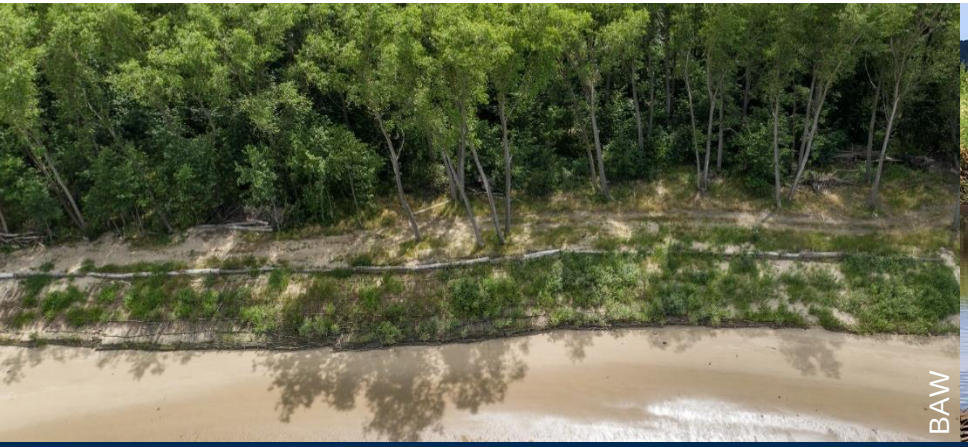
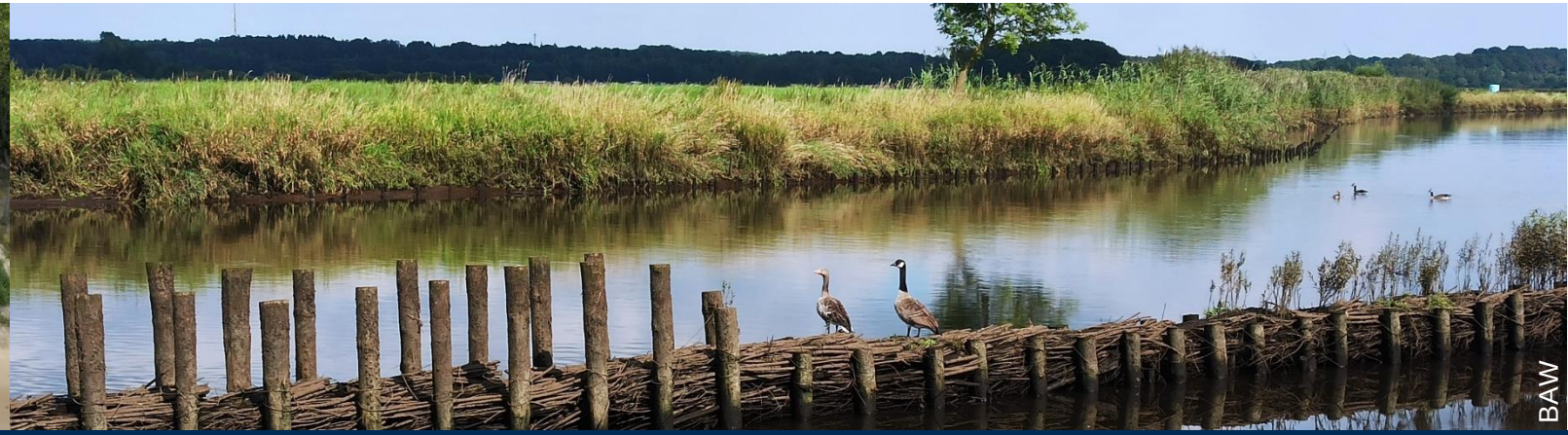




Federal Waterways Engineering and Research Institute & Federal Institute of Hydrology

Nature-based solutions for bank protection in estuarine waterways

Collection of measures in tidal areas

30.04.2026
Version: 4

Content

Weser Estuary

Vegetation boxes Lemwerder

- **Km 11,7-17,0** left bank Lower Weser
- **Implementation:** 2015 - 2016
- **Contact**: WSA Weser-Jade-Nordsee: abz-habenhausen@wsv.bund.de
- **Construction design:** During the construction of the new revetment, several vegetation islands made of gabion boxes were integrated into the revetment at intervals of approximately 320 m. The boxes are 4 m x 5 m in size and were installed in the area around mean high tide and higher, so that they are only flooded at higher water levels. The gabion boxes were filled by hand with $LMB_{10/60}$ class stones (aiming for a void ratio of approximately 30%) The vegetation bales from the bank and reed zone were placed in the voids between the stones or after removing individual stones from the filled gabion boxes and weighted down with additional stones. The remaining gaps were filled with a pumpable soil-bentonite mixture.
- **Development:** The vegetation has developed well and various plant species can be found within the vegetation boxes. No major maintenance work has been necessary to date. Occasionally, blackberry plants are removed as they are an invasive species.

Vegetation boxes Schönebeker Sand

- **Km 15,875-17,325** right bank Lower Weser
- **Implementation:** 2018-2019
- **Contact**: WSA Weser-Jade-Nordsee: abz-habenhausen@wsv.bund.de
- **Construction design:** During the construction of the new revetment, several vegetation islands made of gabion boxes were integrated into the revetment at intervals of approximately 250 m. The boxes are 4 m x 5 m in size and were installed in the area around mean high tide and higher, so that they are only flooded at higher water levels. The gabion boxes were filled by hand with $LMB_{10/60}$ class stones (aiming for a void ratio of approximately 30%) The 2-year-old and older vegetation bales from the riparian and reed zone were placed in the cavities between the stones or after removing individual stones from the filled gabion boxes and weighted down with additional stones. The remaining gaps were filled with a pumpable soil-bentonite mixture.
- **Development:** The vegetation has developed well and today, in addition to various reeds and other plants, willows can also be found in the vegetation boxes. No major maintenance work has been necessary to date. Occasionally, blackberry plants are removed as they are an invasive species.

Brushwood training wall at Warflether Sand

- **Km 23,50-24,90** left bank Weser
- **Implementation:** unknown, last maintenance in 2020
- **Contact**: WSA Weser-Jade-Nordsee: abz-farge@wsv.bund.de
- **Construction design:** Brushwood training wall (longitudinal structure consisting of tied fascines) made of hardwood fascines to protect the beach
- **Development:** The training wall is fulfilling its purpose and is maintained in sections. The next maintenance is planned for 2026.

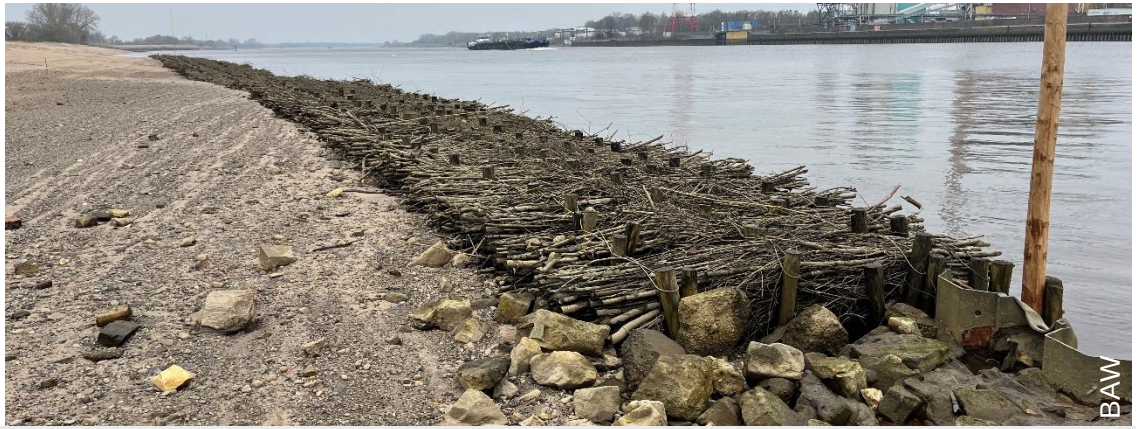
Brushwood groynes at Warflether Sand

- **Km 23,50-24,90** left bank Lower Weser
- **Implementation:** unknown, last maintenance in 2020
- **Contact**: WSA Weser-Jade-Nordsee: abz-farge@wsv.bund.de
- **Construction design:** Brushwood groynes made of hardwood fascines tied to piles
- **Development:** The groynes are fulfilling their purpose and are maintained as needed. The next maintenance is planned for 2026.

