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Chapter 16

Room for the River: Innovation, or Tradition? The Case of the Noordwaard

Sander van Alphen

Abstract Dutch river management has changed dramatically over the past two hundred years. Approaches to flood management, however, date back many more centuries. This chapter compares the state river management program, Room for the River (undertaken from 2006 to 2015), to historical flood management strategies and techniques. We consider which measures used in this program might be useful in addressing the possibly accelerated pace of climate change and rise in sea level. We focus on the cultural water landscape of the Noordwaard. Formed in response to large river discharges occurring in 1993 and 1995—and the precautionary evacuation of two hundred fifty thousand inhabitants which accompanied them—Room for the River consisted of more than thirty projects and eight measures. In a departure from past policies, most measures took place in the winter bed, or floodplain, of the river or behind its dike. Another innovative characteristic was its dual objective of ensuring safety and contributing to spatial quality—which the program defined as the balance between hydraulic effectiveness, ecological robustness, and cultural meaning and aesthetics. The program dedicated a special team to monitor progress on cultural issues. Room for the River represented a paradigm shift from the flood management policies of the recent past. Yet, some of the measures it recommended, such as digging a bypass and raising mounds in the Noordwaard, also recalled into practice much older approaches. This cutting-edge program made visible and returned to use traditional ways of flood management.

Keywords Heritage · Cultural heritage · Floods · Noordwaard · Water management · Rivers · Spatial quality · Ruimte voor de rivier · Polder · Depoldering

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C. Hein (ed.), *Adaptive Strategies for Water Heritage*,
https://doi.org/10.1007/978-3-030-00268-8_16

Introduction

The Dutch landscape is characterized by river deltas, through which large rivers like the Rhine, the Meuse, and the Scheldt meander to the sea. Because twenty-five percent of the country lies below sea level, approximately two-thirds of the country is at risk of flooding when storms come inland from the sea or rain causes rivers to overflow. Between 1200 and 1953, the country experienced about one hundred and thirty floods (Van Veen 1962). Floods are an important part of the national collective memory: history, literature, and folklore often referred to the management of floods as the “battle against the waterwolf,” casting the devouring action of wind-driven water on soft shores as wolfish destructiveness (Te Brake 2002). Today’s landscape reflects this long tradition of flood management.

In 1953, one thousand eight hundred thirty-six people drowned and seventy-two thousand people lost their homes. This calamity led to the Delta Act and the construction of the Delta Works (from 1958 to 1997). These steps reduced the probability of flooding in the southwestern river delta to 1:4000 per year (Bijker 2007). During this time, the southeastern part of the Netherlands was twice endangered, in 1993 and 1995, by large discharges of river water. The first case caused thousands of inhabitants of the province of Limburg, located along the Meuse River, to be evacuated, resulting in restoration costs of over two hundred fifty million guilders. The second case caused two hundred fifty thousand people to be evacuated amid operations conducted day and night to strengthen the dikes.

The high water levels of 1993 and 1995 renewed awareness on the vulnerability of the country to sea and river flooding. Moreover, few Dutch trusted their traditional flood protection. In initiating the ten-year program Room for the River (hereafter, RfR), the national government aimed to protect the Netherlands against extreme river discharges over the long term and, at the same time, to contribute to spatial quality—which it defined as the balance between hydraulic effectiveness, ecological robustness, and cultural meaning and aesthetics. In the light of such a history, this article explores the following questions: How do historical flood management strategies and techniques compare to RfR? What measures from RfR might be effective in addressing possibly accelerated climate change and rise in sea level?

Dutch approaches to water management have been internationally recognized for centuries. This has included international activity as well as work conducted in the Netherlands itself—as early as 1113, the Dutch were involved in reclaiming the Weser valley near Bremen in Germany (Van de Ven 2003). This legacy is visible today. By 2018, seven water-related sites in the Netherlands had received UNESCO World Heritage status, a development which recognizes the Dutch testimony to the ongoing battle against the sea, architectural ingenuity, orderly design, large-scale implementation, and their representation of different strategies and techniques in the development of Dutch water management (Van Rotterdam 2015). In the face of climate change and rising sea levels, adaptive water management has proved again and again to be an important intervention. The long history and innovative character of Dutch water management heritage may well offer inspiration for the future.

