

Initiation of dike-construction in the German clay district

Johannes Ey,

Lower Saxony Institute for Historical Coastal Research, Viktoriastraße 26/28,
D-26382 Wilhelmshaven, ey@nihk.de

1. Introduction

Before dikes existed in the North German clay district, the earliest housing settlements in the marshes were found on natural levees. Not later than 2000 years ago, dwelling mounds ('wurten') had been established as residential platforms to protect the population and their property against the North Sea.

Later in this paper, the development of medieval dike construction will be shown, as well as methods of reconstructing the course of those early dikes. As well as looking at early diking in various Frisian landscapes of the clay district, we shall also analyse particular examples of diking in three selected regions of the Lower North Sea marshes: Butjadingen, district of Wesermarsch; Wangerland, district of Friesland, both in Lower Saxony; as well as Eiderstedt, Schleswig-Holstein.

2. Building of the first dikes

Archaeological sources show that the first dikes were embankments of clay sods with gentle seaward slopes. Until the 16th century, carriers and wheelbarrows had clearly been used for transporting the sods from their source seaward of the dike to the embankment under construction. It was not until the 17th century that the 'Wüppe' was introduced. This was a three-wheeled cart pulled by horses and designed to tip. Written records of early diking are very poor. The first to refer to dike construction in the North German clay district are the legal statutes of the Frisian people, 'Siebzehn Küren' (Seventeen Elections) of the late 11th century A.D. (Buma and Ebel, 1963, p. 15). However, in these documents, merely the fact of dike building is mentioned, with no evidence of who was in charge of building the dikes, how they were constructed and maintained, the course or size of those early dikes.

According to historical-geographical investigations (see below), there are three main phases: ring-shaped dikes; low dikes taking their course parallel to the streamlets, and at the seaward end, dikes with their course parallel to the coast. The first and the third phases coincided with the construction of early sluices.

As the ring-shaped dike protects only very small areas, we assume it is the earliest phase of dike construction and we can date its construction to the 11th century. It encircled the infield area of each village community, thereby protecting its arable land against flooding, it crossed no streamlets. Therefore this early phase of dike construction must have been organised and later on maintained by each wurten village community on its own. Recent research reveals that the water table of the winter storm floods during the 11th century was up to about one metre above the mean high water table (Behre, 2003, p. 15). Those early dikes were probably raised above the surrounding area by about one metre and thus the mean high water table by about 1.4m, so presumably protecting settlements and agricultural land even against the high and more dangerous winter storm floods. Therefore, it must have been necessary to install sluices within these ring-shaped dikes, although these have not yet been discovered.

It is extremely difficult to trace and map those early dikes, since they were built so many years ago and in the meantime most of them have been destroyed by ploughing or digging. However, working with historical maps from the 18th and 19th centuries, the course of a ring-shaped dike at the wurten village of Sillens, municipality of Butjadingen, district of Wesermarsch, was reconstructed by analysis of the field-patterns (Krämer, 1984). The dike corresponds to the wurten village of Sillens and encloses an area of about 80 ha. These results of the historical-geographical analysis were later confirmed by two archaeological sections (Schmid, 1988). The medieval dike's height of probably one metre had clearly been ploughed down to about 0.2 m today. The medieval surface remains for about 9 m, which corresponds to the original width of the embankment.

Another ring-shaped dike of a similar age as the Sillens embankment was to the west of Jade Bay within the municipality of Wangerland, district of Friesland. It stretched west of the shoreline of the previous Crildum marine bay and could be traced both by analysis of field-patterns (Nitz and Jachens, 1993, which however gives an outdated

state of research) and – for the first time within Lower Saxony – by digital terrain modelling (Ey, 2007). This approach revealed different levels in topography caused by the deposition of sediment inside the ring-shaped dike. Even very low linear remnants of embankments can often be traced by digital terrain modelling. Here, at least two phases of diking can be traced (Fig.1), the older one matching the wurten villages of Oldorf and Neuwurten and enclosing an area of about 80 ha just like at Sillens. The newer phase encircles an area of more than 300 ha and extends the protected fields by more recently reclaimed marshland in the area bordering the previous Crildum Bay. The width of the embankment's older stage would have been similar to that of the Sillens dike.