Brushwood training wall at Juliusplate

- **Km 25,00-25,50** left bank Lower Weser
- **Implementation:** unknown, last maintenance in 2025
- **Contact**: WSA Weser-Jade-Nordsee: abz-farge@wsv.bund.de
- **Construction design:** Brushwood training wall made of hardwood fascines for beach protection in two sections; gap at the ferry terminal Berne at km 25,35-25,45
- **Development:** The training wall is fulfilling its purpose and is maintained as needed; last maintenance was conducted in 2025.

Brushwood training wall in section 1 at the harbour entrance at km 25,0 in 2014.



Brushwood training wall in section 2 at km 25,45-25,95 in March 2026.

Brushwood groynes at Juliusplate

- **Km 25,00-25,50** left bank Lower Weser
- **Implementation:** unknown, last maintenance in 2020
- **Contact**: WSA Weser-Jade-Nordsee: abz-farge@wsv.bund.de
- **Construction design:** Brushwood groynes made of hardwood fascines to protect the beach
- **Development:** The groynes are fulfilling their purpose and are maintained as needed. The next maintenance is planned for 2026.

Brushwood box at Bunker Bay - Southern bank 1

- **Km 27,850** right bank Lower Weser
- **Implementation:** November 2020, last maintenance in December 2023
- **Contact**: WSA Weser-Jade-Nordsee: abz-farge@wsv.bund.de
- **Construction design:** Brushwood box to damp a tidal creek running alongside the revetment.
- **Development:** The brushwood box is fulfilling its purpose. The next maintenance is planned for 2026.

Brushwood box before maintenance in June 2023 .

Brushwood box after construction in November 2020.

Brushwood box shortly after maintenance in January 2024.

Brushwood box in July 2025.

Brushwood measure at Bunker Bay - Southern bank 2

- **Km 27,850** right bank Lower Weser
- **Implementation:** December 2023
- **Contact**: WSA Weser-Jade-Nordsee: abz-farge@wsv.bund.de
- **Construction design:** Dead wood measure made of brushwood fascines laid on the ground in the direction of flow. The fascines are secures with piles and wire.
- **Development:** The measure was constructed in addition to another brushwood box to damp the tidal creek running alongside the revetment. It is fulfilling its purpose.

Construction of the measure in 2023

Final measure in January 2024.

Brushwood box at Bunker Bay - Northern bank

- **Km 27,850** right bank Lower Weser
- **Implementation:** July 2025
- **Contact**: WSA Weser-Jade-Nordsee: abz-farge@wsv.bund.de
- **Construction design:** Brushwood box to damp a tidal creek, running along the revetment at the northern bank of the Bunker Bay. The brushwood box was supplemented by a ‚groyne head', which is at least halfway filled with sediment in order to create colonisation areas for site-typical vegetation.
- **Development:** No statements on development available yet.

Living tree for bank protection at Bunker Bay - Northern bank

- **Km 27,850** right bank Lower Weser
- **Implementation:** July 2025
- **Contact**: WSA Weser-Jade-Nordsee: abz-farge@wsv.bund.de
- **Construction design:** Living willow tree to damp a tidal creek and to create structural diversity in the riparian zone.
- **Development:** It is still unclear whether the tree will sprout. The crown had to be severely pruned for transport.

Brushwood groynes Elsflether Sand

- **Km 28,50-31,40** left bank Lower Weser
- **Implementation:** unknown
- **Contact**: WSA Weser-Jade-Nordsee: abz-farge@wsv.bund.de
- **Construction design:** Brushwood groynes made of hardwood fascines for beach protection
- **Development:** The groynes are fulfilling their purpose and are maintained as needed. However, no repairs are currently planned as the section of beach is stable.

Brushwood mattress at Elsflether Sand

- **Km 28,50-31,40** left bank Lower Weser
- **Implementation:** ab 2016/2017
- **Contact**: WSA Weser-Jade-Nordsee: abz-farge@wsv.bund.de
- **Construction design:** Willow brushwood mattress for bank protection and to stabilize sand nourishments. Additionally, initial plantings with willow cuttings were placed around mean high water.
- **Development:** The brushwood mattress is fulfilling its purpose and is maintained as needed. However, no repairs are currently planned, as the section of beach was replenished in 2022.

Brushwood mattress for bank protection placed at the height of the groyne root.

Brushwood mattress at Yacht harbour Elsfleth

- **Km 32,75** left bank Lower Weser
- **Implementation:** 2015
- **Contact**: WSA Weser-Jade-Nordsee: abz-farge@wsv.bund.de
- **Construction design:** Brushwood mattress made out of hardwood for bank protection and to trap sediment at the lock entrance.
- **Development**: The brushwood mattress is maintained as needed.

Brushwood groynes for beach protection

- **Km 33,10-33,25** left bank Lower Weser
- **Implementation:** unknown
- **Contact**: WSA Weser-Jade-Nordsee: abz-farge@wsv.bund.de
- **Construction design:** Brushwood groynes for beach protection made out of hardwood fascines and located directly at the Weser dyke
- **Development**: The groynes are maintained as needed.

Brushwood groynes at Harriersand

- **Km 33,30-34,25** right bank Lower Weser
- **Implementation:** unknown
- **Contact**: WSA Weser-Jade-Nordsee: abz-farge@wsv.bund.de
- **Construction design:** Brushwood groynes made out of hardwood fascines tied to piles for beach protection
  Development: The groynes are several decades old and have not been maintained for some time due to staff shortages. However, the bank and the surrounding area remain stable.

Brushwood training wall at Käseburger Siel

- **Km 36,50-36,60** left bank Lower Weser
- **Implementation:** 2013
- **Contact**: WSA Weser-Jade-Nordsee: abz-farge@wsv.bund.de
- **Construction design:** Brushwood training wall for beach protection made of hardwood fascines
- **Development:** The brushwood training wall is fullfillig its purpose and is maintained as needed. The measure was last maintained in 2025.

Brushwood training wall during construction in 2013.

Brushwood training wall at Schierlohstrand

- **Km 38,10-38,20** left bank Lower Weser
- **Implementation:** 2013
- **Contact**: WSA Weser-Jade-Nordsee: abz-farge@wsv.bund.de
- **Construction design:** Brushwood trainings wall for beach protection made of hardwood fascines
- **Development:** The brushwood training wall is maintained as needed. Currently no maintenance is planned.


WSA Weser-Jade-Nordsee


WSA Weser-Jade-Nordsee

Brushwood training wall at Harriersand

- **Km 39,875-40,62** right bank Lower Weser
- **Implementation:** approx. 2000, last maintenance in 2024-2025
- **Contact**: WSA Weser-Jade-Nordsee: steffen.buchner@wsv.bund.de
- **Construction design:** Brushwood training wall made of brushwood fascines tied to 4 pile rows. The measure is directly connected to a sheet pile wall.
- **Development:** The training wall is fulfilling its purpose and the area has silted up. Last maintenance has been conducted in 2024/2025.

WSA Weser-Jade-Nordsee

Brushwood box to damp a tidal creek

- **Km 42,400** right bank Lower Weser
- **Implementation:** approx. 2008
- **Contact**: WSA Weser-Jade-Nordsee: steffen.buchner@wsv.bund.de
- **Construction design:** Brushwood box to damp a tidal creek for bank protection
- **Development:** The area has calmed. Reeds have established on the landward site of the measure, and rushes are settling in front of the brushwood box. The area is completely overgrown and the measure is no longer being maintained.

Brushwood training wall at Sandstedt

- **Km 43,100- 44,100** right bank Lower Weser
- **Implementation:** approx. 1950, last maintained in 2018
- **Contact**: WSA Weser-Jade-Nordsee: steffen.buchner@wsv.bund.de
- **Construction design:** Brushwood training wall to ensure and control sluice drainage
- **Development:** The measure is successful and is maintained regularly. Last maintenance was conducted in 2018 and next maintenance is planned for 2026.

Brushwood groynes at northern tip of Harriersand Island

- **Km 43,125-44,050** right bank Lower Weser
- **Implementation:** approx. 1987 (island tip), approx. 1994 (brushwood groynes)
- **Contact**: WSA Weser-Jade-Nordsee: steffen.buchner@wsv.bund.de
- **Construction design:** Brushwood groynes acting as silt traps to reduce local dredging volumes. The fascine material is tied to four pile rows with wire.
- **Development:** The brushwood groynes are covered with silt, so no maintenance is necessary. Approximately one-third of the structure is overgrown with vegetation. The area is stable and no maintenance is planned for the future.

