized in April 2017 in relation to the Protocol on Water and Health (1999) (PoWH) of which the Netherlands is a signatory since 2007. The Ministry of Infrastructure and Water management (IenW) has taken the lead in one of the work areas of the PoWH in 2016; Safe and Efficient Management of Water Supply and Sanitation Systems of with climate change is an important aspect.

In the capacity as WHO Collaborating Centre for Risk Assessment of Pathogens in Food and Water, RIVM supports the Ministry and will continue to do so for the 2019-2021 programme of work. IenW and RIVM both link the work under the PoWH to achieving the UN Sustainable Development Goals for 2030, and the goals related to health (SDG 3), water (SDG 6) and climate change (SDG 13) specifically.

Recurring themes of the symposium have been Water and Sanitation Safety Plans, which have been developed by the WHO to assess and address the hazards (microbiological, chemical, physical) and risks for drinking water production and waste water systems, including the risk of climate change. The geographical focus of the symposium has been on case examples from the pan-European region, in line with the regional character of the PoWH which is administered by the joint UNECE and WHO Regional Office for Europe secretariat.

Keywords: water, climate, SDG 3, SDG 6, SDG 13

# Publieksamenvatting

**Op weg naar klimaatbestendige veiligheidsplanning voor drinkwater en afvalwater**
pan-Europees symposium rapport (2017)

Klimaatverandering veroorzaakt extreem weer, dat droogte of juist hevige regenval en overstromingen tot gevolg heeft. Extreem weer heeft effect op de productie van schoon drinkwater en de verwerking van afvalwater, en vraagt daarom de komende jaren aandacht. Dit blijkt onder andere uit het symposium dat het RIVM in april 2017 heeft georganiseerd. Onderwerp van het symposium was het gebruik van de beoordelingskaders die de WHO heeft ontwikkeld om de effecten van de klimaatverandering voor deze systemen te kunnen opvangen. Het symposium was bedoeld om bewustwording van de effecten van klimaatverandering te vergroten en kennis te delen. Ook zijn voorbeelden gegeven van de manier waarop de WHO-kaders in de praktijk worden gebruikt. De nadruk lag op ervaringen in de zogeheten pan-Europese regio van de WHO: de Europese Unie, de Balkan, Oost-Europa, de Zwarte Zee-regio en Centraal Azië.

Aangezien de gevolgen van extreem weer niet altijd zijn te voorkomen, is het belangrijk om goed voorbereid te zijn en te handelen als ze zich voordoen. Aanbevelingen voor een dergelijke voorbereiding zijn onder andere beschikbare data om te zetten naar bruikbare gegevens voor de mensen die er in de praktijk mee moeten werken. Dit kan bijvoorbeeld door complexe data beter te visualiseren. Ook is risicocommunicatie belangrijk om te voorkomen dat na overstromingen infectieziekten uitbreken. Om zo veel mogelijk mensen te bereiken, is het van belang om hierover via verschillende kanalen te communiceren. Daarbij valt ook te denken aan social media-kanalen.

Het symposium is georganiseerd in verband met het Verdrag Water en Gezondheid (1999). Nederland heeft dit verdrag is in 2007 ondertekend. Sinds 2016 is het ministerie van Infrastructuur en Water (IenW) voor Nederland de trekker van het onderdeel: Veilige en efficiënte management van water- en afvalwatersystemen, waarbij klimaatverandering een belangrijke factor is. Als partnerinstituut van de WHO voor de risico-analyse en -management voor ziekteverwekkers in voedsel en water, ondersteunt het RIVM het ministerie bij de uitvoering van het genoemde onderdeel, dat doorloopt in een nieuw programma voor 2019-2021. IenW en het RIVM koppelen het werk voor het verdrag aan activiteiten om de VN Duurzame Ontwikkelingsdoelen (SDG's) voor 2030 over gezondheid (doel 3) en water (doel 6) te halen.

Kernwoorden: water, klimaat, SDG3, SDG6, SDG13

# Contents

# Summary

In April 2017, a pan European symposium was organized to share knowledge and experiences from within the region and to advance the topic of climate-resilient planning for water supply and sanitation services. In response to extreme events, adaptation strategies are being developed and implemented, at policy level, but also by drinking water and sanitation service providers. Water and sanitation safety plans (WSSP), as recommended by the World Health Organization, offer comprehensive risk-based management tools to enhance these efforts focusing on preventive measures and emergency response and preparedness planning.

