



National Climate Adaptation Implementation Programme

*Smarter, more systemic,
for all and by all*

November 2023

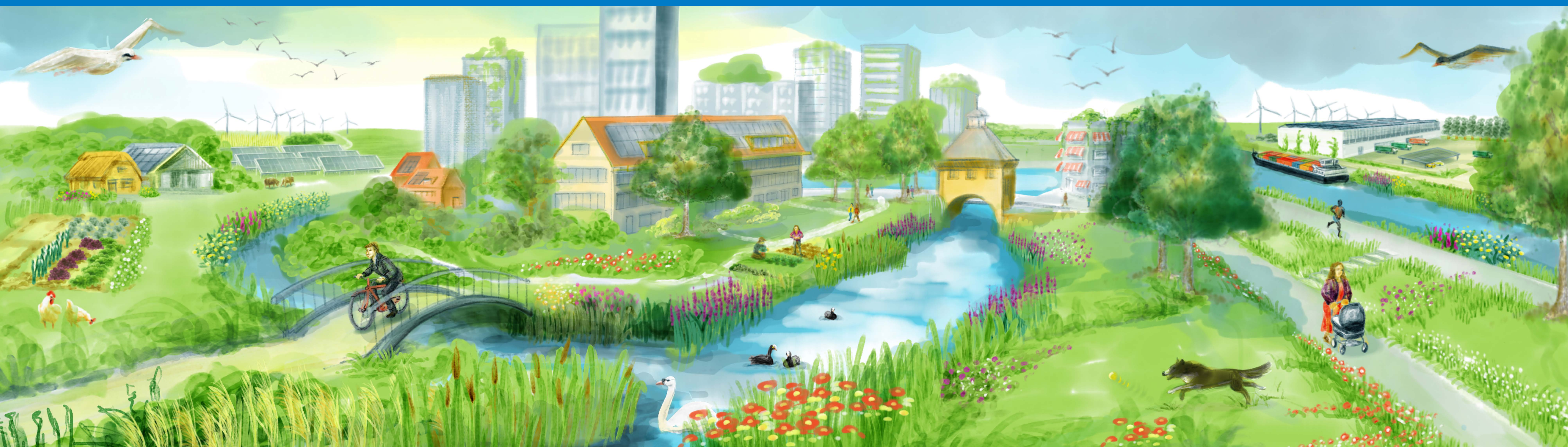


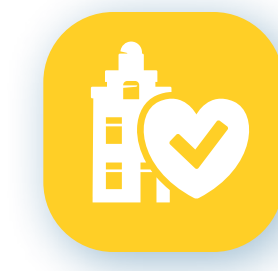



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Preface



The climate is changing. So rapidly, in fact, that we commissioned a study in 2022 to find out if the 2016 “National Climate Adaptation Strategy” is still on track. The evaluation revealed that the sense of urgency regarding climate adaptation has become a lot more acute. Provinces, municipalities, district water boards and other stakeholders have stepped up their efforts to prepare for the effects of climate change, which is very encouraging. There are action plans, programmes and agendas abound as well, but these efforts are not enough. If we want to pick up the pace, we will have to switch to a more structural, fundamental approach. Our standard response to any developments in the Netherlands should factor in the rising sea level, higher temperatures, longer periods of drought or, alternatively, extreme precipitation. Of course this will require clearly defined goals, knowledge that is both accessible and applicable, clearly defined responsibilities, sufficient capacity and structural financing.

This is why the “National Climate Adaptation Implementation Programme” was created. This programme provides insight into current climate adaptation efforts in the Netherlands, what still

needs to be done, and how we can accelerate. This may sound like an extensive list of actions, but an effective approach starts with a clear overview, because this will help us spot weaknesses and define concrete objectives. I therefore see this implementation programme as a first step towards a concrete plan, which will help us pick up the pace to fill the gap between planned and needed actions. This should also bring us closer to the creation of the next “National Climate Adaptation Strategy” in 2026.

Of course climate adaptation initiatives, projects and policies are always evolving, so this implementation programme is a snapshot of the current situation. It isn’t a perfect picture, but it does show where we are and where we should be heading. It goes without saying that we cannot do this alone. This is why this programme includes examples of inspirational climate adaptation projects from all over the Netherlands. Together, we can accelerate our efforts to make people, culture and nature resilient to extreme weather and other effects of climate change.

Mark Harbers, Minister of Infrastructure and Water Management

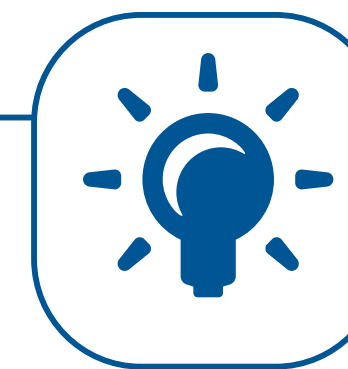
Management summary

One goal

To accelerate climate resilience in the Netherlands

3 principles

Smarter
knowledge is accessible
and applicable



More systemic
adaptation is mainstreamed
into all policies and developments



More inclusive
adaptation for and by all



15 key challenges
for adaptation

Water



- Well-protected against flooding
- Sponge cities
- Future-proof freshwater supply
- Good water quality

**Agriculture,
nature and the
environment**



- Climate-resilient agriculture
- Climate-resilient nature
- Well-protected hazardous industries

**People and
culture**



- Heatproof cities
- Staying healthy in times of climate change
- Well-protected cultural heritage

**Working and
living**



- Green climate-adaptive new developments
- Climate-resilient housing for all
- Green and healthy working landscapes
- Strong and resilient infrastructure
- Climate-adaptive waterways

5 priorities

1

To develop concrete adaptation targets



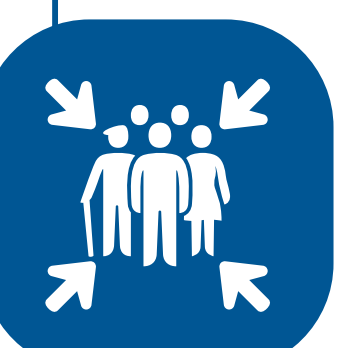
2

To increase accessibility and applicability of knowledge products



3

To increase attention to climate justice



4

To mainstream adaptation into all policies and implementation



5

To explore opportunities to expand adaptation finance



Introduction

1.1 Rising sea levels, increasing weather extremes

The climate is changing, and temperatures are rising all over the world. This is resulting in rising sea levels and more frequent extreme weather events. These changes are noticeable in the Netherlands as well. We experienced heat waves in 2018 and 2019 and extreme droughts in 2018, 2020 and 2022. In July 2021, heavy rains in Germany, Belgium and the Netherlands caused high water levels in the Maas in Limburg and Noord-Brabant and flooding in the brook valleys of villages and cities in Limburg.

- Pluvial flooding can block roads and damage the natural environment, crops, buildings and infrastructure. Prolonged periods of rain cause the soil to become saturated with water, which may result in flooding of agricultural areas or residential basements and crawling spaces.
- Prolonged periods of drought can cause water shortages. This may lead to subsidence, salinisation, damage to crops and to the foundations of buildings and cultural monuments. Nature conservation areas may dry out, which in turn increases the risk of wildfires. Inland shipping may be affected by low water levels, and businesses may face coolant shortages.
- Heat can lead to increased health problems and deaths during the summer. Exposure to UV radiation increases the risk of skin cancer. Prolonged pollen seasons will result in more “allergy days”. Heat can lower productivity at work, affect water quality and damage infrastructure, for example in the form of melting asphalt or impingement of bridge mechanisms.
- Flooding as a result of a breach in a primary water defence along a river or along the coast may lead to significant damage, injuries and deaths. Vital functions, such as municipal water supply, the electrical grid and telecommunication networks may be affected as well.

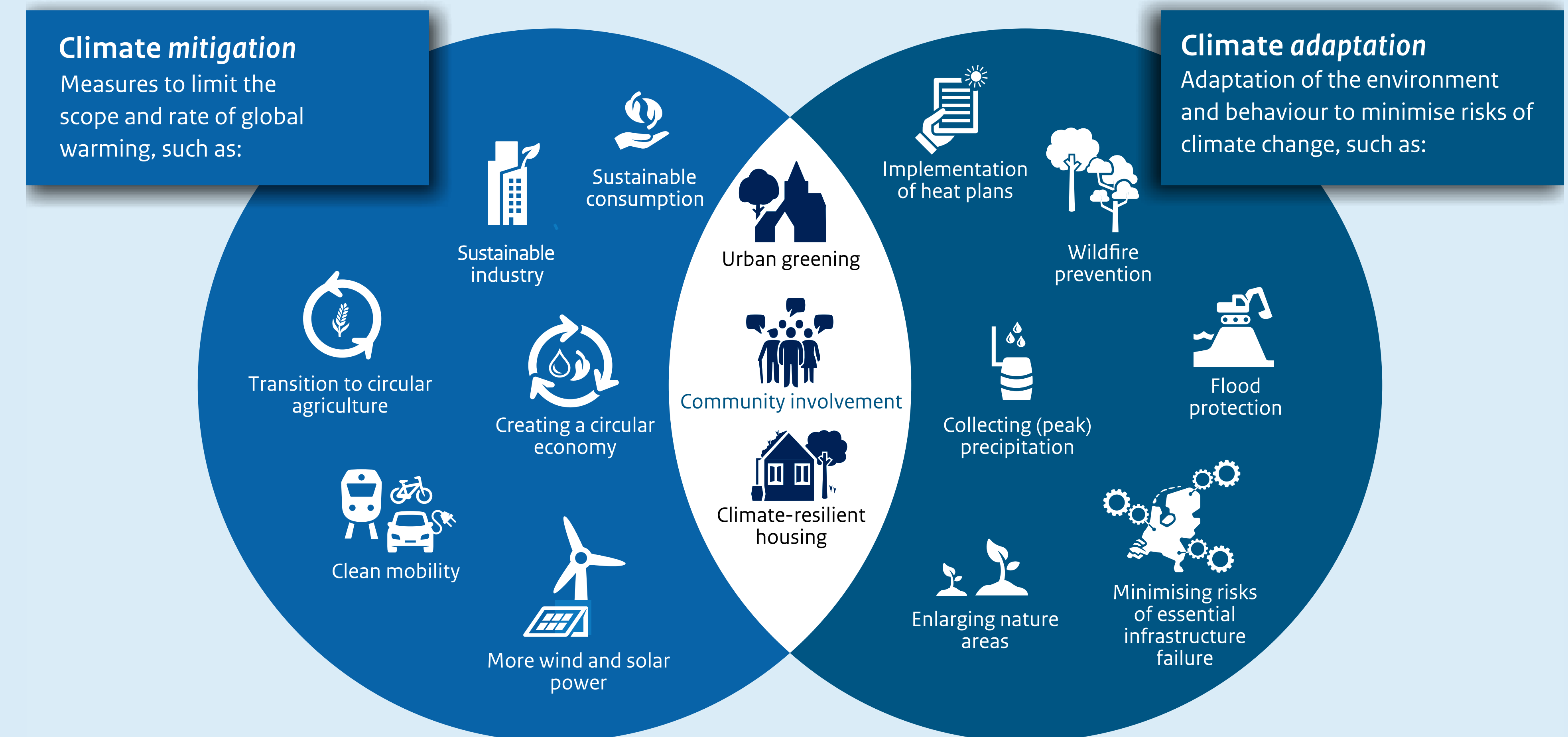
- Drought, heat, rising sea levels and tropical storms are the primary threats to liveability on the Dutch Caribbean islands (Bonaire, Sint Eustatius and Saba). Small islands are also vulnerable to the indirect effects of climate change, such as disrupted supply chains or global price fluctuations as a result of harvest failure.

Non-climate-related factors exacerbate the impact

Population growth, population ageing, and increased social inequality are examples of non-climate-related factors that can exacerbate the impact of climate change. The growing elderly population is especially vulnerable to heat, for example: significantly higher temperatures may affect their self-sufficiency and lead to more frequent requests for care. The construction of large numbers of new houses and the energy transition may affect the impact of climate change as well, as more people and assets (buildings, areas) are exposed. These types of non-climate-related changes make the task of climate-proofing the Netherlands not just more complex, but more urgent as well.

Causes and effects of climate change: climate mitigation and climate adaptation

Ever-increasing concentrations of greenhouse gases in the atmosphere, primarily as a result of the increased use of fossil fuels, are causing global warming. The Netherlands is taking measures to limit the scope and rate of global warming; this is called “climate mitigation”. In addition, the Netherlands is preparing to deal with the risks of climate change and to adapt the environment and our behaviour in order to minimise these risks. This is called “climate adaptation”. This also includes taking advantage of opportunities presented by climate change.



1.2 Evaluation of the National Climate Adaptation Strategy

The [National Climate Adaptation Strategy \(NAS\)](#) explains how the Netherlands is adapting in order to mitigate, or at least manage, the negative effects of climate change. The Delta Programme contributes to the NAS in the areas of water safety, freshwater supply and spatial adaptation. Several programmes for climate adaptation in the natural environment, agriculture and the built environment have been launched in recent years.

The NAS was adopted in 2016, and its implementation was [evaluated](#) in 2022. The evaluation revealed that many measures are being implemented that are making the Netherlands more resilient to climate change. By now, many parties are aware of the climate risks that affect them and are taking steps to reduce these risks. There were also three important recommendations:

- Set concrete goals and provide more information about progress and effectiveness.
- Provide more guidance, coordination and “implementation capacity”.
- Focus more on the effects of climate change on people, culture and the natural environment.

The pace of the implementation of the NAS needs to be picked up as well. This is because the climate is changing at an increasing rate and because non-climate-related developments and transitions may increase climate risks. For this reason the Council of Ministers approved the creation of this new National Climate Adaptation Implementation Programme (Dutch NUPKA) you are reading.

The NUPKA primarily covers the European Netherlands, but it also includes tasks and measures that are planned for the Caribbean Netherlands. The purpose of the “Bonaire Climate Table” (a platform for agreements to limit CO₂ emissions and to prepare for the effects of climate change) and the preparation processes for the climate plans for Saba and Sint Eustatius is to gain a more complete understanding of what is needed in the Caribbean Netherlands in terms of climate adaptation.

1.3 Purpose of the National Climate Adaptation Implementation Programme

This implementation programme provides an overview of the main actions in the area of climate adaptation that are already being implemented or that are being prepared for implementation¹. This document is intended for anyone who wants to know how the Netherlands is adapting to climate change and what still needs to be done to achieve this goal. The implementation programme also explains how the NAS is implemented and what additional steps will be needed to pick up the pace. These steps are summarised in five priorities. We want to address these priorities within the framework of the recalibration of the NAS, which is expected to be published in 2026.

This document primarily contains actions on the part of the Government, but municipalities, district water boards and provinces are taking adaptation measures as well, and the same applies to housing associations and home owners. Examples are highlighted in the form of “spotlights”, which are intended to inspire and to show examples of the implementation of measures by all these parties.

It is important to note that this implementation programme is a snapshot. New initiatives are continually being added, so this implementation programme will be updated on a regular basis. The next version will be published right after the new NAS and will be updated every two years from then on. This implementation programme is not complete: it contains the fifteen most important adaptation challenges we are currently working on. Additional challenges may be added in the future based on new insights.

1.4 Procedure

The overview of the most important current and planned adaptation actions is based primarily on policy documents, but also on information from reports by working groups and networks of professionals who are working on climate adaptation. In addition, important input was gathered during a meeting on 9 March 2023 of more than one hundred experts and stakeholders in the field of climate change. They discussed urgent challenges, activities and priorities for the future. The National Climate Adaptation Implementation Programme was established in cooperation with the NAS Interdepartmental Consultation Committee (Dutch IO-NAS) and the NAS Directors

¹ It concerns the most important promised policy actions in the area of climate adaptation that are planned or already being implemented at the time of this writing.

Consultation Committee (Dutch DO-NAS). The following parties are represented in these consultation bodies: the Ministry of the Interior and Kingdom Relations, the Ministry of Economic Affairs and Climate Policy, the Ministry of Infrastructure and Water Management, the Ministry of Justice and Security, the Ministry of Agriculture, Fisheries, Food Security and Nature, the Ministry of Education, Culture and Science and the Ministry of Health, Welfare and Sport, plus the Association of Provincial Authorities of the Netherlands (IPO), the Royal Netherlands Meteorological Institute (KNMI), the Netherlands Environmental Assessment Agency (PBL), the National Institute for Public Health and the Environment (RIVM), the Association of Netherlands Municipalities (VNG), the Association of Regional Water Authorities (UvW) and the Delta Programme Commissioner Staff.

1.5 How to use this document

The chapter titled “Where are we, where are we going” provides a brief summary of what is currently happening in the area of climate adaptation, what is still needed and what the priorities will be for the coming years.

The chapter “Starting Points” explains how the Netherlands will have to adapt to climate change in the coming years, i.e. in ways

that are smarter, more systemic and more inclusive. This chapter covers topics such as knowledge, financing and justice.

Next up are the various “Challenges”, which are subdivided into four domains:

- Domain I - Water;
- Domain II - Agriculture, nature and the environment;
- Domain III - People and culture;
- Domain IV - Living and working.

The most important challenges in each domain will be discussed. Each section describes the challenges resulting from climate change, the selected approaches, the most important adopted actions and what is still needed.

Of course many of these subjects are interrelated; for example, flooding (domain Water) may cause damage to the infrastructure (domain Living and working). The decision to assign a challenge to a particular domain is based primarily on the impact of the climate effect in question; it may affect water quality, the natural environment or public health, for example. The challenge is then assigned to the domain that best represents this impact; in this case that would be domains I, II and III, respectively.

2 Where are we, where are we going?

Climate change is affecting every level of Dutch society. This National Climate Adaptation Implementation Programme lists the fifteen most important challenges with regard to climate adaptation, ranging from housing to public health and from infrastructure to cultural heritage. All these topics are inter-related: the way we manage fresh water is closely connected to our spatial planning policies, and storing surplus water will make the natural environment more resilient to prolonged periods of drought.

Progress varies in terms of implementation. Based on our centuries of experience protecting the land against high water levels, we have already established concrete standards and measures for water safety in the Netherlands. However, drought and heat, which can cause wildfires for example, are relatively new threats. Knowledge and policies on these topics will be developed over the next few years.

Despite these differences in progress, we can definitely draw some helpful conclusions based on the evaluation of the NAS ([see paragraph 1.2](#)) and the different starting points and challenges. The participants in the stakeholder meeting of 9 March 2023 also offered recommendations for further action. This chapter summarises the overall picture of climate resilience in the Netherlands and the areas that will receive special attention during the run-up to the new version of the National Climate Adaptation Strategy (the “recalibration of the NAS”).

2.1 Conclusions from the National Climate Adaptation Implementation Programme

Conclusions about the starting points

If the Netherlands wants to achieve climate resilience in time, it must implement policies that are smarter, more systemic and more inclusive. These starting points are described in more detail in Chapter 3.

Smarter Many parties will reassess their climate risks on the basis of the [KNMI'23 scenarios](#). Sharing knowledge and ensuring that this knowledge is applicable and accessible is important for a smarter climate adaptation policy as well. Existing websites (including the [Climate Adaptation Knowledge Portal](#)), network organisations (including [Climate-Proof Together](#)) and pilot programmes (including [LIFE IP](#)) are used to collect and disseminate practical knowledge. There are still gaps in our knowledge as well, for example about cascade effects and the impact of climate change on our living environment and (mental) health.

More systemic: There are several programmes that automatically factor in climate adaptation in designs and processes, such as Water and Soil as Guiding Principles or the National Approach to Climate Adaptation in the Built Environment. The agriculture transition is also linked to the Freshwater Delta Programme. Unfortunately this is not happening in all areas yet, including the energy transition. A frequent comment is that many parties are wrestling with the question of how to go about it. Setting clear goals and clearly defining what “climate resilience” means in practice will be helpful in this regard and in the development of design standards and other standards and protocols. This also requires a more systemic approach to a clear division of responsibilities and sufficient capacity at implementation organisations.

More inclusive - For all and by all: We have to work together if we want to make the Netherlands climate-proof. Everyone must be involved in this transition; no one should be left behind. This is not just a public challenge; it also requires active cooperation with market parties and residents. A broad participation process to develop a climate policy also ensures more public support. Since the publication of the [WRR report](#) on justice in climate policies, justice is increasingly becoming a topic of concern in political and public debate. An example of this would be “distributive justice”: how the costs and benefits of adapting the Netherlands to climate change are distributed. Although there is increased interest in this topic, it still requires further attention.

Conclusions for each domain

1 Domain ‘Water’

The National Delta Programme includes sub-programmes for water safety and fresh water, which consist of large-scale research and investment programmes that are evaluated on a regular basis to see if additional measures are needed. In the area of large-scale regional pluvial flooding, the recommendations of the Policy Forum on Pluvial Flooding and High Water will be followed. This Policy Forum was created in response to the flooding in Limburg in July 2021. Over the

next few years, there will be some exploration of whether and how guidelines regarding municipal water management might be incorporated into laws and regulations: the intention is for these guidelines to be as concrete as possible. On the topic of water quality, the current emphasis is on achieving the objectives of the EU's Water Framework Directive and the National Water Plan. Long-term financing is a point of attention, not only in this context but in the context of climate adaptation in general as well.

2 Domain 'Agriculture, nature and the environment'

Farmers, (natural) site managers and hazardous industries (that keep large quantities of hazardous substances on the premises) will have to adapt to changing climatological conditions, such as drought, pluvial flooding, heat waves and salinisation. Agricultural businesses are taking climate-adaptive water, soil and crop measures, for example. Another priority within this domain is climate adaptation of and by means of the natural environment. This means preserving the resilience of the natural environment, while also using the natural environment as a tool for climate adaptation in the living environment, for example for cooling purposes and for storing surplus rain water. An important challenge for hazardous industries (besides high safety levels) is to be resilient to increasing weather extremes. Cooperation, the development, dissemination and application

of knowledge (internationally as well) and the promotion of a sense of urgency are important components of the approach to climate resilience for parties in these three sectors.

3 Domain 'People and culture'

The challenges in the areas of heat and health are relatively new. Not everyone has a clear understanding yet of what they are expected to contribute to the broad approach to heat. Further research on the impact of climate change and the effectiveness of measures is necessary to better protect people against heat; mental health must be considered as well. The risks of infectious diseases and allergies are very much dependent on local conditions, which makes it hard to take national measures. Climate change also leads to damage to culture heritage sites: the risks and effects are mapped out and operational goals and measures are defined to protect these sites. It is important for heritage professionals and public authorities to be aware of the impact of climate change on cultural heritage and to make more of an effort to connect with other parties in the field. Another tactic is to mine the past for useful knowledge, by redeploying old solutions for water storage for example, or bringing back historical landscape elements to improve biodiversity.

4 Domain 'Living and working'

Within this domain, the plan for the foreseeable future will be to work on defining starting points for climate-adaptive and future-proof public spaces, buildings and infrastructure. The work will be focused on design and maintenance as well as replacement and renovation. The goal is to determine whether buildings in the Netherlands are sufficiently climate-proof and whether they can still be used “comfortably” during and after extreme weather. New construction offers the opportunity to build and equip future-proof structures. Adapting existing buildings and areas is often a more complex proposition, because the building is already there and the features of the public space are already in place. It is important for public authorities, entrepreneurs and owners of commercial real estate to work together to make commercial sites (“work landscapes”) climate-proof. The climate resilience of the infrastructure, including essential networks and processes, is extremely important as well for the functioning of society and the economy. Certain risks, such as cascade effects, do not stop at the border. This is why there should be a greater focus on (cross-border) effects, as problems in one essential sector or one location may impact other sectors or locations.

Prepared for all climate extremes

The work within these four domains can be summarised with the following question: are we sufficiently prepared for the risks of climate change? In terms of preparation, the short-term goal is to gain more insight into the acute dangers of extreme weather conditions. To this end, the KNMI has developed the [Early Warning Centre](#). The centre provides earlier, more accurate warnings about extreme weather and promotes national and international cooperation with market parties, knowledge institutes and public authorities. Sharing knowledge and joining forces allows us to take action during the early stages of extreme weather in order to limit its impact on society.

In the medium term, preparations are being made for more gradual climate extremes, such as prolonged drought in combination with a heat wave. Such a combination of drought and heat can lead to cascade effects, a series of events such as environmental damage, crop failure and mental health concerns. These effects require a coherent approach. In practical terms, this means ensuring that all parties involved are well prepared and that everyone knows who is responsible for which effects. In the long term, it is extremely important to make our society climate-adaptive to future climate extremes, not just in the area of water, where a lot has been done already, but for all extremes.

2.2 Most important signals from the field

On 9 March 2023 a meeting was held where a large number of stakeholders had the opportunity to share actions taken with regard to climate adaptation and what they thought the priorities should be going forward. Their input was not just addressed to the public authorities. During the meeting there were also calls for more cooperation between regional and local authorities, civic organisations, market parties and residents.

The most important signals were:

- 1 Pay more attention to the human aspects of climate change. There needs to be increased awareness and acceptance of climate risks. The costs of climate policies need to be distributed fairly. The community needs to be involved in formulating a vision and coming up with solutions.
- 2 Provide clear standards that are future-proof. Without future-proof standards we will continue to create future problems.
- 3 Provide structural rather than incidental financing for climate adaptation. Determine whether municipalities can be relieved of some of the burden in this area. There should be increased cooperation with the financial sector and market parties. The cost of climate adaptation has been borne

primarily by the public authorities so far, and that needs to change.

- 4 Increase the implementation capacity, in particular of the local and regional authorities. This can be done for example through the creation of “expert pools”, regional cooperation, student involvement and involvement of the educational sector.

2.3 Priorities going forward

The activities in the area of climate adaptation that are listed in Chapters 3 - 7 are established policy. However, in light of the increasing challenges, more is needed to keep the risks manageable. The determination of what else is needed (the priorities, see further on in this chapter) factored in the outcomes of the NAS evaluation and the stakeholder meeting of 9 March 2023. The five most important priorities for the next few years were identified in consultation with the ministries involved. The priorities will also be addressed by the Bonaire Climate Table and in the climate plans that are being prepared for Saba and Sint Eustatius.

