Water system and urban form in Holland

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[...]

The seaward drainage of a substantial area of Europe runs through the Netherlands. Via the major rivers, especially the Rhine, huge volumes of water enter the Holland delta (fig. 002). The main objectives of the water system are to regulate the outflow of water to the sea, to drain the low-lying, chiefly agricultural land and, at a more local level, to manage the water level and water quality in the cities and beyond. Over the centuries a vast, complex and intricate network of polders, boezems[5] and main drainage channels has been constructed for this purpose.

This study is about the low-lying, vulnerable peatland area between the rivers Lek and IJ, bordered to the east by the Utrechtse Heuvelrug and in the west by the barrier bars and dunes along the coast (fig. 003). The urbanised peatlands in the low-lying part of the Netherlands constitute the demographic and economic heartland of the Netherlands; they also boast what many people around the world regard as the country's most typical and unique landscape. Within that landscape, at all levels of scale, the water system provides structure and is visually defining. It has a huge influence on the location and shape of the cities, and on how they function. Knowledge of the water system is hugely important, yet it is something of a neglected area.[6] This issue of OverHolland aims to contribute to our knowledge of the Dutch water system by examining it on a large scale and over a long period of time. By looking at and analysing data at system level, national and local governments are better able to assess the risks of change in a specific situation and to tailor their policies accordingly.

[...]

The series of maps provide a general overview of the drainage of the area in relation to the territorial and administrative development of the district water boards and, within that, the role of the towns and cities. The legends on the maps reflect trends in the period concerned. Only those engineering works relevant to the themes of the map in question are represented. To illustrate these themes we opted for several map series. The first series comprises four overview maps sketching the evolution of the water system. Then the connections and tensions between the water system, the water boards and the drainage areas are visualised: how does the physical situation relate to administrative entities?

Three cities: Amsterdam, Leiden, Gouda

The theme is then elaborated at the urban level of scale in maps of the water systems of Amsterdam, Leiden and Gouda. These three cities were chosen because of the

clear differences in location, size and water-related issues, which allowed us to cover as many aspects as possible of urban water management. The issue of urban water was most complex in Amsterdam owing to the city's vast scale, its peatland location on a river with almost no fall and beside a body of water with minimal tidal movement. The city had the financial means to realise solutions, but in so doing ran up against the interests of other parties, in particular the neighbouring water board district of Rijnland.

Leiden, the second largest city in Holland in 1575, was many times smaller than Amsterdam. It stood at a spot where the Oude Rijn intersected the barrier bar. It did not have to contend with undyked water and was the seat of the powerful Rijnland district water board. However, it did experience serious and prolonged problems with water quality, mainly due to its textile industry.

Gouda was smaller still and until the nineteenth century stood outside Rijnland's territory. It was able to resolve the water quality issue by exploiting the town's location on the Hollandse IJssel, a tidal river with a substantial difference in water level between ebb and flood.

Of the three cities in this study, Gouda currently has the most serious problems with water: soil subsidence and unstable foundations present the city with substantial challenges. We therefore conclude with an analytical map of Gouda in which its historical development is combined with the city's current problems.

Water system 1575 – Everything under control? (fig. 004)

The core of the study area consists of large-scale peatland reclamations dating from the eleventh, twelfth and thirteenth centuries.[11] Before the peatland could be used for farming, it first needed to be dewatered by digging drainage ditches. That dewatering in turn caused soil settlement and subsidence and because of the latter landowners were increasingly faced with drainage problems. Not long after reclamation, arable farming was no longer possible, and the peatland could only be used as pasture.

In order to control the water level, the area was eventually divided into a large number of polders: tracts of land enclosed by dykes and embankments, each with their own water level that could be regulated if necessary by hydraulic works. Excess water from the polders was initially discharged into the undyked water by gravitational flow. But as the polders sank due to subsidence the coast and the rivers needed to be dyked, at which point the undyked water (buitenwater) became storage water (boezemwater). Via the boezems, the excess water from the polders was discharged into the sea or major rivers. Management of the water level in the boezem was the responsibility of the district water boards of which Rijnland, established in 1257, is the oldest. Over time this resulted in a complex network of polders, boezems and sluices, built and managed by polder boards, water boards and cities.

On the map (fig. 004), roughly anticlockwise, are the six water systems: the Rhine, the Vliet and the Schie, the Rotte, the Hollandse IJssel, the Vecht and the Amstel.

[...]

Water system 1680 – Urban influence: reclamations, peat cutting and barge canals (fig. 005)

In the period 1575-1680 – the Dutch Golden Age – there were no changes in the principal drainage system. There were, however, three developments that affected the water system during this period: a series of big and small reclamation projects, the construction of a network of barge canals, and the large-scale extraction of peat for fuel. These developments were triggered by the strong economic and demographic growth of both countryside and cities in Holland.[22] A number of already big cities, such as Amsterdam, Leiden and Haarlem, expanded dramatically. Urban interests gained greater influence over the use, layout and drainage of the countryside of Holland. Technical improvements in polder mills increased their capacity and facilitated deeper drainage; more and more polders were drained using these large, modern mills. The price of farming land rose, raising the prospect of financing the reclamation of peat bogs with money borrowed on the capital market. Town councils and consortia of urban entrepreneurs carried out reclamation projects with a view to adding the newly acquired land to the existing farming acreage.

[...]

Water system 1900 – Centralisation and scaling-up (fig. 006)

In the nineteenth century, the Netherlands became a unitary state, which had a huge impact on the organisation of water management (fig. 006). In 1848 Rijkswaterstaat was established as the successor to the Bureau voor den Waterstaat, which dated from in 1798. The national government now had an organisation to manage the main shipping routes and the larger seaports. Rijkswaterstaat was not responsible for sea and river dykes, which continued to be managed by the water boards under the supervision of the provincial governments. The king maintained 'supreme control', but in practice this was confined to legislation and regulation. Dune management was also the responsibility of the provinces.

The major rivers had never before been under any form of stewardship: the dykes had been managed by water boards and although there had been ad hoc interventions, only now did the shipping routes themselves come under systematic, sustained management.