The primary objective of the symposium has been to provide a platform for exchange on how to deal with effects of climate change and increased occurrence of extreme weather events for policymakers, operators and the scientific community in the fields of water and sanitation management and public health.

If there is one main message from this symposium it must be that extreme weather events pose a challenge to water and sanitations service delivery to all countries in the pan European region. The session presenters and key-note speakers have shared their main concerns, lessons learned and promising strategies and tools that are being developed in their respective countries. Other important messages included the need for translation of climate research outcomes and for the the local level in an accessible form. Also it was concluded that emergency planning in the water and sanitation sector can at least in part prevent public health impacts, specifically in case of flooding (chapter 4). Climate resilient WSP furthermore, can aid continuous service delivery in case of droughts (chapter 4). Intensified wastewater reuse as one of the consequences of climate change warrants Sanitation Safety Planning and there were several presentations on the subjects of integrated water and sanitation planning (chapter 5 and 6).

It is our hope that this symposium has made a contribution to the integrative thinking around SDG 3, SDG 6 and SDG13 within the framework of the Sustainable Development Agenda 2030 and provides input for further elaboration of the working programme of the UN-ECE/WHO Protocol on Water and Health for international cooperation in achievement of these SDGs.

# 1 Introduction

The Dutch National Institute of Public Health and Environment (RIVM) and the Ministry of Infrastructure and Environment organized a scientific symposium, to advance the integration of safe water and sanitation management in light of extreme weather event pressures, in close coordination with the World Health Organization Regional Office for Europe, the World Health Organization and the United Nation Economic Commission for Europe. The symposium has been organized as an activity within the Protocol on Water and Health working program 2017-2019. The Spanish Ministry of Agriculture, Fisheries, Food and Environment, The German Environment Agency and the International Water Association have furthermore supported the program committee. International Water Conferences assisted the organization of the symposium.

The overall program consisted of 6 sessions with presentations by researchers and was complemented with a number of workshops and a regulators forum.

The primary objective of the symposium was to provide a platform for exchange on how to deal with effects of climate change and increased occurrence of extreme weather events for policymakers, operators and the scientific community in the fields of water and sanitation management and public health. The WHO has been proposing comprehensive risk management and planning approaches in the form of Water safety planning (WSP) and Sanitation safety planning (SSP) since 2009 and 2015 respectively. These approaches have already proved important concepts in several countries and projects worldwide, as they provide a common framework and language for risk management in the water, wastewater and sanitation sector (WHO, 2017). Its users, ranging from community supply owners and utility operators, to national governments, illustrate the wide applicability of the framework. To provide a minimum level of safe and secure water services to the pan-European population is still a task underway. Now climate-change issues like extreme weather events are putting more strain on water resources. Further objectives of the symposium were:

1. To explore existing approaches for managing climate change and extreme weather events and their integration into climate resilient risk management.
2. To explore current implementation of WSP and SSP in the realm of climate adaptation, water and public health sector
3. To create awareness among the symposium participants about the potential of WSP and SSP as a instruments for climate adaptation and as tools for the provision of safe and secure water and sanitation services

## 1.1 Key figures and overview of the symposium programme

- 60 delegates attended the symposium from the European water and health sectors.

- Water and Sanitation Safety Planning formed the backbone of the symposium; the approaches developed by the WHO are further explained to the reader in chapter 3
- The symposium consisted of 6 sessions and two plenary workshops. In this summary report the highlights and take-away lessons from the presentations and workshops are presented.

*Table 1: overview of symposium sessions and workshops*

| | |
|---|---|
| **Session 1** | Climate change and water management: context and nexus |
| **Session 2** | Impact of floods |
| **Session 3** | Water planning for peri-urban and rural areas |
| **Session 4** | Sanitation safety planning in urban environments |
| **Session 5** | Impact of droughts on water supply |
| **Session 6** | Regulatory requirements for water and sanitation (regulators forum) |
| **Water safety planning workshop** | The role of water safety plans in addressing climate change risks |
| **Sanitation safety planning workshop** | Sanitation safety plans for managing risks in wastewater reuse |