Brushwood training wall at Niedersachsenkai

- **Km 43,300-44,125** left bank Lower Weser
- **Implementation:** approx. 1995, last maintenance in 2021
- **Contact**: WSA Weser-Jade-Nordsee: steffen.buchner@wsv.bund.de
- **Construction design:** Brushwood training wall made of 4 tied pile rows to stabilise the bank and encourage tidal flat development. The training wall is split into a northern and southern section. The medium section has been dredged away to make way for the “Niedersachsenkai” pier.
- **Development:** The brushwood training wall was built over as part of the expansion of Brake's northern harbour. Currently, only an approx. 120 m long section of the training wall remains at km 43.300 left bank. The purpose as bank protection was successful and the training wall is maintained every 6 years, with the next maintenance planned for 2026/2027.


WSA Weser-Jade-Nordsee

Pile and brushwood groynes at Sandstedt

- **Km 44,250-44,500** right bank Lower Weser
- **Implementation:** approx. 1985 (brushwood groynes), since approx. 1993 pile groynes, last maintenance in 2023
- **Contact**: WSA Weser-Jade-Nordsee: steffen.buchner@wsv.bund.de
- **Construction design:** 2 brushwood groynes and 6 pile groynes with a brushwood groyne head. The pile groynes are built out of pine/larch piles.
- **Development:** The brushwood groynes suffered from premature rot in the beach area. This posed a danger to beach visitors, so they were replaced by single-row pile groynes. The next maintenance is planned for 2028.


WSA Weser-Jade-Nordsee

Brushwood training wall - Supply to the Upper Schweiburg

- **Km 44,500-44,800** left bank Lower Weser
- **Implementation:** approx. 1990-2000, last maintenance in 2023/2024
- **Contact**: WSA Weser-Jade-Nordsee: steffen.buchner@wsv.bund.de
- **Construction design:** Brushwood training wall made of 4 tied pile rows to support water supply to the Upper Schweiburg, bank stabilisation and tidal flat sedimentation.
- **Development:** The brushwood training wall has been constructed twice: the first structure was situated 50 m further west (landward) and rapidly silted up, albeit without completely meeting the intended purpose. The second structure was built at today's position, again to supply more water to the Schweiburg, but proved to be only partially effective for this purpose. Tidal flats have stabilised. The next maintenance is planned for 2027/2028.


WSA Weser-Jade-Nordsee

Brushwood boxes for protection of a groyne root at Rechtenfleth

- **Km 46,625** right bank Lower Weser
- **Implementation:** approx. 2000-2005, last maintenance in 2017
- **Contact**: WSA Weser-Jade-Nordsee: steffen.buchner@wsv.bund.de
- **Construction design:** Brushwood box system to protect the groyne root from permanent exposure to scouring and damaging effects. Since an armour stone extension of the groyne towards the embankment has not sufficiently reduced the level of hydrodynamics, the brushwood box was built to contain water motion.
- **Development:** The area has silted up as desired and has developed positively. Maintenance is currently not necessary and is not planned.

Reduction of water motion at Königsbalje

- **Km 47,58-47,875** right bank Lower Weser
- **Implementation:** approx. 1994, last maintenance in 2021
- **Contact**: WSA Weser-Jade-Nordsee: steffen.buchner@wsv.bund.de
- **Construction design:** Combined armour stone/dead wood structure: brushwood training wall (2 tied pile rows) with a riprap toe protection to slow down water motion. The structure has been installed at a distance of 5 m from the bank and is aligned to the bank's natural shape.
- **Development:** The measure is fulfilling its purpose. In 2021, an additional deflector was installed as part of maintenance work. There is currently no further need for maintenance.

WSA Weser-Jade-Nordsee

Brushwood measure to damp a tidal creek

- **Km 48,150** right bank Lower Weser
- **Implementation:** approx. 2008, 2019
- **Contact**: WSA Weser-Jade-Nordsee: steffen.buchner@wsv.bund.de
- **Construction design:** Dead wood measure to damp a tidal creek and protect a groyne. The structure is made of brushwood fascines laid on the ground in the direction of tidal creek flow. The fascines are secured to four pile rows with wire.
- **Development:** Water motion in the area has effectively slowed down and was maintained for the last time in 2019. Since then, the measure has served its purpose, so no further maintenance is necessary.


WSA Weser-Jade-Nordsee

Brushwood training wall Strohauser Plate

- **Km 48,500-50,380** left bank Lower Weser
- **Implementation:** approx. 2010-2018, last maintenance in 2025
- **Contact**: WSA Weser-Jade-Nordsee: steffen.buchner@wsv.bund.de
- **Construction design:** Brushwood training wall made of fascines tied to 4 pile rows (built in 6 construction phases) to stabilise tidal flats.
  Development: The measure is fulfilling its purpose. Last maintenance has been conducted in 2025 and will continue in 2026.

Brushwood box with riprap toe protection

- **Km 49,125-50,07** right bank Lower Weser
- **Implementation:** 1992-1998, last maintenance in 2017
- **Contact**: WSA Weser-Jade-Nordsee: steffen.buchner@wsv.bund.de
- **Construction design:** Brushwood box with a riprap toe protection (iron silicate slag)
- **Development:** Prior to building of the brushwood box steep erosion edges were present. Now, the area is developing well and the measure is occasionally maintained as needed.

Protection of the tip of the Strohauser Plate Island

- **Km 50,380-51,640** left bank Lower Weser
- **Implementation:** approx. 1987 (tip of the island), approx. 1995 (brushwood groynes)
- **Contact**: WSA Weser-Jade-Nordsee: steffen.buchner@wsv.bund.de
- **Construction design:** Training wall along the entire stretch and adjacent transverse brushwood groynes at km 50.700, km 51.000 east and west, km 51.200 east and west, km 51.400. The original brushwood training wall was covered with iron silicate slag.
- **Development:** As intended, the area around the tip of the island has become heavily silted up, reducing local dredging volumes. There is currently no need for maintenance; however, the measure is being monitored on an ongoing basis.


WSA Weser-Jade-Nordsee

Brushwood mattress to damp a tidal creek

- **Km 50,380** left bank Lower Weser
- **Implementation:** approx. 1993
- **Contact**: WSA Weser-Jade-Nordsee: steffen.buchner@wsv.bund.de
- **Construction design:** Longitudinal brushwood mattress structure to damp a tidal creek in order to protect the bank and groyne and support reed growth and tidal flat sedimentation.
- **Development:** The mudflats and reeds behind the structure have stabilised. The groyne is secured and the tidal creek has been diverted. No maintenance is currently necessary as the area is silted up and stable.

Brushwood box to damp a tidal creek

- **Km 52,350** left bank Lower Weser
- **Implementation:** approx. 1999, last maintenance in approx. 2021
- **Contact**: WSA Weser-Jade-Nordsee: steffen.buchner@wsv.bund.de
- **Construction design:** Brushwood box to damp a tidal creek in order to protect the bank and groyne and support reed growth and tidal flat sedimentation.
- **Development:** The reed bed behind the brushwood box has stabilised well and the groyne is completely secured. The structure was last maintained around 2021.

WSA Weser-Jade-Nordsee

Bank protection of former ferry landing site at Kleinensiel

- **Km 53,500** left bank Lower Weser
- **Implementation:** approx. 1991
- **Contact**: WSA Weser-Jade-Nordsee: steffen.buchner@wsv.bund.de
- **Construction design:** Solid bank protection made of brushwood boxes with riprap cover as scour protection at the ferry landing site
- **Development:** The bank protection dates back to the time when the ferry was still in operation and high loads were exerted on the bank, making bank protection necessary. The bank has stabilised, is largely silted up and overgrown, so that maintenance is no longer necessary.

Living crib wall at Kleinensiel

- **Km 53,550-53,600** left bank Lower Weser
- **Implementation:** March 2026
- **Contact**: WSA Weser-Jade-Nordsee: steffen.buchner@wsv.bund.de
- **Construction design:** Living crib wall with willow cuttings and initial plantings of *Cornus sanguinea* and *Crataegus*
- **Development:** The measure is intended to stabilize an erosion edge of approximately 2 m height. It was constructed as a pilot site and monitored through regular site inspections. It is as yet unclear whether the soil introduced will survive the initial phase until the plants have established roots or whether it will be washed away. Immediately after construction, there was already some slight washout of the soil material at higher water levels, so that some soil material was replenished. The development of the measure is being continuously monitored.

