Programme Integrated River Basin Management

Public summary

How to achieve a future-proof river system?

Rhine and Meuse System Review

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Reading Guide

The Rhine and Meuse System Review was conducted on behalf of the Programme Integrated River Management (IRM). The research report describes the development of our rivers and outlines possible interventions to future-proof the river system. The System Review does not make any policy statements.

This is a *public* summary of the System Review report.

Download the full report (dutch) and/or the separate executive summary (dutch) at www.bouwplaatsirm.nl/systeembeschouwing
You can also find more information (dutch) about the IRM programme here.
An English explanation can be found at www.bouwplaatsirm.nl/en

Rhine and Meuse System Review

The Rhine and Meuse System Review describes the state of our rivers and their development. The System Review also explains how we can prepare rivers for climate change and how we can make the river system work properly (again). This helps in making policy choices for the riverbed level, sediment management and storage and discharge capacity for 2050 and beyond. These choices are recorded in the Programme under the Environmental Planning Act (Programma onder de Omgevingswet (POW)) for Integrated River Basin Management (IRM). The POW will determine the further approach to IRM and the design of the river basins.

What is going on?

We are experiencing increasingly erratic weather due to climate change.
This is reflected in our rivers.

More and more often, water levels are very high for short periods of time and then very low for long periods. Both situations are undesirable. Therefore, we need high water levels in rivers to drop and low water levels to rise. So we need to ensure that rivers can safely discharge more water during floods, and during droughts discharge water at a slower rate and distribute the available water fairly.

There is also another problem. Partly because of our tinkering with the rivers, nature in the rivers and floodplains has deteriorated significantly. Therefore, we need to strengthen nature in and around rivers.

Do we want (excessive) water to be able to continue to flow safely to the sea? That we continue to distribute water properly across our land? And for river nature to have more of a chance? Then measures are needed.

A priority is in any case raising the significantly sunk river bed in the main river channel. This is important not only for shipping and water distribution, but also for safety, nature and agriculture, among others.

Photograph: Paul Poels fotografie

Zooming in on problems in the river system

All kinds of things have been done over the past centuries to enable living with flood risk in the river basins and use our rivers. We now suffer from the consequences of some of these interventions. What is going on?

Sinking river bed: harmful to nature, agriculture, shipping and structures

In the past, we fixed the river channels with groynes and breakwaters. Due to the construction of weirs and dams, hardly any sand and gravel (sediment) is supplied from upstream. The river bed continues to erode and sink.

We have also straightened rivers by cutting-off meanders. The river flows less frequently across the entire active floodplain, but instead remains in the channel. As a result, the river is unable to erode the floodplain and carry the sediment back into the river. This results in the floodplains getting higher and higher. This creates a vicious circle. The deeper the river bed erodes, the less water passes through the floodplain, the higher the floodplain becomes and the more the river bed sinks again.

The lower the river bed, the lower the river water levels and the groundwater levels. This affects, among other things, nature, agriculture and structures in the floodplains. Also at some distance from the rivers. The lower levels of the water in the rivers makes it more difficult for ships to navigate the rivers. It also makes ports and sluices less accessible. Because at those locations, the bottom does not sink.

A sinking river bed is also dangerous. Cables and pipelines passing under the river may become exposed. Banks, quays and flood defences can become unstable. Lower (ground)water levels can also cause structures in and along rivers to become less stable or their foundations to be affected.

During droughts, water distributions fails

The river bed does not sink at the same rate everywhere. This changes the discharge distribution where rivers branche off.

The river bed of the Waal is sinking faster than that of the Pannerdensch Canal. And the bed of the Upper IJssel is still sinking, while that of the Lower Rhine no longer is. As a result, too much water flows to the Waal and too little water flows to the IJssel. And therefore the IJsselmeer – and thus the north of our country – is not getting enough water. The eastern Netherlands also receives less water via the Twente canals.

This, too, is self-reinforcing. More and more water is flowing through the rivers where the bed has sunk furthest, causing the bed to erode even faster. So an increasing amount of water flows in the ‘wrong’ direction.