## 1.2 Principles of WSP and SSP

The symposium had particular sessions about the risk assessment and risk management concepts of WSP and SSP. The WHO developed these concepts, in 2004 and 2015 respectively. One of the primary objectives of the symposium has been to review the current implementation of these concepts, or concept alike, in the Pan-European region. The WHO organized two workshops titled: ‘Sanitation safety planning for managing risks in wastewater reuse’ and ‘The role of water safety plans in addressing climate change risks’, which presented the principles of WSP and SSP. The workshop on WSP furthermore explained how to integrate climate change data and other existing approaches to enhance climate resilience of WSP planning. Some of the key principles are given below as well as a comparison of the two (Table 2). In Annex I the overview of all steps and modules is presented for both SSP and WSP.

*Table 2 WSP and SSP compared (adaptation WHO 2015)*

| | **Water Safety Planning** | **Sanitation Safety Planning** |
|---|---|---|
| **Risk Assessment and Risk management approach's objective** | To consistently ensure the safety and acceptability of a drinking-water supply and to reduce the risk of drinking water contamination | To [minimize contact] and to reduce negative health impacts of use of wastewater, excreta or greywater while maximizing the benefits [...] |
| **Chain of operation** | Follows the drinking water supply chain. Contracts from catchments and converges to drinking water delivery points after treatment | Follows the sanitation chain. Expands from waste generation to its capture, collection, treatment, reuse and/or discharges into the environment |
| **Exposure groups of interest** | Considers single exposure groups (drinking-water consumers) | Considers multiple exposure groups |
| **Regulatory framework** | Usually operates in a clear regulatory framework – roles and responsibilities are clear (unless small-scale/ community supply systems) | Usually no clear regulatory framework – roles and responsibilities are shared over different sectors and levels |
| **Financial model** | Clear cost-benefit model – drinking water utility (in charge of treatment and distribution system) and drinking water consumer | Often more complex - Multiple actors, public and private, and several business models that may be intertwined or separate. |

Both WSP and SSP deal with aspects of the waste and water cycle. The goal of sanitation safety planning is 'to [minimize contact] with fecal matter, and furthermore, to reduce negative health impacts of the use of wastewater, excreta or greywater, while maximizing the benefits (WHO, 2015). While the goal of water safety planning is 'to consistently ensure the safety and acceptability of drinking water supply and to reduce the risk of drinking water contamination (WHO/IWA, 2009).

# 2 Key symposium messages

If there has been one main message of the symposium it is that extreme weather events pose a challenge for drinking water and sanitation service delivery for all countries in the Pan-European region. The authors, based on the symposium minutes and presentations, have selected the following key symposium messages. They represent overall take-home messages from the symposium presentation. More highlights per session are to be found in the remainder of the document.

1. In his opening keynote Professor Pier Vellinga from Wageningen University brought to the attention of the audience that **there is a climate adaptation deficit in European cities**. Research and data gathered at the meta-level are not being implemented into climate adaptation plans at the local level, while adaptation and mitigation need to happen locally.
2. **Climate adaptation measures can be added to climate mitigation plans** (which are often considered more urgent). Before convening with stakeholders from the water sector to discuss on climate adaptation: start with analysis of problems and solutions around in other sectors or around other issues (housing, ageing population, ecological decline, health) and identify alternative or additional climate robust solutions, which tackle multiple issues.
3. **Better visualization of highly technical information and scenarios** in an easily accessible way are important in order to inform smart climate adaptation services at the local level. Visualization and scenarios can also be a useful in the identification of overlap of interests of multiple stakeholders and possible co-benefits.
4. **Big data to small data**: New opportunities arise from new technologies(e.g. big data, remote sensing, source tracking/genome sequencing, Artificial Intelligence), The challenge however is that these opportunities and the data they result in still **need to be formed into simple messages, and to the local level**. An exchange from bottom up, together with top down approaches is needed for adaptation planning.
5. **Less people are dying from floods because we manage them better**, explained **Professor Paul Hunter** from Norwich Medical School, University of East Anglia. However, the case of Hurricane Katrina showed that many people did not receive or did not understand the call for evacuation.
6. **Use multiple channels when it comes to risk communication** around flooding; Good planning is needed to reduce adverse public health impacts of floods; Chemical contamination of food and water stocks, anxiety and infectious disease. Not all of these effects are unavoidable and can be dealt with through proper emergency planning.
7. Climate change is expected to **alter the frequency and intensity of weather events** and is expected to **increase the existing stress on water resources**. Water suppliers must consider their resilience to the impacts of climate change and variability both **now and into the future**.