Finished crib wall with initial plantings in March 2026.

Brushwood boxes to stabilize an erosion edge at “Kleinensieler Plate“

- **Km 54,350-54,450** left bank Lower Weser
- **Implementation:** approx. 2018
- **Contact**: WSA Weser-Jade-Nordsee: steffen.buchner@wsv.bund.de
- **Construction design:** Brushwood box to stabilize an erosion edge
- **Development:** During the implementation of the compensation scheme “Kleinensieler Plate” soil filling created a steep bank entirely left to nature after completion in 2000. Due to the raised embankment, erosion edges continue to form, some of which are secured by brushwood boxes. During construction several excavator shovel loads of soil containing rhizomes were deposited in the area between the brushwood box and the erosion edge to encourage vegetation growth. The structure is fulfilling its purpose. Bank erosion has been stopped and a vegetation belt approximately 5 m wide has established between the brushwood box and the erosion edge.

Brushwood box in March 2026.

Brushwood boxes to stabilize an erosion edge at “Kleinensieler Plate“

- **Km 54,600-54,850** left bank Lower Weser
- **Implementation:** 2018, last maintained in 2025
- **Contact**: WSA Weser-Jade-Nordsee: steffen.buchner@wsv.bund.de
- **Construction design:** Brushwood box to stabilize an erosion edge
- **Development:** During the implementation of the compensation scheme “Kleinensieler Plate” soil filling created a steep bank entirely left to nature after completion in 2000. Due to the raised embankment, erosion edges continue to form; trees and shrubs have established on the crest of the embankment and occasionally fall into the water during storms or as a result of erosion, thereby compromising safety. The erosion edge is secured by brushwood boxes in some sections. In the area between the brushwood box and the erosion edge, several excavator shovel loads of soil containing rhizomes were introduced to encourage vegetation growth. Bank erosion has been stopped and a vegetation belt approximately 5-10 m wide has established. The last maintenance of the measure was carried out by replenishing fascine material in 2025. The next maintenance is planned for around 2029.

Brushwood boxes to stabilize an erosion edge at “Kleinensieler Plate“

- **Km 54,850-55,000** left bank Lower Weser
- **Implementation:** 2019/2020, last maintained in 09/2025-04/2026
- **Contact**: WSA Weser-Jade-Nordsee: steffen.buchner@wsv.bund.de
- **Construction design:** Brushwood box to stabilize an erosion edge
- **Development:** During the implementation of the compensation scheme “Kleinensieler Plate” soil filling created a steep bank entirely left to nature after completion in 2000. Due to the raised embankment, erosion edges continue to form, some of which are secured by brushwood boxes. During construction several excavator shovel loads of soil containing rhizomes were deposited in the area between the brushwood box and the erosion edge to encourage vegetation growth. The structure is fulfilling its purpose. Bank erosion has been stopped and a vegetation belt approximately 5-10 m wide has established between the brushwood box and the erosion edge.

Indirect bank protection at Großensiel

- **Km 56,100-56,500** left bank Lower Weser
- **Implementation:** approx. 1990
- **Contact**: WSA Weser-Jade-Nordsee: steffen.buchner@wsv.bund.de
- **Construction design:** Longitudinal riprap structure as an indirect bank protection to promote the development of reed beds and ruderal areas
- **Development:** The structure is functioning properly. The area is silted up, and no maintenance is required.

Bank protection Luneplate

- **Km 58,400-58,875** right bank Lower Weser
- **Implementation:** approx. 2003
- **Contact**: WSA Weser-Jade-Nordsee: steffen.buchner@wsv.bund.de
- **Construction design:** Brushwood box with a riprap toe reinforcement
- **Development:** The measure is working as intended. The area is completely silted up, and no maintenance is required.

WSA Weser-Jade-Nordsee

Willow mattress at the Delme

- **Km 0-0,750** right bank Delme
- **Implementation:** 2010
- **Contact**: WSA Weser-Jade-Nordsee, Abz. Habenhausen: friedrich.hauptmann@wsv.bund.de
- **Construction design:** Replacement of an old, erosive riprap revetment with a willow mattress with a toe protection consisting of a brushwood box and riprap reinforcement to protect a dyke without foreland. The willow mattress consists of sprouting and non-sprouting willow rods, which were harvested from the willow stands at the top of the embankment and immediately reused for the living bank protection measure on site. The Delme is not a waterway under the jurisdiction of the Waterways and Shipping Administration, and the maintenance obligation stems from an old project to deepen the Weser to 8 m depth.
- **Development:** The willow mattress is fulfilling its purpose and willow growth has successfully established; no repairs have been necessary to date. Since 2019, the body of water has been a designated nature reserve, and any major maintenance work must be reported to the Lower Nature Conservation Authority. The willow mattress is selectively pruned annually to avoid clear-cutting (approximately 2 days with 5 staff members per year).

Compensation scheme Hunte expansion Hollersiel

- **Km 11,9-12,0** right bank Hunte
- **Implementation:** 2018
- **Contact**: WSA Weser-Jade-Nordsee: Dieter.hoeffmann@wsv.bund.de
- **Construction design:** A brushwood box consisting of two rows of wire-bound piles, filled with fascines and a straw filter, was placed directly in front of the erosive bank. A secondary protective structure made of riprap was constructed in front of it to shield against wave impact. The original plan called for a second pile structure, which could not be installed and was therefore replaced with stones. The structure is located away from the navigation channel behind a former dyke and is subject only to moderate tidal influence.
- **Development:** Since construction, there has been neither a deterioration nor an improvement in the erosion. The bank is stable, and most of the fascine material is no longer present (see photo on the right). The measure has not been maintained to date. Since the area is stable, no maintenance is planned for the future.

Finished measure immediately after construction in 2018.

Measure in November 2025.

Brushwood box to secure a breach

- **Km 5,15-5,20** right bank Wümme
- **Implementation:** Winter 2014/2015
- **Contact**: WSA Weser-Jade-Nordsee: abz-farge@wsv.bund.de
- **Construction design:** Brushwood box training wall made of hardwood fascines securing a breach in a bend to prevent further abrasion and maintain the natural river course.
  Development: The measure is functioning as intended, and no maintenance is currently planned.

WSA Weser-Jade-Nordsee

Wümme pilot site 1

- **Km 17,31-17,39** left bank Wümme
- **Implementation:** Winter 2013/2014, last maintenance in 2020
- **Contact**: WSA Weser-Jade-Nordsee: abz-farge@wsv.bund.de
- **Construction design:** Combined structure of brushwood box (hardwood fascines) and brushwood mattress. Backfilling up to the level of the reed behind the brushwood box and minor initial planting of reeds.
- **Development:** The measure is the pilot site 1 under the maintenance plan for the Lesum/Wümme. It was implemented for bank and dike protection and to prevent scouring. The project is fulfilling its purpose, and no repairs are currently planned.

Wümme pilot site 2

- **Km 17,00-17,08** right bank Wümme
- **Implementation:** Winter 2013/2014, last maintenance in 2020
- **Contact**: WSA Weser-Jade-Nordsee: abz-farge@wsv.bund.de
- **Construction design:** Brushwood mattress made out of hardwood fascines for dyke toe and bank protection
- **Development:** The measure is the pilot site 2 under the maintenance plan for the Lesum/Wümme. It was implemented for bank and dike protection and to prevent scouring. The project is fulfilling its purpose, and no repairs are currently planned.

Wümme pilot site 3

- **Km 16,18-16,24** right bank Wümme
- **Implementation:** Winter 2013/2014, last maintenance in 2020
- **Contact**: WSA Weser-Jade-Nordsee: abz-farge@wsv.bund.de
- **Construction design:** Brushwood box filled with hardwood fascines and a pile wall. Backfilling up to the level of the reed behind the brushwood box and minor initial planting of reeds.
- **Development:** The measure is the pilot site 2 under the maintenance plan for the Lesum/Wümme. It was implemented for bank and dike protection and to prevent scouring. The construction design used on this pilot site has not proven effective, and the section will therefore no longer be repaired. The structure was only partially stable, and the pile wall did not achieve the desired effect. The design was modified by replacing the pile wall with a brushwood box.

Pilot site 3 at the Wümme: Brushwood box with behind a pile wall in 2014.