Core message

In order to get up to speed in the implementation of the adaptation measures, we need to switch to a more fundamental

approach: each development in the Netherlands must factor in the rising sea level, increased heat, longer periods of drought or, alternatively, extreme precipitation. Clearly defined goals are necessary to book results and to be able to determine through monitoring to what extent the Netherlands is more resilient to the effects of climate change. We also need to work on knowledge that is both accessible and applicable, clearly defined responsibilities, sufficient capacity and structural financing. We are working with other public authorities, civic organisations, market parties and citizens to make the Netherlands climate-proof more quickly, with particular care and concern for people in vulnerable positions. In short, the adaptation policy needs to become smarter, more systemic and more inclusive.

Top 5 priorities

The table below shows five priorities with the related follow-up steps that will be *additionally* taken once this Implementation Programme is adopted in the run-up to the next NAS.

Priority	Coordinator*, partners	Follow-up step	Schedule	
1	Develop concrete adaptation targets. Well-defined, concrete targets are a precondition for establishing policies and taking measures. They are also needed for monitoring and financing purposes: without concrete targets it's difficult to specify how much it will cost to reach that target.	Ministry of Infrastructure and Water Management*, Ministry of the Interior and Kingdom Relations, Ministry of Economic Affairs and Climate Policy, Ministry of Justice and Security, Ministry of Agriculture, Fisheries, Food Security and Nature, Ministry of Education, Culture and Science, and Ministry of Health, Welfare and Sport	If concrete targets are still lacking for any challenge they will be defined, starting with a heat- and climate-proof energy infrastructure.	First set of concrete targets ready by the end of 2024
2	Make knowledge about the effects of climate change and possible measures more accessible and applicable, to residents as well, and work on gaining more knowledge where necessary. It is important for all parties to be aware of climate risks.	Ministry of Infrastructure and Water Management*, Ministry of the Interior and Kingdom Relations, Ministry of Economic Affairs and Climate Policy, Ministry of Agriculture, Nature and Food Quality, Ministry of Justice and Security, Ministry of Education, Culture and Science, Ministry of Agriculture, Fisheries, Food Security and Nature, in cooperation with other public authorities and knowledge institutes	Based on the climate adaptation knowledge agenda, a plan of action will be created with stakeholders within the knowledge domain in order to address topical knowledge questions and to be even more effective in communicating the available knowledge to the target group.	Plan ready in 2024
3	Invite a large group of stakeholders to provide input on the direction and content of the revised NAS and on the question of how climate adaptation can be implemented more fairly.	Ministry of Infrastructure and Water Management*, Ministry of the Interior and Kingdom Relations, Ministry of Economic Affairs and Climate Policy, Ministry of Justice and Security, Ministry of Agriculture, Fisheries, Food Security and Nature, Ministry of Education, Culture and Science and Ministry of Health, Welfare and Sport in cooperation with other public authorities	A broad group of stakeholders will be invited for the NAS recalibration to provide recommendations and give input on the direction and content of the NAS (procedural justice). One of the topics will be how climate adaptation can be implemented more fairly, with special focus on "distributive justices".	2024-2026

Priority	Coordinator*, partners	Follow-up step	Schedule	
4	Explore how we can make sure that climate resilience standards are factored into all policies, even for larger transitions and challenges. Effective action requires clearly defined responsibilities and a transparent organisational structure.	Ministry of Infrastructure and Water Management*, Ministry of the Interior and Kingdom Relations, Ministry of Economic Affairs and Climate Policy, Ministry of Justice and Security, Ministry of Agriculture, Fisheries, Food Security and Nature, Ministry of Education, Culture and Science and Ministry of Health, Welfare and Sport in cooperation with other public authorities	<p>a Make agreements about the responsibilities within the Government and between public authorities with regard to coordination, cooperation, direction, and (administrative) consultation and decision-making structures.</p> <p>b Explore which large-scale programmes and relevant policy changes should take climate adaptation into consideration and how this should be done.</p> <p>c Where possible and useful, translate targets into policy, laws and regulations, design standards, performance requirements, action perspectives, schedules of requirements or other standards.</p>	<p>Schedule a: 2024</p> <p>Schedule b: 2024</p> <p>Schedule c: end of 2025; it should be clear for each target what would be the best way to ensure this.</p>
5	Explore potential options for expanding the structural financing of climate adaptation.	Ministry of Infrastructure and Water Management*, Ministry of the Interior and Kingdom Relations, Ministry of Economic Affairs and Climate Policy, Ministry of Justice and Security, Ministry of Agriculture, Fisheries, Food Security and Nature, Ministry of Education, Culture and Science, Ministry of Health, Welfare and Sport in cooperation with Ministry of Finance ² and other public authorities (including the Association of Netherlands Municipalities and the Association of Provincial Authorities)	<p>a Each Ministry will provide, insofar as possible, a general outline of a cost-benefit analysis for adaptation measures.</p> <p>b Explore potential options for more structural financing of climate adaptation, within the context of other challenges facing the Government, provinces, municipalities and district water boards.</p> <p>c Explore public-private solutions for the financing of climate adaptation measures.</p> <p>d Explore what instruments the financial sector could use to realise adaptation measures.³</p>	End of 2025: insight into adaptation costs (general outline for each challenge) and an overview of potential sources for structural financing.

² Cooperation with the Ministry of Finance applies to 5c and 5d.

³ This is also important within the European context, because some EU subsidies require investments to be climate-resilient, for example for projects involving the TEN-T networks. There is also a requirement for “climate proofing”, which is verified for projects that apply for co-financing.

3

Starting points

In the previous chapter we wrote that if the Netherlands wants to become climate-proof in time, it must implement policies that are smarter, more systemic and more inclusive. In the section below we explain what this means and how this will be done over the next few years. The three starting points are based on the [adaptation strategy](#) of the European Union, the [evaluation](#) of the National Climate Adaptation Strategy (NAS) and the [recommendations](#) from the Netherlands Scientific Council for Government Policy (WRR) on fairness in climate policy.

3.1 Smarter

It is important for all Dutch citizens to know how the climate is changing, what the potential negative effects will be and what is the best way to deal with this. We already have a lot of knowledge and experience in the area of water safety, but this is not the case for many other climate challenges. This is why the effects of climate change and the most effective measures need to be made clear for all challenges.

- The most important knowledge gaps that need to be filled were published in early 2023 in the Climate Adaptation [Knowledge Agenda](#). Topics include: monitoring, financing, health, cascade effects and the economic value of climate-adaptive spatial planning.
- Knowledge should be linked more effectively so we can better understand concepts like cascade effects, but also so it can be useful for more than one programme at the same time.
- And finally, the knowledge must be accessible and applicable for everyone: residents, businesses, civic organisations and public authorities. All these parties should be able to find, understand and apply the information. This will broaden the action perspective with regard to climate-adaptive actions.

A number of successful initiatives in this area will be continued for the next few years, such as the Climate Adaptation [Knowledge Portal](#). This website provides practical information for anyone who works on climate adaptation. The [Climate Effect](#)

[Atlas](#) is an important source of information as well, with detailed maps that show how vulnerable particular areas are to heat, drought and flooding.

Climate-Proof Together is a network by and for professional “climate workers” who are helping to make the Netherlands more resilient to climate change. Sharing practical experience and knowledge with each other will result in better, faster solutions. The [Knowledge Bank](#) on Blue-Green Networks collects scientific knowledge about measures and effects for climate-effective urban planning. It is aimed primarily at students and spatial planners.

In addition, there are Dutch initiatives for international knowledge sharing and development, such as the [Global Centre on Adaptation](#) in Rotterdam and the [International Panel on Deltas and Coastal Areas](#) (IPDC) which was launched in 2023 and provides customised recommendations to countries that request advice.

Looking ahead to the next few years

Action	Explanation	Initiator*, partners	Schedule
Update KNMI scenarios	The KNMI'23 climate scenarios show which climate changes we can expect in the Netherlands by 2050 and 2100. Separate climate scenarios are being developed for the Caribbean Netherlands for the first time.	KNMI*	2023
Recalibrate climate risks and install an adaptation monitor	The Netherlands Environmental Assessment Agency educates people on the current and future impact of climate change and the associated risks. One of the tools used to assess the current risks of climate change are the KNMI'21 Climate Signal. One of the tools to assess future risks is the KNMI'23 scenarios. This agency also analyses the effectiveness of the policies that are implemented and measures that are taken, it investigates the "adaptive capacity" of the Netherlands and is designing a permanent monitoring and evaluation system to be implemented after 2026.	This is done at the instructions of the Ministry of Infrastructure and Water Management, the Ministry of Economic Affairs and Climate Policy, the Ministry of Health, Welfare and Sport, the Ministry of the Interior and Kingdom Relations, the Ministry of Education, Culture and Science and the Ministry of Justice and Security.	2023-2026
Supraregional stress tests <i>Policy Forum on Pluvial Flooding and High Water</i>	As many supraregional stress tests for flooding will be performed as possible in 2024 under the direction of the provinces. To this end, the Ministry of Infrastructure and Water Management will reach out to all parties involved to make sure that the stress tests are performed correctly so the results can be compared more accurately.	Provinces in cooperation with district water boards and Rijkswaterstaat	Starting in 2024
DPRA climate stress tests <i>Delta Plan for Spatial Adaptation (DPRA)</i>	As agreed in the Delta Plan for Spatial Adaptation, starting in 2025 all municipalities, district water boards, provinces and the Government will perform new climate stress tests.	Provinces, municipalities, district water boards, the Government (for the main roads, railways and waterways) and network managers for mains services	Starting in 2025
Gain and share practical experience <i>LIFE-IP Climate Adaptation</i>	LIFE-IP Climate Adaptation is a Dutch programme which is co-financed by the European Union for the purpose of accelerating the implementation of climate adaptation in the Netherlands through: <ul style="list-style-type: none"> • Development of knowledge products that are accessible and easy to understand, as well as business models and different types of financing. • Promotion of awareness, a sense of urgency and an integrated approach. 	The Government (coordinated by the Ministry of Infrastructure and Water Management), provinces, municipalities, district water boards, municipal health services and civic organisations	2022-2027

Action	Explanation	Initiator*, partners	Schedule
Develop new climate charts and update existing ones	The Climate Effect Atlas will be updated in 2024 on the basis of the KNMI'23 scenarios. Starting in 2023, a separate Climate Effect Atlas will be developed for the Caribbean Netherlands.	Establish climate adaptation services at the instructions of the Ministry of Infrastructure and Water Management* together with knowledge partners	2023-2024
Create climate adaptation knowledge programmes	An approach will be developed, in part on the basis of the (2023) Climate Adaptation Knowledge Agenda, for the development, sharing and application of climate adaptation knowledge. This approach includes regular evaluations to determine whether it is still effective.	Ministry of Infrastructure and Water Management	Started in 2023 (ongoing)
Interdisciplinary research ⁴	Interdisciplinary Research Programme Red&Blue explains climate risks for the built environment and offers solutions The Dutch Research Council has requested input from the Dutch Research Agenda in order to gain further insight into the drought problem in the built environment and to develop possible action plans. The research consortiums will be selected and commence their work in 2024.	Delft Technical University in partnership with research institutes, public authorities and market parties	Started in 2022

3.2 More systemic

The most recent report of the Intergovernmental Panel on Climate Change (IPCC), the United Nations organisation which assesses climate change risks, reveals that the climate is changing faster than we thought. The evaluation of the NAS also makes it clear that we need to pick up the pace of our adaptation efforts. Furthermore, climate change affects all sectors and all layers of society. This requires a more systemic approach, by

taking climate change into account in any investments in construction, management, maintenance and replacement projects in the Netherlands, in particular large projects. Another term for more systemic in this context is “more intensive”: climate adaptation must be implemented throughout our society.

This approach requires practical goals in the area of climate resilience and the translation of these goals into design standards and other standards and processes. This does not just

⁴ More challenge-oriented studies are listed under the relevant challenges.

require effective cooperation, but also a clearly defined division of responsibilities and sufficient financing and capacity of the implementation organisations. At the national level, the Delta Fund allocates structural funds to the water domain only. In other words, it does not fund the adaptation challenges in other domains such as the natural environment, agriculture, energy, health and the built environment. At the municipal and provincial levels, many measures are currently financed by one-time budgets, temporary programmes and subsidy schemes. The challenges we are faced with will require structural financing and the possibility of combining budgets.

The Delta Plan for Spatial Adaptation (DPRA) offers tools that enable stakeholders to conduct so-called “risk dialogues” with one another. In these dialogues, the stakeholders can address vulnerabilities to and measures against flooding, as well as topics such as heat stress and drought.

In terms of goals, Water and Soil as Guiding Principles partially overlaps with the NAS. The aim of the Water and Soil as Guiding Principles-approach is to work towards the protection and improvement of the water and soil system in all changes in land use or spatial planning, now and in the future. This means that the effects of climate change are factored in as well. Eventually we will need more space for dikes to protect the land against

rising sea levels, and parts of the Netherlands will become more saline, which means we will have to adapt our land use. The NAS and Water and Soil as Guiding Principles-approach can strengthen each other by coordinating measures and sharing knowledge about the necessary adaptations.

Despite all our efforts, there is always a risk of natural disasters such as flooding or wildfires as a result of extreme weather. Society, emergency services and crisis organisations need to be prepared for this. In concrete terms this means: being ready to respond to a disaster or crisis. It also means factoring in the possible negative effects on safety and emergency services before implementing measures in the area of climate mitigation and adaptation.

Looking ahead to the next few years

Action	Explanation	Initiator*, partners	Schedule
Adaptation and mitigation quick scan	This study investigates how adaptation and mitigation policies can strengthen each other (for example by performing activities at the same time) and how they might be at cross-purposes, for example if cooling measures lead to increased CO ₂ emissions.	The Ministry of Infrastructure and Water Management* in partnership with the Ministry of Economic Affairs and Climate Policy	Ready in 2023
Integration of climate adaptation and mitigation in the Caribbean Netherlands	Bonaire is setting up a Climate Table to develop an integrated approach to climate adaptation and mitigation challenges. At the same time, the island is working with Saba and Sint Eustatius to come up with an integrated climate plan.	The Island Authority of Bonaire* in partnership with the Ministry of Infrastructure and Water Management, the Ministry of Economic Affairs and Climate Policy and the Ministry of the Interior and Kingdom Relations	Start at the end of 2023
Make climate adaptation a standard consideration for the built environment <i>National Approach to Climate Adaptation in the Built Environment Phase 1</i>	Implementation of the four lines of action in the national approach. This approach describes the ambition of the Government with regard to climate adaptation in new construction developments and in areas with existing construction. The approach aims to move towards a less voluntary approach and to a climate-proof and green design and redesign of the built environment. There will also be further exploration of what else is needed to develop a more systemic approach for the next phase (2025-2030).	Ministry of the Interior and Kingdom Relations, Ministry of Infrastructure and Water Management and Ministry of Agriculture, Fisheries, Food Security and Nature	2022-2024
Make water and soil a standard consideration <i>Letter to the House of Representatives on Water and Soil as Guiding Principle</i>	The Cabinet wishes to take water and soil into consideration to a greater extent in the spatial planning of the Netherlands. This is why various “structuring choices” have been made. Based on these choices, provinces can work with all stakeholders to create a region-specific approach. During the coming years, the Government will work with other public authorities to translate these structuring choices into an implementation strategy. There will be a spatial assessment framework that will make it clear where and under what conditions construction can be permitted.	Ministry of Infrastructure and Water Management*, Ministry of the Interior and Kingdom Relations and Ministry of Agriculture, Fisheries, Food Security and Nature, and Provinces and District Water Boards	2023-2024
Early Warning Centre (EWC)	The KNMI is continuing its work on an Early Warning Centre, which should help to prevent and mitigate damage and suffering caused by increasing weather extremes as much as possible. To this end, the KNMI provides the community and professional users as early as possible with the most detailed, adequate, independent and reliable information possible about risks, the expected effects and the potential impact of extreme weather due to climate change.	KNMI	Continually in development

Action	Explanation	Initiator*, partners	Schedule
Strengthen crisis management and increase readiness <i>Security Strategy of the Kingdom of the Netherlands</i>	Climate change and natural disasters are important points of attention within the Security Strategy. Besides mitigation and adaptation, the strategy specifically addresses crisis management in response to pluvial flooding, wildfires and other climate effects. These are addressed in the form of national crisis plans, for example.	Ministry of Justice and Security, Ministry of Infrastructure and Water Management and Ministry of Agriculture, Fisheries, Food Security and Nature	2023-2029
(Knowledge) Programme on Climate Adaptation and Security (emergency services/crisis management)	Several knowledge programmes have been started that deal with the topics of climate mitigation and adaptation, specifically in relation to emergency services and crisis management. The focus is on wildfires and energy transition, among other things.	Netherlands Institute for Public Safety Safety regions Ministry of Justice and Security	2023-2025

3.3 More inclusive: for all and by all

Climate change affects everyone, so everyone should be involved in the transition to a climate-proof Netherlands and no one should be left behind. A more inclusive process for developing a climate policy will ensure more public support and more attention for climate vulnerability, which is important for the distribution of the costs and benefits of measures across society at large. This is crucial for a successful transition. All parties, not just the government but civic organisations and the financial sector as well, must be involved in order to make climate policies more inclusive and to map out and help minimise risks in terms of affordability and insurability. The Netherlands Scientific Council for Government Policy stated in its report “Justice in Climate Policy” that there should be a

continual focus on fair distribution of climate policy costs. Costs and benefits must be distributed fairly between organisations such as district water boards as well.

Taking the necessary adaptation measures requires sufficient implementation capacity. Current shortages are already a significant issue, so capacity and skills are issues that require immediate attention and action. Besides sufficient entry, current demographics and the labour market will also require lateral entry and continual development of new skills.

Looking ahead to the next few years

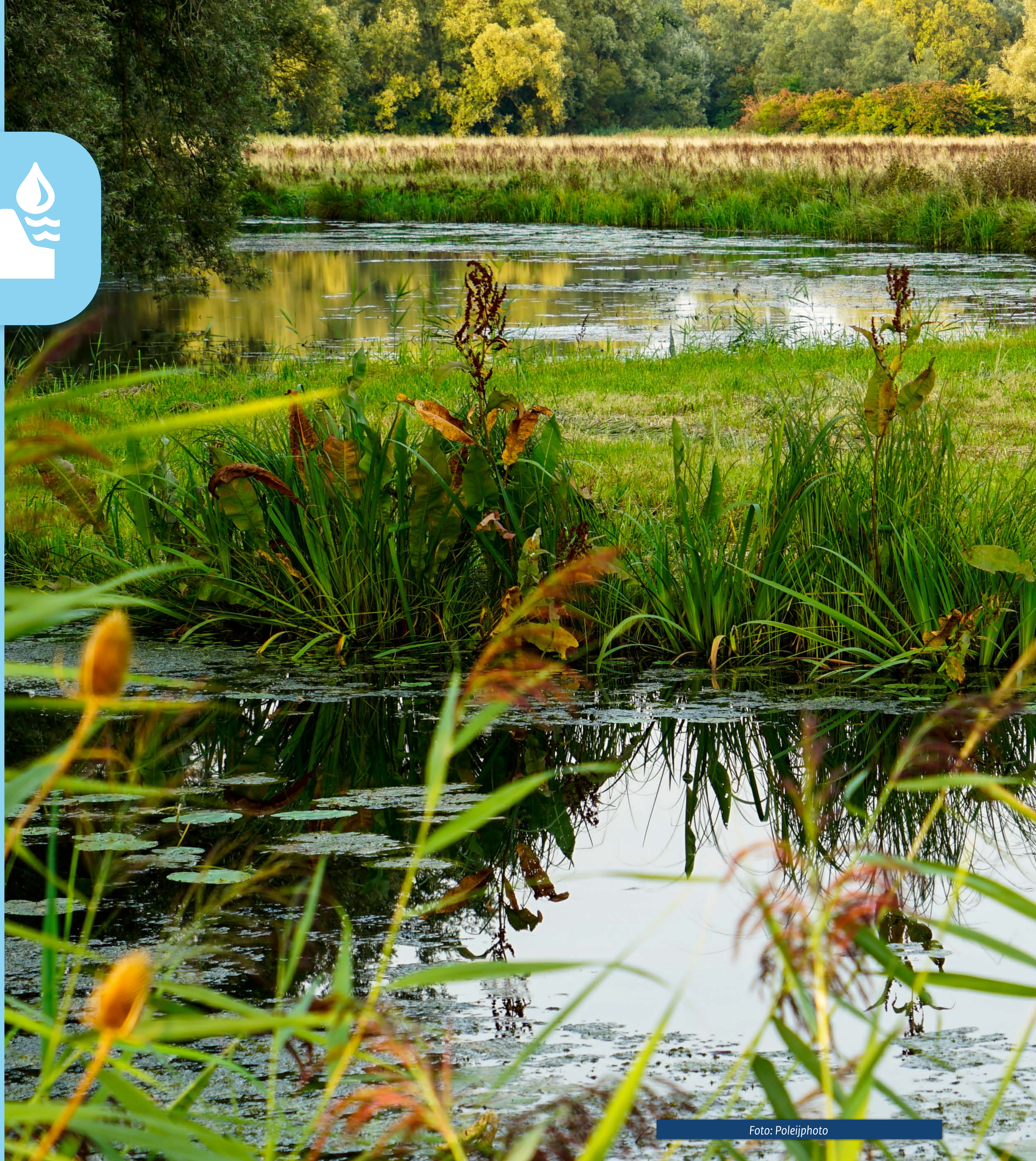
Action	Explanation	Initiator*, partners	Schedule
<p>Explore the impact of climate risks on the financial sector and the possibility of joint (public-private) solutions</p> <p>Working Group on Climate Adaptation, in partnership with the financial sector</p>	<p>The Working Group on Climate Adaptation was formed in 2022. This was done in partnership with the financial sector, as part of the Sustainable Finance Platform of the Nederlandsche Bank. Together with the government, the platform assesses the impact of climate change on the built environment and on sectors that are relevant for the financial sector, such as agriculture, industry and transport. In addition to performing an impact analysis, the working group explores which public-private solutions might be feasible and suitable for specific challenges such as damage to foundations. The working group expects to publish a report with an analysis of different scenarios by the end of 2023. The report will also include recommendations for developing solutions within the financial sector in partnership with the government that will help make the Netherlands more climate-proof.</p>	<p>Working Group on Climate Adaptation Chairmanship: Achmea, Rabobank and a.s.r.</p> <p>Representatives of various banks, insurers, real estate companies, investment companies, Ministries and other organisations</p> <p>Supported by the Climate-Proof Together Platform</p>	<p>Delivery of the report by the end of 2023</p>
<p>Attention for justice and fair processes</p> <p>Cabinet response to the Netherlands Scientific Council for Government Policy report on Justice in Climate Policy</p>	<p>The new NAS, which is scheduled for completion in 2025-2026, will provide a clearer overview of the costs of adaptation policies and it will pay more attention to the effects of climate change and climate adaptation on people, culture and the natural environment. In addition, a broader group of stakeholders will be involved in the run-up to the new NAS in order to gain more insight into the perspectives of minorities and vulnerable groups.</p>	<p>Ministry of Infrastructure and Water Management</p>	<p>2024-2026</p>
<p>Exploring the needs of the labour market in terms of climate adaptation</p>	<p>The Social and Economic Council of the Netherlands (SER) will explore implications of the transition to a green economy for the labour market in the Netherlands. An adequate supply of employees from the green and blue segments will contribute to a sustainable, climate-proof Netherlands. The exploration will shed light on work opportunities and on the challenge of creating sufficient labour capacity.</p>	<p>SER at the instructions of the Ministry of Infrastructure and Water Management and the Ministry of Economic Affairs and Climate Policy</p>	<p>2023-2024</p>

Action	Explanation	Initiator*, partners	Schedule
<p>Prepare a cooperation agenda for an inter-administrative approach to climate adaptation in the built environment</p> <p><i>National Approach to Climate Adaptation in the Built Environment Phase 1</i></p>	<p>Participants in the National Approach to Climate Adaptation in the Built Environment are working on a cooperation agenda. Starting in 2025, we want to see an inter-administrative approach (joint effort by all public authorities) to climate adaptation in the built environment. Substantive and financial explorations are part of this process.</p>	<p>The Ministry of the Interior and Kingdom Relations in partnership with the Ministry of Infrastructure and Water Management, the Ministry of Agriculture, Fisheries, Food Security and Nature, the Association of Netherlands Municipalities, the Association of Provincial Authorities and the Dutch Water Authorities</p>	<p>2022-2024</p>
<p>Increase awareness of climate risks and action perspectives on the part of residents</p>	<p>In order to make residents more aware of the impact of climate change and what they can do to limit negative effects and damage, we have prepared a plan to encourage conscientious water use. This plan focuses on three priority action perspectives: conservation of drinking water, greening of gardens and being prepared for pluvial flooding. Campaigns, public communications and behavioural research are all part of this plan. We are also developing an approach for a more systemic approach to education.</p>	<p>The Ministry of Infrastructure and Water Management in cooperation with the partners of Ons Water [Our Water] The Association of Regional Water Authorities, the Association of Netherlands Municipalities, The Association of Provincial Authorities, Ministry of Infrastructure and Water Management, the Delta Programme Commissioner Staff and the Association of Water Companies in the Netherlands</p>	<p>Started in the Fall of 2023, duration until the end of 2028</p>

3.4 What is still needed for smarter, more systemic and more inclusive climate adaptation?

Priority	Explanation
<p>More concrete goals for all adaptation challenges</p> <p><i>NAS evaluation</i></p>	<p>The NAS evaluation concludes that it is difficult or even impossible for most sectors to determine whether progress has been made in reducing or managing climate risks. This is partly due to the fact that climate adaptation is a relatively new policy area and many sectors do not have any concrete policy goals or monitoring systems yet. Positive exceptions to this are high-water protection, water quantity and water safety.</p>
<p>Improvements in the direction and coordination of the NAS and clearly defined responsibilities</p> <p><i>NAS evaluation</i></p>	<p>There is room for improvement in the direction and coordination of the NAS at the national level, including clear agreements about the division of responsibilities between the various departments and public authorities.</p>
<p>Structural financing and capacity of all public authorities</p> <p><i>NAS evaluation, Position paper Climate-adaptive municipalities (Association of Netherlands Municipalities) (only available in Dutch), The Implementation Capacity of Municipalities (Association of Netherlands Municipalities) (only available in Dutch), DPRA monitor 2023 Research Report The Physical Domain is Creaking and Groaning (Association of Netherlands Municipalities) (only available in Dutch)</i></p>	<p>Budget and capacity increases are needed to be able to make the Netherlands climate-proof at all scale levels in all sectors. In the public sphere it is up to the municipalities to take the relevant measures. However, the Association of Netherlands Municipalities has stated in various articles and reports that municipalities lack the necessary resources, both financially and in terms of personnel.</p>
<p>Make climate adaptation a standard consideration</p> <p><i>NAS evaluation</i></p>	<p>It is becoming increasingly important to quickly factor in climate adaptation in all challenges and transitions the Netherlands is involved in. Failure to do so to a sufficient extent will lead to more damage and adaptation costs.</p>
<p>Make the safety risks of climate and natural disasters a standard consideration at an early stage</p> <p><i>Security Strategy of the Kingdom of the Netherlands</i></p>	<p>In order to keep society safe, potential safety risks must be identified, including those that are the result of climate adaptation measures. Opportunities for emergency services to reduce or manage those risks must be included as well. We recommend involving the safety regions, the police and municipal health services in an advisory capacity at an early stage.</p>
<p>Increase residents' awareness of climate risks and encourage them to take action to reduce these risks</p> <p><i>Policy Forum on Pluvial Flooding and High Water</i></p>	<p>Explain that there will be more frequent occurrences of extreme events that the government cannot fully protect against, and what people can do themselves to reduce negative effects. Encourage residents through communication and behavioural expertise to take action.</p>

4 Domain I Water





Challenge 4.1 Well-protected against pluvial flooding and high water

The challenge

When we talk about protection against excess water, we often make a distinction between pluvial flooding and water safety: protection against flooding from sea and rivers. The flooding in Limburg in July 2021 revealed the kind of damage and disruption that can be caused by extreme precipitation. We expect not only that these types of events will happen more frequently as a result of climate change, but also that these events will become even more extreme. This chapter describes all aspects of the challenge to protect the Netherlands against water threats.