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The arrival of the steam engine spawned large-scale industrial concentrations on the outskirts of existing cities. To serve them, new infrastructure in the form of railways and canals was constructed, especially around the international seaports of Amsterdam and Rotterdam. The Merwedekanaal was built in the years 1880-1892 as part of the shipping route between Amsterdam and Germany.[37] The Noordzeekanaal, a new shipping route between Amsterdam and the North Sea, began as a private initiative in 1865 but was not completed until 1876 after a long and complicated process which ended with the government taking over its construction. The Nieuwe Waterweg, opened in 1872, was

another of these largescale, government-organised operations to create new shipping routes. These canals were managed by Rijkswaterstaat and were primarily aimed at stimulating the economy. To this end, new fixed navigable depths were established, calculated to accommodate the ever-bigger steamships that berthed at the newly constructed docks. These were built progressively further away from the old city centres. In Amsterdam the harbour expanded eastwards and westwards along the shore of the IJ; in Rotterdam the harbour developed to the west of the old city centre, further and further in the direction of Maasmond.

[...]

The introduction of the steam engine also vastly improved the performance of pump machinery. This in turn made much larger reclamation projects possible. One example of this concerned the IJ polders, which were part of a much larger project, the construction of the aforementioned Noordzeekanaal. This canal was in effect a channel carved through a series of large-scale reclamation works along both shores of the IJ.[39]

Even the Haarlemmermeer could now be reclaimed, which occurred in 1850 with the aid of six big steam-driven pumping stations. As a result, the size of the Rijnland boezem was drastically reduced (from 22,000 to 4,000 hectares), thereby creating a need for greater discharge capacity.[40] [...] The reclamation of the Haarlemmermeer led to the complete mechanisation of drainage in Rijnland, just as the construction of the Merwedekanaal (with steam pumping stations at Zeeburg and in the Oranjesluizen) had done for Amstelland.

Wherever there was an instance of severe subsidence, steam pumps were deployed, alongside or in place of polder mills. Because they were cheaper to run, many windmills continued to operate, especially in smaller polders with fewer or poorer landowners, and thus with less money and less administrative clout.

[...]

Water system 2015 – The Dutch belief in the ‘makeability’ of the landscape **(fig. 007)**

The twentieth century was first and foremost characterised by rapid urbanisation. Especially after the Second World War the population and economy of Holland grew rapidly, as did the cities. The impact of this was compounded by an enormous increase in land use.[41] The living area per inhabitant multiplied, the row house with garden front and back and a car out front became the norm. This coincided with an increasingly rigorous separation of living and working. Vast tracts of land on the outskirts of the cities were consumed by housing developments and industrial estates, to such an extent that the cities started to grow together.[42] This trend was intensified by the fact that commuting by car now made it possible to live in previously relatively remote villages. In the wake of the Second World War an automobile infrastructure of unprecedented scale and density was rolled out across the country: a new motorway network was supplemented by the widening or construction of secondary and tertiary roads. On top of that there was aviation; the Schiphol and

Rotterdam-The Hague airports occupy an area the size of a large city. A substantial part of West-Nederland was covered with asphalt.

Most new housing estates were constructed according to the tabula rasa principle: before construction began a thick layer of sand was laid over the bare peatland. All the underground infrastructure was incorporated in this stratum, after which construction began. The result was that many small polders around the cities disappeared and either their datum was adjusted to that of the city, or the new extensions were given their own datum. The existing, sometimes extremely old, drainage systems were wholly or partially decommissioned or moved. Subsequent drainage problems in the urban area could be solved through the construction of high-capacity pumping stations powered by an electric or diesel engine. No great changes occurred in the main drainage network (fig. 007).

The countryside underwent far-reaching intensification and large-scale mechanisation. As farms increased in size, larger contiguous holdings were worked with machines. Many small drainage ditches and canals were filled in or closed off during this process of scaling-up and mechanisation. To make the soft peat soil traversable by heavy machinery, the groundwater level needed to be drastically lowered. Once again modern pumps were put to work on a massive scale. This led to a reduction in the number of secondary water outlets while the main drainage canals became comparatively more important. As a result, large parts of the western Netherlands could no longer discharge excess water into the big rivers or the sea by gravity alone: the Randstad became completely dependent on mechanical drainage.

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5 A boezem is a system for storing and draining polder water.

6 In recent discussions about the composition of water boards, doubt was cast on the need for expertise or representation; some political parties want to do away with the system of ‘safe seats’ occupied by stakeholders, which perpetuates the old principle of chief landowners and the adage ‘he who pays the piper calls the tune’. J. Coppes, ‘Morrel niet aan de waterschappen: ze doen het prima’, NRC Handelsblad, 21 August 2020: www.nrc.nl/ nieuws/2020/08/21/morrel-niet-aan-de-waterschappen- ze-doen-het-primaa4009439 (accessed 9 September 2020).

11 See and compare: G. Borger et al., ‘Twelve centuries of spatial transformation in the western Netherlands, in six maps: landscape, habitation and infrastructure in 800, 1200, 1500, 1700, 1900 and 2000’, OverHolland 10/11 (2011), 5-125.

22 J.E. Abrahamse and R. Rutte, ‘1500-1850 – Changes in urbanization: differentiation, expansion and contraction’, in: R. Rutte and J.E. Abrahamse (eds.) Atlas of the Dutch Urban Landscape. A Millennium of Spatial Development, Bussum 2016, 188–211.

37 www.rijkswaterstaat.nl/ water/vaarwegenoverzicht/ merwedekanaal/index.aspx (accessed 3 February 2020).

39 In 1861 an Amsterdam notary received a concession for this from the government, allowing the Amsterdamsche Kanaal- Maatschappij to set to work: Abrahamse, Kosian and Schmitz 2010 (note 23), 42.

40 L.A.M. Giebels, ‘Het stoomgemaal van 1857 en het dieselgemaal van 1936. Twee generaties boezemgemalen in Gouda’, in: L. Giebels (ed.), Waterbeweging rond Gouda van ca. 1100 tot heden, Leiden 1988, 39-57, esp. 40.