Modified measure in 2020.

Scour restoration at Verlaat

- **Km 4,450-4,500** right bank Rechter Nebenarm (Secondary channel of the Lower Weser)
- **Implementation:** 2020
- **Contact**: WSA Weser-Jade-Nordsee: andre.benthien@wsv.bund.de
- **Construction design:** The goal of the project was to protect the outlet area of the Verlaat from scouring. The previous paving and the wooden sheet pile wall were not restored. To mitigate hydrodynamic stress, the slope was reprofiled, the scour hole was filled with sand as a water-conducting layer, covered with a geotextile, and stone mattresses were laid out over the entire area. Coconut fibre mats enriched with seeds (a native reed mixture) were laid down and interwoven with the stone mattresses. Additional stability is expected to result from the roots growing through the stone mattresses.
- **Development:** The vegetation has quickly established and spread and has withstood storm surges. During the annual inspection, no defects or recurring areas of damage have been identified to date, so no further action has been required. The material is maintenance-free and requires neither regular upkeep nor maintenance measures such as repairs or follow-up treatments.

Measure immediately after construction (08.10.2020)

Measure on 08.11.2023

Elbe Estuary

Lowering of the revetment at the Altengamme Elbe meadows

- **Km 589,000 – 591,000** right bank Elbe
- **Implementation:** 2024
- **Contact**: Stiftung Lebensraum Elbe, WSA Elbe-Nordsee
- **Construction design:** Lowering the revetment to 1 m above sea level to encourage natural bank dynamics, vegetation establishment, the formation of tidal creeks and the development of sandy bank areas.
- **Development:** A more natural bank has been created, and so far no maintenance work has been required. The protection provided by the groynes remains in place.

Before

After

After

Lowering of the revetment at „Wrauster Bogen“

- **Km 603,000-603,000** right bank Elbe
- **Implementation:** November 2019
- **Contact**: Stiftung Lebensraum Elbe, WSA Elbe-Nordsee
- **Construction design:** Lowering the revetment of around 1.5 m along 30 m to allow natural bank development.
- **Development:** A more natural bank has been created, and so far no maintenance work has been required.

Summer 2022, 3rd year after implementation.

Summer 2022, 3rd year after implementation.

Brushwood boxes at Overhaken

- **Km 606,000-606,150** right bank Elbe
- **Implementation:** 2026
- **Contact**: Stiftung Lebensraum Elbe
- **Construction design:** Brushwood boxes to stabilize an eroding bank and protect a tidal creek located in the hinterland. One brushwood box is positioned approximately 5-7 m in front of the eroding bank, whilst the second is placed directly at the erosion edge. The area between the brushwood boxes has been filled with sand.
  Development: The project was completed in early 2026. It is therefore not yet possible to comment on its progress.

Construction of the brushwood boxes in December 2025. At the time the picture was taken, the area between the brushwood boxes had not yet been filled in and the edges of the boxes had not yet been completed.

Lowering of the revetment at „Bunthäuser Spitze“

- **Km 609,000 – 612,000** left and right bank of Süder- und Norderelbe (Southern and Northern Elbe) at „Bunthäuser Spitze“
- **Implementation:** November 2022
- **Contact**: Hamburg Port Authority, Stiftung Lebensraum Elbe
- **Construction design:** Removal of riprap and lowering the revetment by around 1-1.5 m in six 10 m wide sections. The goal of this measure is to promote the development of tidal creeks and increase structural diversity behind the lowered revetments, as well as to encourage the growth of primary vegetation in the bank area.
- **Development:** So far, no changes to the remaining revetment have been observed, so no maintenance is necessary. Minor changes, such as the formation of tidal creeks and the leveling of the relief in the adjacent areas, have been observed. In addition, initial growth of primary vegetation and algae has begun.

Norderelbe, February 2025. First tidal creek structures visible; season Prielstrukturen sichtbar; due to the time of year, no primary vegetation is visible yet.

After lowering of the revetment.

Norderelbe, April 2024: Establishment of primary vegetation.

Lowering of the revetment at Schweenssand

- **Km 613,000 – 615,000** left bank Süderelbe (Southern Elbe)
- **Implementation:** 2018-2019
- **Contact**: Hamburg Port Authority, Stiftung Lebensraum Elbe
- **Construction design:** Lowering of the revetment by approximately 1 m over a width of approximately 10 m. The aim of this measure is to encourage the development of tidal creeks and increase structural diversity behind the lowered sections of the revetment, as well as to encourage the growth of primary vegetation on the exposed bank areas.
- **Development:** First tidal creek structures are visible, and in some places initial growth of algae and primary vegetation can be observed. Hardly any changes were observed in the adjacent riprap revetment, so no maintenance has yet been necessary. A relatively large amount of the underlying revetment has been exposed within the lowered area.

After implementation.

Measure at the beginning of 2023. Many of the underlying stones have been uncovered.

Tide pools at “Bubendeyufer“

- **Km 628,500** left bank Elbe
- **Implementation:** September 2019
- **Contact** Hamburg Port Authority
- **Construction design:** Improvement of the structural diversity of the bank areas and underwater habitats through the integration of five tide pools made of bioactive concrete into the revetment.
- **Development:** Monitoring has shown that the pools have resulted in a more structured community of phyto- and macrozoobenthos compared to riprap structures without pools.

Tide pools at “Genter Ufer“

- **Km 629,500** left bank Elbe
- **Implementation:** April 2020
- **Contact** Hamburg Port Authority
- **Construction design:** Improvement of the structural diversity of the bank areas and underwater habitats through the integration of five tide pools made of bioactive concrete into the revetment.
- **Development:** Monitoring has shown that the pools have resulted in a more structured community of phyto- and macrozoobenthos compared to riprap structures without pools.

Vegetated revetment at “Genter Ufer“

- **Km 629,500** left bank Elbe
- **Implementation:** Juni - Juli 2020 (gabion mattresses); Mai – Juli 2021 (vegetation mats)
- **Contact** Hamburg Port Authority
- **Construction design:** Replacement of the existing riprap with gabion mattresses, onto which planted (pre-cultivated) vegetation mats were placed.
- **Development:** Growth of the reed bed was observed between 0.9 and 1 m above mean high water. Regular maintenance is necessary to prevent the introduction and spread of invasive species.

October 2024

Willow mattresses for beach protection on Elbe island Hanskalbsand

- **Km 642,300-642,700** left bank Elbe
- **Implementation:** 2017-2023
- **Contact**: WSA Elbe-Nordsee: abz-wedel@wsv.bund.de
- **Construction design:** Several sections of willow mattresses around 1 m above mean high water to protect the beach and prevent bank erosion. Toe protection of the willow mattresses consists of sproutable and non-sproutable fascine rolls.
- **Development:** The willows have established successfully and are pruned regularily. The next pruning is scheduled for 2026.

Brushwood box groynes at the Elbe Island Hanskalbsand – facing the navigation channel

- **Km 642,300-642,700** left bank Elbe
- **Implementation:** ab 1995
- **Contact**: WSA Elbe-Nordsee: abz-wedel@wsv.bund.de
- **Construction design:** Groynes made out of brushwood boxes to prevent scouring and to block the flow of water behind the riprap training wall after flooding, in order to promote sedimentation.
- **Development:** The brushwood box groynes were designed to reduce the current in a tidal creek running behind the training wall and to allow sedimentation to occur. They are fulfilling this purpose. The brushwood boxes are maintained on an irregular basis, whenever materials from willow pruning and human resources for implementation are available.

Willow mattresses for tidal creek protection on Elbe island Hanskalbsand

- **Km 6,700-7,000 right bank** Hahnöfer Nebenelbe
- **Implementation:** 2005, 2008, 2016/2017
- **Contact**: WSA Elbe-Nordsee: abz-wedel@wsv.bund.de
- **Construction design:** Pilot site in two sections with willow mattresses to protect a tidal creek and other erosive banks.
- **Development:** Long-term monitoring of the experiment in the first section showed that the willow shoots did not sprout permanently until approximately 1 m above mean high water. Based on these results, another section near the tidal channel mouth was secured in 2008. This was expanded in 2016/2017 to also secure the higher-lying bank areas with a willow mattress. The measure is fulfilling its purpose, and a robust willow stand has formed. Damage from wildlife browsing can be observed. The willow mattresses are maintained irregularly through pruning every 4-5 years and, as needed, selective replanting using cuttings. The next pruning of the willows is planned for 2026.