Water safety: protection against high water

Primary water defences protect the Netherlands against flooding from the sea and large rivers and lakes. These defences are dikes, dunes, dams and storm-surge barriers. The area protected by the primary water defences is inhabited by approximately nine million people who earn about 70 percent of our gross national product. Providing protection against flooding is an ongoing challenge. The effects of climate change, such as rising sea levels and increased river runoff, make this challenge

more difficult (“river runoff” is the amount of water that runs through a river at a particular point at a particular time).

The goals of water safety policies are:

- Ensure that everyone in the Netherlands who lives behind a primary water defence will enjoy a basic level of protection of a least 1 in 100,000 per year by 2050. This means that the chances of an individual dying as a result of flooding does not exceed 0.001 percent per year.
- Providing additional protection in areas that are at risk of sustaining large-scale fatalities, substantial economic damage and/or severe damage due to a failure in essential, vulnerable infrastructure.

In order to reach these goals, new, future-oriented safety standards were implemented for the primary water defences on 1 January 2017. These standards are based on a so-called “risk-based approach to flooding”. The greater the potential consequences of flooding (in terms of damage and victims), the higher the standard should be for the water defence. All primary water defences must meet the legal standards by 2050.

Strengthening the primary water defences will reduce the risk of flooding between now and 2050. After 2050 the risk of flooding will, at a minimum, meet the lower threshold specified in [the Dutch Water Act](#).



Pluvial flooding: protection against extreme precipitation

The flooding in Limburg in July 2021 revealed that extreme precipitation can cover a large area and that its effects can be felt across borders. The size of the storm system was equivalent to half the size of the Netherlands and also caused flooding in Belgium, Germany and Luxembourg. If the rain had fallen elsewhere above the Netherlands it would have caused a lot of damage in those areas. If that had happened, the fact that water tends to pool for long periods in flat areas could have led to societal disruption in those areas.

The district water boards and municipalities have a duty of care to protect the Netherlands against excessive precipitation. In recent years, emergency water basins have been created throughout the Netherlands to store rainwater, and investments have been made in materials that can be deployed in emergency situations. Cities have been taking measures as well: examples are disconnection from the sewer system (so relatively clean rainwater is not disposed of but infiltrates into the soil) and the creation of rainwater buffers. ([See Sponge cities.](#)) However, the flooding in Limburg clearly revealed that more is needed. The Policy Forum on Pluvial Flooding and High Water concluded in 2022 that there is no way to prevent pluvial flooding as a result of these types of extreme circumstances in the future either, and that it may have a significant impact in other

parts of the Netherlands as well. This is why additional measures are needed to limit the effects of extreme precipitation and prevent societal disruption insofar as this is possible and feasible.

The approach

Protection against flooding consists of several layers; the totality of these layers is referred to as the model of “multilayer safety”. At the advice of the Policy Forum on Pluvial Flooding and High Water, this model is now also being applied to pluvial flooding.

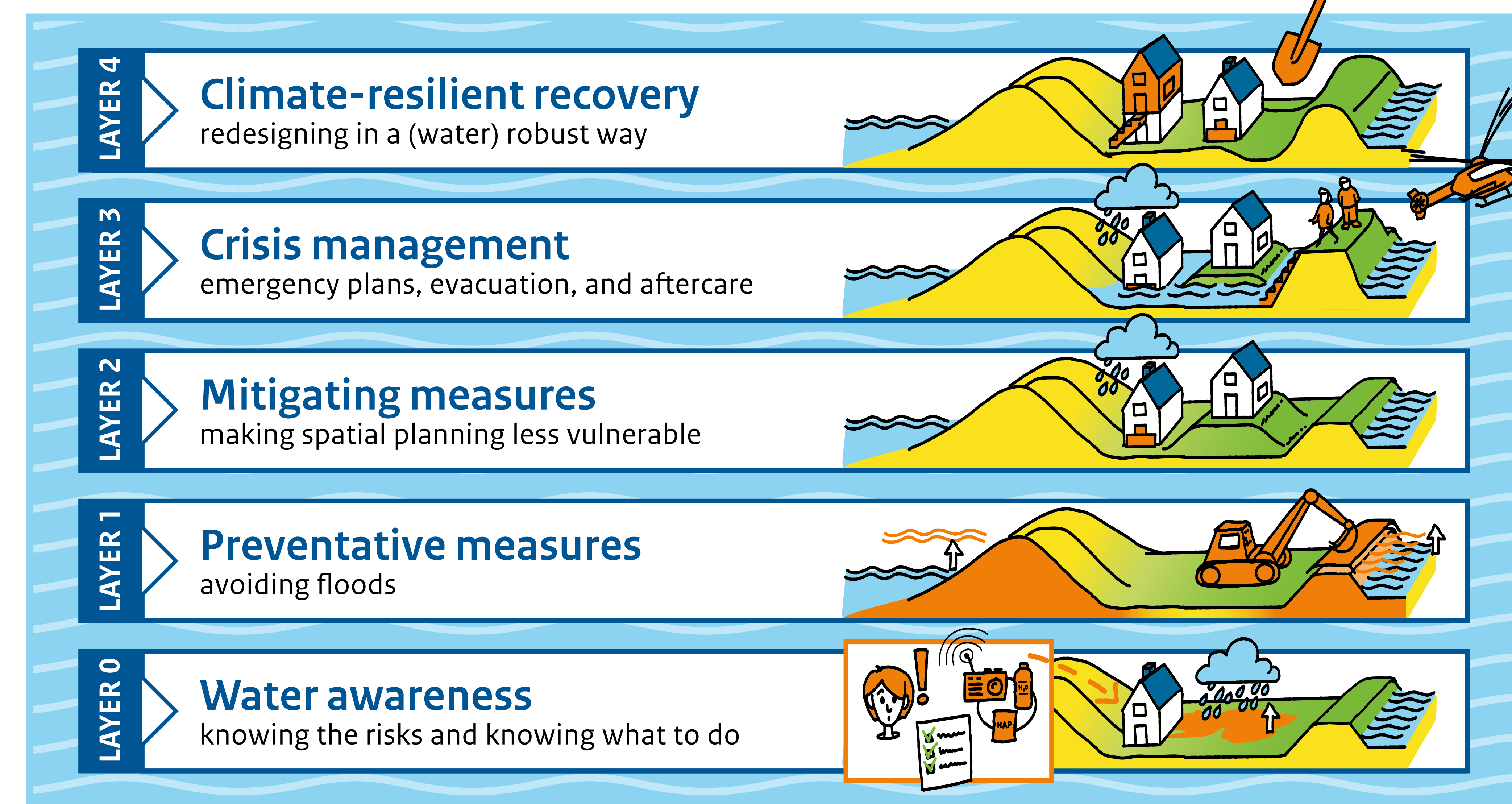
- o. The base layer is *water awareness*: everyone in the Netherlands should be aware of what could happen as a result of extreme precipitation or flooding and what they can do themselves to reduce risks and limit damage and negative effects.
1. *Preventative measures* are used to prevent flooding. In the Netherlands we already have strong dikes, dams and dunes and we make sure that the runoff capacity of rivers is adequate. The primary and regional water defences ([see Regional Water Defences](#)) are maintained by means of regular assessments, management and maintenance, and reinforcement where necessary. Rivers are given plenty of space, both now and in the future, so the Netherlands can be prepared for increased river runoff. To protect against



flooding from the sea, the basic coastline is maintained and measures are taken to ensure that the coastal foundation will be able to handle rising sea levels. Preventative measures for extreme precipitation consist primarily of adaptations throughout the river basin; one example is increasing the sponge function of the soil. This allows the groundwater to be replenished more quickly and provides increased buffering during precipitation. Setting aside space for retaining smaller bodies of water, such as brooks, is an option as well.

2. *Mitigating measures* limit the damage and the number of victims if an area does get flooded. Examples are: compartmentalisation (reducing the surface area affected by water), placing critical infrastructure higher up and creating evacuation routes. This is also referred to as “water-resilient spatial organisation”. At the advice of the Policy Forum, supra-regional stress tests will be performed in order to take into account effects that manifest at higher scale levels (as happened in Limburg: reaching far beyond municipal boundaries). Steps are also being taken to develop a mitigation standard to make it easier to determine which measures need to be taken. This standard would specify how a hospital should function if an area is flooded, for example, or it would cover the high-voltage grid or vulnerable nature areas.

MULTILAYER SAFETY



3. The aim of *crisis management* is to manage any disasters that might occur as effectively as possible. To this end, the following are important: proper preparation (having emergency plans in place), smooth evacuation and proper follow-up care. The safety regions are responsible for the organisation of crisis management. Scenarios for extreme precipitation will be included in the preparation in accordance with the advice from the Policy Forum.
4. *Climate-resilient recovery* means that climate change and what this means for building requirements, for example, is taken



into account after a disaster. In the past, the focus after a disaster has often been on a quick return to the old situation: rebuild it the way it was before, in the same location. Climate-resilient recovery must become the standard for citizens, businesses and public authorities. It should also be included in insurance conditions and regulations.

Continual adjustments

The rate and extent of climate change are uncertain, while spatial investments are costly and long-term. This is why it is important to check on a regular basis whether adjustments are needed with regard to protection against flooding. There are two ways to do this:

1 Anticipation through policy

“Adaptive delta management” is a key objective. It means: looking (far) ahead, taking additional measures in a timely manner as necessary and being open to solutions for the future. In terms of water safety, it will take the following forms:

- The safety standards for the primary water defences are based on the expected situation in 2050. This means that the future growth of the economy and the population have been factored in.

- The safety standards are evaluated on a regular basis. Outcomes will be reported in 2024, 2037 and 2049, in accordance with the Water Act.
- Water managers will set aside space along dikes and dunes for future reinforcements. The locations of these areas are specified in a document (called a “ledger”) that is continually updated. The water managers determine what developments are feasible within these “reserved areas”.
- The addition of sand to the coast (“sand supplementation”) is a flexible measure, meaning that it can be modified in response to changing circumstances. For example, if sea levels rise faster than expected, more sand can be added.

2 Anticipation through knowledge development

In order to protect the Netherlands against flooding in the future as well, it is important to understand exactly what developments we can expect. There is ongoing research on the potential consequences of climate change and strategies to deal with this. Examples of this research:

- The new KNMI climate scenarios.
- The Knowledge Programme on Rising Sea Levels, which is relevant for future water safety in the Netherlands.
- Regular updates of the information and knowledge used by managers in their assessments and reinforcement of the



existing primary defences. Knowledge is developed in the programme Water Defence Knowledge.

Regional water defences

In addition to the primary water defence system, the Netherlands also has about 14,000 kilometres of regional water defences that protect low-lying areas against flooding from inland waterways. Inland waterways include storage basins, regional rivers and canals. The majority of regional water defences are managed by district water boards. The provinces have laid down the standards for these regional water defences in environmental regulations. The Government is only responsible for a small percentage of the regional water defences (approx. 500 kilometres). These are primarily water defences along shipping canals, such as the Amsterdam-Rijn Canal and the Juliana Canal. The standardisation of these regional defences is laid down in the Water Decree.

The consequences of flooding caused by the failure of a regional defence are much less severe than if a primary defence is breached. The damage will be along the lines of tens of millions of euros, and there is a limited risk of fatalities.





4.1



Looking ahead to the next few years

Action	Explanation	Initiator*, partners	Schedule
No construction in floodplains <i>Water and Soil as Guiding Principles</i>	Construction in floodplains will no longer be allowed in the future in light of the Policy Guideline on major rivers. This is to counteract developments that might make it impossible in the future to expand river areas and to prevent potential damage due to high water levels and flooding.	Ministry of Infrastructure and Water Management	Evaluation of Policy Guideline on Major Rivers in 2023
Update on water defence areas <i>Water and Soil as Guiding Principles</i>	We need enough space around dikes, dams, dunes and water defence structures to perform reinforcements, even after 2050. This is why we are working with district water boards, provinces and municipalities to reassess which areas around primary water defences should be set aside (“free space profiles”); this is done on the basis of information from the Knowledge Programme for Rising Sea Levels.	Ministry of Infrastructure and Water Management	2023-2025
Reinforcement of primary water defences (district water boards) <i>High water defence programme</i>	Reinforcement of primary water defences managed by district water boards is done as part of the High Water Defence Programme (HWBP). Rijkswaterstaat and the district water boards join forces in this programme to make the Netherlands water-safe by 2050.	Ministry of Infrastructure and Water Management District water boards* Rijkswaterstaat	On an ongoing basis; the defences will comply with the standard by 2050
Reinforcement of primary water defences (Rijkswaterstaat) <i>National Water Defence Programme</i>	Reinforcement of primary water defences managed by the Rijkswaterstaat is done as part of the National Water Defence Programme.	Ministry of Infrastructure and Water Management Rijkswaterstaat*	On an ongoing basis; the defences will comply with the standard by 2050
Assessment of primary water defences <i>National Assessment Round</i>	The water defence managers assess their defences at least once every twelve years. The Minister of Infrastructure and Water Management will report to the Senate and the House of Representatives about the condition of the primary defences before the end of 2023. This is done on the basis of the first National Assessment Round (LBO1) and it is called: the National Safety Review (LVB). The next assessment round (LBO2) lasts from 2023 to 2035 and will lead to a new assessment on the basis of the knowledge available at that time.	Ministry of Infrastructure and Water Management* District water boards Rijkswaterstaat	2023 (LBO1) 2023-2035 (LBO2)
Periodic adjustment of sand and coast supplementations <i>Coastline Management Implementation Programme</i>	The coastline is subject to structural erosion caused by tides and storms. In the long term, climate change has an impact as well, resulting in rising sea levels for example. The Government strives for a structural balance in the coastal foundations by periodically adjusting the sand supplementation volumes to the current sea-level rise.	Ministry of Infrastructure and Water Management Rijkswaterstaat*	On an ongoing basis, four-year programme



Action	Explanation	Initiator*, partners	Schedule
<p>Research on the mechanisms and effects of rising sea levels</p> <p><i>Knowledge Programme on Sea Level Rise</i></p>	<p>The aim of the Knowledge Programme on Sea Level Rise is to better understand the mechanisms that accelerate sea-level rise, to assess the sustainability of our current strategies for water safety and freshwater supply and to identify potential long-term solutions, with scenarios in which the Netherlands experience rising sea levels of up to 5 meters.</p>	<p>Ministry of Infrastructure and Water Management*</p> <p>Delta Programme Commissioner*</p>	2019-2026
<p>Development of an integrated vision and approach to the river region</p> <p><i>Integrated River Management Programme</i></p>	<p>The Integrated River Management Programme offers a coherent approach to the river region. The Government is working towards sustainable river management. A new policy will be developed during the next few years for the runoff capacity of the rivers and the riverbed elevation.</p>	<p>Ministry of Infrastructure and Water Management*</p> <p>Various partners</p>	2019-2026
<p>River expansion projects</p>	<p>While projects that are part of the High Water Protection Programme are being implemented, research is done to locate sites where river expansion can be combined with dike reinforcement. Examples of this are the following projects: Arcen, Well, Meanderende Maas, Vierwaarden Venlo and Zuidelijk Maasdal along the Maas, Paddenpol and Klimaatpark IJsselpoort along the IJssel.</p>	<p>Ministry of Infrastructure and Water Management*</p> <p>Various partners</p>	2016-2050
<p>Delta Programme on Spatial Adaptation (DPRA): layer 2</p>	<p>In the DPRA, public authorities and stakeholders take a step-by-step approach to mapping out vulnerabilities in spatial planning and implementing measures to achieve greater climate resilience. They focus on the effects of pluvial flooding, water safety, drought and heat. The measures may also concern the practical application of layer 2 of the multilayer safety concept.</p>	<p>All public authorities and stakeholders (in particular organisations that are responsible for essential and vulnerable (network) functions).</p>	<p>On an ongoing basis, in six-year cycles; the goal is for the spatial organisation of the Netherlands to be climate-proof by 2050</p>
<p>Improved warning system</p>	<p>Improved coverage of precipitation monitoring during crisis situations</p>	<p>Ministry of Infrastructure and Water Management</p>	2023-2025
<p>Improved high water forecasts and measurements</p>	<p>Based on the evaluation of the summer of 2021, improvements will be implemented in high water forecasts at Sint Pieter and the high water measurements downstream in the Maas.</p>	<p>Rijkswaterstaat</p>	2023-2025
<p>Implementation of the recommendation from the Policy Forum on Pluvial Flooding and High Water</p>	<ul style="list-style-type: none"> • Increase water awareness and self-sufficiency • Increase sponge and buffer capacity of the river basins • Establish standards for mitigation • Include scenarios for extreme precipitation in crisis plans • Promote climate-resilient recovery from damage • Cooperation with neighbouring countries 	<p>Various Ministries and public authorities, including the Ministry of Infrastructure and Water Management, Rijkswaterstaat, the Dutch Water Authorities, the Association of Provincial Authorities, the Association of Netherlands Municipalities and the Province of Limburg</p>	2023-2027 and beyond



What is still needed?

The Netherlands has centuries of experience with water management, it has adhered to an “adaptive policy” (a policy which addresses opportunities as well as uncertainties), and is continually working on developing knowledge. As a result, it is always clear what is needed in terms of water safety and protection against pluvial flooding. Every six years, the Delta Programme evaluates the primary goals for water safety, fresh water and spatial adaptation. This also applies to the delta decisions and preferred strategies: they are adjusted if there is reason to do so based on new developments and insights.

Every six years, and whenever there is reason to do so based on spatial developments, municipalities, district water boards, provinces and the Government perform or update a stress test. Stress tests reveal which areas are vulnerable to extreme weather (wet/dry/hot) and high water (sea/river). The public authorities use the results to consult with other relevant parties and organisations and make agreements on how to manage the vulnerable areas.

And finally, we keep our knowledge up to date through research programmes that provide the most accurate information about climate change, its effects and possible strategies for dealing with it.



Spotlight

Climate-resilient brook landscapes

The province of Noord-Brabant consists largely of brook landscapes. These have become vulnerable to the impacts of climate change, as land use has become increasingly disconnected from the soil and water system. The province and district water board are therefore working on climate-resilient brook landscapes.

In a climate-resilient brook landscape, important infrastructure is not built in locations that are vulnerable to pluvial flooding, for instance. Agriculture and industry do not use more water than can be replenished through natural means. The landscape as a whole is able to retain water. The brooks no longer function as drainage machines, but gradually discharge large amounts of precipitation.



Photo: Amphi



Challenge 4.2 Sponge cities

The challenge

Since the nineteenth century, water and sewage systems in the Netherlands have been designed to discharge rainwater as quickly as possible. Now that dry periods are becoming more frequent and droughts last longer as well, the availability of fresh water in urban areas is becoming more and more of an issue. The fact that cities consist largely of paved surface areas makes it difficult to retain water, while water is sorely needed. Trees and plants need water, and trees create shady spots that offer a welcome respite for humans and animals when temperatures rise. Water is also needed to keep wooden foundation piles moist. Urbanisation – accompanied by paving – will only make the water shortage worse.

Besides drought, rainfall is becoming more frequent as well: periods of extreme precipitation are causing problems. Our systems were not designed to process large amounts of water in a very short period, which can lead to more frequent pluvial flooding. More and more often, overburdened wastewater systems are discharging a combination of rainwater and waste water onto surface

waters, which has a negative effect on water quality. Sometimes it even flows onto the streets, which can be a threat to public health. Buildings are sustaining damage more frequently as a result of flooding of basements and houses; even in the Netherlands Caribbean heavy rainfall is leading to water damage as a result of poor drainage.

In urban areas with soft soil, groundwater shortages can also lead to subsidence and damage to foundations. Estimates are already projecting that damage will run into the tens of billions of euros by 2050; this could increase further, if we do not act now.

The approach

These problems require a new approach to our urban water cycle. We must learn from the past and – as we have done before – do a better job adapting urban development to the natural environment (see text box on next page).



Urban genesis: the relationship between city, water and soil

Cities used to develop organically in relation to the surrounding landscape. Once cities began to expand beyond the city walls (starting in the late nineteenth century) this changed and the landscape began to be modified to suit human preferences. Natural surroundings became more uniform and lost part of their identity. In addition, biodiversity decreased while vulnerability to climate change increased. Research on the beginnings of a city (referred to as its “*genesis*” (website only available in Dutch)) reveals the original relationship between the urban development and the natural water and soil system. This relationship can then be restored.

The water cycle is restored by allowing the city to function more like a sponge. Rainwater is stored in locations where the water and soil system is suitable for that purpose. These reservoirs allow for the gradual discharge of water in times of extreme precipitation to prevent damage. During periods of drought, the water reserves can be used for various other purposes.⁵

The *National Benchmark* for a green, climate-adaptive built environment explains what is meant by climate-adaptive new construction and layout. The benchmark consists of goals, performance requirements and guidelines in the areas of flooding, drought, heat, biodiversity and subsidence. The following strategy has been selected with regard to pluvial flooding (also referred to as the “order of preference”). In order of importance, the water will be:

- 1 used and conserved;
- 2 retained for infiltration;
- 3 stored;
- 4 discharged.

There are three ways to increase the sponge function of the city:

1 Reduce paved surfaces through green and blue measures

Green is more permeable than paved surface. The sponge function of the city can be increased for example by creating more green public areas, arroyos (green ditches) and green roofs on buildings. More green also means more cooling and more biodiversity. More surface water (more “blue”) increases the buffer capacity of the city in times of extreme precipitation. Evaporation of locally stored water provides cooling on hot

⁵ These two functions are called the buffer and delay response, see: <https://klimaatkrachtig.nl/sites/default/files/files/COPKlimaatadaptatie-2019-StatalsSpons.pdf>



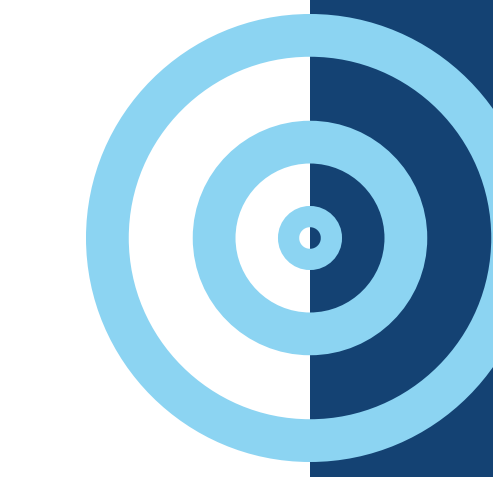
days and helps reduce the effects of rising temperatures and heat stress. More and more public authorities are opting for green solutions in line with the National Benchmark for a green, climate-adaptive built environment. Greening is not without risks, however, and we need to take that into account: an increased risk of wildfires in urban environments, more pests and allergy-related health problems (such as hay fever).

2 *Grey measures*

“Grey measures” will remain necessary as well. This includes: infiltration boxes in the ground that are used to catch rainwater, creation of water-permeable street surfaces and installation of rain barrels. The creation of a separate sewage system (with separate pipes for waste water and rain) will make it easier to (re)use rainwater to water green areas, and it will reduce environmental damage in case of sewage overflow during extreme precipitation.

3 *Active groundwater level management*

Active groundwater level management brings groundwater to the desired level within a demarcated area. This approach is being studied and applied in different locations in the Netherlands, but opinions vary on its mechanism and applicability.



Spotlight Climate-adaptive public squares

In Driebergen, two neighbouring squares were made climate-adaptive with the help of the residents. This was an experiment which led to the establishment of so-called “climate building blocks” (webpage only available in Dutch). These are different measures for building a square that is able to withstand the effects of climate change.

Other municipalities in the province of Utrecht can choose which building blocks are most suitable for the local situation. For example, a square can be made more climate-adaptive and more liveable by creating grass areas, flower beds, open or half-open paving or infiltration areas with plants and greenery.



