

**DELOS – EVK3-CT2000-0041**  
**Deliverable No 5 for WP1.1**  
**LCS in NL**  
**Based on the brief questionnaire**

This document summarizes the information collected for DELOS WP1.1 “Inventory of engineering properties of LCS”.

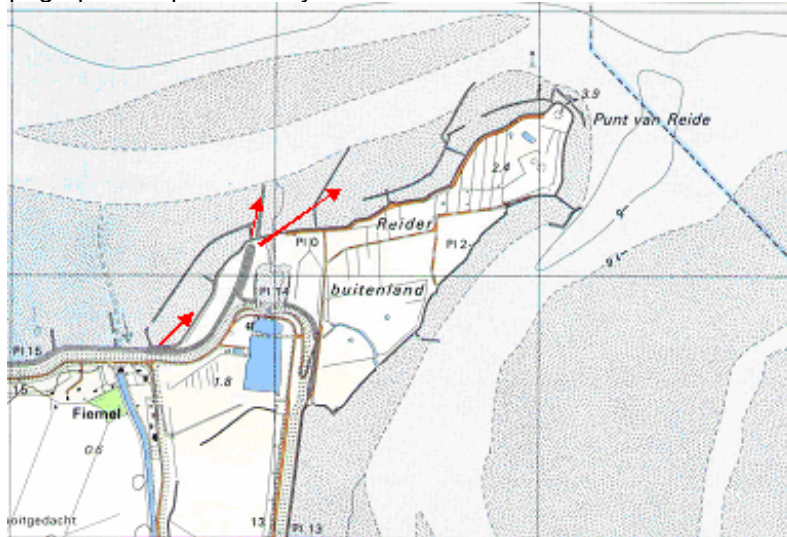
NL Map.....	2
INF_NL_001, LCS at Punt van Reide .....	3
INF_NL_002, Pollendam.....	5
INF_NL_003, West Terschelling .....	7
INF_NL_004, LCS at Ameland .....	9
INF_NL_005, Normerven.....	10
INF_NL_006, Napoleon dam .....	11

## NL Map



### INF\_NL\_001, LCS at Punt van Reide

One square on the topographic map is 1 km by 1 km. All information is based on this map only.