About 1 km to the west of Oldorf, the medieval farmers of the wurten village of Pievens had also built a ring-shaped dike. Nearby, and just south of that bay, are some more examples of ring-shaped dikes around the wurten villages of Haddien and Tünnen. Again, two phases of diking can be identified by digital terrain modelling (Fig.1). Only a few km to the south, within the municipality of Wilhelmshaven, medieval ring-shaped dikes were identified by the historical-geographical methods of field system analysis and interpretation of place names (Reinhardt, 2003). Thus, in the western part of the town, the line of a ring-shaped dike matched the wurt of Hessens. Another ring-shaped dike in the eastern part of Wilhelmshaven enclosed the wurt of Heppens. In Schleswig-Holstein, the Danish scholar Saxo Grammaticus refers to low embankments in the marshes around 1200 AD. Archaeological investigations and aerial photos of the peninsula of Eiderstedt revealed, amongst other things, a ring-shaped overflow dike from the 12th century which protected the polder 'St. Johannis Koog' (Meier, 2001, part 2, Fig. 53 et seq.; Meier, 2001, part 1, Tab. 13, 1–2; Fig. 67, stage 6; Meier, 2001, supplement 36.1). In Northern Frisia on the island of Pellworm, the medieval dike 'Schardeich' remained, protecting the polder 'Großer Koog' since around 1200 AD. (Kühn, 1992, p. 31).

3. Construction of low dikes

The second type of embankment, low dikes ('Sietwendungen'), was built from the 12th century and relates to the medieval colonization of the fenlands around Bremen. The technical term 'Sietwendung' corresponds to the Dutch 'Zijtwende' – a term in use from the 11th century – and denotes an early dike orientated rectangularly to the main stream (Renes and van de Ven, 1989, Fig.25). Those dikes had been designed to channel the out-flow-

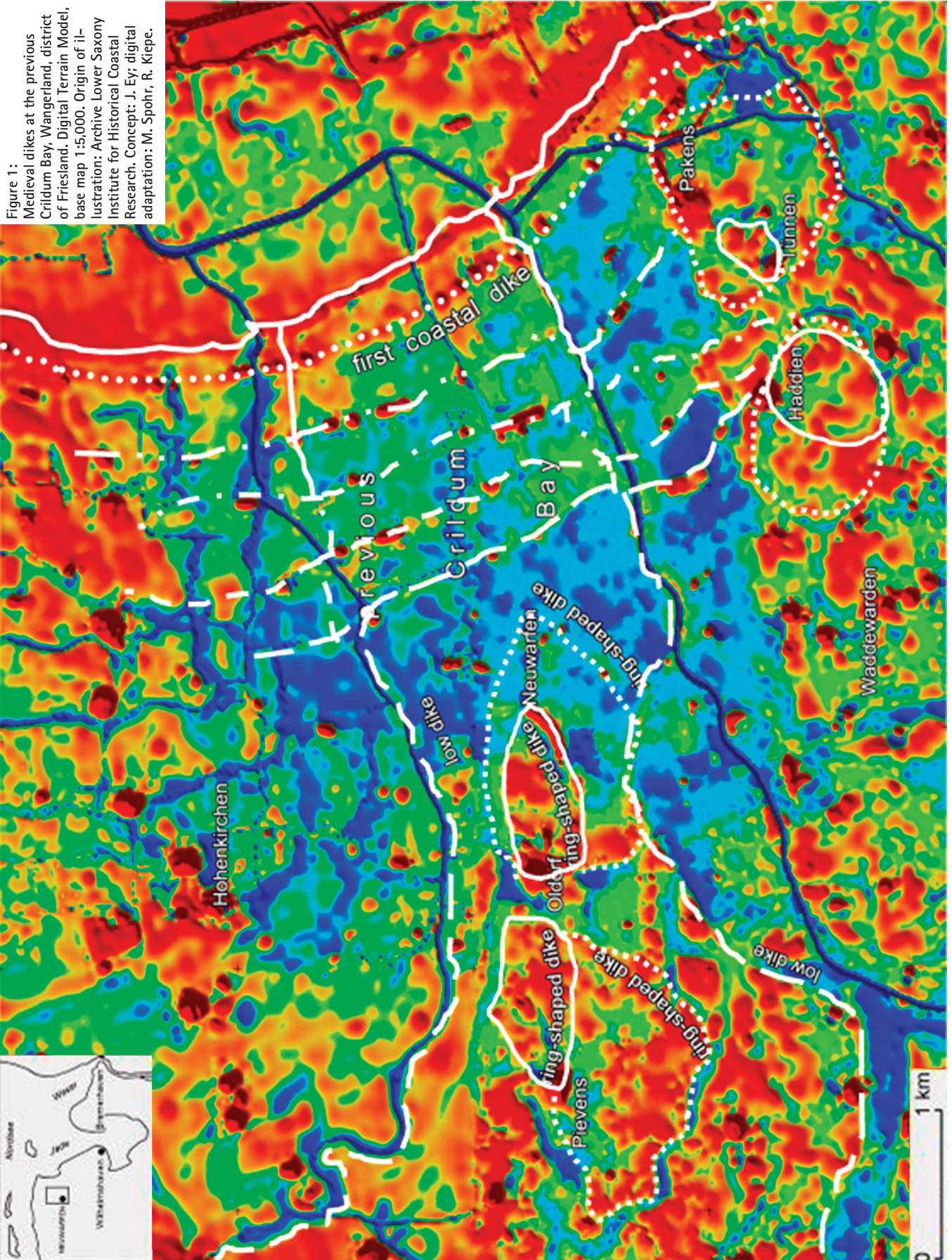
ing waters from the geest and bog areas, which is why it generally takes its course rectangularly to the later coastal dikes. As the 'Sietwendungen' usually match the parish boundaries, they serve as a watershed between them. Therefore the construction of the 'Sietwendungen' must have been organized and later maintained by one or two parish communities. After the coastal dikes had been built (see below), the 'Sietwendungen' served as wing-dikes which prevented flood waters from entering the area from the neighbouring parish after a breach. Since most of the old 'Sietwendungen' have been ploughed or dug, they can now be traced only by field or path names, or as a boundary between plots of land. Thus in the clay district of 'Land Hadeln', south of the Elbe river, a 'Sietwendung' named 'Langen-Acker' can be traced by field-system analysis; another one is named 'Warnings Acker-Weg' (Ey, 2000, p. 18).