Photo: www.klimaatadaptievebeelden.nl

Looking ahead to the next few years

Action	Explanation	Initiator*, partners	Schedule
<p>Exploration of expansion of the National Benchmark to existing construction and legal exploration</p> <p><i>National Benchmark for a green, climate-adaptive built environment</i></p>	<p>The sponge function of the city can be expanded with new construction based on the National Benchmark through increased infiltration of rainwater, minimising paved surfaces, and the creation of green, cool areas nearby. The natural runoff of rainwater can be stored and used instead of discharged.</p> <p>The National Benchmark only applies to new construction so far. During the next few years we will determine whether and how the benchmark can be applied to existing construction as well.</p> <p>The Government will also initiate a legal exploration in 2023 on how the benchmark can be enshrined in legislation. This is in accordance with the final recommendation from the Policy Forum on Pluvial Flooding and High Water. Pending a decision, all parties have agreed to start applying the benchmark as much as possible in their construction plans.</p>	<p>Ministry of Infrastructure and Water Management, Ministry of the Interior and Kingdom Relations and Ministry of Agriculture, Fisheries, Food Security and Nature</p> <p>Municipalities</p> <p>Provinces</p> <p>District water boards</p>	<p>2023-2024</p>
<p>Delta Programme on Spatial Adaptation and Incentive Scheme</p>	<p>In the Delta Programme on Spatial Adaptation (DPRA), 45 regions are working on the objective of making the Netherlands more resilient to flooding, heat and drought. This is done by means of a step-by-step approach: stress tests are performed, risk dialogues are conducted and implementation programmes are prepared with adaptation measures.</p> <p>The Incentive Scheme (only available in Dutch) is part of the DPRA and provides co-financing for measures in the areas of flooding risks and drought by the Government, municipalities, provinces and district water boards. Applications may be submitted until the end of 2023, on the condition that the subsidised measures are implemented before 1 January 2028.</p>	<p>DPRA partners (Government, provinces, district water boards and municipalities)</p>	<p>Applications by the end of 2023</p> <p>Implementation by the end of 2027</p>
<p>Creation of a monitoring system, formulation of concrete goals and exploration of structural financing of spatial adaptation</p> <p><i>Delta Programme on Spatial Adaptation</i></p>	<p>In 2023, we will start, under the auspices of the DPRA, to explore the options for a good monitoring system, formulated concrete goals for spatial adaptation and investigated ways to obtain structural financing for spatial adaptation.</p>	<p>DPRA partners (Government, provinces, district water boards and municipalities)</p>	





Action	Explanation	Initiator*, partners	Schedule
Climate Table and climate plan for the Caribbean Netherlands	Bonaire is starting a Climate Table (a consultation body with representatives from public authorities, businesses and civic organisation) for the purpose of arriving at an integrated approach to climate adaptation and mitigation challenges. In other words, the goal is to adapt the environment and functions to the effects of climate change and to prevent further climate change as much as possible. They will also work with Saba and Sint Eustatius to explore ways for the islands to create an integrated climate plan.	The Island Authority of Bonaire in partnership with the Ministry of Infrastructure and Water Management, the Ministry of the Interior and Kingdom Relations and the Ministry of Economic Affairs and Climate Policy	Starting at the end of 2023

What is still needed?

Priority	Explanation
Establishing standards for green and blue areas around homes <i>Recommendation from Delta Programme Signal Group 2022</i>	The Delta Programme Signal Group 2022 recommends developing local standards for the amount of green and blue around residences.



Challenge 4.3 Towards a future-proof freshwater supply

The challenge

Economic growth and population growth have resulted in an increased demand for fresh water. Fresh water is needed for the production of drinking water and also for the natural environment, electricity production and industry. The agricultural sector also needs fresh water, both for the crops and to combat salinisation of the soil. Fresh water is also needed to stabilise dikes, to combat subsidence (in peatlands) and to preserve greenery in the built environment, which also helps to keep cities cool.

Climate change (more heat, more drought) not only increases demand for fresh water and clean drinking water, it also reduces the freshwater supply. It is not just the available quantity of water but also the quality of water that is under pressure due to increasing concentrations (as a result of decreased dilution) of pollutants in surface water and ground water. [See also the challenge *Improving the water quality*](#).

In the Caribbean Netherlands there is no fresh water that can be used to produce drinking water, so drinking water is made from seawater. In the European Netherlands, even climate change on a regional scale can lead to freshwater shortages; without inter-

vention these shortages are expected to be felt throughout the country starting in 2030.

The approach

The design of the water system in the Netherlands must be “water-resilient”, meaning that it must be able to withstand climate change. In terms of regional water management, in particular guaranteeing the availability of water and preventing pluvial flooding, the following strategy will be used (“order of preference”, see the [Delta Programme on Fresh water](#)):

1 *Water availability needs to be a bigger factor in spatial planning and land use*

Natural features and the identity of an area must be the main consideration in choices about spatial organisation. Water levels should not be adjusted to land use, but the other way around. “Function follows level” means that economic activities such as agriculture, industry and shipping should adapt to the availability of the water.

The fact that Water and Soil are guiding principles in the spatial organisation of the Netherlands means that we should not just consider where to build, but also where not to build. The latter applies to sites that will be needed later to store water, for example, such as the lowest areas of low-lying polders and the shores of freshwater storage areas. Function has the least



weight in these areas, and if construction is to happen at all, it must be done in a climate-resilient way.

2 *All water users must conserve water*

Sustainable water use starts with reducing our freshwater use. Water that isn't used does not need to be produced. Besides encouraging individuals and companies to use less water, we also aim to reduce the use of groundwater and fresh surface water. The use of unconventional sources is encouraged, such as the use of brackish groundwater for drinking water and the reuse of waste water.

3 *Improved catchment, retention and storage of water and smarter distribution*

We have to change our water system in order to make it climate-resilient. We have to slow down the runoff rate and retain and store as much water as possible during wet periods to give it a chance to infiltrate. We can learn from the past, when successful measures were taken that were in harmony with the water system. One such measure is the creation of embankments between ditches; they keep the trees dry while the ditches contribute to draining. Other examples are the creation of wooden walls and the designation of country estates

as water catchment areas. Restoring the natural system to its original condition can also be effective: examples are the re-meandering of streams and the restoration of natural water buffers and wet nature features⁶. "[Sponge cities](#)" shows what the latter means for the urban environment. For that matter, possible risks such as exposure to infectious diseases should be taken into consideration in the creating of water storage areas. [See challenge *Staying healthy in times of climate change*](#).

4 *Residual risks and damage*

If there is less water than we need, we will have to distribute the water. This is done on the basis of the so-called "priority sequence" from the Water Act, which specifies how fresh water should be distributed in times of shortage. Water defences and dikes that are sensitive to drought are the first to receive water. This is because drought can cause tears in dikes and damage water defences. Drinking water supply and energy supply have priority as well. There is a guide which provides information about the priority sequence and its application; you can find it [here](#).

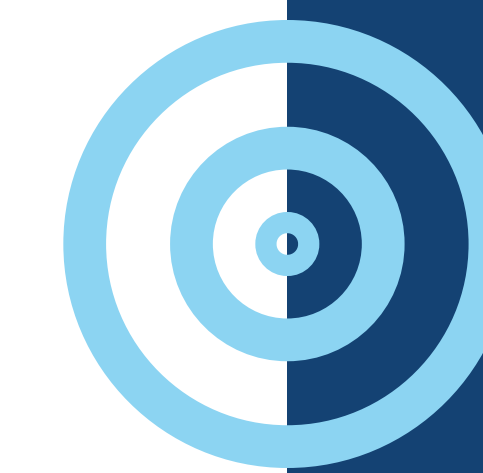
⁶ Ministry of Infrastructure and Water Management, 2021 Freshwater Delta Plan 2022 – 2027



4.3

Groundwater

The provinces are in charge of groundwater; they work with the district water boards and municipalities on sustainable groundwater management. The letter on Water and Soil as Guiding Principles states that provinces must list all groundwater withdrawals in the regional programmes for the National Programme on Rural Areas. They must also prepare a so-called “groundwater ceiling”, with a priority sequence. Provinces and district water boards can use this to make more informed decisions about groundwater use and groundwater management.



Spotlight – Aquifer storage

Drinking water company PWN and the municipality of Hoorn are investigating whether aquifer storage may supply more water to the distribution pump station in Hoorn. The pump station sends water to two regions in the province: North and Middle-South. The study will hopefully reveal whether or not storing water will affect the quality of drinking water.

The system used to store the water underground is called “Aquifer Storage & Recovery (only available in Dutch) (ASR). The knowledge and experience that is gained can also be used for other applications, such as the creation of buffers for “process water”. This is water that is used in manufacturing plants.



Looking ahead to the next few years

Action	Explanation	Initiator*, partners	Schedule
<p>Measures and investment designed to make the Netherlands more resilient to water shortages.</p> <p><i>Freshwater Delta Plan phases 1, 2 and 3</i></p>	<p>The Freshwater Delta Plan contains measures and investments designed to make the Netherlands resilient to water shortages. Its central tenet is that spatial planning should be more in alignment with the availability of fresh water. The plan also includes measures for improved catchment and smarter distribution of water, and measures to help conserve water. The Delta Plan also includes a priority sequence for regional water management to ensure the availability of water and prevent pluvial flooding.</p> <p>The implementation of phase 1 (2015-2021) of the Freshwater Delta Plan is nearing completion. A recent milestone was the successful deployment of smart water management during the dry summer of 2022. Another important achievement was the realisation of improved freshwater supply in West-Brabant via the water inlet Roode Vaart, as is the completion of phase 1 of the so-called “regional processes for water availability in urgent regions”. A few measures are still on the agenda for the next few years, such as reinforcement of the IJsselmeer coast and completion of the expansion of climate-proof water supply for the west of the Netherlands and the Noordervaart Canal.</p> <p>The realisation of the measures in phase 2 started in 2022. More than half of the investments in this phase are designated for the elevated sandy grounds in order to work towards improved water retention. Other measures are focused on more effective and targeted distribution of the available water, the use of alternative sources (such as treated waste water and brackish groundwater, also referred to as “effluent” and “brackish seepage”, respectively), and climate-resilient organisation and management of the water system. Investments are made in agricultural and other innovations as well.</p> <p>The goals will be specified in further detail during the preparation for phase 3 of the Freshwater Delta Plan. These concrete goals can then be used to determine whether the measures are effective enough. It is important to keep investing in sufficient freshwater supply, even after 2027.</p>	<p>The Ministry of Infrastructure and Water Management in partnership with the Association of Provincial Authorities, the Dutch Water Authorities, the Association of Netherlands Municipalities and interest organisations</p>	<p>Phase 1: 2015-2021</p> <p>Phase 2: 2021-2027</p> <p>Phase 3: 2028-2033</p>
<p>Activities focused on sufficient sources of drinking water</p> <p><i>Drinking Water Implementation and Execution Agenda of the Policy Document on Drinking Water 2021-2026</i></p>	<ol style="list-style-type: none"> 1 Update the groundwater protection policy and monitor the progress of the Supplemental Strategic Supplies project⁷ 2 Investigate the long-term availability of a sufficient number of sources of drinking water 3 Clarification of the scope of the duty of care 4 Investigate what is needed to be able to deploy alternative sources to supply drinking water 	<p>Ministry of Infrastructure and Water Management, the Association of Provincial Authorities, the Association of Regional Water Authorities, the Association of Netherlands Municipalities and the Association of Water Companies in the Netherlands</p>	<p>2021-2026</p>

⁷ By the end of 2022, ten provinces had included the SSS in their regional policies.





Action	Explanation	Initiator*, partners	Schedule
<p>Activities focused on high-quality sources of drinking water</p> <p><i>Drinking Water Implementation and Execution Agenda of the Policy Document on Drinking Water 2021-2026</i></p>	<ol style="list-style-type: none"> 1 Improve and monitor the quality of the surface water and groundwater in relation to the drinking water supply 2 Prepare a guide for applying a “prevention ladder” for the protection of drinking water sources 3 Work on implementing the recommendations from the 2020 Government report on drinking water sources, published by the RIVM in 2021 4 Cooperation with countries upstream 	The Ministry of Infrastructure and Water Management, the Association of Provincial Authorities, the Association of Regional Water Authorities, the Association of Netherlands Municipalities and the Association of Water Companies in the Netherlands	2021-2026
<p>Activities that are focused on intentional, responsible water use</p> <p><i>Drinking Water Implementation and Execution Agenda of the Policy Document on Drinking Water 2021-2026</i></p>	<ol style="list-style-type: none"> 1 Improve communication about intentional, responsible water use by households 2 Explore and develop an approach to intentional, responsible water use by residential and commercial users. 3 Investigation of pricing for wholesale users 	The Ministry of Infrastructure and Water Management, The Association of Provincial Authorities, the Association of Regional Water Authorities, the Association of Netherlands Municipalities and the Association of Water Companies in the Netherlands	2021-2026
<p>Activities focused on the treatment, quality and supply of drinking water will remain relevant at all times</p> <p><i>Drinking Water Implementation and Execution Agenda of the Policy Document on Drinking Water 2021-2026</i></p>	<ol style="list-style-type: none"> 1 Implement the new regulations in the European Drinking Water Directive 2 Solve the financing problems faced by the drinking water sector 3 Safeguard the drinking water infrastructure in environmental laws 4 Explore and formulate instruments for drinking water restrictions 	The Ministry of Infrastructure and Water Management, The Association of Provincial Authorities, the Association of Regional Water Authorities, the Association of Netherlands Municipalities and the Association of Water Companies in the Netherlands	2021-2026
<p>Realisation of additional production capacity</p> <p><i>Letter to the House of Representatives on the Action Plan for Supply Security</i></p>	An Action Plan for Supply Security for Drinking Water will be prepared to realise additional production capacity in the short term. This will be done by the Association of Water Companies in the Netherlands and the Association of Provincial Authorities in partnership with the Ministry of Infrastructure and Water Management. The goal is to guarantee the availability of water for the drinking water supply between now and 2030.	Ministry of Infrastructure and Water Management, the Association of Provincial Authorities, the Association of Water Companies in the Netherlands	Plan ready by the end of 2023
<p>Structuring options for drinking water, groundwater and freshwater supplies</p> <p><i>Water and Soil as Guiding Principles</i></p>	So-called “structuring options” are offered on the basis of Water and Soil as Guiding Principles. With regard to drinking water, groundwater and freshwater supplies, this specifically means increasing the freshwater supply (for example by storing more water in the IJsselmeer and Markermeer and taking active steps in terms of groundwater management to retain water), no new construction on sites that are needed for the storage and discharge of water, and working towards the goal of using 20% less drinking water.	Ministry of Infrastructure and Water Management Ministry of the Interior and Kingdom Relations and Ministry of Agriculture, Fisheries, Food Security and Nature	Possible strategy adjustment based on recalibration of Freshwater Delta Decision 2026





What is still needed?

Priority	Explanation
<p>Greater commitment to water availability in the European Netherlands</p> <p><i>Available water for the production of drinking water until 2030 – problems and possible solutions – RIVM</i></p>	<p>The RIVM has advised the Ministry of Infrastructure and Water Management and the provinces to:</p> <ol style="list-style-type: none"> 1 Update the current and future water availability and water demand for various functions for every region and solve potential problems in consultation with water users and licensing authorities (the competent authorities). 2 Increase efforts to reach the goals from the Water Framework Directive so more high-quality surface water and groundwater will be available for the production of drinking water. 3 Investigate what is needed to be able to deploy alternative sources to supply drinking water. <p><i>The recommendations from the RIVM</i> will be included in the Action Programme for the Availability of Drinking Water Sources, which is expected to be adopted in 2023.</p>
<p>Structural measures against drought in Noord-Brabant</p> <p><i>Report of the Drought Advisory Committee: Without water, there is no later (2022)</i></p>	<p>An independent advisory committee submitted proposals for dealing with drought in Noord-Brabant at the request of the partners of the Broad Administrative Groundwater Consultation Committee. In the final report <i>Zonder water, geen later</i> which was presented on 15 September 2022, the Committee pleads for a radical change of direction in groundwater management. In order to be drought-proof by 2040, the provincial groundwater levels must be raised on a structural basis. To that end, significantly larger amounts of water need to be retained, less groundwater should be extracted, and water infiltration needs to increase.</p>
<p>Structural measures in sandy regions in the southern, middle and eastern parts of the Netherlands.</p> <p><i>Drought in Sandy Regions in the Southern, Middle and Eastern Parts of the Netherlands (2021)</i></p>	<p>At the instructions of several provinces, district water boards and the Government, a research consortium which includes water research institute KWR published a report titled Drought in Sandy Regions in the Southern, Middle and Eastern Parts of the Netherlands (2021). The main recommendations from the report are:</p> <ol style="list-style-type: none"> 1 Implement all measures down to the smallest capillaries of the water system, because that is the only way for structural measures for the surface water system to make a difference in the groundwater system. 2 Create uniform definitions of drought that should be used in the various components of the water system, based on proper, up-to-date measurement data. That way the differences between regions are always clear, and the parties involved can work together on the basis of shared insights to limit drought-related damage. 3 Assign clearly defined responsibilities to the parties involved and designate a coordinator with the requisite permanent authority to supervise.



Challenge 4.4 Improving water quality

The challenge

The problem of water quality is not just complex but many-faceted as well, and it is affected by more factors than climate change alone. Land use, emissions (of harmful substances), and the leaching of nutrients (in particular nitrate) and chemical substances have a significant effect on water quality. Urban water management affects water quality (and water quantity) as well. When the water supply decreases due to prolonged dry periods and ground water extraction, the concentration of pollutants increases. In the Caribbean Netherlands, the challenge is to connect homes to better sewage systems (such as improved septic tanks) to prevent pollution of the groundwater and the marine environment (the sea and surrounding areas).

Higher temperatures and unpredictable precipitation patterns (periods of drought and peak precipitation) are two main aspects of climate change that affect water quality.

1 **Salinisation:** Climate change can lead to increased salt concentrations in the surface water. This can happen for example when rising sea levels and subsiding sea beds lead to increased saltwater seepage. Another cause may be the fact that less water flows through the rivers during dry periods,

causing the “saline wedge” (salt water that penetrates the rivers from the sea) to move ever further inland. This puts pressure on freshwater inlets and drinking water intake locations; in the most extreme cases they even become unusable.

- 2 **Eutrophication:** Phosphor and nitrogen concentrations are higher in peatland waters. This is caused by factors like higher temperatures in combination with drier or wetter conditions, resulting in accelerated mineralisation. In addition, organic compounds such as plant remains are converted by microorganisms in the soil into mineral compounds such as nitrate or carbon dioxide. “Eutrophication” means an excess of certain nutrients in the water. Climate-change-related precipitation peaks (for example after dry periods in elevated sandy areas) may also cause nutrients and other chemical substances to leach into the groundwater.
- 3 **Lack of oxygen:** If the weather is warm for long periods and the water temperature rises, the oxygen concentration goes down. One of the reasons for this is that organisms use more oxygen in warm water. In the case of heat waves this can even lead to a lack of oxygen in the water. The latter usually occurs in shallow and/or standing water with a lot of organic material at the bottom. In addition, sewer overflows during extreme precipitation (where waste water diluted with rain-



water ends up in the surface water) can lead to emissions that affect the water quality.

- 4 **Pollutants and pathogens:** Climate change may lead to an increased amount of pathogens in recreational waters. More frequent sewer overflows after extreme precipitation will lead to more “faecal pollution” (pollution caused by faeces). Eutrophication in combination with temperature effects can cause the amount of blue-green algae to increase. As stated in the introduction to this chapter, reduced water quantities can also lead to higher concentrations of existing pollution. There is also an increased risk of infection by the so-called *Vibrio* bacteria in brackish and salt water, like the sea⁸.
- 5 **Drier conditions:** Dry periods are increasing due to climate change, which in turn increases the risk of deterioration of the water quality and waterways running dry.

In short, the creation and preservation of good water quality is an urgent challenge, not just for aquatic life, but also because this water is the basis for our drinking water and food production.

Approach

Of course, any solutions for problems that are caused in part or in full by climate change depend on location and context. A few examples are measures which:

- 1 minimise the runoff and leaching of nutrients and chemical substances as a result of extreme precipitation;
- 2 promote the retention of water;
- 3 facilitate the unimpeded flow of bodies of water (if there is enough water) or enable temporary flow where it is not the case;
- 4 have a buffering or filtering effect and prevent substances from entering the water, e.g. the creation of buffer strips;
- 5 increase the oxygen concentration in the water, for example by installing fountains or bubble screens⁹.

⁸ [Risks of *Vibrio* infection in bathing water, shellfish production water and shellfish | RIVM](#)

⁹ [How can negative effects on water quality be mitigated? - Climate Adaptation \(klimaatadaptatienederland.nl\)](#)





Looking ahead to the next few years

Action	Explanation	Initiator*, partners	Schedule
Implementation of measures from different water quality programmes	We implement measures from the Water Framework Directive (KRW), the KRW Incentive Scheme, the river basin management plans 2022-2027, the 7th Nitrate Directive Action Programme 2022-2026 with addendum, the derogation decision and the Programme-Based Approach to Large Bodies of Water. It also concerns measures that arise from implementation programmes such as programmes for the reduction of medicine residues and other chemical substances. Provinces work with district water boards and other regional partners to specify in their regional programmes which measures will be needed where, in order to reach the goals of the KRW, the Nitrates Directive, the Directive on the Sustainable Use of Pesticides and the Bird and Habitats Directives.	Ministry of Infrastructure and Water Management, Ministry of the Interior and Kingdom Relations and Ministry of Agriculture, Fisheries, Food Security and Nature Provinces District water boards* (implementation of measures)	2023-2027
Implementation of measures from river basin management plans <i>National Water Programme 2022-2027 and Water Framework Directive</i>	The Netherlands has prepared separate management plans for each river basin, which set out all environmental objectives for the ground and surface water and protected areas. The plans also include measures to achieve these objectives, such as excavation of water beds, re-meandering of waterways, improving the treatment capacity of wastewater treatment facilities and reducing the use of pesticides.	District water boards	2022-2027
33 structuring options for Water and Soil as Guiding Principles	We minimise the inflow of water that is foreign to a particular region. We combat salinisation by making as much fresh water as possible available for water level management (the retention of fresh water in rivers). The provinces and district water boards create room in regional processes for the catchment and storage of as much water as possible that is native to the region. External supply will still be needed, in particular in times of (extreme) drought.	Ministry of Infrastructure and Water Management (system manager), Ministry of the Interior and Kingdom Relations and Ministry of Agriculture, Fisheries, Food Security and Nature Provinces (implementation) District water boards (implementation)	



What is still needed?

Priority	Explanation
Administrative agreements to reach KRW goals (part of KRW Incentive Scheme) <i>Position paper: Delta Approach to Water Quality</i>	In its position paper Delta Approach to Water Quality , the Association of Provincial Authorities calls for further administrative agreements to reach the KRW goals. This is necessary in light of new issues, such as more “emerging substances”. These are new substances in the soil for which no standards have been established yet, like medicine residue and (micro)plastics.
Financial resources for measures resulting from structural choices. <i>Water and Soil as Guiding Principles</i>	Improving water quality and freshwater availability will require significant short-term and long-term investments in industry, sustainable drinking water supply, agriculture and new construction. Eventually, many of these investments will lead to cost savings. Measures resulting from structural choices can be partially funded by national programmes such as the Fresh water Delta Programme, implementation of the Water Framework Directive, the Programme-Based Approach to Large Bodies of Water, Pluvial Flooding in River Basins in the Southern Regions of the Netherlands, and the Integrated River Management Programme and earmarked funds from the Transition Fund. The remaining part will have to be funded through other means.
Particular attention for salinisation in the following river basin management plans <i>Water and Soil as Guiding Principles</i>	The relationship between salinisation and water quality will require particular attention in the next river basin management plans (2028-2033), because increasing salinisation may make it more difficult over time to achieve the ecological objectives of the Water Framework Directive, which are currently based on fresh water. The same applies to the Natura 2000 goals.
Early-warning monitoring network for the groundwater. <i>Groundwater Study Group</i>	We have to take action to prevent the further decline and deterioration of the quality of the deeper groundwater. To this end, emissions must be reduced as much as possible. An early-warning monitoring system would enable us to detect pollution sooner, establish more effective supervision of the use of permitted substances, and reduce emissions in the groundwater through regulations.

5 Domain II

Agriculture, nature and the environment





Challenge 5.1 Climate-resilient agriculture

The challenge

During the past five years, the Netherlands in general and the agricultural and horticultural sectors in particular have been dealing with various weather extremes and increasing salinisation. Think of the hail damage in 2017, the three dry summers in 2018, 2019 and 2020 and the massive flooding in Limburg in 2021, while the lack of precipitation in the spring of 2022 caused worries about drought to resurface. These events show that climate change has a significant impact on agriculture and horticulture and that climate adaptation is an urgent concern for these sectors.

The impact of the effects of climate change varies by region, sector and crop:

- Flooding is a risk primarily in the river region (floodplains filling up during the growth season) and the hill region in Limburg (flooding of the Maas and subsidiaries). Extreme rainfall (peak downpours) can cause pluvial flooding throughout the country, however.
- Drought is a particular risk in the elevated sandy regions in the eastern and southern parts of the Netherlands, and it affects all sectors in those areas.

- Salinisation as a result of rising sea levels in combination with drought and subsidence is an important factor in the western and northern parts of the country along the coast and in Flevoland. This affects agriculture and horticulture in the south-western delta as well as capital-intensive, salt-sensitive crops like trees (Boskoop) and flower bulbs (dune and bulb regions, Kop van Noord-Holland).
- Fruit crops are also exposed to risks associated with night frost, heat and sunlight.
- Extreme weather conditions also affect livestock farms. For example, higher temperatures can cause heat stress in livestock in pens and fields and during transport. Other examples are reduced crop yields, less home-grown forage and animals that have to spend more time inside due to extreme (wet or hot) weather conditions. Subsidence and salinisation also have consequences for meat and dairy farms in peatlands.

The approach

The Ministry of Agriculture, Fisheries, Food Security and Nature worked with several other parties to develop the [*Action Programme for Climate Adaptation in Agriculture \(AP KAL\)*](#). This programme centres on the farmers themselves, the possible actions they can take, and the future prospects for their business. The objective of the action programme is for all agricultural and horticultural businesses to be able to deal with



climate change in a sustainable and effective manner by 2030. The programme actions focus on improved retention of water in agricultural soil through water and soil measures, reducing heat stress in cattle and adapting crop and livestock systems. Knowledge and innovation, a regional approach and risk management are important tools in this regard.