41 H. Engel, ‘Drawings and calculations for the Zaan Corridor’, OverHolland 16-17 (2015), 39-75.

42 J.E. Abrahamse, Y. van Mil and R. Rutte, '1950-2010 – Explosive growth: the welfare state, motorways, and the rapid expansion of the built-up area', in: R. Rutte and J.E. Abrahamse (eds.), Atlas of the Dutch urban landscape. A millennium of spatial development, Bussum 2016, 238-259.

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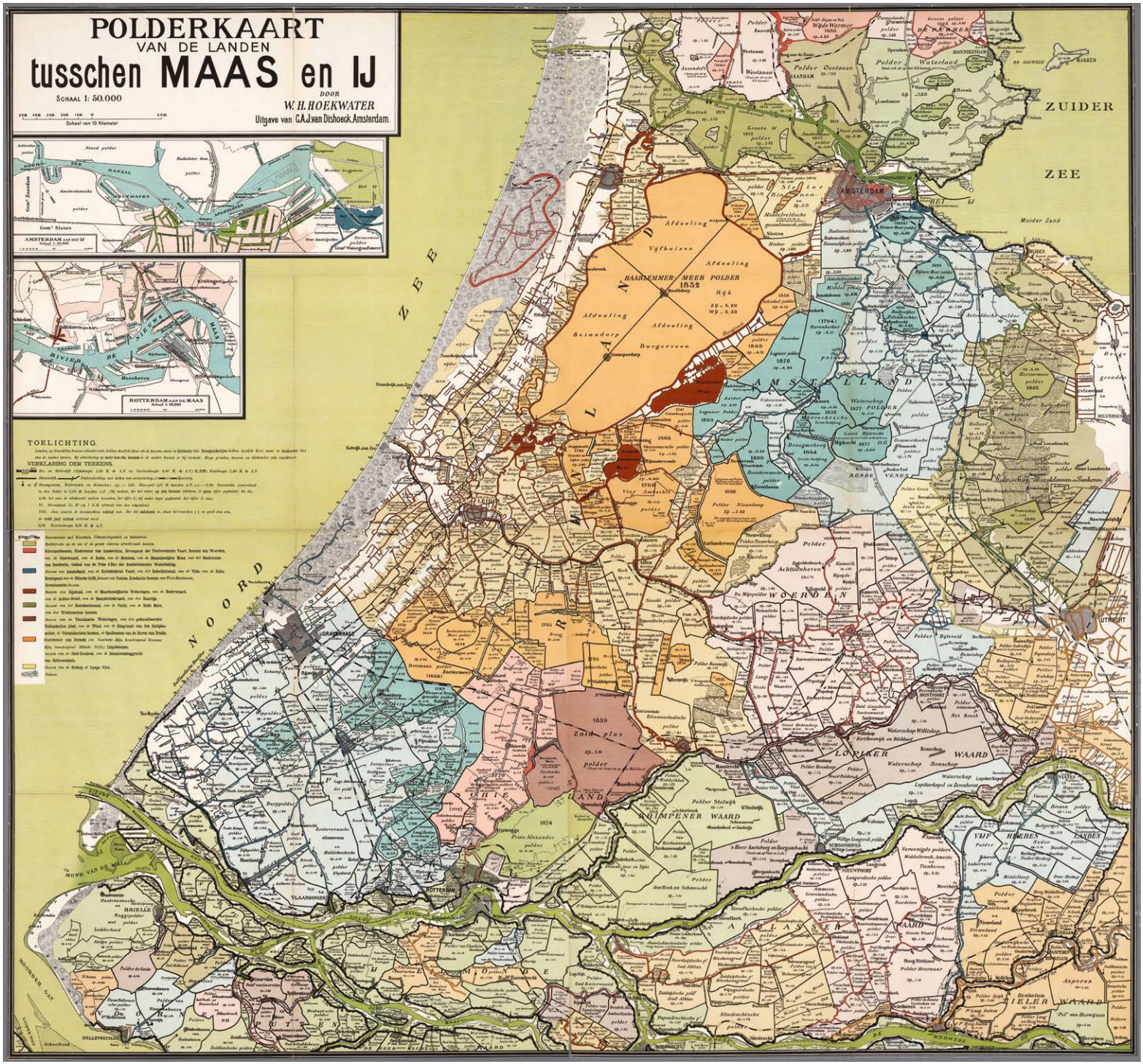
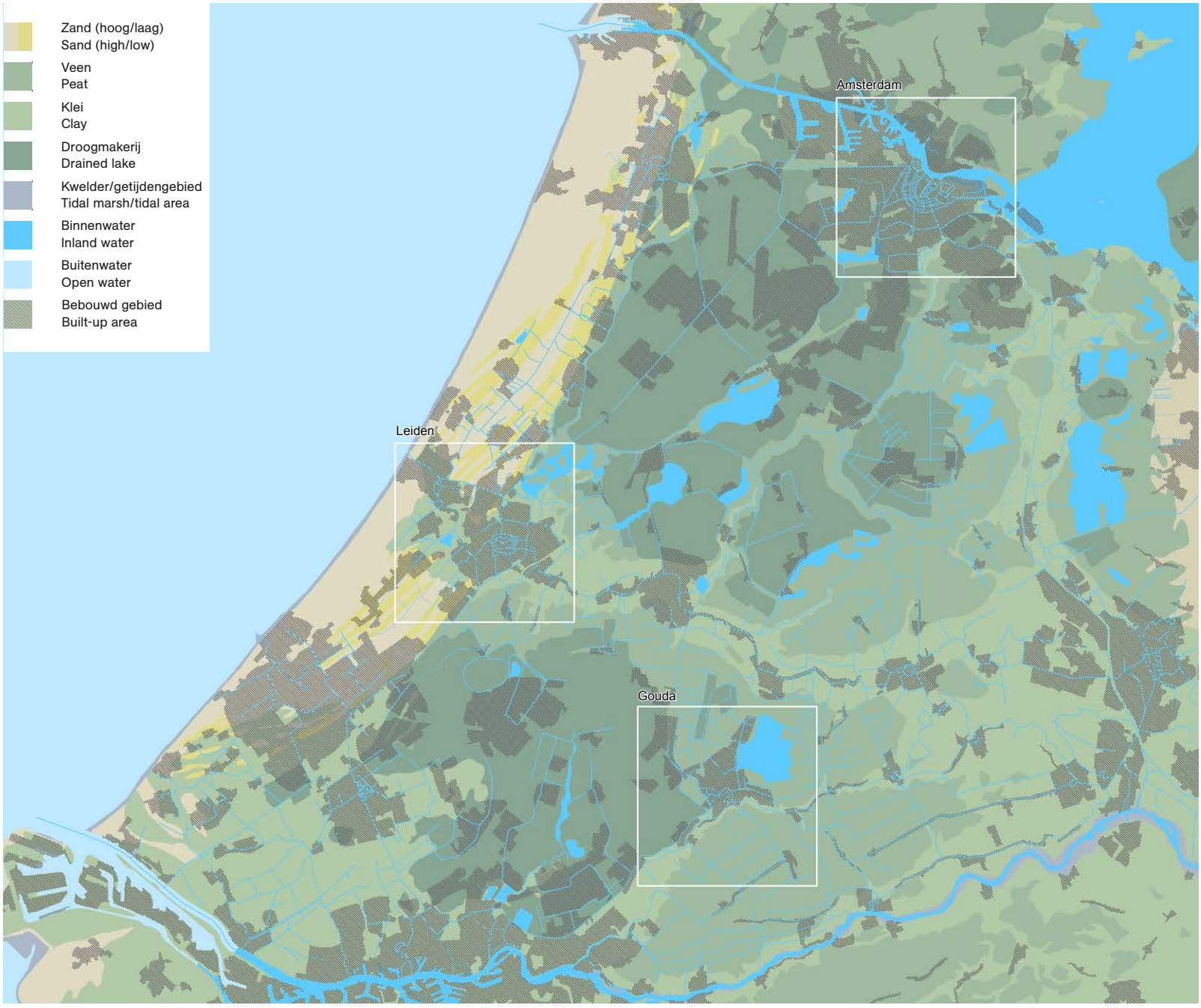