One of very few excellently conserved examples in Lower Saxony is the 'Sietwendung' running parallel to the streamlet of 'Poggenburger Leide' (Fig.1) within the northern part of the previous Crildum marine bay in the Wangerland. It has been well preserved to a length of 160 m, raised above its surroundings by 0.65 m, with a basal width of about 10 m (Ey, 1998). The course of this west-east running 'Sietwendung' is divided into sections by northward and southward turnings of the dike. This leads to the conclusion that from west to east there had been at least four stages in construction of the 'Sietwendung'.

4. Diking of marine bays

As a result of the growing population during the High Medieval Era, it became necessary to enlarge the area available for agriculture. This was achieved mainly by diking marine bays. In the clay district of Wangerland, the Crildum Bay silted up very early, from the Early Medieval period. According to archaeological studies, its western parts seem to have been diked since the late 11th century, which must be contemporaneous with the early – westward – stages in setting up the 'Sietwendung'. Building such dikes which cut off tidal outlets paved the way for the construction of coastal dikes, which – embracing all Frisia – ran parallel to the shoreline and rose above the winter storm tide water table.

According to a postscript in the 'Asegabuch', a Frisian legal statute, such dikes along the North German coast were built from the 13th century (Buma and Ebel, 1963, p. 90 et seq.). However, the documents give no hint of who built the dikes nor what the course and size of these embankments was. As we know by archaeological sections across



some well preserved medieval dikes in the German Federal State of Schleswig-Holstein, these dikes had a gentle seaward slope. This is demonstrated by a dike from the 15th century on the peninsula of Eiderstedt (Meier, 2001, part 1, Tab. 13, 2; Fig. 67, stage 7; Meier, 2001, supplement 36.1).