A Short History of Dutch Flood Management

Although the oldest surviving written records of Dutch water management date from the eighth century BCE, the earliest physical remains date to the fifth century BCE (Van de Ven 2003). These artificial mounds, known in Dutch as “terp” or “wierde,” which can be found in the northern provinces of Friesland and Groningen, served as a refuge for cattle during high waters (Van Dam 2010). Often located on top of existing hills, a *terp* is constructed of sea clay. Over time, a *terp* would be raised and expanded so that an entire village could fit on top. By the middle of the nineteenth century, however, farmers had dug into and excavated many of these mounds for their fertile soil (De Langen et al. 2016). *Terps*, it is worth noting, offer three solutions that work in tandem: higher ground for evacuation from high water; dikes, or raised ramparts, along bodies of water, to block water from coming on land; and dams to provide the higher ground that prevents flooding from occurring in the first place.

About two thousand years ago, inhabitants of the Netherlands constructed the first dikes to protect their agricultural land (Projectbureau Belvedere 2010). By the eleventh century, dikes were built along great rivers and tidal inlets in the south-western and northeastern provinces. Currently, the Netherlands has over seventeen thousand, five hundred kilometers of dikes and relics (Lascaris 2012).

In contrast to dikes, dams are sited in the water. A dam closes off the water behind it; water level can then be regulated by a sluice or pumping device. The dam works even when the water level outside it rises. Thus, dams not only block the water but also regulate the amount of water and strength of its flow. The early seventeenth century Haarlemmer Sluice—which continues to connect the Nieuwendijk and the Haarlemmerdijk in the center of Amsterdam—is one such sluice dam. Dams also provide paths across bodies of water and were often where ships distributed their goods. As a result, the names of some Dutch cities: Amsterdam, Edam, and Rotterdam still end with the word *dam*.

From about 1200 on, the character of dikes would change, now they would become part of efforts to reclaim land from the sea—largely for agriculture. However, an area could only be reclaimed if it had enough sediment and if it only flooded at high water levels. Even after the arrival of this new kind of dike, living on mounds remained prevalent to minimize the impact of floods (Van Dam 2010). According to Petra van Dam, Professor of Water History at the Vrije Universiteit Amsterdam, raising dikes compartmentalized the landscape, a strategy which also reduced the speed, extent, and damage of a flood. A compartmentalized landscape could offer people more time to evacuate themselves and their cattle, depending on how far away dry ground was.

The diking and draining of marshes were so extensive that soil gradually dried out and descended toward the groundwater beneath. The rate of resulting subsidence is estimated at approximately fifteen to twenty centimeters per century (Van de Ven 2003). As a result, large parts of western and northern Netherlands have entered an ongoing spiral of “dredging or drowning” (Te Brake 2002).

Although the Romans had already built hydraulic engineering works in the Rhine–Meuse river area—including sluices, culverts, and dams—the Dutch viewed rivers as unmanageable natural phenomenon until the eighteenth century (Lascaris and de Kraker 2013). Since authorities did not believe conditions could be remedied, they focused on fighting their symptoms (Van der Ham 2004). From the end of the eighteenth to the beginning of the nineteenth century, spillways and bypasses were commonly used to direct surplus river water. Diverting rivers became a popular measure because it could be performed in a relatively short time. At times, as was the case after the flood of 1809, it was important to act quickly.

While the first state plans to manage rivers were presented at the beginning of the seventeenth century (Van der Woud 2006), only individual interventions were carried out. These often merely protected private territory. Contemporaneously, state water engineers and river experts, Christiaan Brunings and Rudolph Tutein Nolthenius, blamed the poor state of river beds and dikes, as well as numerous irregularities in the river system in the first half of the nineteenth century on these unwise remedies which, in turn, led to reduced flow capacity and regular floods (Van Heezik 2007).

Under the influence of the Enlightenment and the Industrial Revolution, a new worldview gradually but decisively developed, characterized by infinite confidence in the power of human reason and the desire for a socially engineered society (Van Heezik 2007). An elite body of engineers at the time possessed the required technological expertise to carry out state-level river management. However, it would be almost one hundred years before the Netherlands would benefit from their understandings (Van der Woud 2006).