001
Polderkaart van de landen tusschen Maas en IJ door W.H. Hoekwater uit 1901.

001
Polder map of the lands between Maas and IJ by W.H. Hoekwater, 1901.

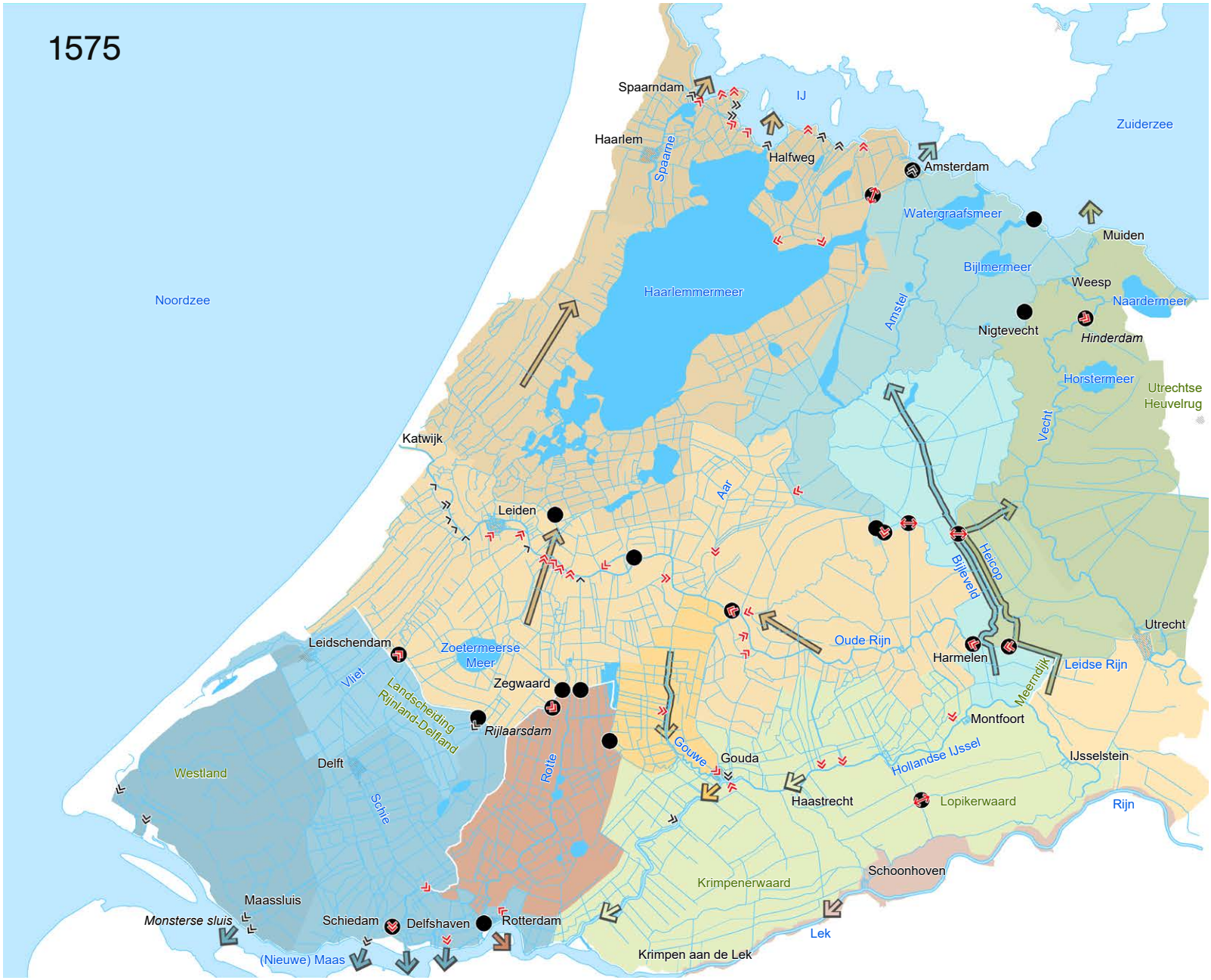
002
Stroomgebieden van Schelde, Maas, Rijn en Eems.

