

BATTLE AGAINST THE SEA

Much of the Netherlands is below sea level, in some places 20 feet below, a vast outwash where three major European rivers wind their way to an often violent North Sea. Not surprisingly, water management is a national religion, and today the Netherlands is the global gold standard in flood control.

THE PROBLEM
The hazard of so much land below sea level was worsened by long estuaries historically penetrating the Netherlands' ragged coast.

Map showing the Netherlands' coastline and major rivers (Rhine, Meuse, Scheldt) flowing into the North Sea. A legend indicates: Dunes (white), Sea flooding area (red), River flooding area (orange), and Surge (black arrows). Major cities like Amsterdam, Rotterdam, and Antwerp are marked. A 20-mile scale bar is provided.

PROTECTING THE NORTH
In 1932, the Dutch dammed the Zuiderzee with a rampart more than 20 miles long, closing off a storm-surge highway that led straight to Amsterdam.

Map showing the location of the Afsluitdijk dam across the Zuiderzee. Callouts state: "The Afsluitdijk dam was built in 1932 to stop storm surge" and "Land was then reclaimed from the Zuiderzee". Major cities like Amsterdam, Rotterdam, and Antwerp are marked. A 20-mile scale bar is provided.

DISASTER IN THE SOUTH
The catastrophic 1953 flood pointed out the extreme vulnerability of the nation's southwest flank and triggered a change in flood-control philosophy.

Map highlighting the area affected by the 1953 flood in the southwest Netherlands. Callouts state: "The Afsluitdijk dam protects the northern area" and "In 1953, a spring tide and a powerful storm combined to flood about 500 square miles and kill 1,835 people". Major cities like Amsterdam, Rotterdam, and Antwerp are marked. A 20-mile scale bar is provided.

THE SOLUTION

To secure southwest Netherlands against flooding, the Dutch opted to cut off key waterways and thus block storm surge at the source rather than continually having to raise the height of the levees. The Delta Works Project led to a variety of innovative barriers placed at the mouths of estuaries that cut deep into the nation's interior.

ZUIDERZEE WORKS PROJECT

Map showing the Zuiderzee Works Project. Callouts include: "Afsluitdijk Dam: Completed in 1932 to block storm surge from entering the mainland through the Zuiderzee, later renamed Lake IJssel." and "Markerwaard Dike: Completed in 1976 to create new land in an area to be called Marken, as had been done with Flevoland, until environmental groups halted the plan to drain the new lake." A "WATER KEY" indicates Saltwater (blue), Brackish (green), and Freshwater (light blue). Major cities like Amsterdam, Rotterdam, and Antwerp are marked. A 20-mile scale bar is provided.

DELTA WORKS PROJECT

Map showing the Delta Works Project with numbered callouts 1 through 9. Major cities like The Hague, Rotterdam, and Antwerp are marked. A 20-mile scale bar is provided.



1 HOLLANDESE IJSEL STORM SURGE BARRIER
Storm surge barrier protects the lowest region of the Netherlands. Two enormous doors span the 260-foot wide structure, suspended between two towers. When water levels rise too high, the doors are lowered and dam the river.
Completed: 1958



2 MAESLANT STORM SURGE BARRIER
Storm surge barrier protects Rotterdam. Huge gates — each nearly as wide as three football fields — sink into the shipping channel after they swing shut. Generally, though, they stay open. The structure is expected to be used once or twice a decade.
Completed: 1997



3 HARINGVLIET DAM
Open dam prevents flooding while also allowing drainage between two key rivers and the North Sea. When levels near Rotterdam get too high, drainage sluices remove excess water. The structure includes tunnels to allow fish to swim to and from the North Sea, even when the dam is closed.
Completed: 1970



4 VOLKERAK DAM
Dam built primarily to aid in the creation of other dams. It prevents too much freshwater from flowing into the brackish waters of the Zeeland and includes a lock to facilitate shipping between Antwerp, Belgium, and Rotterdam.
Completed: 1969



5 BROUWERS DAM
To create the dam, sandbars were enlarged, giant caissons were sunk then filled with sand, plus more than 660,000 tons of enormous concrete blocks were plunged into the sea. The dam, however, blocked tidal flow, destroying the area's character. In 1978, a sluice was built into the dam to restore salinity levels.
Completed: 1971



6 GREVELINGEN DAM
Nearly 4-mile dam created across sandbars to facilitate construction of other dams in the area and to prevent water from manmade lakes created by the other dams from flowing back toward the sea.
Completed: 1965



7 EASTERN SCHELDT STORM SURGE BARRIER
Originally envisioned as a dam, plans were completely revised, partly because of unintended environmental changes wrought by the Brouwers project. The dam would have destroyed oyster farming and decimated the fishing industry. The partially built structure was modified into a barrier with a series of giant doors that slide shut during a storm.
Completed: 1986



8 VEERSE GAT DAM
9 ZANDKREEK DAM
Dams designed to connect islands and block key flood pathways. A brackish lake, the Veerse Meer, between two islands was created upon completion of the dams.
*Veerse Gat completed: 1961
Zandkreek completed: 1960*