New social conditions, including political stability, technological development, and economic growth, would eventually enable the Dutch to modernize river management during the second half of the nineteenth century. The transition was precipitated by an immediate influence: continuing pressure from the German shipping trade industry required both improving the navigability of Dutch rivers and reducing the number of near-floods (Van der Woud 2006). This resulted in another national paradigm shift, in which people and even the law newly considered the general interest to be more important than the private.

The state now adopted a new technique of river management, normalizing the water level, or creating a less irregular course for the summer beds of rivers. Techniques used here included dredging shoals and constructing groynes perpendicular to the river bank in order to create regular width and a steady flow pattern. Diverting rivers was seen as a last and far less favorable remedy (Van der Ham 2004).

With these strategies at hand, better control of rivers would be realized over the next hundred years. Figure 1 is taken from the *Spankrachtstudie* (2004) and was drawn up prior to RftR. Red boxes in the table indicate the number of floods that have occurred along the Rhine River since 1500. As is shown, floods took place at about every ten years. From 1850, when normalization was introduced, the number of floods decreased significantly until the end of the twentieth century, when the occurrence of river floods almost completely stopped. Rivers did, nevertheless, flood in 1926, 1993, and 1995. This last flood triggered the formation of RftR.

Fig. 1 Floods along different streams of the Rhine River branches from 1500 on/to the present. *Source* Van der Ham (2004). Afleiden of opruimen: de strijd om de beste aanpak tegen het rivierbederf. p. 56; released under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License

The Dutch also improved the river area to benefit shipping and freshwater supply during the twentieth century. Interesting architectural examples are the three concrete weir structures along the Lower Rhine, which possess graceful curves that can absorb great pressure.

Room for the River

The high water levels which occurred along the Meuse and the Rhine at the end of the twentieth century illustrated the Netherlands' flood vulnerability. In response to

Fig. 2 Room for the river: plenty of possibilities. *Source* Silva, W., Klijn, F. and Dijkman, J.P.M. Room for the Rhine branches in the Netherlands, what the research has taught us. Arnhem: Deltares (WL)/Rijkswaterstaat RIZA. p. 56; released under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License

this, the Minister of Transport and Water Management and the Minister of Housing decided, in 1996, that additional measures were needed to adapt to adverse climate change and to provide the river area sustainable protection from floods. The national government presented its plans for spatial planning in the 1996 *Planologische Kernbeslissing* (hereafter PKB-4). Although parts were legally binding, the PKB-4 was primarily symbolic.

The PKB-4 had two goals: ensuring the required level of protection against river flooding and contributing to the improvement of spatial quality in the river area. As ensuring sufficient safety levels was the main objective, the report stipulated that by 2015, the discharge capacity of the Rhine should be at 16,000 m³/s (cubic meters per second) and the Meuse at Borgharen 3800 m³/s (RPO 2006). However, it was argued that, in response to climate change, normative discharge capacity might have to be raised in the next century.

In total, the PKB-4 identified over 30 locations and proposed a basic set of eight measures to achieve the dual objectives of RftR. The eight measures are shown in Fig. 2.

Most of the measures were proposed for the winter bed of the river (lowering floodplains and dike displacement) or the area behind the dike (locally setting back dikes and retention reservoirs). Although these are not shown in Fig. 2, the PKB-4 also included more traditional dike improvement techniques (encompassing the raising, widening, or strengthening of dikes). Further measures, such as digging bypasses and depoldering, are also absent from Fig. 2.

During the 1970s, the ecological movement often regarded traditional flood protection measures as a threat to the dynamic character of the estuary (Disco 2002). Furthermore, the drastic way in which the state raised the height of river dikes without public consultation—often removing houses—led to resistance from local populations.

However, 1975 would be a turning point. That year, local citizens successfully fought against the dike reinforcement at Brakel in court. Eventually, Plan Ooievaar (1986) would demonstrate that ensuring a sufficient safety level could go hand-in-hand with spatial quality.