The action programme uses three adaptation strategies that connect short- and long-term goals and that can be used by business owners to optimise their business operations, adapt their operations in response to climate changes in the medium term and move towards transformation of the business and crop cultivation by 2050:

- Examples of **optimisation** of business operations are water and soil management, risk distribution in crop cultivation (plans) and time, and the use of drought- and/or heat-resistant crops. A number of adaptation measures are already well-known and can be applied by farmers right now.
- **Adaptation** in response to climate changes might mean planting combination crops, convertible covers for fruit crops (innovative covers that close when it starts raining), agroforestry (combining crop farming, cattle farming and/or vegetable cultivation with trees and bushes on the same lot) and crops that grow on brackish land. Research on these activities is still at an early stage.

- **Transformation**, the greatest challenge, assumes that the current agricultural systems and strategies are not enough to compensate for the effects of climate change, and that we need to develop completely different (food) production systems. Examples are different crops (shift of southern crops like soy, grapes and peaches to the north), continued development of salt-tolerant crops and crops that grow in dry and/or wet conditions, and combination crops such as aquaponics (combination of fish and crop cultivation). Other examples are the wet cultivation of crops like rice, cattail, bulrush and cranberry.



Looking ahead to the next few years

Action	Explanation	Initiator*, partners	Schedule
Interim monitoring of climate adaptation in agriculture <i>Action Programme for Climate Adaptation in Agriculture (AP KAL)</i>	For the purpose of interim monitoring, the Ministry of Agriculture, Fisheries, Food Security and Nature will consult with a wide range of agricultural business owners in 2023 about climate adaptation, similar to the “Agriculture, Nature and Food Quality Community” consultation in 2021. In 2026 a second interim assessment will be made to determine the continued approach as we move towards 2030 and beyond, possibly to 2050 and/or 2100.	The Ministry of Agriculture, Fisheries, Food Security and Nature	2023 and 2026
Make practical knowledge more accessible to agricultural and horticultural business AP KAL	(Practical) knowledge will become easier to find with more business-specific applications to help agricultural and horticultural businesses improve their perspectives for action. This will include long-term information, for example about opportunities resulting from climate change.	Ministry of Agriculture, Fisheries, Food Security and Nature*, knowledge institutes, agriculture and horticulture, regional and chain parties	2023-2027
Increase participation in weather insurance AP KAL	The Ministry of Agriculture, Fisheries, Food Security and Nature wants to work with the sector and insurers on targeted communication to growers to increase participation in weather insurance; larger numbers (more insured business owners) will enable insurers to operate more independently from the government and help agricultural and horticultural businesses if they suffer damage as a result of extreme weather events.	Ministry of Agriculture, Fisheries, Food Security and Nature*, agriculture and horticulture, insurers	2023-2027
Mapping vulnerable agricultural areas AP KAL	In line with the Delta Programme Commissioner’s request and in response to the weather extremes of the past few years, the Ministry of Agriculture, Fisheries, Food Security and Nature has commissioned a map of climate-vulnerable agricultural regions, sectors and crops. Based on this spatial overview, the Ministry of Agriculture, Fisheries, Food Security and Nature will enter into discussions with business owners, sectors and regional parties to find ways to reduce or resolve these vulnerabilities.	The Ministry of Agriculture, Fisheries, Food Security and Nature*, knowledge institutes, agriculture and horticulture	2023-2024
Stimulation of sustainable soil management based on the National Programme for Agricultural Soils NPL	Sustainable soil management leads to a healthy soil which allows rainwater to penetrate more easily into the deeper soil layer while retaining water in the top layer as well. This prevents crops from drying out as fast during periods of drought and it replenishes groundwater stores. The National Programme for Agricultural Soils works with other parties to make agricultural soils more resilient to the effects of climate change and to protect farms and the general region to pluvial flooding and drought. Examples of cooperation are knowledge projects and joint communication.	Ministry of Agriculture, Fisheries, Food Security and Nature, knowledge institutes, agriculture and horticulture, regional and chain parties	2023-2027
Design of the knowledge programme on saline agriculture AP KAL	In 2023 the Ministry of Agriculture, Fisheries, Food Security and Nature will start a multiyear cross-over knowledge programme on saline agriculture for salinisation-sensitive (coastal) areas. This programme has an international reach and may lead to various forms of public-private cooperation. The goal is to use research and innovation to develop short-term, medium-term and long-term business strategies that will help agricultural and horticultural businesses in the northern and western clay regions to combat salinisation and that will introduce them to saline agriculture. The Salinisation Knowledge Cluster is involved in this project as well.	Ministry of Agriculture, Fisheries, Food Security and Nature, knowledge institutes, regional and chain parties	2023-2024



What is still needed?

Priority	Explanation
Increase a sense of urgency on the part of agricultural and horticultural parties <i>Action Programme for Climate Adaptation in Agriculture (AP KAL)</i>	To promote and accelerate agricultural and horticultural adaptation to climate change, there will be an additional emphasis during the next few years on communication and the development of (new) instruments to help farmers prepare for and adapt to the changing climate, including opportunities that will arise. Examples are joint communication in the form of campaigns, and/or communication via the Common Agricultural Policy (CAP).
Address what is still lacking in knowledge development and continue the systemic distribution of knowledge. <i>AP KAL, National Programme on Agricultural Soils and the Delta Plan on Agricultural Water Management</i>	Commitment to knowledge development and distribution is important if we want to reach the goals of the National Programme on Agricultural Soils and the Delta Plan on Agricultural Water Management by 2030. The Delta Plan on Agricultural Water Management will continue its role in the systemic distributing knowledge to agricultural businesses and regional parties.
Involve and cooperate with financial institutions and chain parties <i>AP KAL</i>	If we want to promote the adaptation of agriculture and horticulture and investment in climate-adaptive measures, it is important to attract not only knowledge institutes and regional parties but also financial institutions and chain parties and to cooperate with them in the approach of the Action Programme on Climate Adaptation in Agriculture.



Challenge 5.2 Climate-resilient nature

The challenge

Climate change is making significant demands on the adaptability of our natural environment. We are losing some of our natural environment due to drought and drier conditions: 40 percent of native plants in the Netherlands are at risk due to drought. Salinisation and heat are increasingly causing problems as well. Plant and animal species are threatened with extinction as a result of shifting climate zones and the arrival of invasive non-native species. In addition, the risk of wildfires is increasing and the drying of peatlands is causing additional carbon dioxide emissions.

These climatological changes are disrupting the natural balance of the ecosystem. In addition, due to other “human pressure factors” (changes caused by humans), the resilience of the natural environment is at a historic low due to factors such as: less room for nature and natural connections, water use, eutrophication, and the use of natural resources. This is a problem because a healthy natural environment is essential for our drinking water and food supply, protection against high water and a stable climate.

Climate adaptation of the natural environment is important, but we need to adapt along with it. The natural environment can be deployed in the “physical domain” (spatial organisation, infrastructure, the environment and housing) to make the Netherlands healthy, safe, resilient and climate-proof.

The approach

The Ministry of Agriculture, Fisheries, Food Security and Nature created the Action Programme for Climate Adaptation of the Natural Environment to realise a resilient, climate-proof natural environment and to use this environment for climate adaptation. The goal of this programme is to enable public authorities and site managers by 2030 to limit the negative effects of climate change on the natural environment and biodiversity, and to implement nature-inclusive solutions for climate adaptation. This applies to existing and planned natural environments.

They will work with stakeholders to establish an adaptation strategy and create perspectives for action. Stakeholders will also be encouraged and facilitated as needed, for example through knowledge development. They will map (natural) areas that are vulnerable as a result of climate change, take advantage of “combination opportunities” (where these and other challenges are tackled together) and commit to adequate action in emergency situations.



To achieve results, they will demonstrate their commitment (together with other public authorities and site managers) via *three tracks*.¹⁰

- 1 *Optimisation* of the current situation, for example through more efficient use of the available water (short term).
- 2 *Adaptation* in response to climate change by adapting to the natural conditions (medium term).
- 3 *Transformation* through fundamental and (eco)systemic changes (long term).

These tracks are developed together with stakeholders to meet the specific needs of each region for the purpose of gaining experience and learning from these experiences. This is how we can make the natural environment resilient, connect nature areas with each other, work towards a healthy water and soil system and keep further decline in the condition of biodiversity and the natural environment to a minimum.

Other national strategies and programmes contribute to the realisation of the challenge as well:

- The Forest Strategy;
- The Plan of Attack for Landscape Elements;

- The Basic Quality of Nature project;
- The programme-based approach to Green In and Around the City;
- The Nature Inclusive Agenda;
- The Healthy Green Living Environment programme;
- The Programme-Based Approach to Large Bodies of Water.

1 **Optimisation**

Optimisation of the current situation means: work with other public authorities and site managers to develop short-term perspectives for action in order to limit the effects of the greatest climate risks for the natural environment, in particular the effects of drought, rising temperatures, extreme weather and rising sea levels. If we do not intervene, nature areas that contribute to nature recovery and preservation will be lost as a result of climate change. Optimisation is not a matter of “one size fits all”: local context will be taken into account, and other spatial challenges will be included as well (“combination opportunities”).

One example of optimisation is the deployment of the natural environment in the spatial domain as a climate buffer and

¹⁰ In line with the Draft Approach of the National Programme on Rural Areas



as a Nature-Based Solution¹¹. The creation of buffer zones around vulnerable (groundwater-dependent) nature areas will provide protection and help improve the hydrology (water conditions) in an area. Buffer zones may have multiple functions, as long as these functions do not put pressure on the natural environment. Another example is the creation of natural overflow areas to prevent pluvial flooding and retain water during periods of drought. Enlarging and connecting nature areas will make these areas more resilient, because it provides opportunities for species migration, population growth, increased variation in species and strengthening of the genetic variation within species.

¹¹ Nature-Based Solutions are solutions and ideas that are inspired by or supported by the natural environment. Their goal is to provide effective solutions to societal problems that will benefit humans and the natural environment. Natural and semi-natural ecosystems are restored, protected and managed with sustainable methods.



Spotlight

Recreation, nature and water safety

The dikes between Enkhuizen and Amsterdam will be adapted to make them ready for the future. In Hoorn, water safety is combined with nature and recreation. A foreshore was created: a new, sandy dike in front of the existing dike. This sand structure has created a sheltered body of water with a public beach which is suitable for recreation.

The first part of the beach was opened in July 2023; completion of the project is scheduled for 2024. Young fish are able to mature in the quiet waters. Flowering grasses and native shrubs keep the sand in place and attract insects. The residents of Hoorn have a place to swim and relax on the public beach, which can be reached via several bridges.



concept artist impression



2 Adaptation

Adaptation means making choices about what you can and cannot do in light of the current condition of the water and soil system. It means: looking towards the future and making smart choices. As the climate is changing, we will have to commit to the preservation of habitats, to Nature-Based Solutions and to the nature-inclusive organisation of our physical living environment.

In the medium term, the fact that the climate is changing makes the connection of nature areas an even more urgent challenge: species must be able to relocate in response to shifting climate zones. In line with the Birds and Habitats Directives, unique flora and fauna must be preserved through the creation and maintenance of suitable habitats. These projects will have to factor in the climatological conditions in a particular area.

If optimisation is no longer sufficient to protect and preserve biodiversity, we will have to look at other options. One option to increase the resilience of the natural environment would be to plant tree and plant species with genes that are more suitable for a drier and warmer climate (gene sources). Structural choices will have to be made, for example in terms of the distribution of water during periods of drought. These climate risks

will have to be flagged and discussed in time to be able to make suitable future-proof provisions for the natural environment.

3 Transformation

Transformation of the spatial domain means working to create a nature-inclusive society. The water and soil system are essential considerations in the spatial choices that are made, and climate adaptation, the preservation and restoration of biodiversity and the natural environment are expressly addressed in any challenge the Netherlands takes on. A resilient, climate-proof natural environment will keep the Netherlands safe, healthy and future-proof.

To achieve this transformation, we are working towards systemic changes on the basis of a long-term perspective. This is done by means of priorities, principles and methods that are suitable for the future we are trying to build. In the future, biodiversity and the natural environment will be utilised as well as protected and restored, with the ability to adapt to changing circumstances.

Looking ahead to the next few years

Action	Explanation	Initiator*, partners	Schedule
<p>Formulation of concrete lines of action from climate adaptation of the natural environment towards a programme for climate adaptation of the natural environment.</p> <p><i>Action programme proposed by the Ministry of Agriculture, Fisheries, Food Security and Nature</i></p>	<p>Drought, heat, pluvial flooding and salinisation have a significant negative impact on the natural environment. The previously formulated lines of action will be developed into an action programme proposal in cooperation with stakeholders. Goals: a resilient, climate-proof natural environment and utilising the natural environment for climate adaptation in the physical living environment. Public authorities and site managers must be able to do the following by 2030: limit the effects of the main climate risks for biodiversity and the natural environment and implement nature-inclusive solutions for climate adaptation in the physical living environment. There are also other national programmes that are committed to biodiversity and the natural environment, such as the Nature Inclusive Agenda, the Forest Strategy and the Basic Quality of Nature project. Their cooperation will be requested as well.</p> <p>Further concrete actions are still being developed at the time of this writing and they will be described in the programme proposal.</p>	The Ministry of Agriculture, Fisheries, Food Security and Nature	2023-2030
<p>Knowledge development on climate adaptation of the natural environment</p> <p><i>Knowledge Innovation Agenda (KIA) on Agriculture, Water and Food</i></p>	<p>The Ministry of Agriculture, Fisheries, Food Security and Nature is committed to identifying “knowledge gaps” and developing knowledge about the impact of climate change on the natural environment, and how to deal with it (“perspective for action”) by means of what systems. The Ministry of Agriculture, Fisheries, Food Security and Nature sets up multiyear studies to support its policies via the Knowledge Innovation Agenda (KIA) on Agriculture, Water and Food (website only available in Dutch). Studies have been initiated during the past few years on drought and drying and the impact on the groundwater balance. The relationship between Water and Soil as Guiding Principles and climate adaptation is being studied as well.</p>	The Ministry of Agriculture, Fisheries, Food Security and Nature	2022-2030
<p>Research Programme on Climate and the Natural Environment</p> <p><i>The Dutch Research Council</i></p>	<p>Within the context of the research programme Climate and the Natural Environment, the Dutch Research Council studies issues such as the mutual interaction of climate change and the natural environment and the effects of existing measures on climate, the natural environment and society.</p>	The Ministry of Agriculture, Fisheries, Food Security and Nature	2022-2028
<p>Reinforcement Nature and Environmental Policy Plan for the Caribbean Netherlands</p> <p><i>Nature and Environmental Policy Plan for the Caribbean Netherlands</i></p>	<p>Different measures are being taken within the context of the Nature and Environmental Policy Plan for the Caribbean Netherlands that will contribute to the protection of nature and the (marine) environment. Replanting, measures to discourage overgrazing, and more effective rainwater management will contribute to the climate resilience of the islands.</p>	The Ministry of Agriculture, Fisheries, Food Security and Nature	2020-2030





What is still needed?

Priority	Explanation
Dealing with drought in the natural environment <i>Policy Forum on Drought</i>	Weather extremes, in particular drought, have a significant negative impact on the natural environment. This has been a topic of great interest in the media, the House of Representatives and the community. It is clear that there is a need for a structural approach to drought in the natural environment. The response to this issue will be based on Water and Soil as Guiding Principles, the recommendations from the Policy Forum on Drought and the priority sequence. Further discussion will be needed during the next few years to determine how drought-related damage to the natural environment can be minimised, for example by retaining water, making smart choices in nature management and a healthy soil and water system.
Commitment to Nature-Based Solutions <i>The international climate strategy and the Global Biodiversity Framework</i>	The Netherlands has made a commitment to Nature-Based Solutions within the context of the Global climate strategy and the Global Biodiversity Framework . The Netherlands views the climate in relation to the natural environment and is actively committed to solutions that contribute to reversing global climate problems and that also make a positive contribution to the protection and restoration of biodiversity. This requires the translation of these international goals into concrete measures and commitment to national implementation.
Make climate adaptation (by means) of the natural environment a standard part of policies <i>Wageningen University & Research (WUR) study "NL2120" (only available in Dutch)</i>	If we want to guarantee a safe, liveable, wealthy and sustainable future, the Netherlands must be smart in adapting alongside the natural environment and it must make optimal use of natural processes in spatial planning. This future can be realised only by committing to climate adaptation (by means) of the natural environment as the basis for policies and implementation. In line with the WUR study " NL2120 " (only available in Dutch), the integration of the natural environment with natural processes must be a priority in those policies and it must be in line with the challenge to minimise the effects of climate change on the natural environment.



Challenge 5.3 Hazardous industries must be prepared for climate risks

The challenge

Hazardous industries are businesses that keep large quantities of hazardous substances on the premises. In light of safety and environmental risks, these businesses are required to prepare for climate-change-related extreme weather events such as flooding, peak rainfall, drought and heat stress.¹² Flooding, peak rainfall and lightning strikes may lead to power failures that could affect critical processes or safety provisions. Drought can lead to cooling water shortages and increase the risk of fire. Heat stress can affect the health and concentration ability of employees or cause dangerous temperature increases in hazardous substances during processing or storage.

There are about four hundred companies classified as hazardous industries in the Netherlands at this time, five of which (primarily oil terminals) are located in the Caribbean Netherlands. According to the General Provisions Act Wabo, the competent authority for these companies is at the provincial level, and various public services (supervisory authorities) have

been working together since 2001 to make sure that these companies comply with safety regulations and that uniform monitoring processes are used at every location. This joint effort is referred to as BRZO+, an umbrella term that includes organisations such as environmental services, the labour inspectorate and the safety regions. In the Caribbean Netherlands, the Human Environment and Transport Inspectorate is the supervisory authority.

The risk of flooding is described in detail in the preparation for risks to hazardous industries due to extreme weather events. The Publication Series Hazardous Substances (PGS-6) includes a guide for preparing a qualitative risk analysis for flooding. Measures that are mentioned include dealing with objects that could float by attaching them to something, weighing them down or removing them, making sure that packaged hazardous substances are stored in locations that are high enough to be safe, and securing or even deactivating installations. In 2021 the RIVM made an inventory of the possible consequences and climate risk measures at hazardous industries. The conclusion was that heat stress is the lowest priority at most companies and that they have not prepared a systematic inventory yet. Risks and risk management vary widely between companies. so each

¹² This is set out in the Seveso III Directive and the Dutch implementation in the Major Accidents (Risks) Decree or, as of 1 January 2024, the Environmental Act.



5.3

company needs to prepare its own climate-change-based risk inventory.

Approach

Various measures are being taken and international knowledge exchange is being promoted to help hazardous industries be better prepared for climate risks. The public at large must also be prepared (through risk communication) for possible disasters or crises.



Photo: Claudine Van Massenhove



Spotlight Improved Natech guide

The Netherlands is working with other members of the OECD on an improved [Natech guide](#). The guide is intended for companies and public authorities, to help them be better prepared for dangerous situations caused by natural events.

Floods, heavy storms and earthquakes can cause significant damage to installations. This can result in fires, explosions or the release of hazardous substances; any of these would have a significant effect on public health, the environment and the economy. Previous research on Natech yielded further insights into prevention, preparation, and how to respond to chemical accidents.





5.3

International knowledge exchange

The Netherlands works with other countries to prepare hazardous industries for climate risks through the exchange of knowledge and experience. This is done, for example, within the Hazardous Industries Group: a technical working group created to support the Seveso Directive [hazardous industries directive]. One example of international cooperation is countries exchanging knowledge and experience in the area of spatial planning and possible domino effects. A domino effect happens if an event at one company affects another company. The participating countries are investigating whether these domino effects should be handled differently in light of the increasing weather extremes and whether hazardous industries will need support in this area. In addition, the Joint Research Centre (JRC) of the European Commission has developed an online database to be able to share lessons learned about climate risks for chemical companies. The Netherlands is also working with other members of the Organisation for Economic Cooperation and Development (OECD) to optimise a guide for so-called Natural Hazards Triggering Technological Accidents (Natech). For more information [see the spotlight Improved Natech Guide](#).

Risk communication and awareness

It is important for companies to be aware of the potential effects of climate change on their business activities and what measures to take in case of emergencies or crises. We should also not underestimate the fact that regional incidents often impact companies, public authorities, emergency services and residents in other areas of the country. Good risk communication is extremely important. The board of each safety region is responsible for providing information about disasters and crises that may affect the region, about the measures that have been taken and what residents can do in case of a disaster at a company or in their neighbourhood. Residents can also check the website of the Living Environment Atlas to see where these companies are located and which high-risk activities are taking place in their neighbourhood¹³.

¹³ [Register of External Safety Risks | External safety register](#) (only available in Dutch)





5.3



Looking ahead to the next few years

Action	Explanation	Initiator*, partners	Schedule
Stimulation of (international) knowledge exchange about climate risks for hazardous industries	There are various knowledge exchange initiatives already, such as the Seveso Expert Group, an online database of the JRC and collaborations on Natech within the OECD.	Ministry of Infrastructure and Water Management*, Ministry of Social Affairs and Employment and Ministry of Justice and Security Brzo+	Ongoing
Technical assessment of safety reporting <i>National Approach to At-Risk Companies</i>	Since 2019, the district water boards have been performing technical assessments of the analysis of flooding risks for hazardous industries.	Brzo+	Ongoing, depending on the inspection method
Assessment of safety reporting by hazardous industries in response to flooding <i>National Approach to At-Risk Companies</i>	In 2019 a checklist and inspection methodology were created (revised in 2021) for the assessment of safety reporting on flooding risks by hazardous industries.	Brzo+, Ministry of Infrastructure and Water Management/competent authority under the General Provisions Act Wabo*, Ministry of Social Affairs and Employment and Ministry of Justice and Security	Ongoing
Licensing and supervision on the basis of the Public Housing, Urban Planning and Environmental Management BES Act (Bonaire, Sint-Eustatius and Saba) <i>Public Housing, Urban Planning and Environmental Management BES Act</i>	Since 2015, hazardous industries in the Caribbean Netherlands are required to obtain an environmental permit. The Government is responsible for challenges involving licensing, supervision and enforcement, in light of the scope of the activities and their relation to vulnerable coral ecosystems.	The Ministry of Infrastructure and Water Management*, Rijkswaterstaat (licensing authority), the Human Environment and Transport Inspectorate (supervising authority)	Ongoing

What is still needed?

Priority	Explanation
International knowledge exchange about climate risks for Seveso organisations <i>BRZO Covenant, Article 4 par. 3. BTU Brzo+ consultation of 13/6/2023</i>	Further (international) knowledge exchange between public authorities, businesses and industry associations may increase awareness among hazardous industries about climate risks and help them be better prepared to manage these risks.

6 Domain III

People and culture





Challenge 6.1 Heat-resilient cities

The challenge

Due to climate change we are experiencing more summery days, tropical days and extremely hot days (with maximum temperatures of at least 25, 30 and 35 degrees, respectively). In its most recent national climate risk analysis of 2015, the Netherlands Environmental Assessment Agency identified heat stress as the climate risk with the highest impact. This assessment is supported by facts, because international [studies](#) show that climate change is already resulting in more heat-related deaths. Thirty-one percent of heat-related deaths in the Netherlands from 1990 to 2018 can be ascribed to climate change. This comes down to an average of almost 250 additional heat-related deaths per year. Increasing heat also leads to illness, loss of work productivity and poorer performance in school. The scope of these effects in the Netherlands is unknown. Heat can lead to strokes, kidney failure and respiratory problems. The air quality goes down as well when it's hot, and this can result in "summer smog". People over 75 years of age and people with certain chronic conditions are especially vulnerable to this.

Heat stress is worse in urban areas due to the "[heat island effect](#)". Asphalt, buildings and brick absorb more warmth and re-emit this heat at night. There is also less moisture that can evaporate and provide a cooling effect ([see Sponge cities](#)) and wind cannot blow as freely, limiting its ability to supply cool air to the cities. The difference in temperature can be as much as 7 or 8 degrees at night. In light of the ageing population, urban densification and sprawl, and increasing climate change, it is more important than ever to minimise heat-related deaths and illnesses. We can do this by implementing adaptation measures and changing our behaviour. The [evaluation](#) of the National Climate Adaptation Strategy (NAS) shows that we need to do more to limit climate risks.

The days are not just getting warmer in the Netherlands, it is likely there will be more sun irradiation as well. This is because there are fewer clouds and we are experiencing drier winds from the east in the spring and summer. More sunshine means more ultraviolet (UV) radiation, but on the other hand radiation is going down as a result of the recovering ozone layer. These effects balance each other out to a certain extent, so the net change in UV radiation will probably be small over the next few decades. However, the annual UV exposure (effect of the sun, relevant for the number of skin cancer cases) in the Netherlands is about 10 percent higher than at the start of the 1980s. This





is why it is important (similar to our response to heat) to create enough shady spaces and why it is extremely important to increase people's awareness, including employers, about the risks of exposure to UV radiation.

The approach

Curbing heat in the cities will require a combination of measures. The impact of heat can be reduced further by changes in our behaviour.

1 Area

Reducing heat in an entire area is the basis for the approach to heat stress. Blue-green measures are generally effective because they create evaporation as well as shade and reflection. Other measures include: increasing air flow (which has a cooling effect), installing sun shade sails or other artificial shade structures, and using light-reflective materials. Many of these measures primarily have a local effect on the temperature.

In addition to including the above measures as standard practice in new construction and in transition projects, it may help to create cool, accessible areas in dense neighbourhoods with a lot of brick.

2 Building

At the building level, the first preference is to keep heat out as much as possible, for example through the use of awnings or roof modifications. If cooling is necessary, it is preferable to use sustainable forms of cooling such as natural ventilation and thermal energy storage.

In 2021 the so-called NZEB requirements took effect (NZEB stands for Nearly-Zero Energy Buildings); the purpose of these requirements is to improve the energy performance of new buildings. This includes the so-called Excess Temperatures in July (Dutch TOjuli) requirement to minimise the risk of excess summer temperatures for new houses.

3 Behaviour

Behaviour plays an important role in living in a heat-sensitive city. Staying hydrated, wearing appropriate clothing, moving less during hot periods, using sun shade structures or ventilation at the right moments and finding cool locations are important recommendations. However, not everyone is able to implement these recommendations. The trend is for older people to stay in their own homes longer before moving to a senior care facility. So it is important to look after one another during hot periods and to create a care infrastructure to help elderly people (living at home) to implement these recommendations.