The Meuse also has problems with low water. This river is rainfed. This makes the Meuse particularly vulnerable to climate change. Less rainfall means more frequent low water levels. We are already taking measures to maintain the water levels in the Meuse as long as possible.

River nature is deteriorating

In the Meuse, Lower Rhine and Lek rivers, we have created weirs and locks to regulate water levels. The water is almost stagnant and the height difference between high and low water is decreasing. In other words: natural dynamics are reduced. As a result, the floodplains flood less frequently, to the detriment of river nature.

Rivers need even more room

In recent years, we have made a great effort to give rivers more room. Due to climate change, we expect much more frequent and extreme high water levels in the future. Therefore, rivers must be able to discharge even more water.

Main developments in the Rhine branches

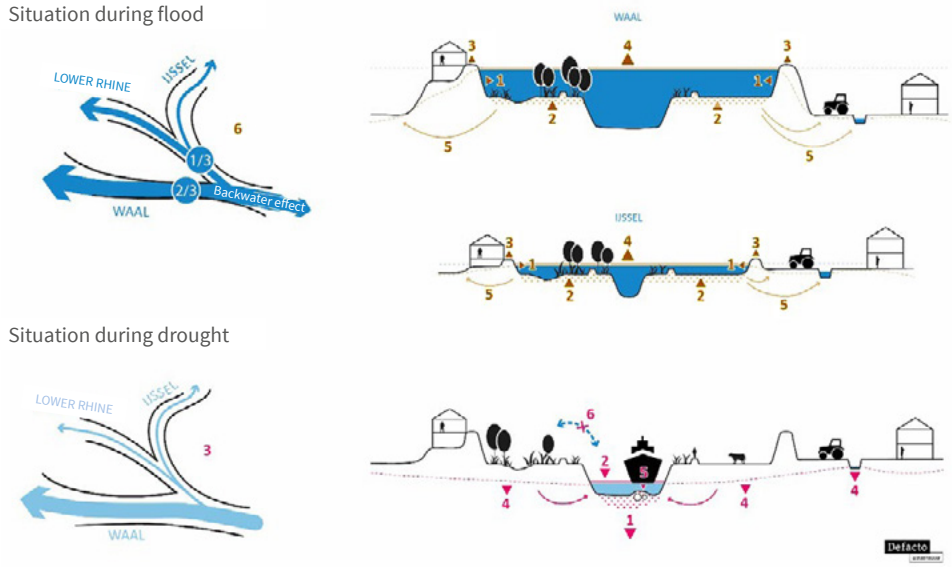

Figure 1 The main developments in the Rhine branches causing problems at high river discharge and low river discharge respectively.

During flood (top two): 1. Embankment moved riverward, 2. Floodplains silted up, 3. Embankment raised, 4. Higher flood levels, 5. Increased probability of instability and piping (seepage under dyke), 6. Backwater effect of high waters into Germany (and narrowing of Pannerdens Canal and IJssel required).

During drought (below): 1. River bed eroded and sinking further, 2. Low water levels dropped and falling further, 3. Discharge distribution skewed, 4. Groundwater levels dropped and falling, 5. Limited draught, 6. Reduced natural river dynamics.