The RftR program also reflected the importance of spatial quality to local citizens and their support of river management. It adopted this as its second objective. In order to ensure that the planning process gave sufficient attention to spatial quality, a Q-team was appointed in 2006. It advised the RftR program office (hereafter, RPO) on conserving and reinforcing spatial quality in water safety, noting that spatial quality is a poorly defined concept that cannot be quantified (Klijn et al. 2013). Spatial quality was, therefore, described as the balance of three values: hydraulic effectiveness—protecting the land from flooding; ecological robustness—building natural processes that require little maintenance; cultural meaning and aesthetics—enhancing existing landscape qualities (Klijn et al. 2013).

To foster these values, the Q-team opted for a formal peer-review approach. However, project leaders and designers of each project were first given the opportunity to raise issues and receive coaching informally. Next, the team visited each project at least three times; after this, key recommendations and a general judgment were presented to the local, regional, or private parties in charge, accompanied by a request for a response. Based on the opinions of the Q-team and initiators' responses, the RPO formulated a provisional statement on the preferred option of the final design. The Vice Minister would then make the final project decision.

In the evaluation process, "cultural meaning" included cultural history, and referred both to human interaction with the water and physical characteristics of the river over time. To research it, the Q-team had to learn about geomorphological origins and current morphological dynamics. The Q-team advocated that planners take a selective approach, in which the past did not lead but co-determined the planning process. The evaluation procedure followed here is in contrast to that at a UNESCO World Heritage Site, where the role of the past plays a more decisive role. However, in the case of the RftR program, other interests, like the agricultural and recreational industry, were also at stake. The role of the past became more subordinate in the planning process. The advice elicited is now being implemented. The various stakeholders are involved in the process at the early stage of plan preparation for dike improvement and river widening projects within the framework of the national Delta Programme (Ministry of Infrastructure and the Environment 2014).

Case Study: The Noordwaard

The sea had been calm for already a couple of years. Perhaps, that's why few had paid attention. But the sea proved unpredictable and unreliable. What was predicted, and feared by many, happened on the eighteenth of November 1421: shortly before the day of the holy Elisabeth, the sea struck relentlessly. It penetrated the land, leaving nothing but destruction behind (Van der Ham 2003).

Fig. 3 Saint Elizabeth's Day Flood. Master of the St Elizabeth Panels, c. 1490–c. 1495. *Source* Rijksmuseum, Amsterdam; released under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License

The St. Elizabeth's Flood in 1421 (shown in Fig. 3) marks the Noordwaard's origin and the beginning of this polder's natural process of accretion. It now consists of nearly two thousand five hundred hectares in the Netherlands' southwest. But the Noordwaard would develop very gradually, not becoming fully formed until 1980. For many centuries, land would only be reclaimed from the water by natural events

Fig. 4 Future dike ring 23. Existing ring in red; future ring in blue. *Courtesy of* Source Ministry of Transport, Public Works and Water Management, and Room for the River programme office, 2010. Toelichting Rijksinpassingsplan: ontpoldering Noordwaard. p. 27; released under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License

such as the accretion of tidal flats, or the growth of shoals and willow trees. Only in the eighteenth and nineteenth centuries did locals conduct the first small-scale reclamations of tidal marshes, surrounding increasingly larger parts of the marshes with dikes (Ministry of Transport, Public Works and Water Management, and RPO 2010). At the onset of the twentieth century, communities merged more and more polders, adjusted the water system, and consolidated agricultural land on a large scale. As it moved from osier fields to grain production in the first half of the twentieth century, the area lost the ability to temporarily store water, as grain required larger farm plots and better drainage. Through such means, a single large polder was created in 1980: the Noordwaard (Marijnissen 2012).

Two particular interventions influenced the creation of the Noordwaard: the construction of the New Merwede Canal (constructed from 1861 to 1874) and the closure of the Haringvliet Dam (in 1970). The New Merwede was dug out to maintain enough drainage capacity on the Upper Merwede River. At the same time, the canal's dike would form the Noordwaard's northern border (shown in Fig. 4). Because of these structures, the Noordwaard could, to a great extent, be drained during the twentieth century. For its part, the closure of the Haringvliet Dam was part of the Delta Works and ensured that the Noordwaard was no longer affected by tidal action.