002
Catchment areas of Schelde, Maas, Rhine and Eems.



003
Landschap en bebouwing in Holland, 2015.

003
Landscape and built-up area in Holland, 2015.



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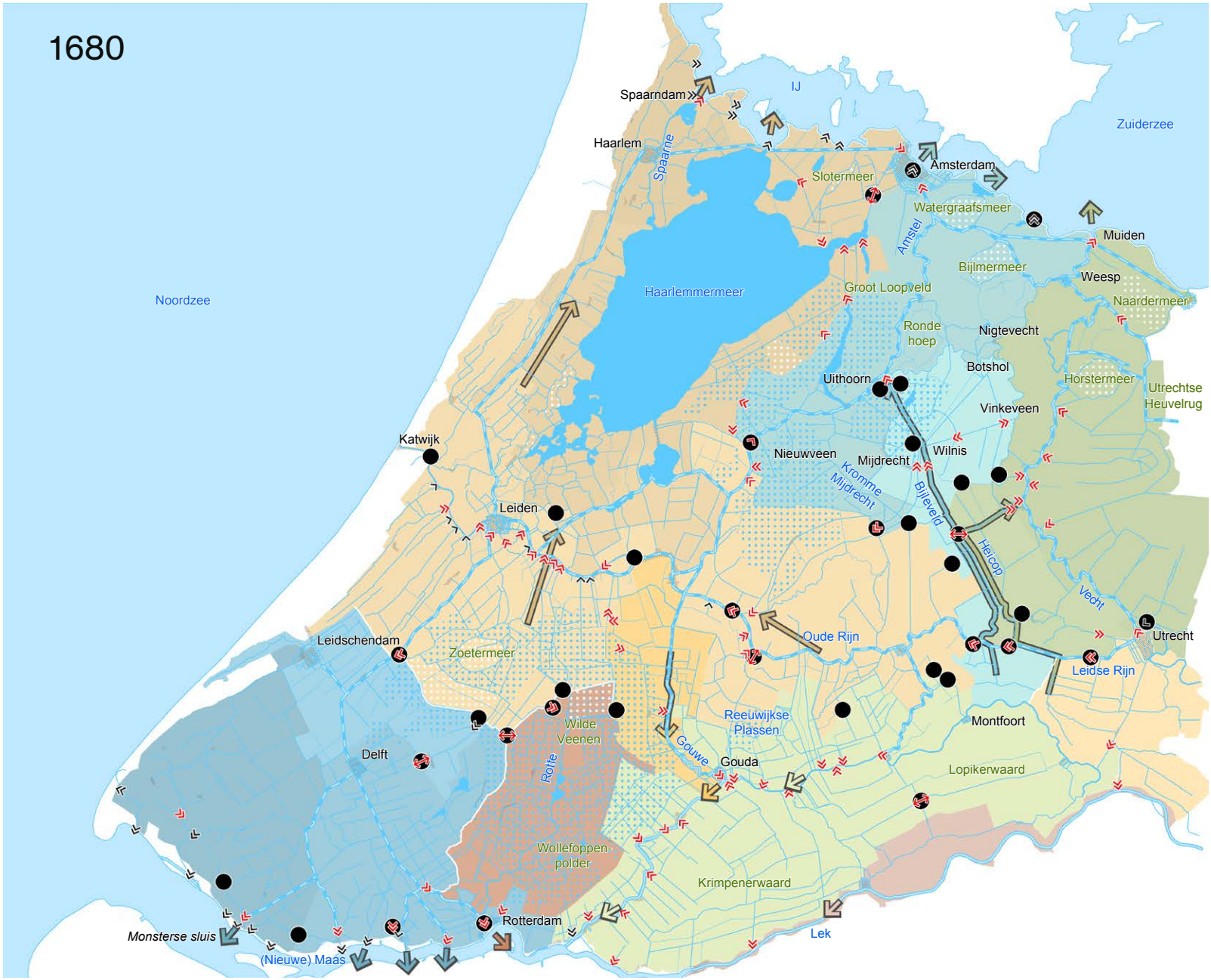