8. To ensure continuous service delivery, **climate change resilience** is key in ensuring sustainably managed services, also for WSP. A climate change resilient WSP approach has recently been developed, and tools and examples are available (WHO, 2011, 2017].
9. Examples of **Sanitation Safety Planning** were presented (Portugal, Finland), and its implementation was demonstrated to be important for ensuring good human and environmental health. SSP **is becoming increasingly important because of climate change, with flooding and droughts, leading to increased direct and indirect reuse of wastewater.**
10. **Integration of the SSP and WSP approach is gaining more attention.** Generally, this is more important for smaller systems where there is less opportunity for specialization and stakeholders /actors may have several responsibilities that may not be as clear-cut or stakeholders may be less informed/haver fewer resources.

# 3 Regulatory requirements for national implementation of water and sanitation safety planning

The symposium brought together regulators for the pan-European region. During the regulators forum representatives from Belarus, Portugal, Serbia, Hungary, Spain and the Netherlands presented their main issues with implementing WSP and SSP in light of climate change issues. The IWA made a video about the regulators forum (follow the link in the footnote to go to the video) [1].

The regulators agreed about that what is currently still lacking are policies and regulations that stimulate the uptake of WSP and SSP. This entails both the national and utility level. The urgency for the uptake of water and sanitation safety planning is still poorly understood in most countries. In light of extreme weather events the urgency is likely to become more apparent. This was illustrated by the Serbian delegation that showed how the 2014 severe floods in Serbia lead to a number of issues during the floods and in the aftermath.

Furthermore it was raised by the Netherlands that WSP and SSP are terms that are not commonly used as such in the country, but many of the issues that were shared in the forum and during the symposium are going concerns in the Netherlands as well. In the country the vulnerability of vital functions - such as the waste water system - against flooding is being assessed. The study will provide for a guideline to improve the resilience of against and recovery after severe flooding.

The following points where raised by the participants of the regulators forum:

- The need was raised for **capacity, training of staff, and adequately trained staff**. Furthermore these issues were found to be **most urgent for small-scale systems in rural areas**;
- In small-scale systems, ownership and regulations are usually the weak parts of the chain**. Clear property rights and responsibility shares needs to be in place in order to enable for preparedness and prevention**;
- Technical details at the local and even micro-level are important, but at the same time it is important to keep a wider perspective by **linking energy and economic needs** for instance. Of course, the health focus should be paramount in the water and sanitation sector;
- Elaborating on this: climate change is forcing water regulators to take a more global perspective into account, and to **review plans holistically**;
- **Collaborations are needed across sectors and with operators and suppliers, and between different countries**.

[1] Link to the IWA regulators forum video https://vimeo.com/216061551/365ae61a22

When collaborating locally across sectors, a clearly defined lead organization is needed, often these will be the health authorities;
- There is not just a need for more regulation; there is a need for **more harmonization of existing regulation** and to include water authorities and institutes managing the water and waste water system in this process as well;
- It is important to **incorporate both health and economics** into the discussions on safety planning for water supply and sanitation.

# 4 Climate-resilient Water Safety Plans

***David Wilkes, Arup, United Kingdom,*** *On the potential of the Holistic Integrity Test said: 'Imagine this headline in 2050: "Today, following a combination of storm surge, high winds and extreme rainfall, a large area of central London was flooded. There were no casualties, essential services will be restored shortly and businesses will be back to normal by the end of the week".*

***Rory McKeown, WHO workshop facilitator****, Climate Change increases the amount of difficult decisions to be made. WSPs provide a proactive approach to effectively address and manage current and predicted climate-related risks.*

During the workshop **'The role of water safety plans in addressing climate change risks'** an overview was given of how extreme events may impact the water supplies by **Rory McKeown**. Water supplies may be impacted by climate change and variability through precipitation and subsequent flooding, droughts, increased temperature and sea-level rise.

