TIDE
Tidal River Development

Project part-financed by the European Union (European Regional Development Fund)

The Interreg IVB North Sea Region Programme

‘Underwater relocation area Medemrinne Ost’

Measure analysis 02
in the framework of the Interreg IVB project TIDE

Hamburg Port Authority, Federal Administration for Waterways and Navigation

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HPA
Hamburg Port Authority

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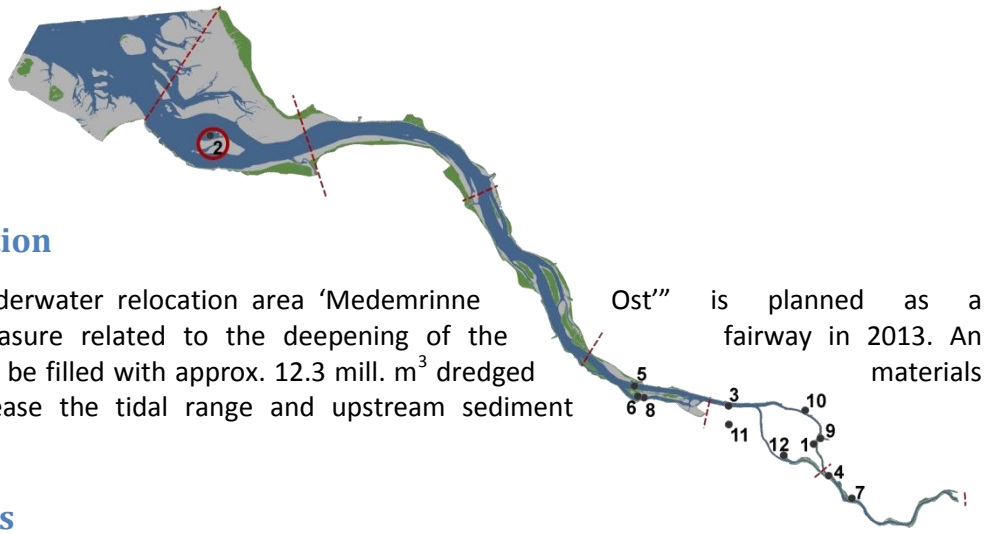
Part 1: Measure description

measure category	hydrology, morphology
estuary	Elbe
salinity zone	mesohaline
pressure	gross change in morphology and hydrographic regime
status	planned
river km	715-720
country/location	Germany, mouth of the Elbe estuary opposite of Otterndorf
responsible authority	Federal waterways and shipping administration (WSV)



1.1 Introduction

The measure "Underwater relocation area 'Medemrinne Ost'" is planned as a compensation measure related to the deepening of the fairway in 2013. An area of 628 ha will be filled with approx. 12.3 mill. m^3 dredged materials in order to decrease the tidal range and upstream sediment transport.

1.2 Objectives

The measure should reduce the effects of an expected raise of the tidal range, induced by the planned fairway deepening. The main target of the measure is to decrease the tidal range and thus the upstream sediment transport. Furthermore the long term loss of sediment in the mouth of the Elbe estuary that occurs irrespectivly of the planned deepening of the fairway should be mitigated.

1.3 Background and side conditions

The measure is a river engineering compensation measure related to the planned fairway deepening project of the Federal Administration for Waterways and Navigation (WSV) and Hamburg Port Authority (HPA). This measure is not carried out for WFD or Natura 2000 objectives.

A study was conducted on how the dredging material, which will come up during the planned deepening of the fairway, can be relocated in the mouth of the estuary in a beneficial way i.e. to meet favorable morphological and ecological aims at the same time. The study was carried out by the Federal Waterways Engineering and Research Institute (BAW) using a 3-dimensional hydrodynamic numerical model.

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1.4 Measure

The underwater relocation area 'Medemrinne Ost' will be located between Elbe km 700 and 717 (Fig. 1). It will cover an area of 628 ha ('Medemrinne Ost') and will be filled with 12.27 mill. m³ of sediment. The water depth will be reduced significantly but the stabilized bodies of sediment will remain well below the water level at any time. The surface of the 'Underwater relocation area' will be covered with sand, and with stones or gravel in areas where currents are strong and erosion has to be avoided. Construction time will be approx. 21 month. Construction costs of the underwater relocation area will be significantly higher than those of dumping the dredged material in the outer Elbe estuary. The difference is approx. 37 mill. €.