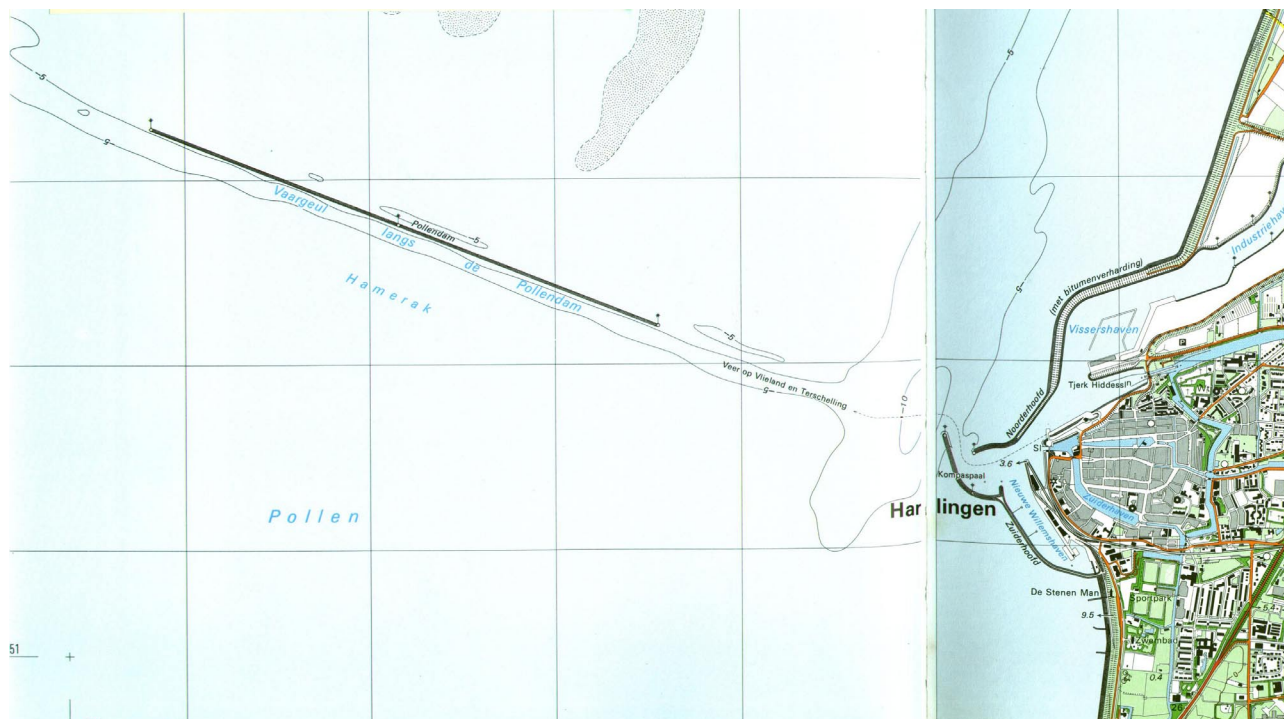




No more information available yet. Jentsje van der Meer, INF will provide more information.

## INF\_NL\_002, Pollendam

Situated along the navigation channel from Harlingen to the islands of Terschelling and Ameland, in the Waddensea. One square on the topographic map is 1 by 1 km<sup>2</sup>. Detailed information from B.J. Kemper, Directie Noord-Nederland, Onderafdeling Waddenzee.



### Main motive for building the LCS

The LCS was built 100 years ago. The design intention was that currents would make a navigation channel through the bank system "The Pollen" in order to make navigation to Harlingen easier. The prediction was that the channel would be developed at the north side of the LCS. Nature decided different and a fairly deep channel developed along the south side. The main and only motive of the LCS is protection of the navigation channel.

### Impacts on bio-environment

It is a long LCS in the middle of the Waddensea. There is no real impact on the bio-environment, possibly the LCS itself contains some life, but that will be all.

### Socio-economic impact

The structure fulfils its function good. Without the structure the navigation channel would require dredging. In that sense there is an economic impact.

### System Layout (dimensioned sketch)

About 4.5 km long in total, see topographic map. Along the navigation channel. The channel is up to 12 m deep.

### Typical cross section (dimensioned sketch)

The structure was originally built with willow mattings and rock. The base was founded at about  $-3.5$  m to  $-4$  m. The crest level is about at  $-0.3$  m. The two ends (both about 800 m long) have a height of  $-2$  m. The slopes are about 1:1.5. Due to scouring at the navigation channel, this south side became unstable. By maintenance the slope from  $-3.5$  to  $-12$  m has been protected through the years by dumping rock, willow mattings and also geocontainers. New rock has been placed on top and was reinforced by bitumen. The LCS needs quite some maintenance.