- Heavy precipitation and flooding may lead to increased upstream erosion and run-off, overwhelmed drainage, wastewater containment systems but also wastewater treatment and distribution facilities.
- Sea-level rise as well, may lead to damaged assets and infrastructure because of inundation, salt water and increased flooding events. Water quality is under threat because of salt intrusion into acquifers.
- Droughts are leading to increased competition for scarce water and on increased dependence of less-safe alternatives. The concentration of contaminants and pollutants may also increase because of droughts. Because of general temperature rises, the growth of cyanobacterial blooms is likely to increase.

Climate-resilient WSPs (CR-WSP) integrate aspects of Integrated Water Resource Management (IWRM) and Disaster Risk Reduction (DRR) to account for long-term changes associated with climate change and mitigation of exceptional events respectively. In principle CR-WSP are an update of the existing WSPs, for improved response and preparedness planning. Climate Vulnerability Assessments (CVAs), ranging from continental to sub-basin level, additionally may provide further input in the local/catchment context. Of 11 steps in the WSP module, 7 were identified as key elements to consider. For more information and guidance on how to implement a climate-resilient WSP see the 2017 WHO guidance on CR-WSPs.

***Kyriaki Iannou, Water Development Department of the Ministry of Agriculture, Rural Development and Environment,*** *More planning and monitoring and better water allocation is ensuring success in water scarce Cyprus*

***Claudia Agudela- Vera, KWR,*** *Climate change brings warmer weather and because of urban heat island, there is also an underground effect. This can be critical for drinking water pipes, for which it is necessary to keep temperature at low because of risk of microbial growth.*

## 4.1 Key areas to increase climate-resilience in WSPs

The following key-areas for climate adaptation where presented by McKeown in his presentation. Modules relate to WSP modules (table 3)

**Module 1 WSP team assembly;** in addition to the usual expertise required in managing a drinking water supply (see WHO/IWA, 2009) additional knowledge inputs should be secured during a WSP cycle to gain information on relevant extreme weather related aspects. This knowledge could come from climatologists, emergency management specialists, public health specialists and a dedicated sanitation safety planning team. The level of integration is depending on the local situation. It was stated during the workshop however, that ad hoc consultation will also be appropriate at the 7 key stages for CR-WSPs.

**Module 2 System description;** Outputs from approaches concerning long-term and disaster- and climate studies can be incorporated to gain a more holistic perspective of the system. Evaluating these outputs can potentially increase the understanding of long and short-time vulnerability in the system. Approaches to consider are for example IWRM, CVAs and DRR.

**Modules 3-5;** follow the same rationale considering information derived from IWRM, CVAs and DRR assessments with regard to specific hazards and hazardous events. This is true for both existing and potential hazards.

**Module 5 Improvement plans**; For improvement planning a number of suggestions were made. For instance: a wider range of source options may be explored to distribute the risk of more scarce water resources. Adaptive water management infrastructure and financial incentives to change consumers behavior should be considered (e.g. water tariffs, water saving policies)

**Module 8 Management procedures;** To anticipate climate change related incidents and disasters and improve resilience, it will be relevant for management procedures to consider information and planning for climate-related emergencies. Emergencies in this meaning could be incidents, disasters and extreme events. Emergency plans may consider: Response actions, Roles and responsibilities, Emergency supplies, Communication and notification.

**Module 9 Supporting programmes;** These might be used to build capacity to manage climate risks. Capacity can be build through partnership programmes, capacity-training of staff in the field of DRR and emergency planning, and research programmes like supply modelling.

***Miljan Rancic , Institute of Public Health, Serbia,***
*Presented on the water and sanitation emergency management response, during extremely severe flooding in Serbia in 2014 which caused casualties and large economic losses. Rancic indicated that this disaster did serve to check whether the emergency procedures that were in place were functional. Lessons learned will be used to improve the overall emergency preparedness strategy. The disaster response did prove to be successful in terms of inter-sectoral and international cooperation.*

# 5 Sanitation Safety Plans and suggestions for increasing climate resilience

***Session keynote Professor Barbara Evans, Public Health Engineering, School of Civil Engineering at the University of Leeds,*** *"It will be impossible to provide one solution like the conventional sewer system with the worlds' cities growing at the current rate. Modular approaches are needed for planning urban sanitation, both horizontal and vertical in term of management capacity and technical solutions."*

***Raquel Mendez, Workshop facilitator,*** *Current goals for SSP are to be taken up in practice and in regulation. Use of wastewater is ongoing, and will only increase and will become more and more dominant. SSP is an approach to handle this reuse and ensure that it is safe'*