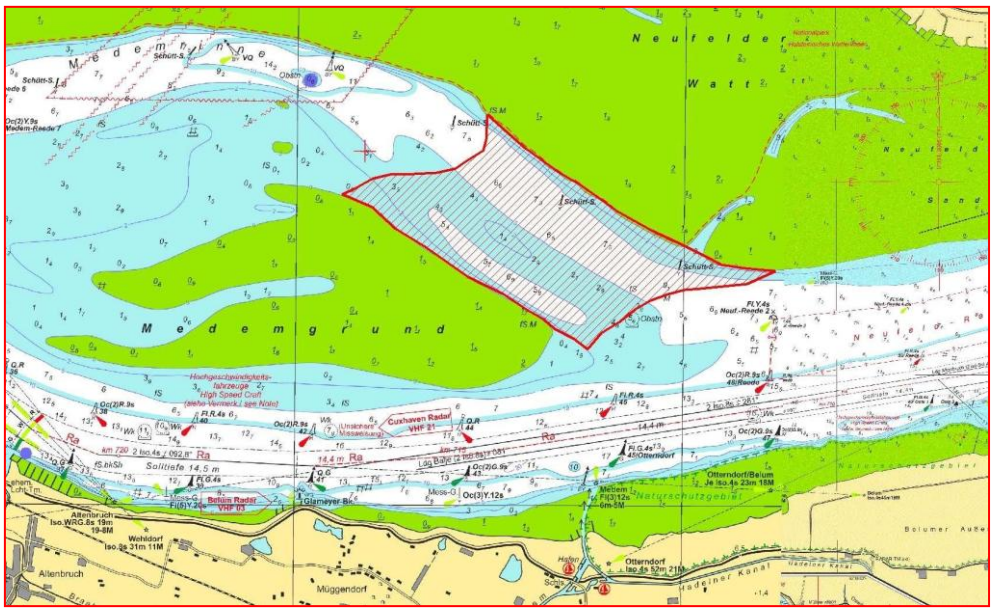

Figure 1: Position and profile of the underwater relocation area

The area was already added to the Natura 2000 area 'Hamburger Unterelbe' and the nature protection area 'Norderelbe'. Estimated costs for the measure are > 50 mill € due to the huge amount of heavy contaminated soil that has to be removed and treated in a special way. A period of three years is expected for the construction time.

In order to introduce the tidal influenced landscape to a wide-ranging public, a 'tidal park' is planned. The aim of the concept is to introduce basic tidal specific phenomena to the public. The complexity of the tidal dynamics and estuarine functioning will be shown within the landscape and not only by informative posters, in order to allow individual experience of the landscape. Objects, textures, vegetation and buildings will be used to present all aspects of the tides.

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1.5 Expected effect

The ”Underwater relocation area ‘Medemrinne-Ost’“ will reduce the tidal energy by reflection and dissipation. Thus, the increase of the tidal range that can occur in the frame of the fairway deepning will be mitigated in a certain extent. It will locally reduce erosion and lead to sedimentation in the Elbe branch ’Medemrinne‘.

An additional environmental assessment study was carried out in order to estimate the effects of the measure on habitats, birds and other species protected by the ‘Birds and Habitat Directive’ (BHD). Herein advices were given in order to minimize the effects of the works, e.g. they should not be conducted within the molting time of certain geese. Phytoplankton will not be affected, fish only during the construction period, and zoobenthos will need some time to recover after the construction. Benthic communities will change where stones or gravel are used to stabilize the 'Unterwater relocation area'.

According to the assessment study there will be an increase of biodiversity. Also new species will occur due to a stony sea bed which differ from those typically found in the Elbe eastuary. However, they will still be typical for the North Sea and German Bight, which also have stony grounds at some locations, e.g. around the island of Helgoland.