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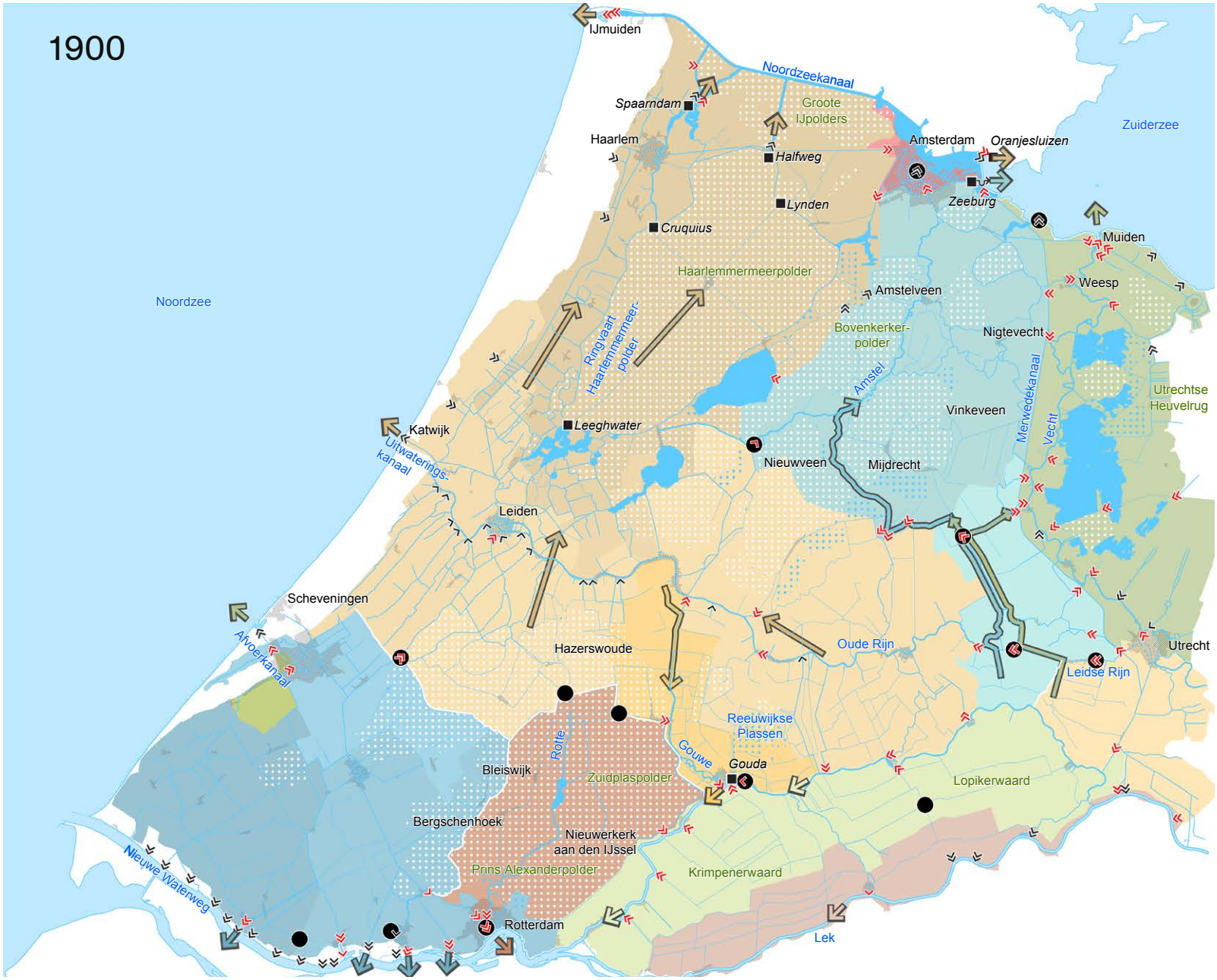

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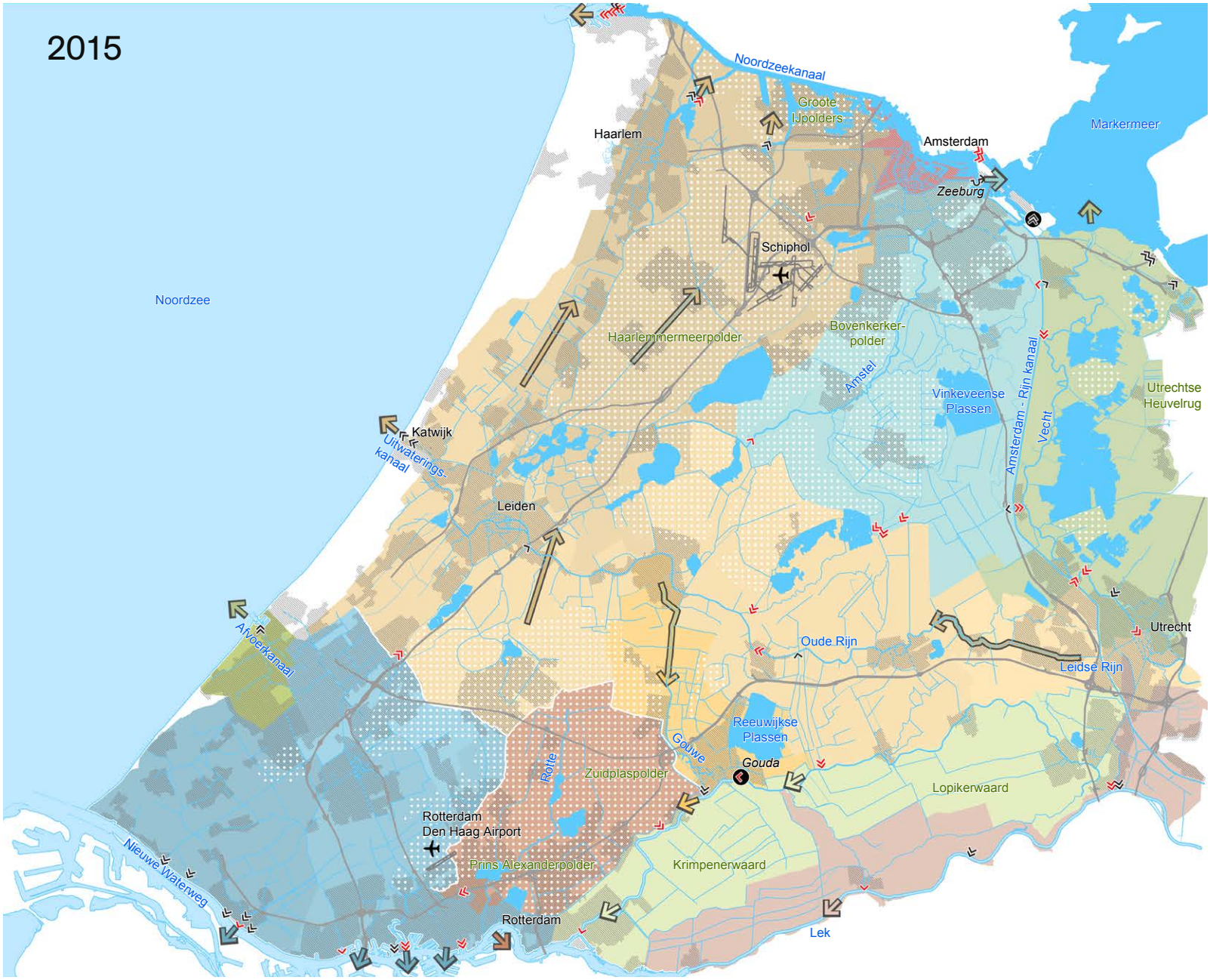