Land reclamation and consolidation in the Noordwaard reached its zenith in the beginning of the 1980s. At that time, the Noordwaard consisted of large patches of land, with a little water between them. However, in 2006, the central area of the Noordwaard polder would be designed as an occasional high water bypass (in a manner similar to the river diverting activity of the first half of the nineteenth century). This would increase the discharge capacity of the New Merwede and, as a direct result, lower its water level at Gorinchem by thirty centimeters and protect the urbanized area around Rotterdam and Dordrecht against floods. Consequently, most of the Noordwaard would no longer be behind a dike; the likelihood of flooding there (as opposed to flooding of urbanized areas) would therefore increase significantly. By reconnecting the embanked polders to a river and reintroducing water and flood dynamics, the Noordwaard partly lost its function as permanent agricultural polder and was effectively depoldered.

In comparison to the depoldering of the Hedwigepolder in Zeeland, creating a new design for the Noordwaard was a relatively smooth process. There, far more opposition from the local population prevailed (Burgers 2014). A relatively small number of houses, about seventy-five, were sited in the Noordwaard (RPO 2006). Along with regional and local governments, the Ministry of Infrastructure, Public Works, and Water Management (hereafter, RWS), investigated several options for increasing the discharge capacity of the New Merwede. Residents were also given the opportunity to participate in decision making. Eventually, thirty people took up the offer (RPO 2006). Of these, twelve testified at the Council of State (Marijnissen 2012).

Most residents of the Noordwaard were unhappy that they had to suffer for the safety of the inhabitants of Dordrecht and its surroundings. Another point of discussion was the insecurity faced by those left behind (Marijnissen 2012). Of the twenty-five farmers who participated in the decision making, fifteen had to leave the area because there would not be enough agricultural land for them in the newly designed Noordwaard. Of the remaining fifty families, about half had to move, because their homes would be in danger of flooding (Metz and Van den Heuvel 2012). Taking this critique into consideration, authorities included evacuation routes in the new design; and the municipality of Werkendam developed a roadmap for evacuation.

In many cases, RWS would sit down at the “kitchen table” with residents to look for individual solutions. In addition, families were offered the opportunity to sell their homes at market value (before RftR); and farmers were helped in their search for new farmland. Those that still wanted to live in the Noordwaard could get compensation for moving to higher ground or taking measures for better protecting against high water. For example, the design of the new (depoldered) Noordwaard included the construction of ten accommodations on top of a newly raised terp (Department of Waterways and Public Works 2011). Furthermore, a dike ring could close some houses off from the water.

Within this new dike ring (marked in blue in Fig. 4) are a residential area, a business park, and the Steurgat fortress, a feature of the New Dutch Waterline. In order to preserve residents' view of the fortress, a new, innovative type of dike was chosen, a wave-resistant dike which could be lower than older dikes. In addition, the impact of waves was further diminished by planting an eighty-meter-wide willow forest on a gentle slope in front of the dike (Department of Waterways and Public Works 2011). The dike realized was 0.7 m lower and eleven meters less wide than a traditional dike would have been (Ministry of Transport, Public Works and Water Management and RPO 2010).

After deciding that the Noordwaard should be a high water bypass, the state still had to choose between constructing one large bypass or a comprehensive set of several branches. Although one large bypass offered benefits, in that it would be cheaper to construct and maintain, it would be less attractive to recreation—a feature which residents sought. The option of a comprehensive set of several smaller branches was preferred, as it served the most interests: safety (better management of flood risks), housing (attractive living environment), nature (more tidal creeks and intertidal zones), and cultural history (recreating old patterns of the river landscape).

In order to allow the river flow to enter the Noordwaard, the dike was lowered to two meters above sea level over a distance of two kilometers (from the Steurgat fortress to Kievitswaard). When the water level exceeds that two meters, which occurs every winter, river water is able to flow over the lowered dike section into the Noordwaard. In addition, four new northeastern gateways and two new southwestern gateways, along with pumping stations between them, provide sufficient capacity to achieve the hydraulic task of lowering the water level at Gorinchem by thirty centimeters (Bureau Noordwaard 2006).