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Part 2: Execution of the main effectiveness criteria

The analysis is based on expert knowledge and the calculations which are documented in the planning approval document, and not on monitoring results.

2.1 Effectiveness according to development targets of measure

Definition of development targets:
The development targets/functions are:

- Minimizing the effects of the fairway deepening, such as the increase of the tidal energy, tidal range, tidal pumping which will result in a reduction of the residual upstream sediment transport.
- Mitigation of unfavorable morphological trends taking place in the mouth of the Elbe estuary such as the long term loss of sediment in the mouth of the Elbe estuary. This phenomenon, caused by the hydrodynamic conditions, is observed since a couple of years, irrespectively of the planned deepening of the fairway.

Achievement of development targets
The measure "Underwater relocation area Medemrinne Ost" has not been implemented so far. Numeric modeling of hydraulic parameters was used to predict whether the target can be met, however it is still unclear to which extent.

2.2 Impact on ecosystem services

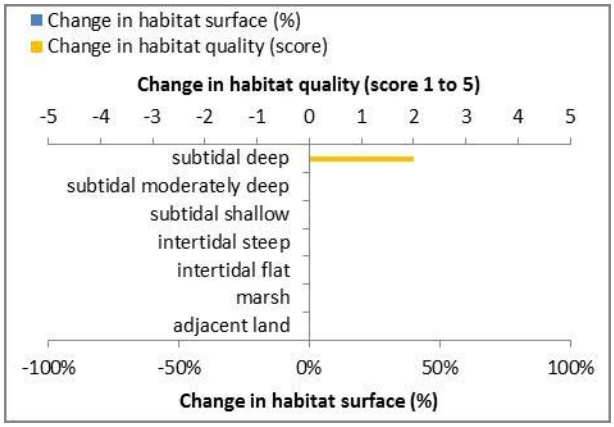

Figure 2: Ecosystem services analysis for Underwater relocation area "Medemrinne Ost": Indication of habitat surface and quality change, i.e. situation before versus after measure implementation.

- From the ES assessment it is concluded that this measure generates overall a slightly positive expected impact for several ES, mainly for:
  - "biodiversity"
  - Cultural services
  - Some regulating services: Erosion and sedimentation regulation (by water bodies); Water quality regulation: transport of polutants and excess nutrients; Water quantity regulation: transportation

  The expected impact for the two development targets ("Water quantity regulation: dissipation of tidal and river energy", and "Water for navigation") is neutral.

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The expected impact for the different beneficiary groups is limited, with a slightly positive expected impact for indirect and future use and for local and region use.

Table 1: Ecosystem services analysis for Underwater relocation area "Medemrinne Ost": (1) expected impact on ES supply in the measure site and (2) expected impact on different beneficiaries as a consequence of the measure.

Underwater relocation area "Medemrinne Ost"

Cat.	Ecosystem Service	Score
S	"Biodiversity"	1
R1	Erosion and sedimentation regulation by water bodies	1
R2	Water quality regulation: reduction of excess loads coming from the catchment	0
R3	Water quality regulation: transport of polutants and excess nutriënts	1
R4	Water quantity regulation: drainage of river water	0
R5	Erosion and sedimentation regulation by biological mediation	0
R6	Water quantity regulation: transportation	1
R7	Water quantity regulation: landscape maintenance	0
R8	Climate regulation: Carbon sequestration and burial	0
R9	Water quantity regulation: dissipation of tidal and river energy	0
R10	Regulation extreme events or disturbance: Wave reduction	0
R11	Regulation extreme events or disturbance: Water current reduction	0
R12	Regulation extreme events or disturbance: Flood water storage	0
P1	Water for industrial use	0
P2	Water for navigation	0
P3	Food: Animals	0
C1	Aesthetic information	1
C2	Inspiration for culture, art and design	1
C3	Information for cognitive development	1
C4	Opportunities for recreation & tourism	1

Beneficiaries:	
Direct users	0
Indirect users	1
Future users	1
Local users	1
Regional users	1
Global users	0

X Targeted ES

Legend: expected impact*	
3	very positive
2	positive
1	slightly positive
0	neutral
-1	slightly negative
-2	negative
-3	very negative

*: Indicative screening based on ES-supply surveys and estimated impact of measures on habitat quality and quantity. Quantitative socio-economic conclusions require local supply and demand data to complement this assessment.