Main developments in the Meuse

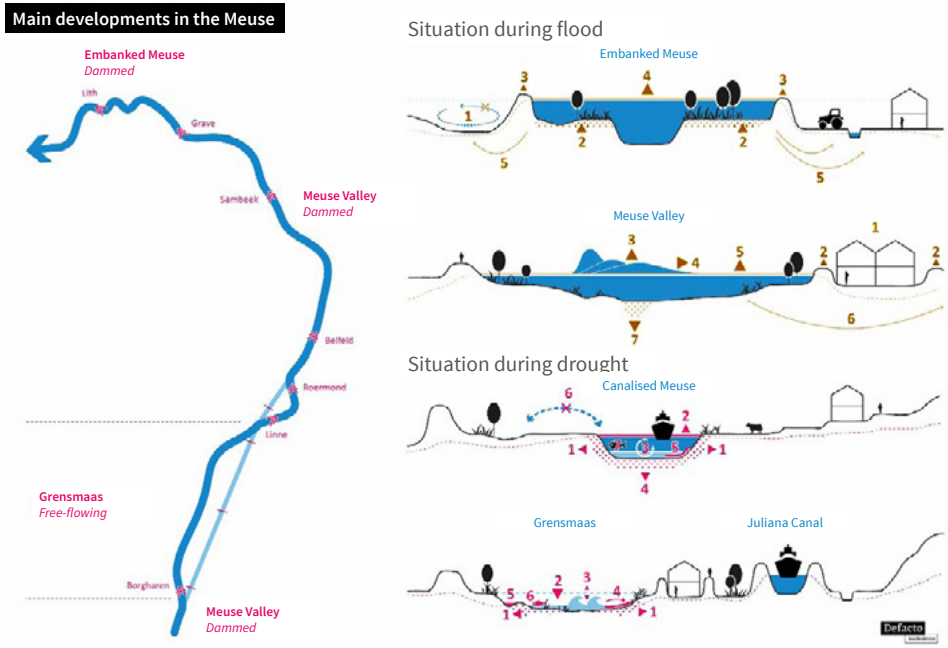

Figure 2 The main developments in the Meuse causing problems at high river discharge and low river discharge respectively.

During flood (top):

Embanked Meuse: 1. Space lost, 2. Floodplains silted up, 3. Embankment raised, 4. Higher flood levels, 5. Increased probability of instability and piping (seepage under dyke)

Meuse Valley: 1. Space lost, 2. Embankment raised, 3. Reduced flood peak attenuation, 4. Faster downstream movement, 5. Increased flood levels, 6. Increased risk of piping (seepage through gravel pack), 7. Risk of deep erosion pits

During drought (below):

Canalised Meuse: 1. Main channel greatly widened (normalisation), 2. Water level regulated (canalisation), 3. Stalled current, 4. Channel deepened, 5. Sediment balance disturbed, 6. Flood dynamics absent, 7. Fish migration impeded

Grensmaas: 1. Channel widened, 2. Discharge narrowed, 3. Unnatural dynamics (sudden peaks in discharge), 4. Gravel bed siltation, 5. Poor water quality of ponds, 6. Spawning habitat unsuitable

The developments of the Rhine and Meuse mapped, both at high water and low water.

What choices should we make?

We must prepare for more frequent and more extreme floods and more frequent and longer-lasting low discharges. And measures are needed to restore the proper functioning of the river system. What are the choices we face?

Increasing river beds and no more sand leaving the rivers

If we want to raise low water levels and groundwater levels, the river beds will need to be raised. This must be effectuated over long lengths and once again match the river bed level of the German Rhine. This is vital for a proper water distribution, but also for shipping, nature, agriculture and the structures in and around the rivers. We will need to explore how this can best be achieved.

If we want to give nature more opportunities, we need to stop sand extraction from the main channel. This will prevent the river bed in the main river channel from sinking any further and river nature from deteriorating even further. We also prevent the risk of damage to cables, pipelines, flood defences, dams and other structures from increasing.

If less water is supplied in dry times, there will not be enough water to keep both the Waal and IJssel river channels as wide and deep as they are today. So in time, we may have to choose: make the Waal a bit narrower, or only allow smaller ships to navigate the IJssel. Or both. Making the IJssel even narrower isn't really an option anymore.

Monitor and better regulate water distribution across the river branches

The IJsselmeer must have sufficient fresh water, as it is an important water storage. We want the rivers to continue to be navigable. And we must ensure that sufficient river water flows to the sea to 'push back' the salty seawater. Otherwise, it will flow too far inland and cause, for example, ditches in polders to become too saline.

If we want to distribute water properly, we definitely need to address the sinking of the river bed in the Upper Waal. At the junction at Pannerdensche Kop, too much water currently flows to the Waal and too little to the IJssel. This will require the river bed of the Waal to be raised more than that of the Pannerdensch Canal. We will also need to start using the Driel weir in a different manner. This is a kind of 'tap': we can use it to allow more or less water to go throught the Lower Rhine, and how much then remains for the IJssel.