Willow mattress with fascine toe protection on Elbe island Hanskalbsand – Hahnöfer Nebenelbe

- **Km 6,700-6,900** Hahnöfer Nebenelbe
- **Implementation:** 2015/2016
- **Contact**: WSA Elbe-Nordsee: abz-wedel@wsv.bund.de
- **Construction design:** Willow mattress with a toe protection using fascine rolls and a filter of double-layered coconut fiber mats to prevent bank erosion caused by a storm surge.
- **Development:** The willow mattress has successfully taken root, and the measure is fulfilling its stabilizing purpose. Damage caused by a series of storms in 2021 was repaired by planting willow cuttings as reinforcements and renewing the toe protection. The condition has remained stable since then.

Lowering of the revetment at Juelssand

- **Km 650,600** right bank Elbe
- **Implementation:** 2004
- **Contact**: WSA Elbe-Nordsee: abz-wedel@wsv.bund.de
- **Construction design:** Lowering of the revetment in one section to improve conditions for the development of estuary-typical bank dynamics, and the establishment of natural vegetation zones in the transition zone between land and water. **Development:** The area has developed positively. Behind it now lies a tidal creek with a near-natural bank featuring sandy mudflats, reeds, and tall grasses.

Lowering of the revetment at Juelssand 2

- **Km 650,600-651,200** right bank Elbe
- **Implementation:** 6 weeks in 2012
- **Contact**: WSA Elbe-Nordsee: abz-wedel@wsv.bund.de, Stiftung Lebensraum Elbe, Integrierte Station Unterelbe
- **Construction design:** Five 10 m wide sections of revetment (total length approx. 600 m) were each lowered by 60-80 cm to allow water to flow over the revetment and into the hinterland area (500 tons of riprap moved). The base and sides of the lowered area were secured with gabion mattresses.
- **Development**: Vegetation has spread within the lowered areas. The wire mesh of the gabion mattresses is partially disintegrating. However, the structure still appears to be stable.

Beginning break down of the wire mesh (01/2026).

Lowering of the revetment at Rhinplate

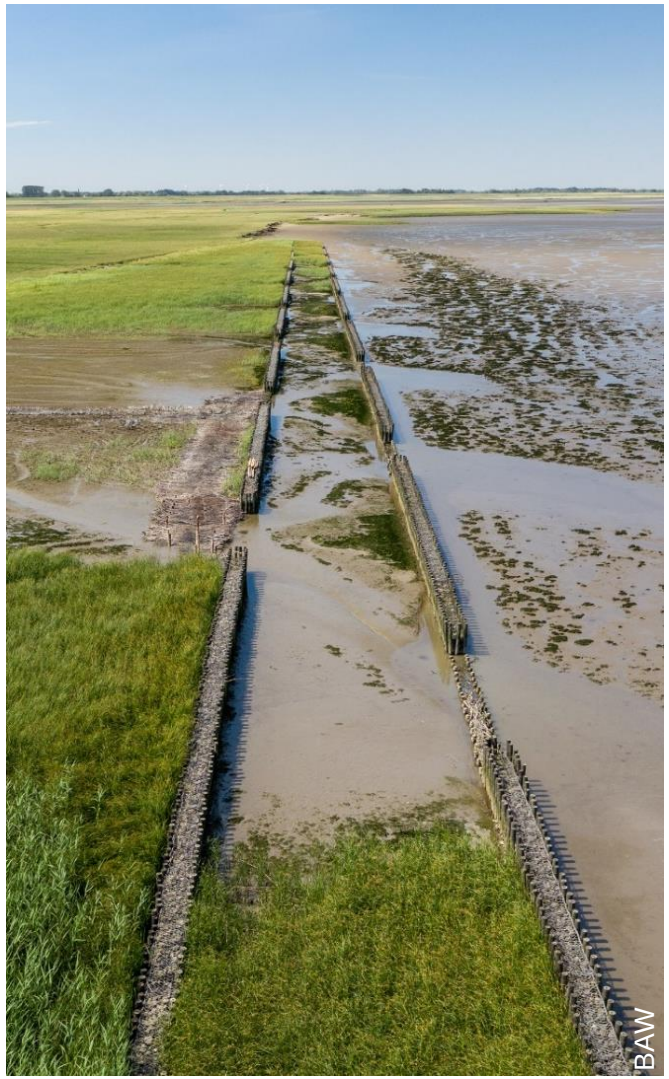
- **Km 670,000 – 675,000** left bank Elbe
- **Implementation:** September 2015
- **Contact**: WSA Elbe-Nordsee: abz-wedel@wsv.bund.de, Stiftung Lebensraum Elbe
- **Bauweise:** Removal of the riprap and lowering of the revetment by approx. 60-80 cm at five 10 m wide sections. The lowered areas are secured using gabion mattresses.
  Development: The wire mesh of the gabion mattresses is slowly disintegrating, but the revetment remains stable overall, and various tidal creek structures are forming within the reeds behind it. An increase in structural diversity has also been observed.


WSA Elbe-Nordsee

Indirect bank protection at Nordkehdingen

- **Km 686,300-687,500** left bank Elbe
- **Implementation:** September 2025; June-October 2026
- **Contact**: WSA Elbe-Nordsee: christoph.gerulat@wsv.bund.de
- **Construction design:** Double rows of piles filled with gabions serve as an indirect bank protection structure located off-bank to prevent further erosion and the associated threat to the dike. The structure features a 10-meter-wide opening every 30 meters, which is secured with lower brushwood boxes.
  Development: The measure will be completed in the summer of 2026, so no statements regarding its development can be made to date.

Indirect bank protection at the Hullen



- **Km 703,150-703,770** left bank Elbe
- **Implementation:** 2003, partially in 2014, last maintained in 2025
- **Contact**: WSA Elbe-Nordsee: abz-cuxhaven@wsv.bund.de
- **Construction design:** Double rows of piles filled with gabions serve as an indirect bank protection structure located off-bank to prevent further erosion and the associated threat to the dike. The structure features a 10-meter-wide opening every 30 meters, which is secured with lower brushwood boxes. The shoreline protection is being carried out in accordance with the maintenance contract, and the structure has been partially taken over by the State of Lower Saxony.
- **Development:** The structure serves its purpose. The area has silted up and vegetation has taken root. As needed, the outlet areas are raised with fascines, missing stakes are replaced, and stones are replenished. Due to high water and wave action, damage and land loss occurred at the former erosion edge during the winter of 2019/2020. To counteract this, the erosion edge was secured with a brushwood mattress. Work began in 2020 and was completed in 2021.

Protection of the erosion edge with a brushwood mattress in 2020.

Rearward groyne protection Otterndorfer Stack

- **Km 709,780-709,800** left bank Elbe
- **Implementation:** February 2011, August 2018, last maintained in 2023
- **Contact**: WSA Elbe-Nordsee: abz-cuxhaven@wsv.bund.de
- **Construction design:** Protection of the groyne foot using brushwood boxes covered by riprap
- **Development:** The brushwood boxes required a high degree of maintenance. During the repair of the groyne, they were therefore first reinforced with a layer of riprap and eventually completely covered with riprap. The measure serves its purpose, and maintenance work now consists of patching the riprap. The next repair is scheduled for 2026.

Groyne protection Medem Stack 3

- **Km 712,460-712,580** left bank Elbe
- **Implementation:** spring 2017, last maintained in 2025
- **Contact**: WSA Elbe-Nordsee: abz-cuxhaven@wsv.bund.de
- **Construction design:** Protection of the groyne foot with brushwood boxes and brushwood mattress
- **Development:** During the first construction phase, vegetated coir logs were used on a trial basis. The trial was unsuccessful, as no vegetation took root and 75% of the filling was lost. The brushwood mattress and the brushwood boxes have been continuously maintained and are functioning properly. In the area of the groyne foot, initial siltation and vegetation growth can be observed. The next maintenance is scheduled for 2026.

Brushwood boxes within groyne field of “Belumer“ groynes 9 and 11

- **Km 73,140-73,375** left bank Oste
- **Implementation:** September 2011, annual maintenance (last maintenance in 2025)
- **Contact:** WSA Elbe-Nordsee: abz-cuxhaven@wsv.bund.de
- **Construction design:** Brushwood boxes for bank protection within groyne field of groyne 9 and 11
- **Development:** Initially, missing fascines in some sections were temporarily replaced with coir logs due to a shortage of fascine material. However, the coir logs had such a short lifespan that their use did not prove effective. The structure is developing positively and is inspected annually; repairs are carried out as needed (in some cases annually) by replenishing fascine material that has been lost due to storm surges and ice drift. Increasing siltation and vegetation growth are being observed.