The screening of ecosystem services (ESS) that were effected by the measure Medemrinne Ost showed no clear results. Some ESS will be influenced positively, but the targeted ESS will not be effected. This outcome made clear that the screening of the effects on the ESS is not applicable on every type of measure executed in the TIDE project

2.3 Degree of synergistic effects and conflicts according the uses

The “Underwater relocation area Medemrinne-Ost” is a measure to mitigate the unfavorable effects of the fairway deepening in the river mouth, secondly 10.2 mill. m³ dredged material can be stored there.

Possible conflicts during the construction period (disturbance of breeding birds and fish) will be avoided by applying a proper construction time regulation scheme.

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Part 3: Additional evaluation criteria in view of EU environmental law

3.1 Degree of synergistic effects and conflicts according WFD aims

Table 2: Effect of the measure concerning the main pressures in the mesohaline zone of the Elbe estuary

Indicator Group	Code	Main pressures mesohaline zone Elbe	Effect?					Description: Effects of the measure "Medemrinne Ost"
			- -	-	0	+	+ +	
S.I.	-	Habitat loss and degradation during the last about 100 years: Subtidal			0			
S.I.	1.1	Habitat loss and degradation during the last about 100 years: Intertidal			0			
S.I.	1.4	Gross change in morphology during the last about 100 years				+		Reducing the depth of the Medemrinne will mitigate the loss of sediments out of the estuary mouth which occurred over the last 50 years.
S.I.	3.1 /3.2	Decrease of water and sediment chemical quality			0			
D.I.	2.6	Capital dredging					++	The measure will be implemented to lower the unfavorable effects of capital and maintenance dredging
D.I.	2.5.	Maintenance dredging				+		
D.I.	2.3	Discharge of nutrients or harmful substances			0			

S.I. = state indicator; D.I. = driver indicator

The measure Medemrinne Ost is not related to the aims of the WFD, nevertheless the measure will be implemented to mitigate the dredging-effects and therefore it is also a measure to lower one of the main pressures in the mesohaline zone.

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3.2 Degree of synergistic effects and conflicts according NATURA 2000 aims

Table 3: Effect of the measure concerning the main conservation objectives in the operational area 6.

Operational area (zone)	Natura 2000 conservation objectives	Effect of Measure on conservation objectives			Description
		Positive	No effect	Negative	
6	Conservation of the near-natural hydro morphological habitat conditions of the habitat type Estuaries (11309), if possible conservation and improvement of estuary typical dynamics	+			
6	Conservation and development of broad mudflats and near-natural land-water intersection with tidal-creeks, tidal reeds and hydrophilous tall herb fringe communities (6430), reestablishment of tidal influence in the "Sommerpolder Belum"		+		
6	Conservation, reestablishment and development of meadows with vegetation typical for the Elbe region, like lowland hay meadows (6510) with respect to their avifaunistical function.		+		
6	Conservation of the function as growth habitat for the twaite shad.		+		
6	Stabilizing of the population of gull-billed tern and common tern.		+		
6	Conservation, partly reestablishment and development of the brooding function esp. for the species on extensive used meadows, large-scale reeds and grassland-ditch complexes of the marshes and the associated habitats.		+		

The measure 'Underwater relocation area Medemrinne Ost' has neither positive nor negative effect on species and habitats that were protected via the BHD. Nevertheless, it will fulfill one of the targets

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that are mentioned in the integrated management plan for the zone 6. The measure has the aim to improve the estuary typical dynamics in this area.

Part 4: Crux of the matter

The measure “Underwater relocation Medemrinne Ost” is a pilot project, though it is not implemented yet. No comparable measure could be found in Europe.
The minimization of unfavorable hydrological effects of necessary river engineering measures by a well directed reassembly of dredged materials is an innovative measure. It should be checked if there other possibilities for similar implementation within the estuary.

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Several planning maps are available (in German).

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