4 Knowledge

Heat is a relatively new topic in the Netherlands. This is why studies are being done on what measures would be most effective here. A few useful results have been published already, including the [Climate Effect Atlas](#) with heat charts and the “Heat-Resilient Cities” report of the Amsterdam University of Applied Sciences. The National Knowledge and Innovation Programme on Water Climate conducted a study in recent years on effective measure to combat heat in homes, and they created a [guide](#) for municipalities and housing associations to deal with heat in homes (only available in Dutch). The Netherlands Organization for Applied Scientific Research (TNO) and Deltares prepared an inventory, at the request of the Ministry of the Interior and Kingdom Relations, of knowledge that is still lacking and what actions are needed to meet the need for cooling in homes. The results were published in the report [Knowledge Agenda](#) for future residential cooling needs.

5 Planning for heat

In 2007 a [National Heatwave Plan](#) was launched, which notifies organisations, (healthcare) professionals and informal care providers of heat forecasts so they can take this into account with regard to vulnerable people in their care. In 2019 a [Guide for Local Heat Plans](#) was published (only available in Dutch). The purpose of the guide is to help local parties, such as pub-



Spotlight

A cool green walking route

Parking lot Fens at the Keizersgracht in the city centre of Eindhoven used to be a paved area. The little greenery that was there was of poor quality, did not look appealing and had little ecological value. Local business owners saw an opportunity to make the site more appealing and more in line with the overall feel of the shopping area. Their idea was consistent with the city’s ambition to make the city centre more climate-resilient. Thus the idea of a green walking route was born.

The business owners helped pay for [the creation of the green walking route](#), which includes sites for bars and restaurants, retail stores, bicycle parking and meeting areas. The walking route has a water storage facility, which helps cool down the area and contributes to biodiversity. The participants combined various ambitions to make the area more beautiful, greener and more climate-adaptive.





6.1

Heat-resilient cities

lic authorities and civic organisations, to prepare a heat plan. These plans establish agreements at the local level about measures that can or must be taken during periods with high temperatures.



Looking ahead to the next few years

Action	Explanation	Initiator*, partners	Schedule
Supporting municipalities in their approach to heat <i>Heat Menu for the built environment</i>	The Heat Menu provides a quick overview of steps municipalities can take to become heat-resilient. New insights are added annually. Pilot programmes will be conducted in ten municipalities. The Climate-Proof Together Platform also has a <i>Community of Practice</i> for heat where municipalities and provinces can exchange knowledge and experience.	The Ministry of the Interior and Kingdom Relations Netherlands Enterprise Agency (Rijksdienst voor Ondernemend Nederland)	2023
Including the health effects of heat in the planning of the physical living environment and in social policies <i>Health and Active Living Agreement</i>	The Health and Active Living Agreement is a tool for municipalities, municipal health services, health insurers and the Ministry of Health, Welfare and Sport to encourage people to lead healthy, active lives with a solid social foundation. Heat-specific agreements are included with regard to this social foundation and the organisation of the physical living environment; the main goal is to provide better protection for vulnerable people.	The Ministry of Health, Welfare and Sport Association of Netherlands Municipalities GGD GHOR NL (Municipal Healthcare Services and Regional Medical Assistance Organisation in the Netherlands) Health Insurers in the Netherlands	2025
Research on adaptation measures for a healthy living environment <i>BENIGN (BluE and green Infrastructure desiGned to beat the urbaN heat) and MANTRA (CliMate Adaptation for HealThy Rural Areas)</i>	The Dutch Research Council has set up two research consortiums: BENIGN and MANTRA. The first is investigating the effect of heat stress on health in urban areas and what measures can be taken to combat this. MANTRA is conducting similar research, but in rural areas.	The Ministry of Public Health, Welfare and Sport, Ministry of the Interior and Kingdom Relations, Ministry of Infrastructure and Water Management and Ministry of Agriculture, Fisheries, Food Security and Nature The Dutch Research Council	2023-2026
Exchange of knowledge and experience <i>Housing Association Heat Group</i>	The Heat Group is a coalition of housing associations and knowledge and research institutes. They worked together to create the Heat Toolbox (only available in Dutch), which can be used by housing association staff members to prevent heat problems for their residents. The group meets several times a year to exchange knowledge and experience.	Ministry of the Interior and Kingdom Relations Green Housing Providers Heat Group	Ongoing
Develop heat charts for vulnerable neighbourhoods and buildings <i>National Knowledge and Innovation Programme for Water and Climate</i>	The National Knowledge and Innovation Programme for Water and Climate has developed a line of research called Climate-Proof Cities. This research is used to develop heat charts for vulnerable neighbourhoods and buildings.	Ministry of Infrastructure and Water Management Foundation for Applied Research on Water Management Deltares	2023
Develop standards for the cooling of buildings <i>Consultation Committee on Standards in Climate Adaptation</i>	The Consultation Committee on Standards in Climate Adaptation has been working on a standard approach to heat stress in buildings, and one of the tools they developed is the Cooling Ladder. The Committee also joined with several organisations that are involved in standardisation to sign a letter of intent regarding climate change and the cooling of buildings. One new development is that substantial standards are being developed that can be easily adopted by organisations that are involved in standardisation. Many people asked for this after the publication of the letter of intent.	Organisations that are involved in standardisation	2024



What is still needed?

Priority	Explanation
Re-evaluation of approach to heat periods <i>Report of the oral Q&A about the heat plan, 6 June 2023</i>	The KNMI published new climate scenarios in October 2023. Based on these scenarios it needs to be assessed whether preparatory measures for heat periods, including the National Heatwave Plan, need to be modified.
Additional cool locations in the city <i>Heat-Resilient Cities study</i>	The Heat-Resilient Cities study shows that cool locations play an important part in the approach to heat stress. The Climate Effect Atlas shows that the number of those locations is still too small.
Insight into future demand for cooling <i>Knowledge Agenda for Future Demand for Cooling in Homes and Recommendations Housing Association Heat Group (only available in Dutch)</i>	There needs to be more insight into the future demand for cooling, because this is important for decisions that are being made in the context of the energy transition. These decisions have focused primarily on heating so far.
Research on current and future health risks of climate change <i>Knowledge Agenda on Climate and Health</i>	The finance organisation ZonMw [Netherlands Organisation for Health Research and Development] asked the RIVM, Maastricht University and Wageningen University & Research in 2019 to prepare a knowledge agenda describing the research that needs to be done to minimise the health risks of climate change. In response to this research, the RIVM published an Action Plan titled Research Programme on Climate Change and Health Effects in 2022 at the request of the Ministry of Public Health, Welfare and Sport. In 2022, ZonMw prepared a research programme at the request of the Ministry of Public Health, Welfare and Sport that is focused on health effects in relation to climate adaptation and mitigation measures. No agreement about the implementation of the commissioned research assignments has been reached yet at the time of this writing.



Challenge 6.2 Staying healthy in times of climate change

The challenge

Public health is affected by climate change in many different ways. This chapter discusses allergies, vector-borne diseases and zoonoses. Temperature- and water-related health effects are explained in [Heat-resilient cities](#) and [Sponge cities](#), respectively.

Climate change can also have an effect on mental health. It is not clear yet whether additional measures will be needed in this area, although it is increasingly becoming a topic of interest; for example, the World Health Organisation (WHO) stresses that climate change constitutes a significant risk for mental health. People are experiencing stress and anxiety due to climate change, and stress caused by the direct or indirect results of climate change events such as floods or wildfires.

1 Allergies

Climate change may lead to more allergies due to an increase in pollen, arachnids and insects:

- The “pollen season” lasts longer, new pollen-dispersing species are migrating north, and drought and increased CO₂ levels lead to more pollen production. On top of that, allergenicity (the extent to which someone is allergic to a substance, in this case pollen) can get worse as well.
- Other ecological circumstances may cause populations of species like the dust mite, the oak processionary caterpillar and the wasp to grow.
- Exposure and sensitivity to substances that can cause allergies (allergens) may increase. People will probably spend more time outside when it’s hotter. Heat reduces the air quality and increases sensitivity to pollen. Pollen concentrations can increase significantly during dry periods. Blue and green measures to promote climate adaptation may have a negative effect on public health, for example due to increased exposure to pollen as a result of more greenery.

2 Vector-borne diseases and zoonoses

Vector-borne diseases are diseases that are transmitted from arthropods (primarily ticks and insects) to people and vertebrates. Zoonotic diseases, or zoonoses, are infections that are transmitted between vertebrates and humans. Some vec-



tor-borne diseases are also zoonotic diseases, for example if a “vector” (such as an insect) transmits an infection between vertebrates and humans. Examples of this are Lyme disease and the West Nile virus.

Climate change can lead to more zoonoses and vector-borne diseases: it affects the presence, population, activity and seasonal rhythm of the pathogens and the vector animals. And, as we just described in the section about allergies, various climate adaptation measures such as more green and blue measures in the urban environment may also increase the habitat of pathogens. But whatever the case may be, the fact is that many other factors besides climate change affect the risk of infectious disease, such as land use, the living environment, mobility and behaviour.

VECTORS

Climate change may lead to changes in the dispersion area of vectors (in particular insects) and to increases or decreases in areas and periods when conditions are favourable to the spread of disease. There have been local reports in recent years on pathogens that are transmitted by mosquitoes or ticks that have never been seen in the Netherlands before. One example is the West Nile virus, which caused several infections in the Netherlands for the first time in 2020. Although a direct relationship is difficult to prove, climate change may have contributed to these situations.

There has also been an increase in recent years in the number of exotic mosquitoes that have been found in the Netherlands. These mosquitoes may introduce tropical infectious diseases into the Netherlands. The policy of the Government is to make every effort to prevent exotic mosquitoes from gaining a foothold in the Netherlands.



The approach

1 Allergens

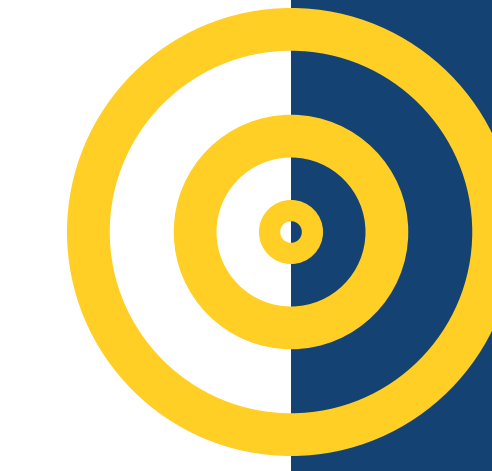
Allergies have always been a problem, and the current approach consists of monitoring and regular medical treatment. It is important to take the allergenicity of plants and the risk of other allergens into account in spatial planning, in particular with regard to green areas (see spotlight: The Tree Compass).

During the next few years we will also have to determine whether we need to take additional measures to combat the effects of allergies (exacerbated by climate change), such as:

- improving the monitoring systems for allergens and disease burden;
- additional (preventive) measures to limit the burden of allergies.



Photo: Animaflora PicsStock



Spotlight

The Tree Compass

More and more cities are planting new trees; this is good for biodiversity and the trees provide shade on hot days. There is a trend to opt for trees that do better in the changing climate. It is also important to pay attention to “allergenicity”: the extent to which a tree can cause hay fever symptoms. This is why [the Tree Compass](#) (only available in Dutch) was developed by Leiden University Medical Centre (LUMC) with a subsidy from finance organisation ZonMw.

The Tree Compass is intended for public authorities and the general public. It shows which trees cause allergies and which trees do not. The extent to which a tree can cause allergies may differ by flower function and even by region. The Tree Compass takes this into account.



2 *Vector-borne diseases and zoonoses*

The fact is that vector-borne diseases and zoonoses have existed long before climate change began to play the part it does today. There are policies that are in place already, which are being reinforced by the 2022 [National Action Plan for the Strengthening of the Zoonotic Disease Policy](#). The policy approach consists of three pillars:

- 1 Prevention through education and factoring in the risk of zoonoses in spatial planning.
- 2 Detection through surveillance of humans, animals and the environment.
- 3 Responsiveness through the creation of contingency plans for outbreaks, guides with instructions on what to do in case of detection and crisis exercises.

FOOD SAFETY

When considering the effects of climate change on public health we should also consider food poisoning. Higher temperatures and changes in precipitation can lead to increased exposure to salmonella, campylobacter, listeria and fungi. How climate change can compromise food safety and how likely it is that this will happen is hard to say exactly at the moment. In any case, existing food safety policies already address the possibility of increased risk of food poisoning in sufficient detail.



Looking ahead to the next few years

Action	Explanation	Initiator*, partners	Schedule
Pollen research <i>Kappa research project</i>	The research project “Het beheersbaar maken van de effecten van klimaatverandering op allergie: van pollen tot patiënt integraal in beeld [Managing the effects of climate change on allergies: an integrated approach from pollen to patient]” lists three research goals: (1) Determine the disease burden of pollen, taking into account any climate-related factors; (2) Determine ways to prepare a reliable spatial assessment of pollen quantity and the best way to communicate this information to hay fever patients; (3) Determine which trees are allergenic and which are not.	LUMC ZonMw	2021-2024
General actions from the <i>National Action Plan for the Strengthening of the Zoonotic Disease Policy</i>	The National Action Plan for the Strengthening of the Zoonotic Disease Policy lists 54 actions, divided between the three pillars prevention, detection and response. Climate change is explicitly named as just one of several factors that increase risk. One of the actions is to combat mosquitoes.	Ministry of Public Health, Welfare and Sport and Ministry of Agriculture, Fisheries, Food Security and Nature Netherlands Food and Consumer Product Safety Authority (NVWA)	2022-2026

What is still needed?

Priority	Explanation
Improve pollen monitoring RIVM Advice	The RIVM was asked by the Ministry of Health, Welfare and Sport to investigate the need for and usefulness of a pollen monitoring network. The RIVM recommends setting up such a network, improving information for hay fever patients, and shedding light on the disease burden and societal costs of hay fever.
Research on current and future health risks of climate change Research Programme on Climate Change and Health Effects	The Ministry of Health, Welfare and Sport asked RIVM to develop a proposal for a research programme to reinforce the national knowledge base on the physical and mental health effects of climate change. The Action Plan Research Programme on Climate Change and Health Effects (RIVM, 2022, only available in Dutch) describes the main research questions for each topic. There is a special focus on research questions about the relationship between various themes, such as pollen, air quality and temperature. Mental health issues such as flooding-related stress are addressed as well.



Challenge 6.3 Well-protected cultural heritage

The challenge

The two main climate threats to cultural heritage sites in the Netherlands are floods and drought. Drought can cause damage to the foundations of valuable buildings like monuments, and flooding can cause water damage to art collections in museums. The increasing risk of fires and storms may cause significant damage as well, to historical buildings for example. In addition, green cultural heritage sites like historic parks and estates are experiencing problems with increasing frequency due to drought or extreme precipitation. And finally, drought affects archaeological sites, including underwater sites.

The measures that are being taken to protect the Netherlands against climate change may affect cultural heritage sites as well. For example, spatial measures such as dike reinforcements and the creation of water buffers may have negative effects if insufficient thought has been given to the cultural heritage site and the relationship to the historic water and soil system. Cultural-historical knowledge may yield possible solutions, like restoring the system of ditches that used to separate lots and redeploying water cellars and watermill systems.

Deep dive - What is cultural heritage?

Cultural heritage is anything produced by previous generations that we want to preserve for future generations. Examples are monuments, archaeological sites, collections, protected city and village views and artistic and architectural works of art. It also includes cultural-historical landscapes and water systems: polders, the extraction landscape with its system of ditches, watermills, water meadows, canals, locks and pumping stations. There is also such as thing as immaterial cultural heritage: old traditions, customs, knowledge and skills that communities consider valuable enough to preserve. Cultural heritage can connect, inspire, and make us think. This is why this heritage has great cultural and social value. The responsibility for heritage management rests on many shoulders: the Government, municipalities and provinces, heritage institutions, private owners of monuments and collections, market parties like restoration and archaeological research companies and public and private funds.



UNESCO World Heritage Sites

The UNESCO World Heritage Sites comprise a special category. These heritage sites are internationally acknowledged as being of “outstanding universal value”. The [Netherlands](#) currently has twelve sites that are registered as World Heritage Sites. Protecting these sites against climate change is a tall order, but they deserve our very best efforts so they will be preserved for generations to come.

The approach

The effects of the changing climate on cultural heritage has only recently become a topic for discussion. The risks to these sites and the challenges involved in protecting them have not fully been identified yet at the national level. The type of site and the effects of climate change vary by region, so the potential risks are extremely diverse as well.

We are committed to the following actions for our cultural heritage sites:

1 *Research on (regional) climate risks for culture heritage sites*

A lot of research is still needed on the effects of climate change on cultural heritage sites. Existing research on climate change can be used to gain some preliminary insights, but it is important to use the existing research on climate change and apply it to our knowledge of cultural heritage sites. The Ministry of

Education, Culture and Science commissioned the Cultural Heritage Agency (RCE) to shed light on the climate risks for cultural heritage sites. The RCE is working on this assignment with other parties such as the Netherlands Environmental Assessment Agency (PBL). The provinces are conducting research at the regional level in the form of “quick scans”. The province of Noord-Holland is the first province to develop a method for this, in partnership with Climate Adaptation Services, a consulting firm ([see Spotlight – Quick scan of cultural heritage](#)).

2 *Creating awareness*

Various [studies](#) show that there is insufficient awareness of the effects of climate change within the cultural heritage sector and beyond. The Ministry of Education, Culture and Science and the RCE are hoping to change that through the Cultural Heritage for the Future programme, which is aimed at heritage professionals and public authorities. Cultural heritage can also be used for the purpose of creating broader public awareness of climate change and climate adaptation. Sharing knowledge about the history of an area, for example, may help residents become more aware of the need for climate-adaptive measures in their immediate environment.



6.3

3 Protective and adaptive measures

The effects of climate change on cultural heritage sites must be identified before we can take the appropriate protective and adaptive measures. Preservation of the cultural-historical value of the heritage sites must be the starting point of any measures that are to be taken. If it is determined that preservation is not realistic, the heritage site must be adapted to the new circumstances. Effective cooperation between public authorities and the heritage sector is extremely important when taking protective and adaptive measures. This approach is also preferred for



Spotlight

Cultural heritage quick scan

The province of Noord-Holland has developed a climate adaptation quick scan for its cultural heritage sites. The scan provides a preliminary overview of the risks of climate change for cultural heritage sites in the province if no measures are taken.

The quick scan is based on data from the heritage objects and sites that identify their geographic location. Combining these data with climate risk data from the Climate Effect Atlas enables the province to determine the risk for each object or site. These risks are translated into “risk scores”. The results are presented in the form of thematic charts and conceptual diagrams.

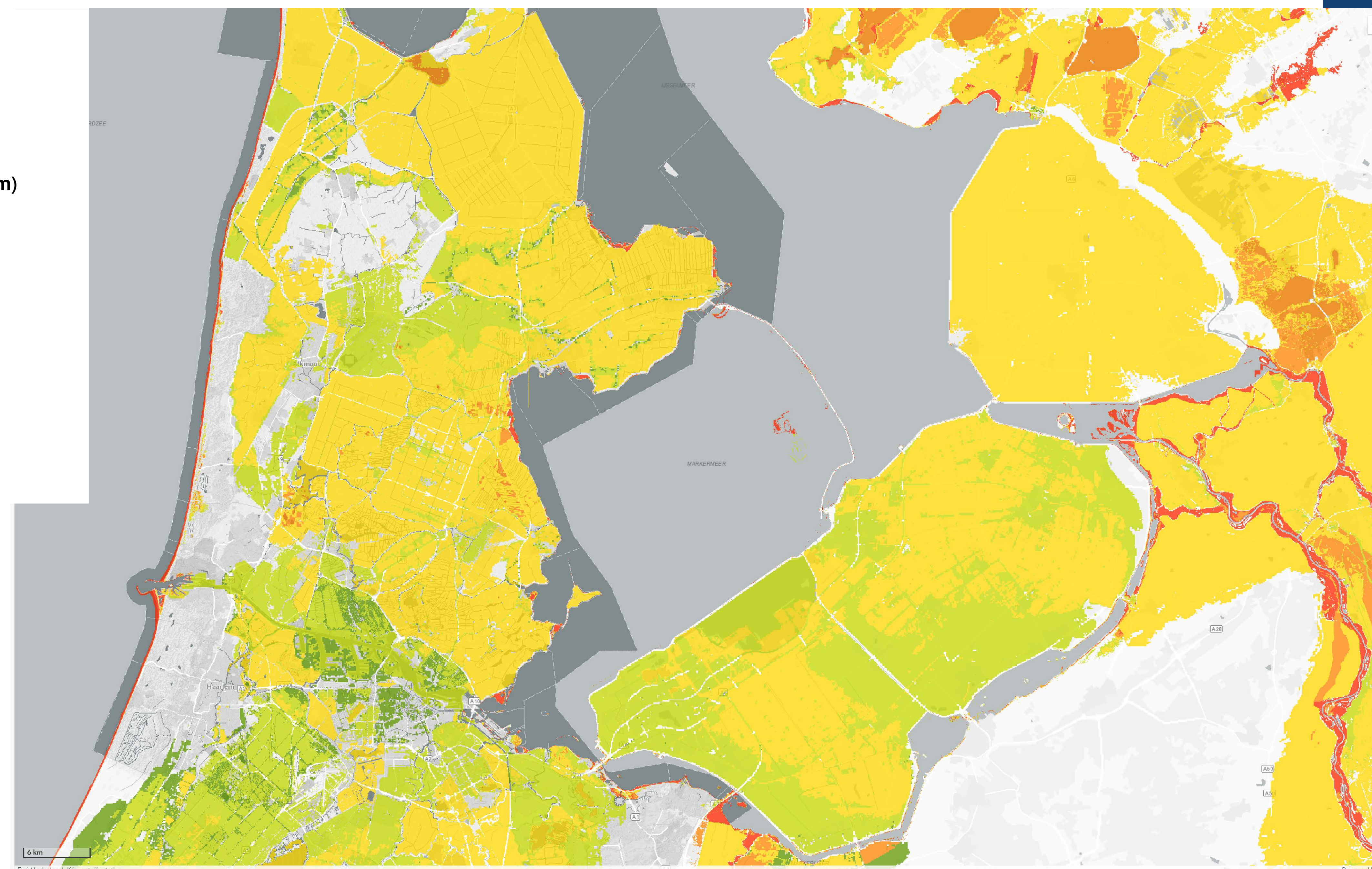
Legend

Climate Impact Atlas layers

Location-specific flood risk by 2050 (more than 20 cm)

Location-specific flood risk by 2050 (20 cm)

- Extremely small chance <1/30.000 per year
- Very small chance 1/3.000 – 1/30.000 per year
- Small chance 1/300 – 1/3.000 per year
- Medium chance 1/30 – 1/300 per year
- High chance >1/30 per year





other major transitions in the spatial domain, like the energy transition. The Heritage for the Future programme demonstrates how the Ministry of Education, Culture and Science will go about this in practical terms.

4 *Acceptance of residual risks*

Not all risks can be mitigated through measures, so we must also look at ways for heritage sites to “move with” the changes. Innovation and the creation of new landscapes can go hand in hand with preservation of the past. Heritage professionals as well as designers and the creative sector can be encouraged to offer inspiration and solutions that are in harmony with the experiential value and identity of a site. The [Heritage Deal](#) programme (website only available in Dutch) has shown through a few successful pilot projects that heritage professionals and designers can play a part in the implementation of climate adaptation measures. One example is the utilisation of the military defence structure [Hoorwerk at the Grebbe Dike](#). Originally built in compliance with the dike height requirements at that time, it is now being restored and will eventually be used for defence purposes again, only now against the threat of high water levels.

Cultural-historical knowledge as an opportunity for climate adaptation

Cultural-historical knowledge about natural systems and how these were used by past generations can provide solutions for climate adaptation. Old water and soil systems can be restored and redeployed to combat the effects of climate change. A beautiful example of this is the [Baakse Beek](#) project (webpage only available in Dutch). This area is very vulnerable to drought and prone to severe peak rainfalls in certain locations. Old water structures in and around several country estates were reconnected to form a resilient water system that can be adapted to changing weather conditions. This replenishes the groundwater supply and it combats drought.



6.3

Well-protected cultural heritage



Looking ahead to the next few years

Action	Explanation	Initiator*, partners	Schedule
Heritage as inspiration and solution for spatial challenges, including climate adaptation <i>Heritage Deal</i>	In the Heritage Deal, different parties make agreements about the preservation and use of heritage sites in major current spatial challenges. One of these challenges is climate adaptation.	Ministry of Education, Culture and Science*, parties that are working together within the Heritage Deal.	Next round: 2023-2025
Research on the risks of climate change on cultural heritage sites <i>Knowledge Programme on Navigating Towards a Climate-Proof Netherlands</i>	The knowledge programme of the Netherlands Environmental Assessment Agency was established within the framework of the National Climate Adaptation Strategy (NAS), and its research topic is cultural heritage. The contribution of the Ministry of Education, Culture and Science consists of the implementation of variant 1: “One-time analysis of current and future climate risks on the basis of several scenarios, and exploration of adaptation strategies.”	Netherlands Environmental Assessment Agency*, the Ministry of Education, Culture and Science, the Cultural Heritage Agency	2023-2026
Insight into the development and condition of Dutch cultural heritage sites <i>Heritage Monitor</i>	The Heritage Monitor provides insight into the protection and adaptation of heritage sites to climate risks and brings this topic to the attention of municipalities. A fixed set of indicators related to archaeology, architectural monuments, historic landscapes and museums and collections is used at set intervals for monitoring purposes.	Ministry of Education, Culture and Science, the Cultural Heritage Agency	Ongoing
Connect heritage sites to transition challenges and stimulate cooperation between public authorities and the heritage sector. <i>Heritage for the Future programme</i>	This programme is focused on challenges pertaining to cultural heritage sites in light of modern-day transitions (climate adaptation, sustainability and urbanization). This is done, for example, by supporting and promoting the creation of awareness among municipalities, provinces and the heritage sector.	Ministry of Education, Culture and Science	2023-2025
Insight into risks for cultural heritage in charts <i>Heritage, Water and Climate programme</i>	Charts (only available in Dutch) are used to determine whether a cultural heritage site is located in an area with a higher risk of flooding, drought or subsidence. The charts also show whether climate-adaptive measures are being taken in that area that could potentially pose a risk (such as dike reinforcements).	Ministry of Education, Culture and Science, the Cultural Heritage Agency	2023-2025
Awareness campaign and courses on climate change and cultural heritage <i>Heritage, Water and Climate programme</i>	The aim of the programme is to increase awareness about the effects of climate change on cultural heritage sites and about measures that need to be taken and the importance of timely involvement on the part of the heritage sector.	Ministry of Education, Culture and Science, the Cultural Heritage Agency	2023-2025



What is still needed?