Brushwood boxes within groyne field of “Belumer“ groynes 7 and 9

- **Km 73,375-73,610** left bank Oste
- **Implementation:** Juni 2013 (continuously maintained), last maintenance in 2025
- **Contact**: WSA Elbe-Nordsee: abz-cuxhaven@wsv.bund.de
- **Construction design:** Brushwood boxes for bank protection within groyne field of groyne 7 und 9
- **Development:** Initially, missing fascines in some sections were temporarily replaced with coir logs due to a shortage of fascine material. However, the coir logs had such a short lifespan that their use did not prove effective. The structure is developing positively and is inspected annually; repairs are carried out as needed (in some cases annually) by replenishing fascine material that has been lost due to storm surges and ice drift. Increasing siltation and vegetation growth are being observed.

Removal of revetment at Asseler Sand (Compensation measure)

- **Km 0,3-0,9** left bank Schwarztonnensander Nebenelbe
- **Implementation:** 2020
- **Contact:** WSA Elbe-Nordsee: abz-wedel@wsv.bund.de
- **Construction design:** Removal of about 640 m of riprap revetment and four partially deteriorated groynes as well as the building of a small riparian inlet to promote typical estuarine bank dynamics and shallow water areas, as well as the promotion of tidal flat and reed development.
  Development: The cleared bank area has developed well, and the first vegetation has taken root. The overflow sill of the riparian inlet was trampled by cattle from the adjacent pasture, so that it now dries up during low water and fails to serve its purpose as a shallow water area. Therefore, plans are in place for 2026 to repair the overflow sill and install a fence to prevent further damage from livestock.

Riparian inlet during construction in 2020

Cleared bank area in 2020

Riparian inlet in 2024

Vegetation mats and gabion mattresses at the Lühe dyke

- **Km 8,345-8,7** left bank Lühe (300 m between the harbour and the road bridge in Steinkirchen)
- **Implementation:** Spring 2012
- **Contact**: WSA Elbe-Nordsee: abz-stade@wsv.bund.de
- **Construction design:** In the winter of 2010-2011, severe longitudinal cracks in the dyke and subsidences along the dyke toe were discovered. As a response, a combined technical-biological bank protection scheme was put in place: The steep embankment with a slope of 1:2 was protected with gabion mattresses. A strip of 1 m in width situated above the gabion mattress is also exposed to hydrodyamic loads in times of flooding. Therefore, it was covered with pre-grown, natural fibre based grass mattresses reinforced with an additional armouring (“composite”). In some sections pile walls (pine wood) were installed as a toe protection.
- **Development:** The measure is serving its purpose. No maintenance work has been necessary so far, and none is planned, as the measure is estimated to last for approximately 30 years. The use of grass mattresses requires a certain degree of predictability of the construction schedule since delays entail major maintenance efforts in terms of rolling out and irrigating the mats.

Implemented measure with pile wall toe protection in 2012

Measure in October 2020

Pile wall toe protection of riprap revetment with natural vegetation

- **Km 0,470-0,560** right bank Schwinge
- **Implementation:** 25 days in 2015, last maintenance approx. in 2018
- **Contact**: WSA Elbe-Nordsee: abz-stade@wsv.bund.de
- **Construction design:** Toe protection consisting of a pile wall made of driven spruce piles plus riprap revetment with natural vegetation to prevent bank erosion due to ship-induced loads
- **Development:** After approximately 3 years, repair work was needed on certain sections of the riprap. The measure is fulfilling its purpose, and no further maintenance work is planned, as its lifespan is estimated to be approximately 30 years.

October 2020

Pile wall toe protection with backfill at the Bützflether Süderelbe

- **Km 2,350-2,380** left bank Bützflether Süderelbe
- **Implementation:** 25 days in 2019
- **Contact**: WSA Elbe-Nordsee: abz-stade@wsv.bund.de
- **Construction design:** Toe protection consisting of a pile wall made of driven spruce piles with a soil backfill and reed cover to prevent bank erosion due to ship-induced loads
- **Development:** The bank is stable and overgrown with reeds. No repairs have been necessary so far, and none are planned for the future.

November 2025

Measure in October 2020

Pile wall toe protection with revetment at the Bützflether Süderelbe

- **Km 2,410-2,550** right bank Bützflether Süderelbe
- **Implementation:** 100 days in 2016
- **Contact**: WSA Elbe-Nordsee: abz-stade@wsv.bund.de
- **Construction design:** Toe protection consisting of a pile wall made of driven spruce piles with gabion mattresses to prevent bank erosion due to ship-induced loads
- **Development:** The measure is serving its purpose, and no maintenance has been required so far. The measure is expected to last approximately 30 years.

Pile wall at the Este

- **Km 7,030-7,090** right bank Este
- **Implementation:** 15 days in 2019
- **Contact**: WSA Elbe-Nordsee: abz-stade@wsv.bund.de
- **Construction design:** Pile wall made of horizontal round timber piles with a soil backfill and natural vegetation to prevent bank erosion due to ship-induced loads.
- **Development:** The section is stable, and the measure is serving its purpose. No repairs have been necessary so far, and none are planned for the future.

WSA Elbe-Nordsee

Bank protection at the Ruthenstrom

- **Km 5,220-5,350** left bank Ruthenstrom
- **Implementation:** 15 days in 2017, last maintained in 2024
- **Contact**: WSA Elbe-Nordsee: abz-stade@wsv.bund.de
- **Construction design:** Brushwood box with willow fascines to protect bank erosion due to ship-induced loads
- **Development:** The measure serves its purpose. Maintenance work involving the replacement of fascine material is necessary approximately every two years, or more frequently depending on the impact of wave action and ice drift.

October 2020

Brushwood box at the Stör

- **Km 6,500-6,600** left bank Stör
- **Implementation:** 2025
- **Contact**: WSA Elbe-Nordsee: abz-glueckstadt@wsv.bund.de
- **Construction design:** Brushwood box to protect the bank from further scouring and the associated threat to the dike. In one section, the brushwood box was filled willow material, that was still able to sprout.
- **Development:** Since the measure was implemented, the scour has not spread further. So far, no significant vegetation growth or sedimentation has been observed behind the brushwood box. The section containing willow material capable of sprouting is still sprouting in 2026.

Unfinished brushwood box in summer of 2025. The piles were still to be cut to a uniform height.

Brushwood mattress at the Pinnau

- **Km 6,750-7,000** left bank Pinnau
- **Implementation:** 29.05-04.07.2018
- **Contact**: WSA Elbe-Nordsee: abz-glueckstadt@wsv.bund.de
- **Construction design:** Protection of dikes without foreland with brushwood mattresses made of willow fascines from the preceding pruning season.
- **Development:** The brushwood mattress is overgrown in the upper half and covered with silt in the lower part. No maintenance has been necessary so far.

Measure during construction in 2018.

Measure in April 2026, upper part covered by vegetation.

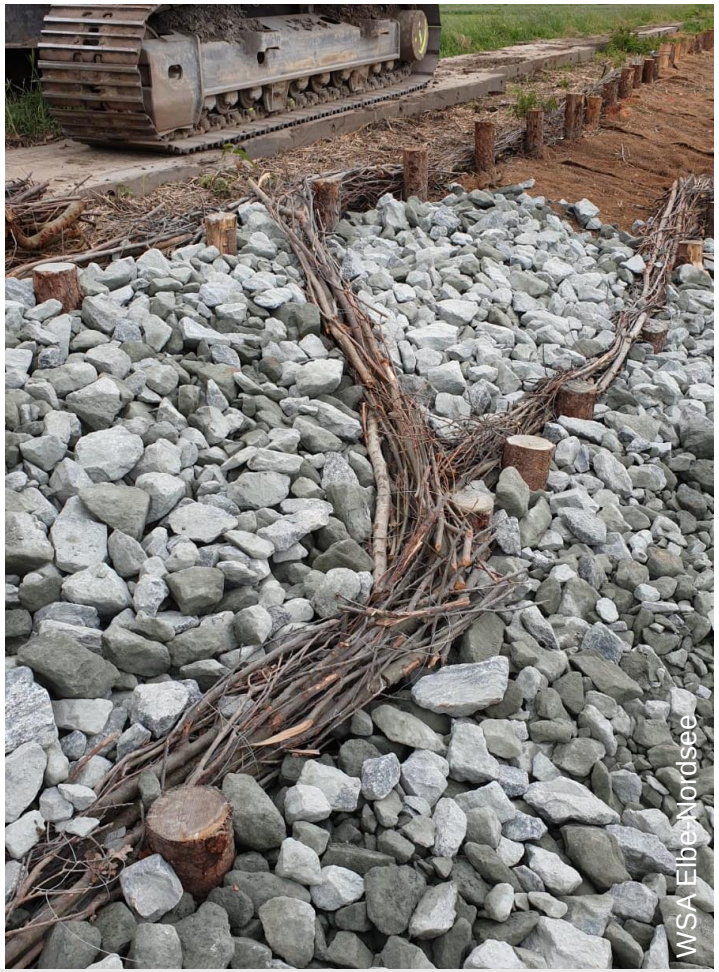
Measure 4 weeks after construction in 2018.