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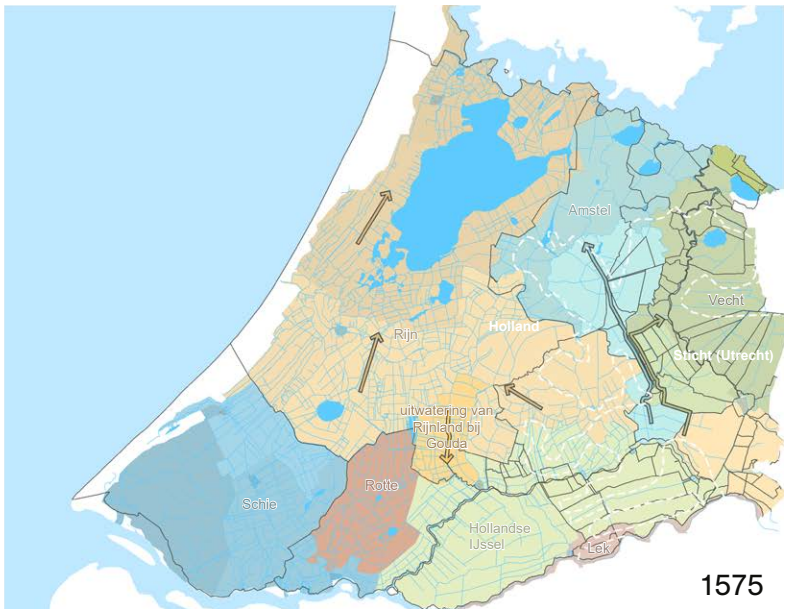

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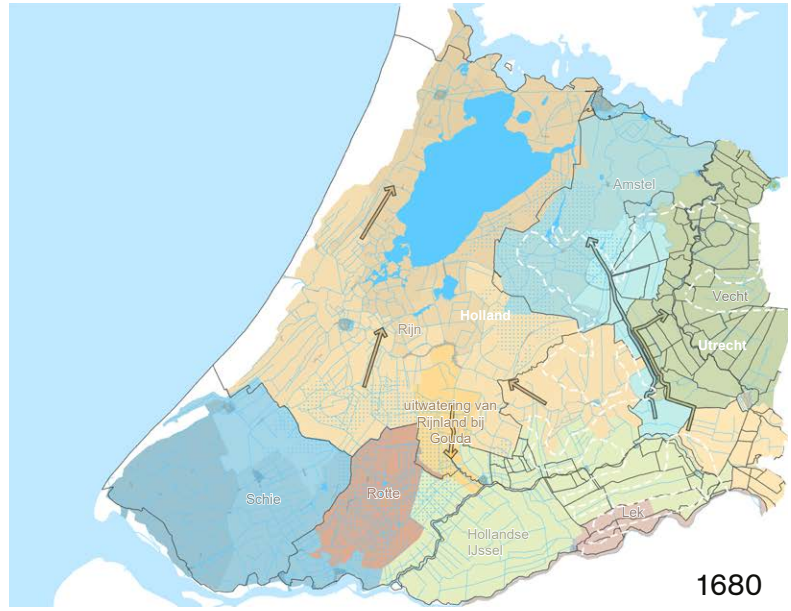

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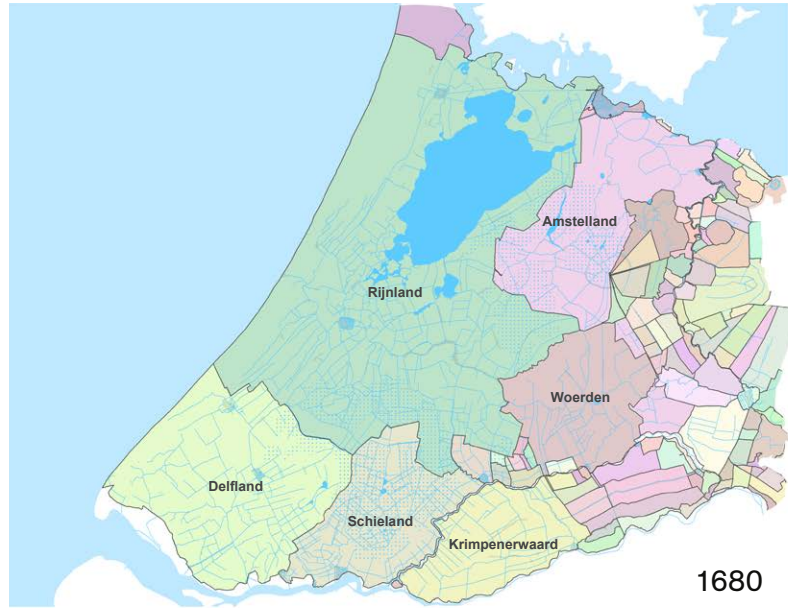

012
Uitwateringsgebieden en bestuurlijke grenzen 1575.
013
Waterschappen 1575.

014
Uitwateringsgebieden en bestuurlijke grenzen 1680.
015
Waterschappen 1680.

012
Drainage areas and administrative boundaries 1575.
013
Water boards 1575.

014
Drainage areas and administrative boundaries 1680.
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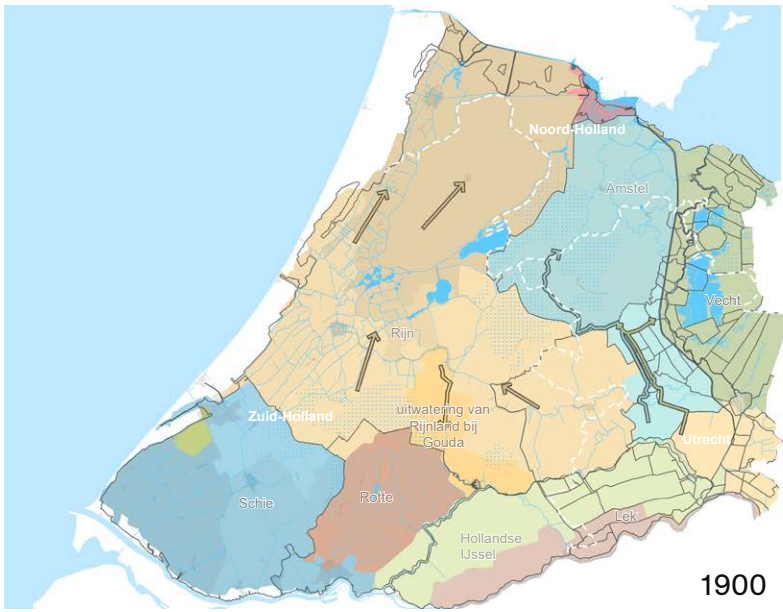
Water boards 1680.