Priority	Explanation
<p>Establish operational goals for protecting cultural heritage sites</p> <p>NAS Evaluation</p>	<p>The focus on the risks of climate change for cultural heritage sites is a relatively new development. No operational goals have been established yet to protect these sites. The value of our cultural heritage is difficult to quantify; the Cultural Heritage Agency has therefore been commissioned by the Ministry of Education, Culture and Science to explore ways to formulate qualitative operational goals.</p>
<p>Timely inclusion of cultural heritage sites in the approach to spatial climate-adaptation challenges</p> <p>Heritage Policy Review and OMC report: Strengthening cultural heritage resilience for climate change (OMC stands for: Open Method of Coordination, a working group of experts from EU member states)</p>	<p>The heritage sector sometimes gets involved too late or to an insufficient extent in climate adaptation measures in the spatial domain. The timely inclusion of heritage concerns and knowledge of how they dealt with too much or too little water in the past can provide solutions for today's challenges. For example, old systems can be utilised to store water, improve water quality and biodiversity and reduce heat stress in the cities. It is important for the various public authorities, district water boards and the heritage sector to start working together more.</p>
<p>Threats to cultural heritage in the Caribbean Netherlands due to climate change</p> <p>Recommendation from the Bonaire Climate Table (only available in Dutch)</p>	<p>Rising sea levels may cause the Salinas (lower-elevation, mostly uninhabited parts of Bonaire) to be submerged by 2050. This early-risk area contains buildings and symbols of significant cultural value, like the slave huts. By 2150 the built areas, like the capital Kralendijk and the Belnem neighbourhood, will be at risk as well. This signal will also be included in the climate plan approach for the Caribbean Netherlands.</p>

7 Domain IV

Living and working





Challenge 7.1 Green climate-adaptive new construction

The challenge

The plan is to build 900,000 new houses by the end of 2030. Some of the houses will be located in vulnerable parts of the country that are at risk of flooding and/or subsidence. Climate change increases this risk of these conditions and others such as drought; new construction developments must be resilient to such events. Of course the location of the new construction is important, but so are the spatial organisation of the area and the way these homes are constructed. For example, part of the planning area could be set aside for water storage, and a choice could be made to build primarily on the most secure ground. When building in existing neighbourhoods, it is important to make sure that the pavements and the buildings are higher than the street. This will limit potential damage during extreme rainfall and the buildings will remain accessible. The Caribbean Netherlands will also have to make choices based on the specific local circumstances. Thinking about and investing in climate adaptation will help to be better prepared for the effects,

so we can live and work in a safe, healthy, green environment, both now and in the future.

The approach

Making smart choices in spatial planning can go a long way towards preventing damage and additional costs as a result of climate change.

1 Choice of location

Locations that are not smart choices for construction include river basins, which are at risk of flooding, and sites along primary water defences, which should undeveloped to ensure water safety¹⁴. Other than these areas, construction is safe in most places in the Netherlands under certain conditions. The Ministry of Infrastructure and Water Management and the Ministry of the Interior and Kingdom Relations worked with other public authorities to develop a [draft assessment framework](#) to provide clearer guidelines in this matter. This framework will help provinces, municipalities and district water boards to make well-informed decisions about where to build and where not to build in light of the water and soil system, the availability of drinking water and the risk of flooding and subsidence. The starting principle is that the costs must remain managea-

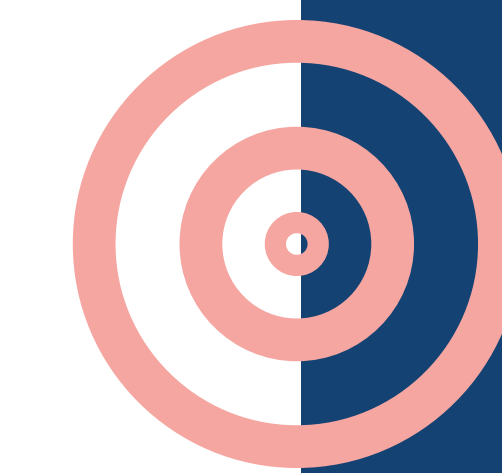
¹⁴ See also the Water and Soil as Guiding Principles, which is referred to several times in Domain I – Water.



ble in the long term as well and that they should not be passed on to the public or to future generations. When considering new developments we should therefore not just look at the development costs but also at future management costs.

2 Spatial planning

Besides choosing a good location, it is important for the spatial organisation of the site to be green and climate-adaptive. The [National Benchmark for a green, climate-adaptive built environment](#) (only available in Dutch) explains what this means. This type of planning includes goals, standards and guidelines for drought, heat, biodiversity, subsidence, pluvial flooding and



Spotlight

A sustainable community centre in a green zone

The dilapidated community centre De Hobbit in Arnhem has been a public nuisance and a threat to public safety for many years. This is why an entirely new building will be constructed with a community centre and a gym. The local residents and nearby schools have been asking for a new gym for years, because the old one is dated and run down. Twelve low-income apartments will be built above the community centre.



The new building will be a sustainable meeting place for the neighbourhood. It does not use gas and it will have central heating. The area around it will be a green zone with walkways and trees. It will also include a water storage facility to provide cooling during the heat of summer.

artistimpression: opZoom architecten



flood mitigation. The benchmark provides a national frame of reference, but it does not prescribe measures. This means that the public authorities are free to work with developers to determine what measures should be taken in an area or project. This leaves room for innovation and smart, market-driven solutions.

3 *Construction method*

Housing developments can incorporate climate-adaptive measures, for example by factoring in the position of the sun, installing shade structures and using green façades to combat heat stress. Green, blue or white roofs are an option as well. A green roof is a roof that is covered with moss, flowers, trees and/or grass. Blue roofs are designed to collect as much water as possible. A white roof reflects sunlight, which lowers the temperature of the building. Another way to take climate change into account is to only build temporary structures in sensitive and vulnerable areas. Also, any measures that are taken should not lead to new problems: for example, newly planted vegetation should not increase the risk of fire or cause more allergies. Municipal Health Services and the Safety Region will be able to give advice.



Looking ahead to the next few years

Action	Explanation	Initiator*, partners	Schedule
<p>National approach to climate adaptation in the built environment</p> <p><i>National Approach to Climate Adaptation in the Built Environment Phase 1</i></p>	<p>In the National Approach to Climate Adaptation in the Built Environment the Government provides an overview of all activities in the area of climate adaptation in the built environment. Phase 1 runs from 2022 to the end of 2024, and during this period the Government will work together with other public authorities and other stakeholders. There will also be further exploration of what else is needed for a more systemic approach during the next phase (2025-2030).</p>	<p>Ministry of Infrastructure and Water Management, the Ministry of the Interior and Kingdom Relations* and the Ministry of Agriculture, Fisheries, Food Security and Nature</p>	<p>2022-2024</p>
<p>Spatial assessment framework for a climate-adaptive built environment</p> <p><i>Water and Soil as Guiding Principles</i></p>	<p>The draft of the spatial assessment framework for a climate-adaptive built environment provides direction in terms of where to build in light of specific local risks related to the water and soil system.</p>	<p>Ministry of Infrastructure and Water Management* and the Ministry of the Interior and Kingdom Relations</p>	<p>2023</p>
<p>Legal and financial exploration for the benchmark and gathering of signals based on practical experiences</p> <p><i>National Benchmark for a green, climate-adaptive built environment</i></p>	<p>The National Benchmark for a green, climate-adaptive built environment provides goals, standards and guidelines for climate-adaptive development. They offer a guideline for public authorities, housing associations and construction parties such as project developers. The Government is working on a legal exploration of how the benchmark can be embedded in legislation and a financial exploration for the implementation of the benchmark. It is also gathering practical experiences.</p>	<p>Ministry of Infrastructure and Water Management, the Ministry of the Interior and Kingdom Relations*, the Ministry of Agriculture, Fisheries, Food Security and Nature, Provinces, District Water Boards</p>	<p>2023-2024</p>
<p>Field lab for innovation of construction-specific measures</p> <p><i>The Green Village</i></p>	<p>This field lab was designed to promote the development of knowledge and new applications for construction-related climate adaptation in the Netherlands. It provides opportunities for science, business and the public sector to come together to experiment and share knowledge.</p>	<p>Ministry of the Interior and Kingdom Relations*, Green Village, Innovation Programme VPdelta+</p>	<p>2022-2025</p>



What is still needed?

Priority	Explanation
<p>Make it standard practice to include climate adaptation in policy objectives for spatial planning, housing construction and the energy transition.</p> <p><i>National Approach to Climate Adaptation in the Built Environment Phase 1</i></p>	<p>Climate adaptation is not a standard consideration yet in spatial planning, housing construction and sustainability plans for the built environment. Effective “spatial adaptation” may be the solution, also for spatial puzzles and housing construction targets. Introduction of the National Benchmark for a green, climate-adaptive built environment may support this process.</p>
<p>Norms and standards for climate adaptation</p> <p>Progress report on Delta Programme on Spatial Adaptation for 2022</p>	<p>Provinces, municipalities and district water boards need uniform standards for measures in the area of climate adaptation. A national base level for climate adaptation (when is which measure the best solution and which quality standard is appropriate in that context) may simplify the work of local and regional authorities.</p>



Challenge 7.2 Climate-resilient housing for all

The challenge

Climate change makes it more difficult to make the built environment future-proof. Its impact on buildings is only increasing: damage caused by extreme weather is becoming more and more common. It's not just new construction that must be more climate-adaptive ([see "Green climate-adaptive new developments"](#)), it also applies to the existing built environment. The latter is often a more complex proposition, because the building is already there and the public space around it is already in use. There is less room for possible solutions, so it requires custom work.

The challenge "Climate-resilient housing for all" is about preventing and repairing damage (including damage to foundations) to houses, buildings and the immediate surroundings as a result of climate change. One example is water damage ([see "Sponge cities"](#)) in houses and basements. Another example is damage to buildings due to heat ([see "Heat-resilient cities"](#)): temperature differences between the interior and exterior of a building can cause thermal cracking in glass. This is an issue in the Caribbean Netherlands as well; any measures that are taken should be based on local circumstances.

Anyone can be affected by damage caused by extreme weather: rich and poor, home owners and renters, residents of rural areas and city dwellers. When it comes to existing homes, the effects are felt most by homeowners and homeowner associations with few financial or organisational resources to invest in their homes. Renters are affected as well, because they are dependent on the willingness of a housing association or commercial landlord to take action. Sometimes the location of a home increases the risk. Conclusion: the specific circumstances determine how resilient a resident will be against climate effects. The gap between different circumstances only seems to get wider over time: more research on and insight into climate justice will enable us to provide more effective and timely help to vulnerable areas and residents and narrow that gap.

Damage to foundations

The condition of the foundation of a home is primarily a structural question, but it can be affected by external factors as well. Subsidence and climate change can accelerate or exacerbate damage to building foundations. Homes that were built before 1970 are particularly at risk; newer homes are often built on better foundations. Foundation damage also affects architectural monuments and historic city centres. The total damage to wooden foundations is expected to range from 5 to 39 billion euros by 2050 if the climate stays as it is. We're talking



about pile rot (caused by low groundwater levels) and differential settlement of buildings with steel foundations (shallow foundation) If climate change leads to more drought, the damage to the foundations can go up even further by 3 to 15 billion euros. Deltares [estimates](#) that about 80,000 homes will have to undergo significant repairs (document only available in Dutch).

The approach

The government has various measures at its disposal to make climate-proof living accessible to everyone. These are: (1) Promote the development of knowledge and education about damage due to climate change and about foundation problems; (2) provide financial and process-based support; (3) link climate risks to social factors to find out which areas or residents are most vulnerable. The government can also take measures at the regional level to promote climate-proof spatial planning for public spaces; this is addressed in the challenges “[Sponge cities](#)”, “Heat-resilient cities” and “Green climate-adaptive new developments”.

1 Knowledge development and education

It is important for professionals and home owners to be able to find information about possible climate risks and measures they can take to make their homes climate-proof. The central government supports municipal officials, housing association

professionals and other real estate owners through knowledge and innovations in the area of climate adaptation. They can stay informed via the [Netherlands Climate Adaptation Knowledge Portal](#). The Delta Programme on Spatial Adaptation (DPRA) shares knowledge and products to support other public authorities and regions.

There are various websites for residents that address climate adaptation, such as the [Climate Effect Atlas](#), the chart on [overstroomik.nl](#) and the information on [Milieu Centraal](#) (only available in Dutch). In addition, there are three large annual [nation-wide campaigns](#) (website only available in Dutch) to help people green their garden or balcony, including NK Tegelwippen (national tile removal championship), and there are local neighbourhood and community initiatives for water collection and greening.

Foundations

The [National Approach to Foundation Problems \(NAF\)](#) is a joint initiative between the Ministry of the Interior and Kingdom Relations, the Netherlands Enterprise Agency (RVO) and various other parties to improve knowledge about foundation problems in the Netherlands and to come up with a better approach. RVO focuses primarily on municipal officials and housing association professionals. A few municipalities have their own foundation help desk. Residents can also contact the [Knowledge](#)



[Centre on the Approach to Foundation Problems \(KCAF\)](#) (website only available in Dutch) and the [Knowledge Centre on Subsidence and Foundations \(KBF\)](#) (website only available in Dutch) for general information and to submit notifications.

Efforts are also being made to develop ways to provide better information about foundation risks for home buyers who are looking to buy a home. This so-called Independent Network for the provision of information about foundations during house transactions is run by the Knowledge Centre on Subsidence and Foundations in cooperation with RVO and the National Approach to Foundation Problems. There are also several other initiatives, from the financial sector as well, to improve the knowledge position of buyers by providing information about climate risks and foundations.

2 Financial and process-based support

Residents can apply for a subsidy from the municipality or the district water board to install a green roof or a rain barrel or to green their own property. The municipalities of Nieuwegein and Rotterdam ([see Spotlight](#)) introduced a specific subsidy for shade structures intended to prevent extreme heat in buildings.

Foundations

The [Sustainable Foundation Repair Fund](#) (Fonds Duurzaam Funderingsherstel (FDF), website only available in Dutch) offers loans to homeowners with foundation problems who cannot get a loan from their own bank for repairs. The Sustainable Foundation Repair Fund offers equity loans with modified conditions and income-based payments. One important condition for municipalities that are registered with the Sustainable Foundation Repair Fund is that they must support homeowners by guiding them through the process. Only five municipalities are registered with the Sustainable Foundation Repair Fund so far; we are investigating whether this fund can be made available nationwide.

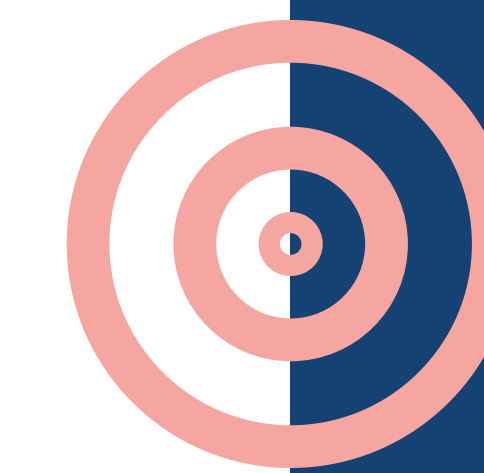
3 Gain insight into distribution effects and social vulnerability

The evaluation of the National Climate Adaptation Strategy (NAS) states that more attention needs to be paid to the effects of climate change and climate adaptation on people, including social and cultural aspects. This is related to the report from the The Netherlands Scientific Council for Government Policy, published in February 2023, on justice in climate change policy. The Netherlands Scientific Council for Government Policy argues that climate policies must systematically pay attention to fair distribution of costs. The report lists several ways to distribute the cost of climate policies, such as raising dikes or making



7.2

cities heat-resilient, across different segments of society. It is important for the central government to gain more insight into these “distribution effects”. The Climate Effect Atlas offers a first impression of the vulnerability of areas in the Netherlands to flooding, heat and drought; this atlas can be accessed by anyone online. This is followed by a social vulnerability chart for heat, which links social-economic factors to the most heat-sensitive areas.



Spotlight

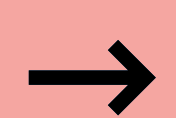
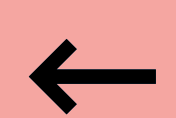
Residents take action

Since 1 July 2023, Rotterdam residents can apply for a subsidy for climate-adaptive measures. These measures include greening of gardens and roof terraces, collection of rainwater, disconnecting the rain pipe from the sewage system, and heat measures such as shade structures and ventilation.



Photo: www.klimaatadaptievebeelden.nl

The municipality of Rotterdam hopes to reach all kinds of different groups with this subsidy programme. Homeowners, renters, homeowners associations, neighbourhood associations and foundations are all eligible to apply. The municipality has stated that these parties must take the initiative themselves because 60 percent of the city is privately owned.





Looking ahead to the next few years

Action	Explanation	Initiator*, partners	Schedule
<p>Knowledge and recommendations for local approach to foundation damage.</p> <p><i>National Approach to Foundation Problems</i></p>	<p>The central government supports municipal officials, housing association professionals and other real estate owners by providing knowledge. The Ministry of the Interior and Kingdom Relations is the commissioning authority, while the Netherlands Enterprise Agency (RVO) is responsible for implementing the programme.</p>	<p>Ministry of the Interior and Kingdom Relations*, the Netherlands Enterprise Agency (RVO), Ministry of Agriculture, Fisheries, Food Security and Nature, Ministry of Infrastructure and Water Management, the Association of Netherlands Municipalities, The Association of Provincial Authorities and the Dutch Water Authorities</p>	<p>2023-2025</p>
<p>Nationwide availability of the Fund for Sustainable Foundation Repair</p>	<p>The purpose of the Fund for Sustainable Foundation Repair is to grant loans to homeowners who urgently need to perform foundation repairs but have not been able to get a loan. Only five municipalities are currently registered. Changes to the fund are being considered so more municipalities can register.</p>	<p>Ministry of the Interior and Kingdom Relations*, the Dutch Municipal Housing Incentive Fund</p>	<p>2023-2024</p>
<p>Explore applicability of national benchmark to existing construction</p> <p><i>National Benchmark for a green, climate-adaptive built environment</i></p>	<p>The National Benchmark for a green, climate-adaptive built environment primarily focuses on new construction for now. But existing built environments will have to be climate-proof by 2050 as well. We will therefore explore how the benchmark can also be applied to existing built environments.</p>	<p>Ministry of the Interior and Kingdom Relations*, Ministry of Infrastructure and Water Management and Ministry of Agriculture, Fisheries, Food Security and Nature</p>	<p>2024-2025</p>
<p>Develop a Framework for Climate Adaptive Buildings</p> <p>National Approach to Climate Adaptation in the Built Environment Phase 1 (only available in Dutch)</p>	<p>The Dutch Green Building Council (DGBC), supported by the Ministry of Infrastructure and Water Management and the Ministry of the Interior and Kingdom Relations, is working on developing a Framework for Climate Adaptive Buildings. This framework provides a clear-cut way to present physical climate risks at the building level. The DGBC is working with a broad alliance of financial institutions, knowledge institutes, consultants and public authorities.</p>	<p>Ministry of Infrastructure and Water Management, Ministry of the Interior and Kingdom Relations, DGBC, financial institutions, knowledge institutes, consultants and public authorities</p>	<p>First version of the framework by 2023</p>
<p>Cooperation agenda for an inter-administrative approach to climate adaptation in the built environment.</p> <p><i>National Approach to Climate Adaptation in the Built Environment Phase 1</i></p>	<p>Participants in the National Approach are working on a cooperation agenda. The goal is to come up with an inter-administrative approach to climate adaptation in the built environment by 2050. Substantive and financial explorations are part of this process.</p>	<p>Ministry of the Interior and Kingdom Relations*, Ministry of Infrastructure and Water Management, Ministry of Agriculture, Fisheries, Food Security and Nature, the Association of Netherlands Municipalities, the Association of Provincial Authorities, the Association of Regional Water Authorities</p>	<p>2022-2024</p>
<p>Spatial Development Programme for the Caribbean Netherlands</p>	<p>The Spatial Development Programme for the Caribbean Netherlands provides an overview of the government policy and offers guidelines that can be used by the BES islands (Bonaire, Sint Eustatius and Saba) for their own spatial planning. Climate adaptation is a large part of the Spatial Development Programme.</p>	<p>Ministry of the Interior and Kingdom Relations</p>	<p>Adoption by the Fall of 2023</p>



What is still needed?

Priority	Explanation
Structural financing for climate adaptation in the built environment Progress report on Delta Programme on Spatial Adaptation for 2022	No structural financing is available yet for climate adaptation. At the national level, the Delta Fund was created to provide “incentive funds” for things like support programmes, pilot programmes and the temporary Incentive Scheme for Climate Adaptation. Due to the lack of structural financing, it is not always easy to turn climate adaptation activities into long-term projects.
Focus on and insight into the distribution effects of the impact of climate change and adaptation policy Report of the Netherlands Scientific Council for Government Policy on Justice in Climate Policy	The Netherlands Scientific Council for Government Policy (WRR) argues that climate policies must make systematic efforts to ensure that the distribution of costs is fair. It is important for the central government to gain more insight into the so-called “distribution effects” of climate change and climate adaptation policy. Specific attention needs to be paid to vulnerable groups in society.



Challenge 7.3 Green and healthy work landscapes

The challenge

“Work landscapes” is a collective term for business parks, industrial sites and the areas around office buildings. The effects of climate change on work landscapes in the Netherlands can be felt already. These landscapes are utilitarian, grey areas that are vulnerable to weather extremes. Rainwater can often freely flow into these areas, roads can get blocked, parking lots can get hot and machines can overheat. Heat stress leads to employee absenteeism and loss of productivity. Businesses suffer enormous turnover volume losses if they have to close down for a day, not to mention the cost of repair or consequences further down the production chain.

These commercial sites can be made more climate-adaptive to prevent damage and problems due to climate change. It will also look better, create a more pleasant environment and stimulate biodiversity. Climate-adaptive measures also promote operational reliability and sometimes there are immediate financial benefits as well. In other words, these measures also

contribute in a broader sense to a positive business climate for companies in the Netherlands.

The approach

The approach to making work landscapes more climate adaptive varies depending on the situation and the location; it will be different for a new development, for example, than for an existing commercial site. Although every work landscape is different, there are three components that are important for making these landscapes more climate-proof: (1) organisation; (2) measures; (3) financing for those measures.

1 Organisation

Measures in the area of climate adaptation are often not taken for individual buildings or lots but for entire areas as a whole. There is still only a limited sense of urgency on the part of business owners and the owners of the real estate; awareness and cooperation should therefore be a standard aspect of every action. The Government and local and regional authorities are increasingly working with various organisations¹⁵ to encourage and assist business owners and owners of commercial sites. Several parties are working together within the [Work Landscapes of the Future programme](#) (website only available

¹⁵ This includes organisations such as the Stichting Kennisalliantie Bedrijventerreinen Nederland [Knowledge Institute for Commercial Sites], the CLOK Foundation and various industry associations.



in English) to develop green, healthy, energy-efficient and climate-proof commercial sites. “Green Deals” will be developed with six provinces during the first year: these provinces commit to providing knowledge, capacity, networks, and co-financing. In 2024 they will begin to test innovations in select commercial sites. The programme will then be scaled up; the goal is to have at least a thousand commercial sites join the programme within ten years.

2 Measures

There are all kinds of measures that can be taken for climate adaptation in a work landscape; the choice depends on the spatial characteristics of a location, the economic and social context and the policies for spatial planning, use and management. There are basically three types of measures:

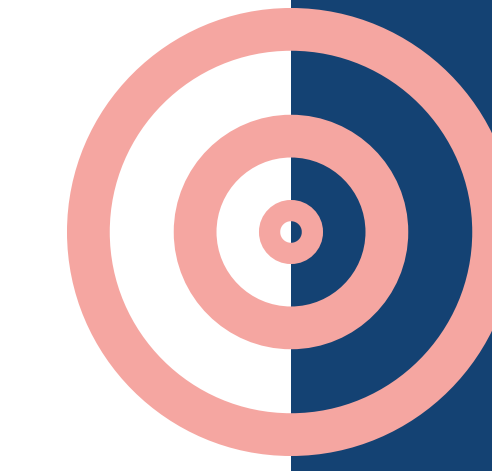
- a. Greening and depaving of the work landscape: an environment with a lot of greenery, water and permeable soil ([see the challenge “Sponge cities”](#)) ensures better runoff, provides cooling during hot periods, improves employee health and promotes biodiversity.
- b. Grey measures: Smart height differences and water collection features can make it easier to discharge and collect rainwater in a controlled manner during times of extreme precipitation. There are things that businesses can do themselves as well: they can opt for light-coloured roofs and façades to reduce

heating and they can disconnect rain pipes. If additional cooling mechanisms are needed, they can look for a combination of climate adaptation and energy efficiency.

- c. Usage and behaviour: company heat plans or emergency plans specify what needs to be done in case of extreme weather events, such as additional cooling and shade (during a period of heat) or modified work hours.

3 Financing these measures

Even though the benefits of climate-proofing work landscapes are obvious, it is often still difficult to find financing. This is because the parties that are asked to invest in climate adaptation are often not the ones who benefit directly. Project developers could invest in green roofs, for example, but it is mostly the property managers and businesses that lease the premises who will benefit. The benefits of preventing damage resulting from extreme rainfall are not experienced until much later. It is often helpful to prepare a broader social cost-benefit analysis (sCBA) in addition to a purely financial analysis. Investments in climate proofing can also be combined with sustainability measures. The Work Landscapes of the Future programme will issue vouchers once the Green Deals with the provinces are concluded. Commercial sites can use these vouchers to make purchases in support of their vision for sustainability. The programme will also investigate potential financing instruments.