Fascine boxes with natural stone filling at the Pinnau

- **Km 7,340-7,500** left bank Pinnau
- **Implementation:** May-June 2020
- **Contact**: WSA Elbe-Nordsee: abz-glueckstadt@wsv.bund.de
- **Construction design:** Stable revetment using fascine reinforcement for dyke protection
- **Development:** The measure has quickly become overgrown, and a new stand of reeds has taken root. This growth was facilitated by the fact that the coconut fiber mesh allows roots to penetrate it. So far, no maintenance work has been necessary.

Measure in April 2026.

Construction of the measure in 2020.



Bank reprofiling test site at the Pinnau

- **Km 7,500-8,080** right bank Pinnau
- **Implementation:** Calendar week 72019
- **Contact**: WSA Elbe-Nordsee: abz-glueckstadt@wsv.bund.de
- **Construction design:** In order to rectify scour damage and bank collapses at dykes without foreland the soil (cohesive, root-permeated) that had slid into the Pinnau River was reprofiled using an excavator to test on a pilot site whether the exposed material would remain stable within the newly formed slope profile.
- **Development:** The reed growth has re-established itself after a short time. However, due to persistent severe flooding during the winter of 2019/20, the cohesive soil material became saturated and slid down again before the roots of the new growth could take hold. The measure has not developed as intended and is under observation and will be replaced by a different measure if necessary.

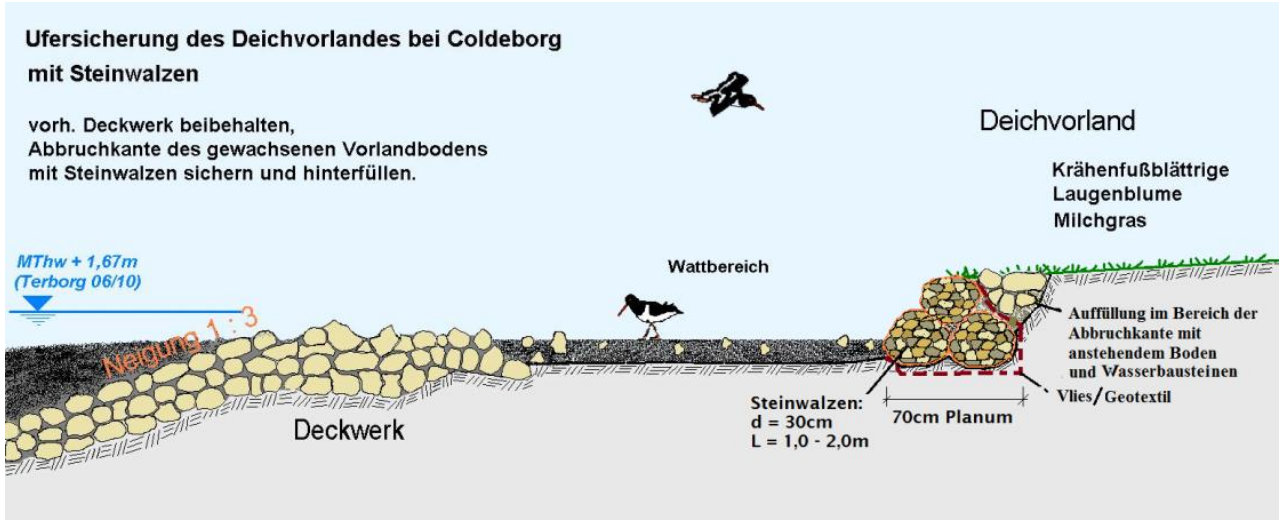
Reprofiling work in 2019.

Bank area in April 2026.

Ems Estuary

Rock rolls near Coldeborg

- **Km 27,2-27,4** left bank Ems
- **Implementation:** 2015, 9 days (7.-15. August 2015)
- **Contact**: WSA Ems-Nordsee: Friedhelm.Roeloffzen@wsv.bund.de
- **Construction design:** Rock rolls to protect an erosive dyke foreland above the revetment crest (see schematic sketch). The reason for the bank protection was the dyke inspection in 2014.
- **Development:** The area is stable and has not required any maintenance to date.



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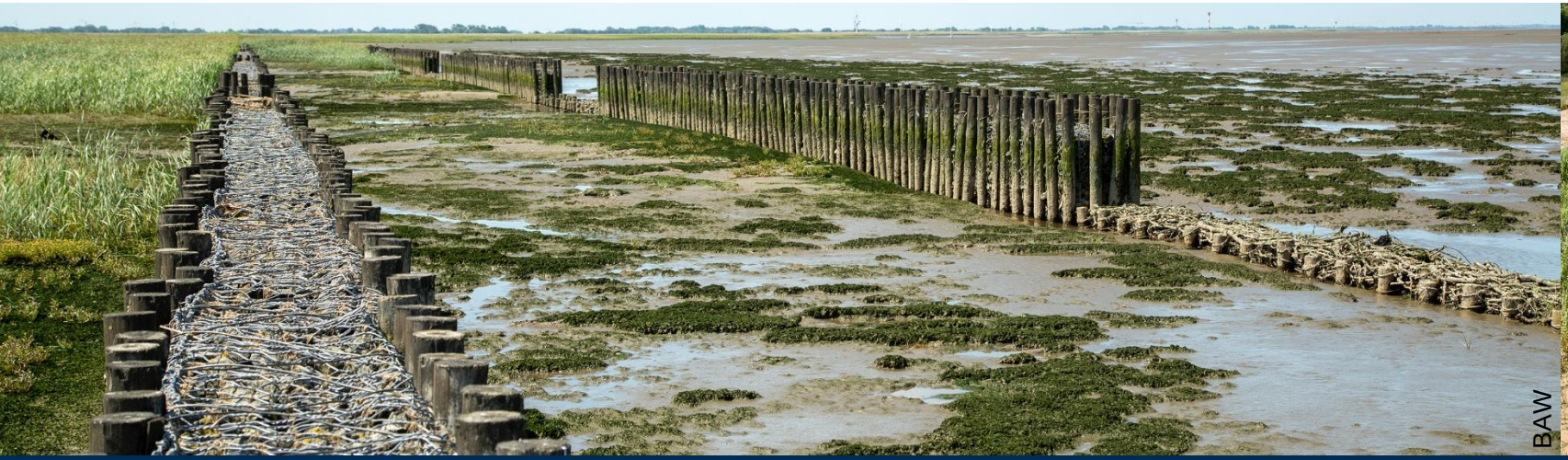
BAW

Erosive bank before (left) and after implementation (middle) and in 2021 (right).

Brushwood boxes to secure the riprap crest

- **Km 218,3-219,8** right bank Dortmund-Ems-Canal
- **Implementation:** 2010-2016
- **Contact**: WSA Ems-Nordsee: abz-lathen@wsv.bund.de
- **Construction design:** Repair of erosion damage to the revetment crest near the summer dike. The area was stabilized using brushwood boxes made from double pile rows and brushwood filling.
- **Development:** The measure is fulfilling its purpose.



Bundesanstalt für Gewässerkunde
Am Mainzer Tor 1
56068 Koblenz
Tel.: +49 (0) 261 1306-0

www.bafg.de

Bundesanstalt für Wasserbau
Wedeler Landstraße 157
22559 Hamburg
Tel. +49 (0) 40 81908-0

www.baw.de