**Indication of water level variations**

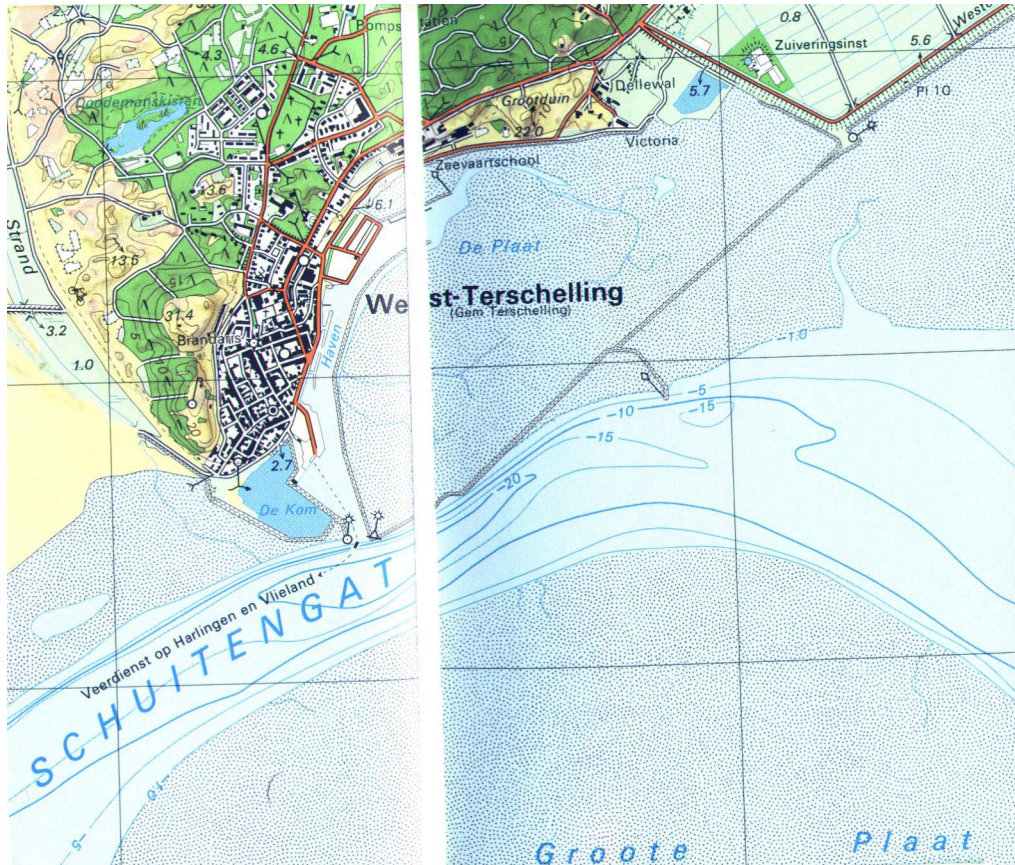
Tidal variation normally between -0.5 and +1 m. Storm surges yearly can come up to +2.5 m.

**Existence of detailed information**

Quite some information has been obtained. As the structure is not related to the coast and has almost no ecological effects, it is not an interesting structure for DELOS.

## INF\_NL\_003, West Terschelling

Situated on the south side of the Wadden island Terschelling. Protected by the island for waves from the North Sea. One square on the topographic map is 1 bij 1 km<sup>2</sup>. Detailed information from Mr Swart, Directie Noord-Nederland, Onderafdeling Terschelling.



### Main motive for building the LCS

The LCS was built more than 100 years ago in various phases. At that time the channel or gully went around the corner of the village and staid close to the coast where now the harbour is situated. This gully caused erosion at the *North East* corner. In order to give the gully a location more offshore construction of the LCS was started at the North East point. This part is called "Grote Rijzen of stenen dam". Also with this LCS built half way, the gully staid close to this LCS, still causing erosion of the coast. Then the LCS perpendicular to the existing LCS was constructed, in order to give the gully another direction. This part is called "Vleugeldam" (wing dam). Later on the LCS was lengthened to the entrance of the harbour and also the south corner near village and near the entrance was protected. The lengthened dam is called "Verlengde dam" (lengthened dam). In order to create a harbour without the necessity of dredging, the North-South dam was constructed as the East boundary of the harbour channel. This works as follows: all structures are low and during high tide the whole area is flooded. During low tide all the water has to flow *through* the harbour channel, keeping this channel free from siltation.

### Impacts on bio-environment

Although the motive for building did not take into account the bio-environment (100 years ago!), it had and has quite some impact. The Waddensea itself is already an important bio-environment and the LCS created a small world on its own, different from the neighbouring area. Twice a day the area is flooded and during low tide the area becomes dry (level about +0.3 m). With each tide some silt comes in and the area within the LCS is more silty than outside. In this area the "Large seaweed" is growing as one of the only two places in the Netherlands. Studies have been done by the Biological centre of RIKZ, Haren, on the area and the seaweed.

**Socio-economic impact**

There is a large socio-economic impact. Without the LCS the coast would have eroded in the North East. Further, the LCS made it possible to create a harbour without maintenance dredging. Nowadays, ferries leave and arrive every two hours with in summer thousands of tourists visiting the island.

**System Layout (dimensioned sketch)**

The system is shown on the topographic map. The deep channel Schuitengat makes it able for ferries to enter the harbour.