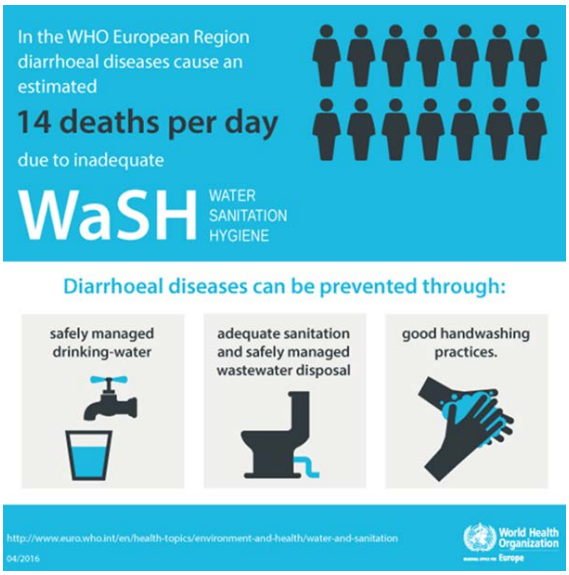


*Figure 1: WHO/EURO 2017*

Many people in the world, including those in the pan-European region, still lack access to improved sanitation. Since 2015 WHO uses safely managed systems as the highest level on the sanitation ladder; meaning adequate toilets are not shared with other households, there is a handwashing facility with soap and safe water and excreta is adequately disposed at the site or treated and disposed away from the household location. Both sewer connected systems and decentralized toilets may be considered safely managed.

The JMP WASH (WHO/UNICEF, 2017) shows that in 2015:

- 39 per cent of the global population (2.9 billion people) used a safely managed sanitation service; that is, excreta safely disposed of in situ or treated off-site.
- Two out of five people using safely managed sanitation services (1.2 billion) lived in rural areas.
- 27 per cent of the global population (1.9 billion people) used private sanitation facilities connected to sewers from which wastewater was treated.

Lacking access to improved and safely managed sanitation systems may have dire consequences for individual health and public health. About 14 deaths per day can be attributed to the lack of water, sanitation and hygiene in the WHO European region alone (WHO EURO, 2017). Sanitation is one of the most important infection prevention measures of our time, preventing exposure to fecal matter, yet at the same time there is a global trend of wastewater and fecal sludge use for economic activities. Long existing practices include wastewater irrigation, and dried or raw sludge application in agriculture. Even in countries with restrictive regulations around these practices, resource recovery in wastewater is gaining attention (WHO, 2018). Depletion of global phosphorus reserves, and other resource scarcities, is driving innovation for recovery techniques and infrastructure. Water scarcity in Israel has been a driver for wastewater use in agriculture for decades. Both climate change and sustainability issues are drivers for an increase in reuse practices.

The scarcity issue has given a more widely acknowledged rise to the identification of the potential economic benefits to be gained from wastewater and fecal sludge as resources. In order to gain the benefits fecal sludge and wastewater have to be collected. This could go in tandem with the obvious public health purpose of sanitation, but design and maintenance of reuse systems require close monitoring. Considering sanitation financing furthermore, which is notoriously insufficient financing in many parts of the world, as Professor Barbara Evans highlighted in her keynote presentation, it is crucial that the health and economic interest are taken into account in an integrated manner. Sanitation Safety Planning offers a comprehensive risk management approach for existing sanitation infrastructure, management and different exposure groups. Economic and climate assessment approaches could be taken into account in an SSP much the same way as is being proposed in climate-resilient WSPs (WHO, 2017).

***Huw Taylor, School of Environment and Technology of the University of Brighton,*** *presented sustainable disinfection of stored storm water flows (other than UV treatment and chlorination). Climate adaptation of the drainage and sewer system in order to ensure their human health protection purpose could mean that the critical control points need to be redefined.*

## 5.1 Key areas for increasing climate-resilience in SSPs

There currently is no specific SSP guidance on climate change related issues, other than the Guidance on Water Supply and Sanitation in Extreme weather Events (WHO/EURO 2011). Based on this guidance, the WHO Climate-resilient WSP guidance [ref ] and the symposium presentations, most relevant SSP modules for climate-resilience are suggested in the next paragraph. The numbering relates to SSP modules (table 3)

**Module 1.2 Set objectives;** Objectives could be specifically targeted towards reducing climate change impact on an existing sanitation system or making a system more resilient

**Module 1.4 Assemble the team;** It could be useful to have the required expertise in the team when the objective is set to incorporate or increase climate resilience of sanitation system, in order to gain a comprehensive understanding of the climate related challenges. Expertise can be secured in the form of SSP team members with experience in response and preparedness planning for extreme events or by engaging external consultants or partners with expertise in the use of climate assessment modelling or other climate adaptively measures.