The new design of the Noordwaard (shown in the map in Fig. 5) is based on the landscape structure of 1905, the period after the completion of the New Merwede and before the large-scale land consolidations. For landscape architect Robbert De Koning, a strong cultural–historical concept offered many possibilities for connecting with the project assignment and for creating a cohesive and recognizable landscape. Due to land consolidations in the twentieth century, many historic elements (such as creeks, polders, terps, osiers, and farms) had disappeared and, consequently, the landscape had lost its cohesion (Bijker 2007). The new design has stored many old waterways at their former location as a method of rectifying the loss and has maintained the original allotment pattern as much as possible. In addition, the return of the creek system has also provided opportunities for nature development.

Conclusion

The case of the Noordwaard represents a paradigm shift in flood management that was developed, ironically, by reviving much older traditions. Living on terps, a form of flood protection dating from the fifth century BCE, has been re-initiated, as has the method of diverting, which involves digging bypasses to drain surplus river water.

Fig. 5 Map of the plan area, showing its sub-regions: 1. northeast gateway; 2. bypass area; 3. southwest gateway. *Source* Ministry of Transport, Public Works and Water Management, and Room for the River programme office. 2010. Milieueffectrapport. Planstudie ontpoldering Noordwaard. Appendix. p. 31; released under a Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License

This recent revival, or reconciliation, with centuries-old means of flood protection not only concerns the Noordwaard but, to a certain extent also envelops the entire RftR program.

The overall RftR strategy of “making room for water” closely captures an adage of one of the oldest written sources on Dutch water management: “not with force, but with sweetness” (Bijker 2007). In the sixteenth century, the dike builder and polder creator, Andries Vierlingh, advised the Dutch to fight the water with a soft hand—that is, to regulate the floodwater—instead of applying brute force (Ministry of Infrastructure and the Environment 2014). Vierlingh understood the opportunities that controlled flooding offered (in agriculture, for example). In the case of RftR, such opportunities were used to help improve spatial quality.

Moreover, the RftR program did not aim to restore uncontrolled river dynamics, but to sustainably protect (in a way that included maintaining local support) the country from the effects of climate change and rising sea levels. Nevertheless, the Netherlands will not be fully climate-proof even after all river-widening projects envisioned are completed. The need to develop additional new programs continues. The success of RftR signals that the future of adaptive flood management will not consist of reconciling with traditional techniques, but rather will call for applying a

set of both old methods such as dike improvement and new techniques such as river widening.

Recently, research has warned us that the speed of climate change and sea level rise might exceed our expectations and preparations (Deconto and Pollard 2016). Dutch water state engineers and policymakers admit that the risk of (especially uncontrolled) floods cannot be fully eliminated. Hence, flood risk awareness should be developed among inhabitants of vulnerable areas who have experienced a long period without floods (Borger 2008). The research has shown, moreover, that the consequences of flooding will be devastating and extensive for delta regions like the Netherlands, threatening ever-larger populations and economic assets (Meyer 2016). Therefore, not only does flood protection deserve our attention but damage prevention also must be highlighted. The National Water Plan (of 2009–2015) accordingly introduced this concern as a matter of multi-level safety.

Acknowledging flood risk allows us to think of ways to reduce the possible consequences of flooding. Again, cultural heritage offers inspiration to this effort. The peninsula of Marken, an island until the closure of the Zuiderzee in 1932, still has some of the seventeenth century wooden pole houses that stood above fluctuating water levels (Holland 2018). Another example of what the cultural heritage offers is the twenty-five thousand year-old strategy of living on mounds in flood-prone areas. This approach to building lets the flood water spread out on a larger than usual surface. As a result, the water level stays much lower than it does between dikes; the water is also able to move more steadily and slowly than the occasional explosive flood after a dike breach. Floods themselves also leave behind a cultural heritage, in dike breach ponds or the curved shape of a dike, which can remind younger generations of where and how frequently they occurred.

Acknowledgements The author thanks Dr. Linde Egberts for reviewing his work and supporting the publication of this chapter.

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