**Typical cross section (dimensioned sketch)**

Originally built with willow matting covered with rock or bricks. Core probably clay. LCS covered with placed block revetment, later on injected with combination of concrete and asphalt. Low maintenance. The crest height is about +0.8 m, this is close to mean high water.

**Indication of water level variations**

Tidal variation normally between -0.5 and +1 m. Storm surges yearly can come up to +2.5 m.

**Existence of detailed information**

Some old drawings of the LCS still exist. Furthermore, a good number of studies have been performed on ecological aspects of this area.

From a technical point of view the LCS is not very interesting. But there are large impacts on the bio-environment and economics. It is an interesting case.



## INF\_NL\_004, LCS at Ameland

Situated on the Northwest coast of one of the Dutch islands. One square on the topographic map is 1 km by 1 km. Information is based on this map and on a telephone call to the owner of the structure, Mr Overdiep of the Dienstkring Ameland.

### Main reason for building the LCS

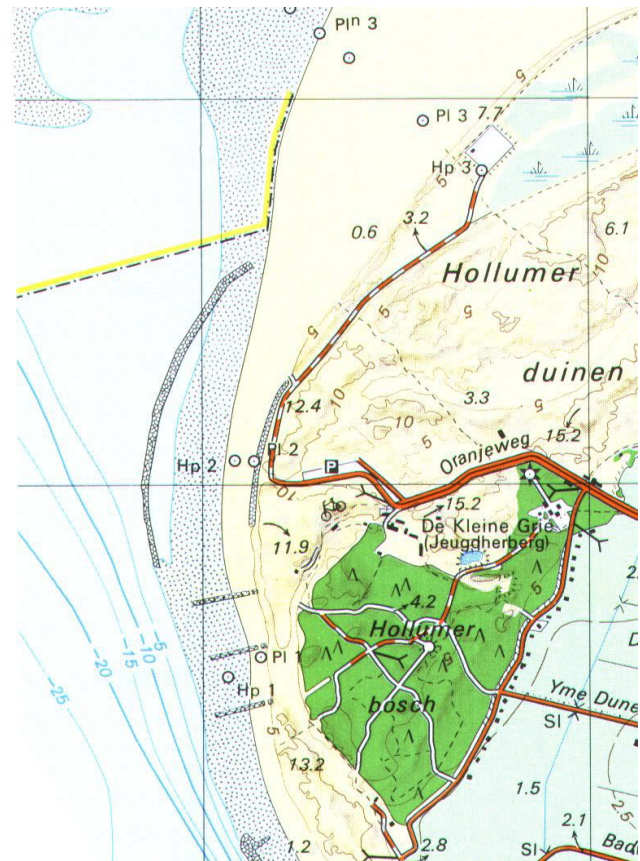
LCS built in 1979 as submerged structure to protect the beach from erosion. Since last decade the beach has been nourished every 3 years. In such a case the beach is filled up to the LCS, the perched beach system. Seaward of the LCS it quickly becomes deeper. This point of the island is critical with large morphological changes. Sand disappears to the north as well as to the south. From 1947 – 1974 the foreshore slope south of the LCS has been protected by rock 40-200 mm up to 60-300 kg. After nourishment this protection is covered by sand.

### Impacts on bio-environment

There is hardly any bio-environment. The nourished sand contains little life and this sand disappears within 3 years. May be some mussels. The LCS itself is partly covered by sand.

### Socio-economic impact

Protection of beach is one of the main functions. The main function is to protect the area for large erosion. With the nourishment the beach is used for recreation.



### System Layout (dimensioned sketch)

See map, is on scale. After nourishment the LCS acts as a perched beach. Steep offshore foreshore slope due to high currents.

### Typical cross section (dimensioned sketch)

Not available. Probably armoured with block revetment as many other groynes in Holland.