**Module 2.4 Gather compliance and contextual information**; It will be useful to gather data on weather variability and climate change data that may influence the sanitation systems objective; whether it may be set at upgrading an urban sewerage systems or protecting consumers from exposure to wastewater irrigated crops during dry seasons.

**Module 3.4 Assess and prioritize the exposure risk:** Is the exposure risk aggravated by extreme weather events in certain seasons or expected to increase over time? Climate data can be of added value when assessing and prioritizing risks in this module. For instance: trend data on seasonal precipitation in relation to combined sewer overflow rates or patterns of drought periods when assessing a risk related to use of waste water in crop irrigation. Prioritization informed by climate data may stimulate suitable control measures in the sanitation and reuse chain.

***Nuno Pimentel, Aguas de Portugal,*** *The predictive Decision Support System that has been developed and piloted in Lisbon's combined sewer system will allow for early warning of extreme events that may cause the system to overflow. Pimentel noted that wastewater in the streets is a serious concern, not only because of health concerns, but also because of financial consequences.*

# 6 Integrating SSPs and WSPs

Considering the similarity in the systematic approach and overlap in goal and purpose of the WSSP and SSP one may question to what extent they may be integrated and in what type of situation this could be beneficial. There seem to be many associations as both deal with the environmental dimensions of water resources and hygiene; SSP focusing on reducing exposure of excreta and waste water to the human population and WSP aiming at reducing contaminants in source water to a safe and acceptable level in order to supply drinking water. In practice however combination of the two approaches has been scarce. The SSP and WSP workshops were concluded with a dedicated discussion on how to combine or integrate the SSP and WSP, facilitated by the International Water Association. Below some considerations that were voiced on combining both approaches have been illustrated hereafter.

**It is important that roles and mandates of the teams are clear from the start.** Bringing together SSP and WSP seems a good idea, but there is a concern that getting too many stakeholders involved could lead to endless conversations. It is important to engage stakeholders at a certain point in time. More detailed discussions in separate groups to optimize the process could be considered.

***Barbara Evans, Public Health Engineering, School of Civil Engineering at the University of Leeds,*** *in her noted session keynote presentation noted that local leadership at the municipal level is crucial, together with an appropriate method and sufficient financing. "Sometimes it is necessary only to give policy advice instead of technical support". According to Evans key is to give the right kind of information to the right people. Capacity building for system management is important.*

**Recreational water and management thereof, could serve as a linking area between the spatial dimensions of SSP and WSP.** In principle, catchments for drinking water production require protection from pollution as do recreational waters. Therefore waste water and fecal sludge are collected, treated and disposed in a safe manner, meaning, in a way that should be minimizing the risk of harm to the human health. But a number of presentations [Helsinki, Madeira] indicated that there bathing waters and recreational areas might often be in fact polluted by wastewater. Increasing run-off caused by extreme events are often shown to be the cause. Increasingly occurring extreme rainfall events can be an aggravating factor of these run-off events. In Finland, one of the first countries to implement SSP at the regulatory level showed the usefulness of the tool in terms of having early warning systems at the city-level when it came to wastewater effluents in waters that were used for recreation in summer.

***Joanna Castrén, Helsinki Region Environmental Services, presented the case of SSP implemention in Finland.*** *In Finland SSP implementation is a mandatory. Castrén noted it takes time to conduct and SSP cycle and it is important to keep staff motivated. There is a need to see the usefulness of the tool for everyday work, not as just a requirement in legislation. It has been a useful tool to know when recreational waters are safe for swimming and to integrate this kind of knowledge into warning systems.*

**In small-scale community systems, often rural or peri-urban, where there is less capacity, resources are scarce and roles and responsibilities are less defined, and an integrated approach of SSP and WSP may have much added value.** Key here would be that the approach is still manageable by small-scale operators and even communities. Peres presented an example from Brazil, illustrating the case for integrating elements of SSP and WSP in low resource arid setting, where community behavior had more impact on the quality of water and sanitation service delivery than in an urban setting (in the Pan-European region). Further implementation research is warranted.