Although we can regulate the water level in the Meuse River effectively through weirs, here, too, freshwater availability is a concern. We already use water as sparingly as possible – at locks, for example – but we need to do more. **We are currently studying how to best maintain the water level in the river during droughts.** As we replace old weirs, we consider whether we could be even more water-efficient when building new ones.

Floods: preparing rivers for the future

Climate change means we face floods more frequently. Therefore, we must ensure that rivers can discharge more water. This applies to the Meuse and Waal rivers, the Lower Rhine and the IJssel (the so-called Rhine branches). The Waal, in particular, is tight.

The Upper Waal already pushes water into the Pannerdensch Canal during very high discharges. Through a narrowing, we prevent too much water from flowing into the Lower Rhine and IJssel. This causes the water levels to rise, as far as in Germany. **We must either widen the Waal significantly or opt for a different discharge distribution during high water.**

We need to quickly decide how much flood peak attenuation we want in the Meuse Valley, as it has implications for the discharge wave we need to safely discharge downstream. This will also determine how much water the Embanked Meuse must be able to discharge and what we need to do to achieve that.

Dealing with floods: customisation per area

To properly prepare for flood peaks, we need to take a close look at how much room the rivers need to safely discharge high water.

In the Meuse Valley, for example, one would desire to flatten flood waves by slowing down the flow. This is no longer possible in the Rhine branches and the Embanked Meuse, because flood waves here last too long and the rivers are too short. So these rivers must be able to discharge more water. **To cope with flood peaks, we have to make customised choices for each area.**

Where possible, it is effective to give space to the river by moving embankments backwards, also for nature rehabilitation. And at 'bottlenecks' (where the river narrows), it is even necessary. At other places, it may be an option to lower the floodplain. And if there really is no other way, we must raise embankment.

Restore more natural dynamics of the rivers

The rivers are lacking natural dynamics and that harms our river nature. We can redress some of this by addressing the sinking of the river bed. This will allow the water to inundate the floodplain more easily. If we also want to give plants and animals that require wetter conditions a chance, we can partly lower the floodplain.

In the Meuse, we can use weirs to restore more natural water level fluctuations. We will, however, need to make sure this does not affect shipping and that we can store sufficient water. In the Meuse and IJssel rivers, we can make the banks more natural by removing stony bank protection: this will improve river nature.

Photograph: Siebe Swart

Making choices: urgency and order

When making choices, the order of decision-making is important. Because much of the river system is interrelated, choices affect each other. How they depend on each other is described in the System Review. The report also addresses the urgency to act.

1 Raise river beds now and and stop extracting sand from the channel

If we want to keep rivers navigable, give nature and agriculture a chance and better distribute and store water during droughts, we need to stop sand extraction from the river's channels as soon as possible and raise the river bed in the Waal and IJssel back up. In the Meuse, we must also do something about the river bed.

2 Give rivers more space before it's too late

To be ready for more frequent and higher floods around 2050, we need to ensure that the Rhine and Meuse rivers are given more space to discharge water.

We must first decide which fraction of the flood water the Waal and IJssel should each be able to discharge after 2050. That distribution must be investigated quickly so that we can now adjust our measures accordingly.

For the Meuse, we first need to decide how much flood peak attenuation we want to achieve in the Meuse Valley. This will determine how much water the Embanked Meuse must be able to discharge.

3 Prepare for more frequent and longer droughts

Raising the river bed in the Waal will also increase the water supply to the IJsselmeer. Whether we also need to retain water in the Meuse for a longer period should become clear from the research now being done by the Delta Programme Freshwater.

4 Restore river nature

Before our characteristic river nature is lost, we need to restore natural dynamics in the rivers as much as possible. Among other things, this means that river water can inundate the floodplain more frequently. By creating drier as well as wetter areas in the floodplain and retaining water there for longer, we increase the habitat suitability of plants and animals that require wetter conditions.

Photograph: Tineke Dijkstra

The System Review also provides longer-term guidance

The System Review helps in making policy choices for IRM in the POW. To assess alternatives, the report also lists criteria. Even after the POW, the System Review will remain very useful. After adoption of the POW, we will start working in an area-specific way: the report offers guiding statements for this purpose.

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Questions? Send them to info@bouwplaatsirm.nl

Photograph: Tom Buijse