On the North Frisian mainland, in the 15th century, the first coastal dike was built at the 'Wiedingharde' (Meier, 2001, part 2, p. 119, Fig. 62). South of Eiderstedt, a coastal dike had been built in Dithmarschen from the 13th century (Meier, 2001, part 2, Fig. 69 et seq.). Even in today's tidal flats of North Frisia, remains of medieval dikes close to the 'Hallig Südfall' had already been mapped in the first half of the 20th century (Kühn, 2007, Fig. on p. 268). In the clay district of the Lower Saxon 'Land Hadeln', construction of early coastal dikes is presumed to have started in the early 13th century (Ey, 2000, p. 17). In 'Wesermarsch', remains of a late medieval dike have been investigated. At Stollhammer Ahndeich, a municipality of Butjadingen, the transect through such an embankment revealed an early coastal dike, which was raised above its previous surroundings by about 1.90 m. It is dated earlier than 1362 A.D. (see below; Brandt 1984, pp. 58, 62) and, like the ring-shaped dikes, it must have been equipped with sluices for controlling effluent waters. West of Jade Bay, in the clay district of Wangerland, a coastal dike from the earliest phase, i.e. the 13th century, can be traced both by field-pattern analysis (Nitz and Jachens, 1993) and by digital terrain modelling (Fig. 1; Ey, 2007). Within the municipality of Wilhelmshaven, an early coastal embankment, presumably from the 12th century, has been reconstructed by historical-geographical analysis, connecting the ring-shaped dike systems of Hessens and Heppens (Reinhardt, 2003). It matches the paths of 'Ebkeriege', 'Kopperhörner Reihe' and 'Heppenser Reihe', which later on became roads. In the far northwest of Lower Saxony – the East Frisian clay district of 'Krummhörn' – the bay of Sielmönken must have silted up during medieval times. Historical-geographical examinations have shown that it had been rediked by the 13th century (Reinhardt, 1965).

5. Organisation of dike construction

The Sietwendungen reveal a transition from the locally built ring-shaped dikes to the much more extensive system of coastal dikes which had been constructed from the High Medieval Era in the period of the Frisian Republics of Farmers ('Friesische Landesgemeinden'. While each

Sietwendung was probably built by only a few parish communities, the raising of coastal dikes must have been organized on a larger scale by the Frisian Republics themselves, representing all parishes of the region.

Since medieval times, in order to maintain the coastal dikes, the technique of personal, segmental diking was in use. Everybody whose plot was sheltered by the embankment was responsible for a defined section of the dike ('Deichpfand'), the length of which corresponded to the size of the owner's plot. That system applied to routine maintenance as well as to repairs to the dike after storm floods. However, this ran the risk of some owners neglecting their duty, thereby jeopardising the dikes. Therefore, there had to be a change towards communal diking ('Kommuniondeichung'). This did not happen everywhere simultaneously, but continued for several centuries. In the marshes of Land Hadeln, district of Cuxhaven, which previously were part of the Duchy of Sachsen-Lauenburg, it did not happen until the 17th century (Peche, 1931, p. 39 et seq.). There, the parishes in the low-lying marshes ('Sietland') far from the coastal dikes were the first to switch to the new technique. Later on, the parishes of the highly upsilted marshes close to the seaward embankment adopted that system of maintenance. In the marshes westward of the river Weser, district of Wesermarsch, which were previously part of the Duchy of Oldenburg, that change took place from the first half of the 18th century onwards.

Generally, construction of coastal dikes resulted in a severe problem. It blocked the water seaward of the embankment, thereby artificially raising the water table particularly during phases of storm floods. This increased the danger of dike-bursts and, as a consequence, of the marshes behind it being flooded.

6. Sluices

The oldest sluice found in a coastal dike in Lower Saxony was uncovered from the previously-mentioned late medieval embankment at Stollhammer Ahndeich in 1982 (Brandt 1984, Tab. 1). Apparently, the storm flood of Saint Marcel's Day (St. Marcellus) on 16th February 1362 damaged the sluice so badly that it no longer worked. The wooden construction, at least 14 m long, is assumed to have been built before 1362, perhaps around 1300 A.D., but this very rough calculation has to be taken with a pinch of salt. Its seaward section was made of a hollowed oak trunk about 10.5 m long, with an internal width of approx. 0.8 m at its mouth. Its flap lowered automatically at high tide to prevent the rising water from flowing

inland. The sluice's landward part consisted of a channel made of oak, which was open with a weir and a slide for regulating the water table in the ditches inland. The internal width of the channel was about 1.5 m and the level fell by 0.8 m from the landward side to seaward.

The captains ('Hauptlinge'), i.e. Frisian rulers of a very small territory, may have organised the construction of the late medieval dikes, and have been responsible for the construction of the contemporaneous sluices too. East of the river Weser, the sluice 'Wehldorfer Schleuse' was found in the 'Alter Hadler Seebandsdeich'. This medieval dike is running parallel to the river Elbe to the east of Cuxhaven. The sluice's tunnel was made from oak, with a square cross section. Dendrochronological dating revealed a date of 1418 A.D. In Schleswig-Holstein an even older wooden sluice from Rungholt, Northern Frisia, has been recorded. It was built no earlier than around 1200 and had two pipes, each with a width of 1.30 m, and a length of 20.50 m (Kühn, 1992, p. 78).

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