***Mario Rodrigues Peres,*** **School of Environment and Technology of the University of Brighton,** *The behavior component – droughts and human handling exacerbate the recontamination of drinking water in semi-arid rural communities in Brasil. Peres proposed a WASH plan* for these settings - integrating elements of WSP and SSP - *to prevent excreta-borne disease transmission.*

***Alida Alves, UNESCO-IHE / PEARL project,*** *Green-grey infrastructure is a solution for cost effective flood protection. It only takes into account water quantity in current scope, water quality should* be considered for the future.

# 7 Literature

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# Annex I: Similarities of WSP and SSP approach

| WSP Modules | WSP Steps | | SSP steps | SSP Modules | |
|---|---|---|---|---|---|
| **1. Preparation** | 1 | Assemble the team | **1. Prepare for Sanitation Safety planning** | 1.1 | Establish priority areas or activities |
| | | | | 1.2 | Set objectives |
| | | | | 1.3 | Define the system boundary and lead organization |
| | | | | 1.4 | Assemble the team |
| **2. System Assesment** | 2 | Describe the supply system | **2. Describe the sanitation system** | 2.1 | Map the system |
| | 3 | Identify hazards and hazardous events | | 2.2 | Characterize the waste fraction |
| | 4 | Determine and validate control measures, reassess and prioritize the risks | | 2.3 | Identify potential exposure groups |
| | 5 | Develop, implement and maintain an upgrade plan | | 2.4 | Gather compliance and contextual information |
| | | | | 2.5 | Validate the system description |
| **3. Operational monitoring** | 6 | Define monitoring of the control measures | **3. Identify hazardous events, assess existing control measures and exposure risks** | 3.1 | Identify hazard and hazardous events |
| | | | | 3.2 | Refine exposure groups and exposure routes |
| | | | | 3.3 | Identify and assess existing control measures |
| | | | | 3.4 | Assess and prioritize the exposure risk |
| **4. Verification monitoring** | 7 | Verify the effectiveness of the WSP | **4. Develop and implement an incremental improvement plan** | 4.1 | Consider the option to control identified risks |

| WSP Modules | WSP Steps | | SSP steps | SSP Modules | |
|---|---|---|---|---|---|
| | | | | 4.2 | Use selected options to develop and incremental improvement plan |
| | | | | 4.3 | Implement the improvement plan |
| **5. Management and communication** | 8 | Prepare management procedures | **5. Monitor control measures and verify performance** | 5.1 | Define and implement operational monitoring |
| | 9 | Develop supporting programmes | | 5.2 | Verify system performance |
| | | | | 5.3 | Audit the system |
| **6. Feedback and improvement** | 10 | Plan and carry out periodic review of the WSP | **6. Developing supporting programmes and review plans** | 6.1 | Identify and implement supporting programmes and management procedures |
| | 11 | Revise the WSP following an incident | | 6.2 | Periodically review and update the SSP outputs |

Please note that WSP entails 6 steps and 11 modules whereas SSP encompasses 6 module and 21 steps. Further note that steps and modules for SSP and WSP have been changed around to aid the comparison.

Water and Sanitation Safety planning follows an iterative cycle. Review times are preset by the respective leading teams or follow an incident that requires reviewing of the systems. An overview of the modules of a WSP is presented in Table 3. A similar set of modules is followed during a sanitation safety plan cycle. In principle the WSP/SSP approaches follow a classic risk assessment method including 1. a system assessment, 2. a hazard and critical control point analysis and 3. improvement planning. The added value is that the WSP and SSP approach give more guidance on how to conduct risk assessment in water and sanitation systems specifically.

WSP and SSP are risk assessment and risk management approaches that are linked through both their systematic approach and overlapping environmental and public health objectives. Their differences are their line of operation (source-to-tap versus waste generation to disposal and/or reuse), relative clarity of roles and responsibilities and number of exposure groups at potential health risk (see table 1). Setting objectives for the SSP for instance is important and maybe less straight forward, whereas in WSP the objective is clear; the production of safe drinking water.

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