### Indication of water level variations

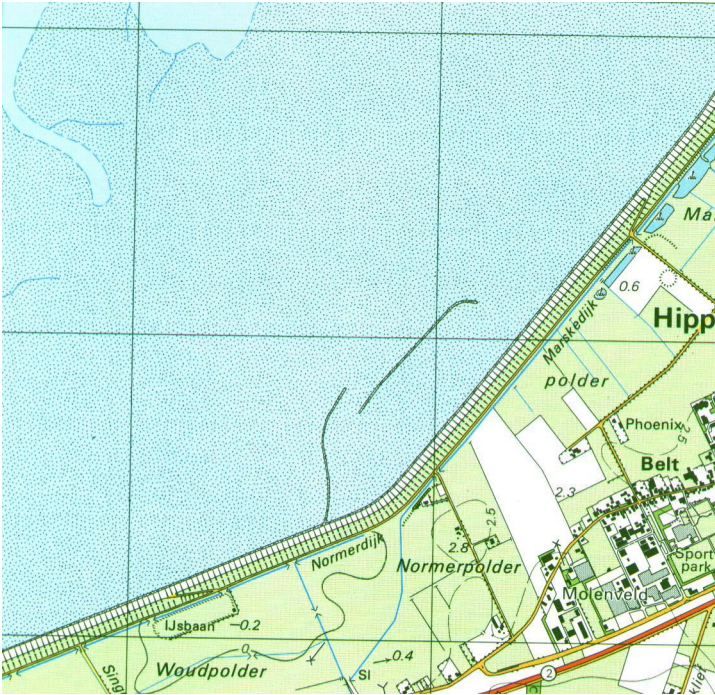
About 1-1.5 m tide. Storm surge max. every year around 2.5-3 m.

### Existence of detailed information

Maintenance only if “holes” become present in the crest, which is only now and then. More information is not known. Due to the fact that most of the time there is no water behind this structure and the (nourished) beach has hardly any biological life, it does not seem to be an interesting site for DELOS.

## INF\_NL\_005, Normerven.

Situated along the North coast of Noord-Holland, in the Waddensea. One square of the topographic map is 1 by 1 km<sup>2</sup>. Information from a telephone call with Mr. D. Rackhorst of Directie Noord-Holland.



### Main motive for building the LCS

Protection of the saltings or mud flats behind the LCS.

### Impacts on bio-environment

Not know yet, but the structures were built to protect interesting bio-environment.

### Socio-economic impact

Not know yet. Maybe area interesting for tourist to visit.

### System Layout (dimensioned sketch)

See topographic map.

### Typical cross section (dimensioned sketch)

Not known yet.

### Indication of water level variations

As the whole area of the Waddensea, tidal variation around -0.5 and +1 m. Yearly storm surges up to +2.5 m.

### Existence of detailed information

There is more information and Mr Rackhorst promised to collect and send more information within two weeks.

## INF\_NL\_006, Napoleon dam

Situated at the boundary between the North Sea and Waddensea, close to the harbour of Den Helder in the North part of Noord-Holland. Information from telephone call with Mr D. Rackhorst from Directie Noord-Holland.



### Main motive for building the LCS

The structure is located East-West in the Waddensea and is connected to the land on the West side. It was built a long time ago, initiated by Napoleon. At that time the harbour was developed with a main channel from the North Sea (at North West point) to the Waddensea (at South East point). There was an open connection between North Sea and Waddensea through this channel. In order to reduce or prevent dredging the LCS was built. With the LCS a larger current during low tide was created in the channel. This worked well, but between 1950 and 1960 the harbour was further developed and was closed. From that time on the LCS has no function anymore. A hole was made in the LCS, close to the coast, in order to let a gully develop along the coast.

### Impacts on bio-environment

No impacts. No difference between North and South side of LCS.

### Socio-economic impact

Not anymore, only during time when the harbour was open on both sides.

### System Layout (dimensioned sketch)

See topographic map. Straight LCS perpendicular to the coast.

### Typical cross section (dimensioned sketch)

Not known.

### Indication of water level variations

Probably tide between  $-0.5$  and  $+1$  m. Yearly storm surges around  $+2.5$  m.

### Existence of detailed information

May be more information is available, but the structure has no function anymore and has no impact on bio-environment. Therefore, it is not an interesting structure for DELOS.