Spotlight

Green, climate-adaptive business park

Work has started on a business park near Eindhoven Airport: [Flight Forum](#). All the activities there must contribute to a future-proof living environment that promotes social connections and will be liveable for future generations. Much of the paving on the site has been removed, so rain is better able to infiltrate the ground. The greenery consists of various native species that promote biodiversity.

An underground box system catches and stores rainwater. Trees and plants are able to draw water from these infiltration boxes during dry periods. The business park is a stone's throw away from Meerland Park and the Beatrix Canal, so people who work there can be in the middle of nature within ten minutes.



Looking ahead to the next few years

Action	Explanation	Initiator*, partners	Schedule
<p>Work Landscapes of the Future (Werklandschappen van de Toekomst)</p> <p><i>National Approach to Climate Adaptation in the Built Environment Phase 1</i></p>	<p>Work Landscapes of the Future focuses on knowledge development, innovation and communication for the transformation of existing commercial sites into green, healthy, energy-efficient and climate-proof work landscapes. Living labs and pilot projects (called “ambassador sites”) are used to develop knowledge and test innovations. This will hopefully lead to: business cases for making commercial sites sustainable and future-proof, public-private financing, more insight into the value of green, development of innovative solutions and a new approach on the part of the labour market to promote the green sector.</p>	<p>Ministry of the Interior and Kingdom Relations*, the Foundation for Work Landscapes of the Future</p>	<p>2023-2031</p>
<p>Accelerating the development of sustainable commercial sites</p> <p>Policy programme to accelerate the development of sustainable built environments</p>	<p>The programme for sustainability of commercial sites focuses on accelerating the development of sustainable commercial sites in the Netherlands. The programme guides business owners through the financing process and provides knowledge and networks to help parties make sustainability a reality. The focus of the programme is on energy transitions on these sites. The Work Landscapes for the Future programme seeks cooperation with other parties in the areas of greening and climate adaptation.</p>	<p>Ministry of the Interior and Kingdom Relations*, the TKI Urban Energy Foundation</p>	<p>2022-2027</p>
<p>Working group on blue-green commercial sites</p> <p><i>Climate-Proof Together</i></p>	<p>The community of blue-green commercial sites of the Climate-Proof Together platform focuses on the acceleration and expansion of climate-adaptive measures and the planting of greenery primarily on existing commercial sites. It does this by seeking out input on these issues and putting them on the agenda, making knowledge available and applying it to real-life situations.</p>	<p>Climate-Proof Together Platform, Ministry of Infrastructure and Water Management, Ministry of the Interior and Kingdom Relations, Stichting Kennisalliantie Bedrijventerreinen [knowledge institutes for commercial sites] in the Netherlands</p>	<p>2019-2025</p>
<p>Legal and financial exploration for the benchmark and gathering of signals based on practical experiences</p> <p><i>National Benchmark for a green, climate-adaptive built environment</i></p>	<p>The National Benchmark for a green, climate-adaptive built environment (only available in Dutch) provides goals, standards and guidelines for climate-adaptive construction. These are designed to support parties involved in the construction of new work landscapes. The benchmark programme can also be used to share practical experiences. The Government is investigating how the measure can be incorporated in legislation, and it is working on a financial exploration for the implementation of the benchmark. The benchmark can also be used for the development of new work landscapes.</p>	<p>Ministry of Infrastructure and Water Management, Ministry of the Interior and Kingdom Relations*, Ministry of Agriculture, Fisheries, Food Security and Nature, Municipalities, Provinces and District Water Boards</p>	<p>2023-2024</p>



What is still needed?

Priority	Explanation
Research on effective protection of employees against heat <i>Platform for the Climate-Proof Together Community for blue-green commercial sites</i>	Not much is known yet on how to protect employees against heat. The Climate-Proof Together platform is working on an initial exploration with the province of Utrecht in 2023. The purpose of this exploration is to find out what effective protection might look like and how this could be implemented, for example through health & safety regulations or a mandatory company heat plan.
Research on effective protection of production and transport in extreme weather <i>Platform for the Climate-Proof Together Community for blue-green commercial sites</i>	Not much is known yet about effective protection of production and transport in extreme weather. An exploration of the use of company emergency plans is a possibility.



Challenge 7.4 Strong, resilient infrastructure

The challenge

Climate change leads to more extreme weather and more frequent (and more severe) natural disasters. This is increasingly becoming a threat to important infrastructure and processes in the Netherlands. Infrastructure includes the roads, railways, waterways, airports and seaports that we consider important to the economy and social welfare. Some of these are classified as essential. Examples of essential processes are electricity distribution, access to financial transactions and healthcare (e.g. hospitals). Failure, interruption or manipulation of these processes can lead to severe social disruption.

Flooding or other extreme weather events may cause these systems to fail, which in turn may lead to cascade effects. Cascade effects are climate effects that spill over from one sector to the next. Failure or disruption can cause a lot of damage and lead to major crisis management problems: digital communication and available roads are crucial for evacuation, for example. This is why it is important to get a clear picture of potential scenarios that might occur and what this means for design specifications, risk management and the management and maintenance of the abovementioned infrastructure.

The approach

Municipalities, district water boards, provinces and the Government have jointly stated their ambition within the framework of the 2015 Delta Decision on Spatial Adaptation to make the Netherlands climate-proof and water-resilient by 2050. They will partner with the (private) managers of essential infrastructure and safety regions to work during the next few years on measures to minimise damage due to heat, flooding and drought. They will take climate change into account wherever possible, for example in the construction of new residential developments, the replacement of sewer systems and the construction and maintenance of transport networks. They will use the knowledge and information from the Delta Programme on the impact of climate risks on essential and vulnerable functions. However, it will take more to make the infrastructure climate-proof in this changing climate.

The effect of climate change on national security is increasingly becoming a topic of concern in the Netherlands. The 2022 [Government-Wide National Security Risk Analysis](#) specifically addressed the issue of climate and natural disasters and their impact on essential processes. The [Security Strategy for the Kingdom of the Netherlands](#) also stresses the importance of climate adaptation and the risk of cascade effects.



Climate-proof networks

(Ministry of Infrastructure and Water Management)

The Delta Decision on Spatial Adaptation (see above) is described in the Delta Plan for Spatial Adaptation (DPRA) as a six-year cyclical process. This process consists of three steps: perform a stress test, engage in a risk dialogue and develop an implementation agenda. The Ministry of Infrastructure and Water Management adopted this process for the climate-proofing of the networks managed by Rijkswaterstaat. The first [Implementation Agenda for Climate-Proof Networks from 2022](#) describes the steps that will be taken by the Ministry of Infrastructure and Water Management over the next few years to make the main waterway network ([see Challenge 7.5 Waterways](#)) that can adapt to heat and to high and low water levels), the main water system and the main road network more climate-proof. A new round of stress tests is scheduled for 2024/2025. The results must be incorporated in a new version of the implementation agenda by 2026. ProRail and the Ministry of Infrastructure and Water Management have prepared a separate [implementation agenda](#) for climate-proofing the main railway infrastructure.

Climate-proofing essential processes

Besides the networks managed by the Ministry of Infrastructure and Water Management, there are other essential processes in the Netherlands (e.g. distribution of gas and electricity)

that are managed by other parties who are responsible for climate-proofing their networks. These are mostly private parties, who primarily follow the so-called “[Approach to Essential Processes](#)”. This is a plan that is designed to help the government protect essential processes and related networks in the Netherlands more effectively. It takes into account the increasing risk of climate and natural disasters. The Government is working with other public authorities, businesses, organisations and information and security services. The aim of the Approach to Essential Processes is to assess the various risks in relation to one another. This means, first of all, that the parties do not just look at physical risks, such as direct damage to essential processes, but also at economic and digital risks such as disruptions caused by cyber attacks. Second, they do not just look at the impact of a failure, disruption or manipulation of a process on the security of the Netherlands but also at the impact on European security. Essential processes are often international in scope and risks do not stop at the border. Third, they will focus more on cross-sector risks and potential cascade effects. The Approach to Essential Processes takes spatial planning into account, including Water and Soil as Guiding Principles and the climate-proofing of the Netherlands.

The Approach to Essential Processes points out the rights and obligations of all providers of essential services. This includes



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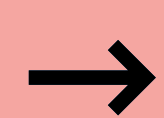
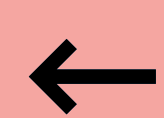
companies, independent administrative bodies and parts of the central government that are responsible for the continuity and resilience of a vital process. These rights and obligations are set out in laws and regulations. Two European directives were adopted and published in 2022: the Network and Information Security Directive (the NIS2 Directive) and the Critical Entities Resilience Directive (the CER Directive). These directives provide a legal framework for the reinforcement and protection of the resilience of essential (and other) processes. They are expected to be implemented in Dutch laws and regulations in 2025.

Some providers of essential processes need to increase their awareness of the potential risks of climate change on their processes. At least every four years, the responsible Ministry performs a resilience analysis and conducts an action programme for all essential processes. This is a way to pay more attention to the effects of climate change and an opportunity to work with the sector to develop concrete actions, which in turn will hopefully lead to standards, instructions or guides. The knowledge and experience gained from the Delta Programme about the impact of climate risks on essential infrastructure provides an important foundation. More knowledge is needed about the presence of essential providers in a particular region and the level of vulnerability. There are some regions that are establishing for the first time, as a result of the DPRA programme, what

is meant by “vulnerable”. This needs to be done nationwide, to prevent the development of conflicting definitions, categories, standards and evacuation strategies.

Cascade effects

Essential processes are often interrelated, which means that failures caused by extreme weather can lead to cascade effects. This insight leads to the question: what else might fail if something happens in one location? How will this impact other regions in the Netherlands and beyond? For example, power outages in a flooded area may also lead to internet connection problems and pumps that don't work in the absence of back-up generators. The supply of several types of energy depends on the availability of (cooling) water. This energy supply is crucial to keep hospitals, businesses and homes running. Problems in mobility networks, whether by land or by water, can make traffic come to a standstill in the event of a disaster. Although partial analyses have been performed of this chain dependence, we do not have an overall picture yet. This is why it is important to perform integrated analyses using the knowledge of essential providers and combining it with our knowledge of climate risks.



Looking ahead to the next few years

Action	Explanation	Initiator*, partners	Schedule
<p>Increased focus on the protection of essential infrastructure</p> <p><i>Approach to essential processes</i></p>	<p>The essential processes cycle will be completed on a regular basis for each essential process. This includes a vital process assessment, a resilience analysis and an action programme. These can be used by the Government and essential process providers to identify risks and take measures to increase and protect resilience. They will also look at physical risks such as wildfires, extreme weather and flooding. During the next few years efforts will be made, in part on the basis of new European legislation, to increase the physical resilience of our essential infrastructure. There will also be a greater focus on climate adaptation. This is in line with the direction of the Security Strategy for the Kingdom of the Netherlands with regard to improved protection of essential infrastructure.</p>	<p>Ministry of Justice and Security (Approach to Essential Processes Coordinator)* National Counterterrorism and Security Coordinator Ministries have systemic responsibility for the processes within their own policy area.</p>	<p>2023-2028 Implementation of CER and NIS2 directives by the end of 2024</p>
<p>Implementation of recommendations from the Policy Forum on Pluvial Flooding and High Water</p> <p><i>Final recommendation from the Policy Forum on Pluvial Flooding and High Water</i></p>	<p>The recommendations from the Policy Forum on Pluvial Flooding and High Water are aimed at making the Netherlands more resilient and minimising the effects of extreme weather. Some of the recommendations pertain to essential objects in relation to high water and extreme precipitation. One recommendation is about “standards for the mitigation of effects on essential objects”; another one is about including climate risks (extreme precipitation) in the risk and asset management of essential providers.</p>	<p>Ministry of Infrastructure and Water Management</p>	<p>2023-2025</p>
<p>Development of policy objectives for climate adaptation of main roads, main waterways, main water systems and railways</p> <p><i>Climate-Proof Networks Programme</i></p>	<p>Policy objectives are being developed for climate adaptation. These objectives will make it possible to prioritise management, maintenance, replacement and renovation projects that do more to take climate proofing into account.</p>	<p>Ministry of Infrastructure and Water Management Rijkswaterstaat ProRail</p>	<p>2024</p>
<p>Update stress tests for the main water system, main road network, main waterway network and railway network, resulting in an updated implementation agenda</p> <p><i>Climate-Proof Networks Programme</i></p>	<p>ProRail and Rijkswaterstaat have performed stress tests for the networks for which they are responsible. Follow-up studies will be done as necessary to update these networks, based for example on the KNMI’23 scenarios.</p>	<p>Ministry of Infrastructure and Water Management* Rijkswaterstaat ProRail</p>	<p>2026</p>
<p>Quick scan of the relationship between climate mitigation (in particular the energy infrastructure) and climate adaptation</p> <p><i>Quick scan of mitigation-adaptation</i></p>	<p>Performing a quick scan (brief investigation) to shed light on opportunities for combined action and potential conflicts between climate adaptation and mitigation. For example, climate adaptation measures may have the unintended side effect of increased energy use, or mitigation measures may not take heat, drought or flooding into account to a sufficient extent. Looking at these two climate dossiers in relation to each other will help us take advantage of opportunities and protect against risk more effectively.</p>	<p>Ministry of Infrastructure and Water Management, Ministry of Economic Affairs and Climate Policy</p>	<p>2023</p>

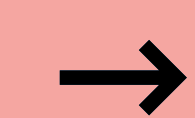




7.4

What is still needed?

Priority	Explanation
Overview of cascade effects on (essential) infrastructure National Climate Risk Analysis 2022-2026	We do not have an overall picture yet of the potential cascade effects of extreme weather events. The NCTV is investigating how these effects can be mapped out.
Adaptation of standards and design guidelines for climate-proof infrastructure Climate-Proof Networks Implementation Agenda	The KNMI'23 climate scenarios can be used as a basis for the adaptation of standards and design guidelines.
Awareness of the risks of climate change on the part of essential providers Letter to the House of Representatives on increased focus on the protection of essential infrastructure (only available in Dutch)	Some parties are still not sufficiently aware of the potential risks of climate change on their essential processes. Risks and measures to minimise these risks could be included in instructions that can be used for “resilience analyses.” These are prepared by Ministries in cooperation with essential providers.
Overview of the presence and vulnerability of essential providers in emergency response Progress report on Delta Programme on Spatial Adaptation for 2022	We don't have a complete overview yet of all the essential providers in a particular region and what their vulnerabilities are. The information we have is often fragmented and the coordination between organisations is not optimal: for example, district water boards know about pluvial flooding, but expertise from other parties is needed to understand the effects of certain scenarios on telecom providers for instance. More insight and central direction is needed, for example to determine what should be prioritised in the event of a disaster.



Challenge 7.5 Waterways that can adapt to heat and to high and low water levels

The challenge

Climate change has a significant effect on river water levels. Inland shipping is responsible for 30 percent of the total transport of goods in the Netherlands, which is naturally very much dependent on the depth of the waterways. The mechanisms of locks and movable bridge parts can be affected by climate change as well. The most important symptoms and effects are:

- 1 **Drier conditions:** drought plus erosion of the soil results in shallower waters, forcing ships to carry less weight. One bottleneck can disrupt the entire corridor (network of waterways), since there are no full-fledged alternative shipping routes. Changes in navigable depth also lead to longer wait times at locks. This in turn leads to higher social costs within the inland shipping sector and the sectors that depend on it.
- 2 **Wetter conditions:** high water levels result in lower clearances under fixed bridges, which is a particular problem for container ships. Movable bridges will have to be raised more frequently as a result of high water, leading to longer wait times for shipping traffic and road and railway traffic.
- 3 **Hotter conditions:** Heat causes bridge and lock components to expand, resulting in tighter movement of the mechanisms.

Digital systems can fail as well, preventing bridges and locks from working properly or even causing damage.

- 4 **Indirect threats:** indirect threats are threats that may result from decisions to redirect a water course or store the water or to allow fewer ships to pass through locks to reduce the inflow of salt water. This is done to prepare for the effects of climate change such as low water and drought. These types of measures may have consequences for the shipping sector, for example if shipping restrictions are imposed.

All these effects of climate change may impede inland shipping. This may lead to delays on roads and railways or to disruptions of the logistics system; the effects of this would be felt throughout the Netherlands and the European hinterland. We expect that the above effects will become more frequent as the years go by.

The approach

Possible solutions will vary depending on the climate scenario, but two things are certain:

- Climate-adaptive measures must apply to the entire network of main waterways.
- Climate-adaptive measures are often very expensive. The question is always: do the costs outweigh the social and eco-



7.5

Waterways that can adapt to heat and to high and low water levels



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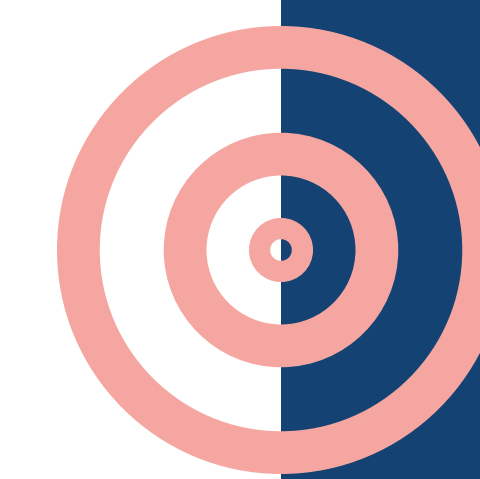
conomic damage resulting from the disruption of the waterway network?

1 Approach to a drier climate

There is not much point in fixing shallow waters on a case-by-case basis: the entire system must be dealt with to keep major rivers such as the Waal and the IJssel navigable. The logistics sector can anticipate climate adaptation through innovation. Possible innovations are ships with reduced draught, a varied fleet consisting of smaller and larger ships, “smart shipping” (extensive use of automation), contract and inventory management the digitisation of information and data management.

2 Approach to a wetter climate

Fixing clearance on a case-by case basis at the local level is complex and expensive. The benefits of raising the height of all bridges in a corridor are still too limited. The professional shipping sector has been looking for



Spotlight Weurt Locks System

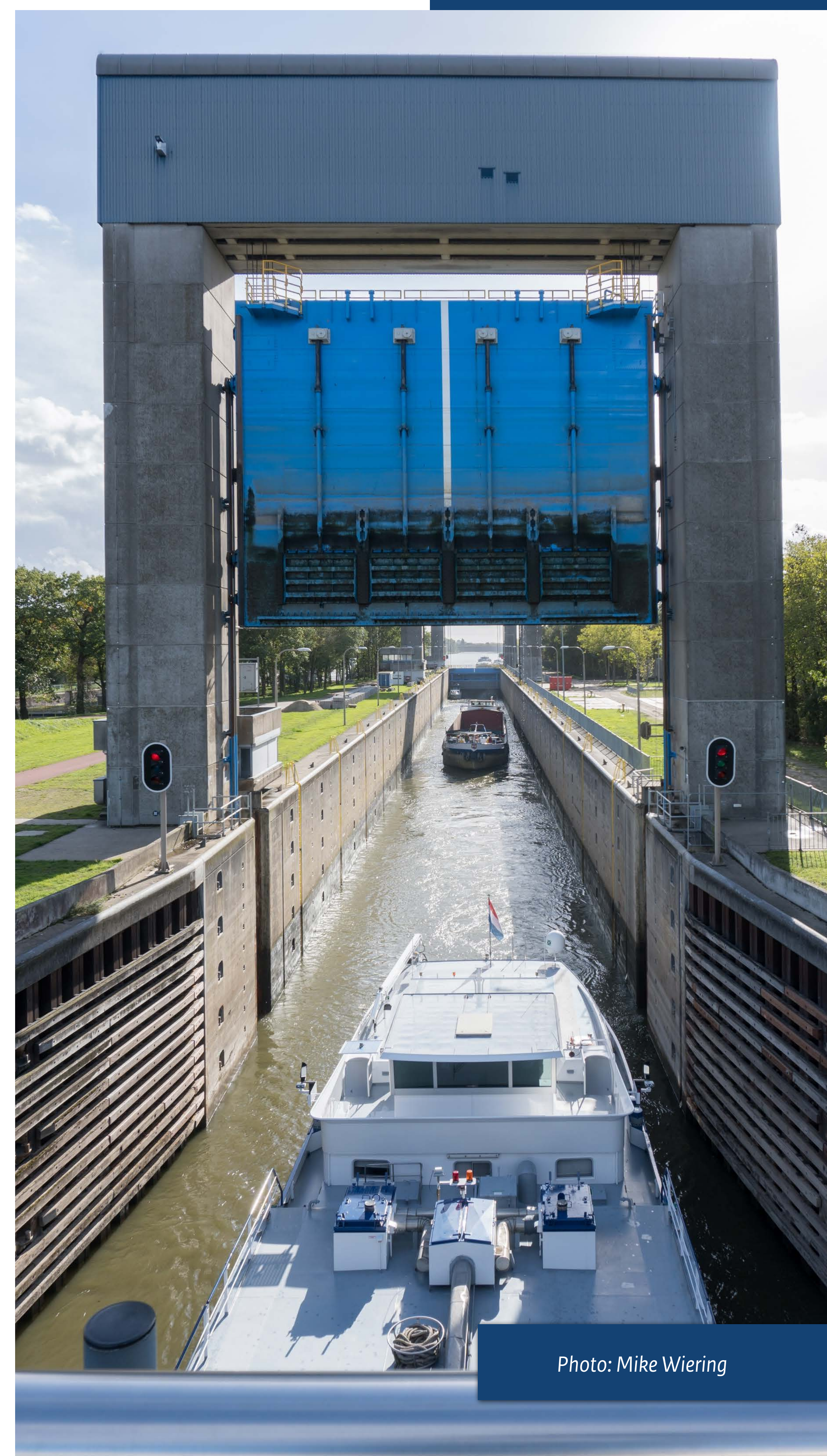


Photo: Mike Wiering

The Heumen and Weurt locks near Nijmegen connect the Maas and the Waal rivers for shipping traffic. They were built in 1927 and are due for a thorough renovation. The locks also need to be adapted to the new climate. These days, ships face obstacles during periods of drought, when the water levels in the Waal are very low. As a result, ships are unable to reach the Maas-Waal Canal and are forced to make a detour.

Parts of the locks will be replaced and other parts will be renovated. This will be done at the same time as the implementation of climate-adaptive measures like restoration of the river bed, which had sunk due to erosion. Cables at the bottom do not sink along with the riverbed, however, which makes things more difficult for ships in low water. Sufficient draught is important in lock repairs as well, to ensure that the locks remain accessible even when the water level is extremely low.



7.5



alternatives, like equipping container ships with ballast tanks to increase their draught temporarily.

3 Approach to a hotter climate

The most effective measure to deal with expanding bridge parts right now is to cool them down with water. On very rare occasions, bridge parts are trimmed to create more room for expansion. Climate change will require more frequent and more prolonged cooling of bridges and bridge installations.

4 Approach to indirect threats

The Integrated River Management (IRM) programme was created to study the various functions (including navigability) to develop an integrated river system. This is also laid down in the Environment and Planning Act. The National Freshwater Strategy takes the shipping sector into consideration as much as possible in its determination of appropriate measures.



7.5

Looking ahead to the next few years

Action	Explanation	Initiator*, partners	Schedule
Measures for the main waterway network against drought, high water and heat Climate-Proof Networks Implementation Agenda	The Climate-Proof Networks Implementation Agenda provides an overview of current measures and studies and it aims to limit the effects of climate change on waterways. The measures and studies are not sufficient yet to make the entire network climate-adaptive.	Ministry of Infrastructure and Water Management*, Rijkswaterstaat	2026
Follow-up study and stress tests for main waterway network Climate-Proof Networks Implementation Agenda	Several follow-up studies and stress tests are being planned or are already being implemented. Like the extreme weather stress test, these tests pay special attention to poor visibility and problems relating to navigation and docking in high winds. Work is also being done to develop a stress test aimed at the functioning and stability of engineering constructions such as bridges, locks and viaducts. Other projects under development: stress test for high water and a study on action perspectives for periods of drought.	The Ministry of Infrastructure and Water Management*, Rijkswaterstaat	2023
Development of a programme under the Environment and Planning Act for Integrated River Management National Delta Programme	Within the Integrated River Management (IRM) programme, regional authorities work with the Government on the basis of a shared vision to make the Maas and Rijn area a safe, navigable, thriving, and attractive region. IRM looks for solutions for existing problems in the river region and tries to anticipate future developments such as climate change.	Ministry of Infrastructure and Water Management*, Ministry of the Interior and Kingdom Relations and Ministry of Agriculture, Fisheries, Food Security and Nature, local and regional authorities	2024



7.5

What is still needed?

Priority	Explanation
Structural financing for climate adaptation measures for the main waterways	It does not look like there will be sufficient financial resources in the foreseeable future for structural climate adaptation measures. This is partially due to the fact that the financial and feasibility consequences have not been fully mapped out yet. We are looking for appropriate measures that can be taken using available means from existing programmes (such as Management and Maintenance, Replacement and Innovation and the Multiyear Programme for Infrastructure, Space and Transport).
Concrete policy objectives for climate-proof waterways Climate-Proof Networks Implementation Agenda	Climate proofing must be incorporated in the frameworks and guidelines used by Rijkswaterstaat. The most recent insights described in the KNMI climate scenarios and the stress test results for each network must be factored in as well. Further research by and coordination with experts from various disciplines is needed to identify the frameworks and guidelines to which this would apply.

Publication details

The National Climate Adaptation Implementation Programme is a publication of the Ministries of Infrastructure and Water Management (IenW), the Interior and Kingdom Relations (BZK), Economic Affairs and Climate Policy (EZK), Justice and Security (JenV), Agriculture, Nature and Food Quality (LNV), Education, Culture and Science (OCW), and Public Health, Welfare and Sport (VWS) in cooperation with the Delta Programme Commissioner Staff, the Royal Netherlands Meteorological Institute (KNMI), the Netherlands Environmental Assessment Agency (PBL), the Directorate-General for Public Works and Water Management (Rijkswaterstaat), the National Institute for Public Health and the Environment (RIVM), the Association of Provincial Authorities (IPO), the Association of Netherlands Municipalities (VNG) and the Association of Regional Water Authorities (UvW).

Editors: Ministry of Infrastructure and Water Management

Final editing and design: Helder en Duidelijk

November 2023

(translation november 2024)