016



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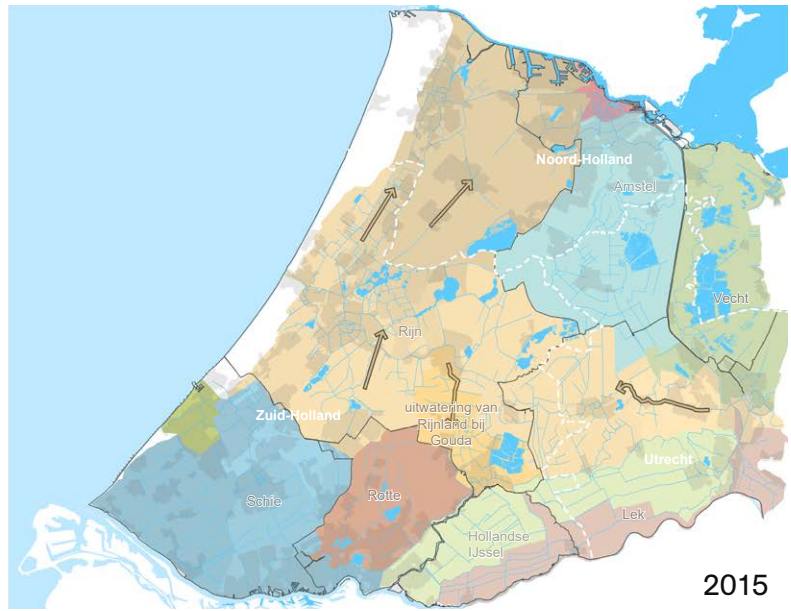

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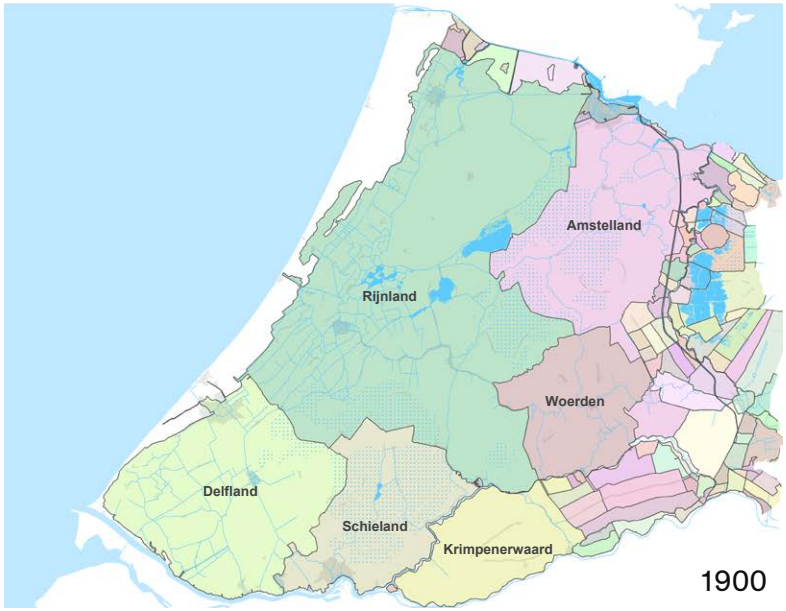

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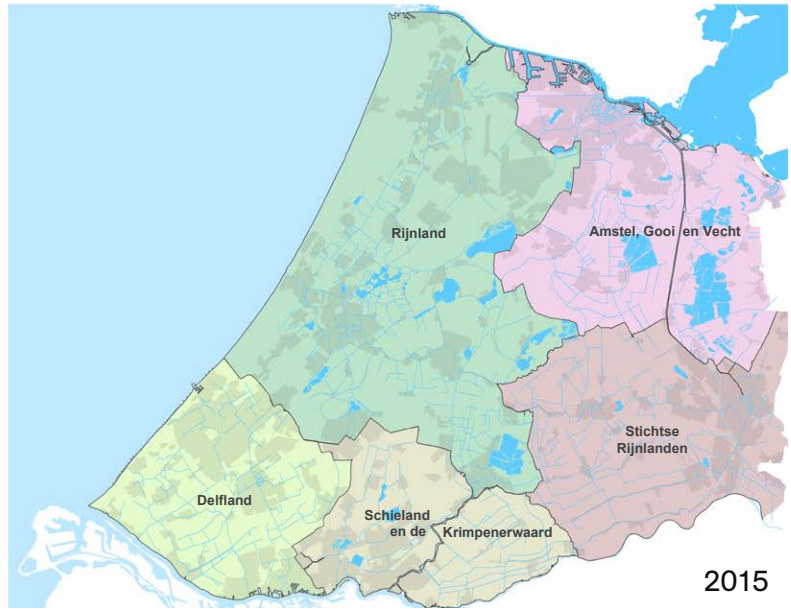

016
Uitwateringsgebieden en bestuurlijke grenzen 1900.
017
Waterschappen 1900.

018
Uitwateringsgebieden en bestuurlijke grenzen 2015.
019
Waterschappen 2015.

016
Drainage areas and administrative boundaries 1900.
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Water boards 1900.

018
Drainage areas and administrative boundaries 2015.
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Water boards 2015.