Work package 5 “Measures”
Dredging and Disposal Strategies

River Elbe – HPA/WSV
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Inhalt

1 Overview on the estuary and its ports

<u>Content:</u>
Position in the estuary, administrative borders and responsibilities

The Port of Hamburg, located 130 km inland, is a true international hub. It is Germany's largest port and third in Europe. Container ships arrive and depart here from and to worldwide destinations (56% Asia, 32% Europe) and the goods are distributed in and out via railway, truck and inland navigation vessels. Also other ports along the Elbe such as those of Cuxhaven or Brunsbüttel play a prominent role in shipment and distribution of goods, Figure 1-1.

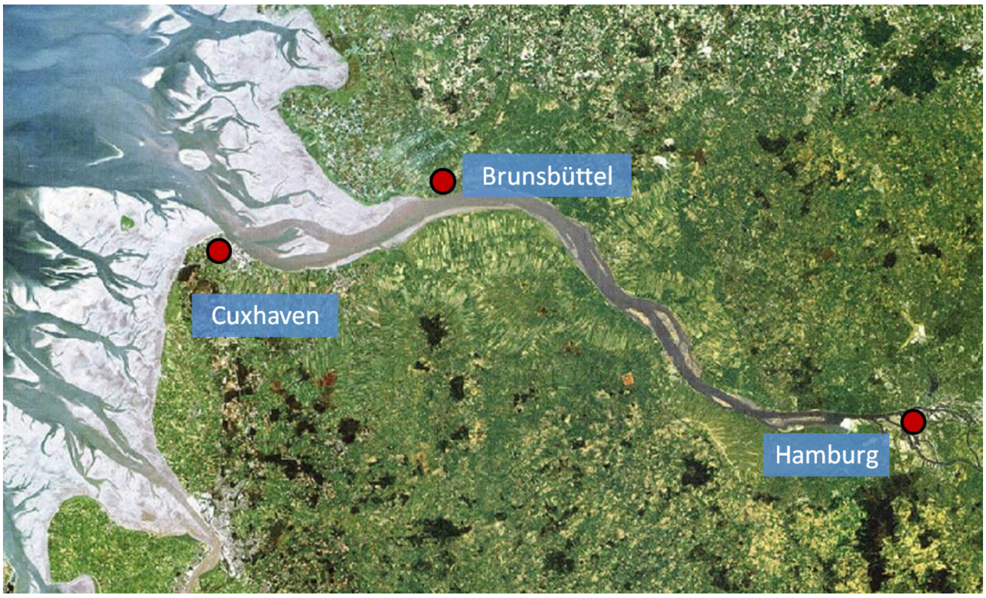

Fig. 1-1 Ports along the river Elbe

In Germany, the Elbe River is a federal waterway owned by the Waterways and Shipping Administration (WSV), who is responsible for its maintenance. In the state area of Hamburg, however, the management of the waterway is delegated to the City of Hamburg, represented by the Hamburg Port Authority (HPA).

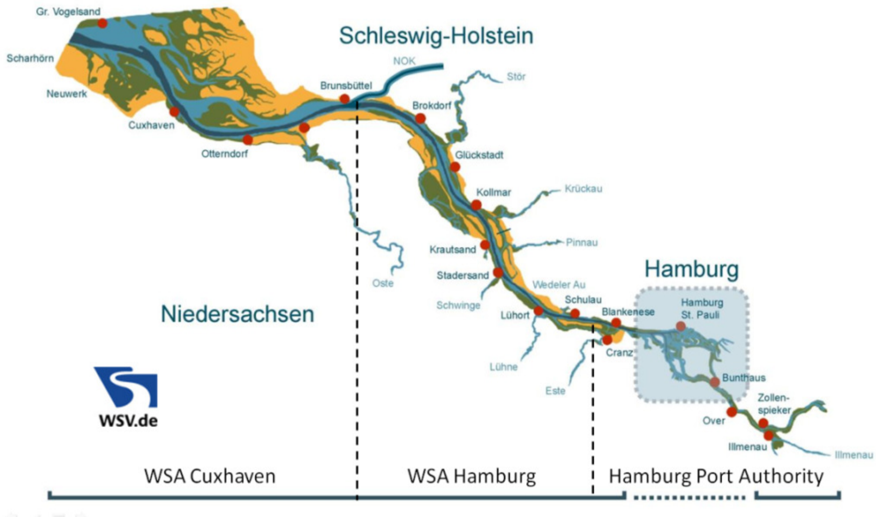

Fig.1-2 Responsibilities along the Elbe River

2 *Traffic*

<u>Content:</u>
Information on all relevant ports: cargo volumes (ocean and inland shipping), traffic numbers, vessel dimensions

A turnover of 113.2 million tons of ocean cargo within the Port of Hamburg was achieved in 2011. The prognoses for the forthcoming years show an increase up to nearly 300 million tons.

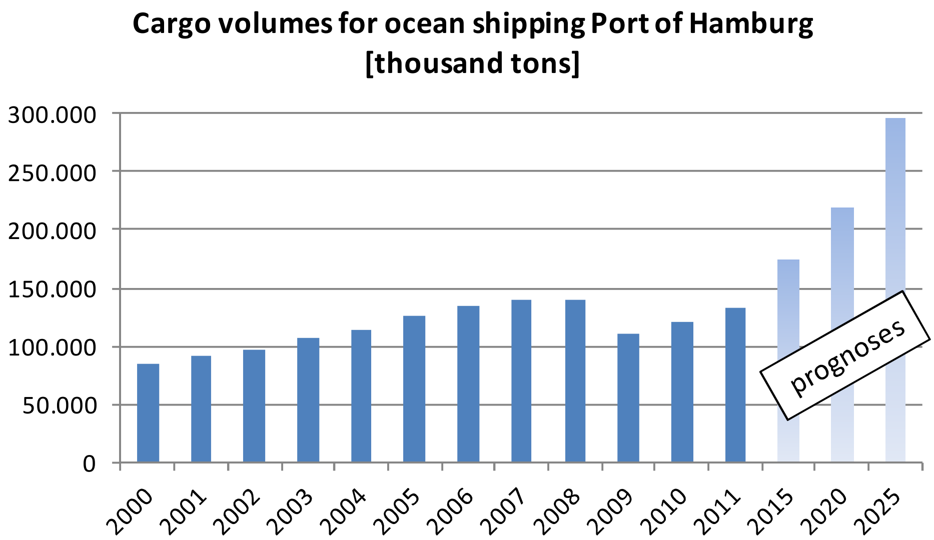

Fig. 2-1 Cargo volumes at the Port of Hamburg

The ports of Brunsbüttel and Cuxhaven show increasing cargo turn-over rate. In the year 2011 the Port of Brunsbüttel had a turnover of about 10 million t. The Port of Cuxhaven accounted for 3 million t in total.

Cuxhaven and Brunsbüttel have a relative high percentage of transshipment (20% and 40%), in the Port of Hamburg only 7% of the incoming cargo were transshipped.

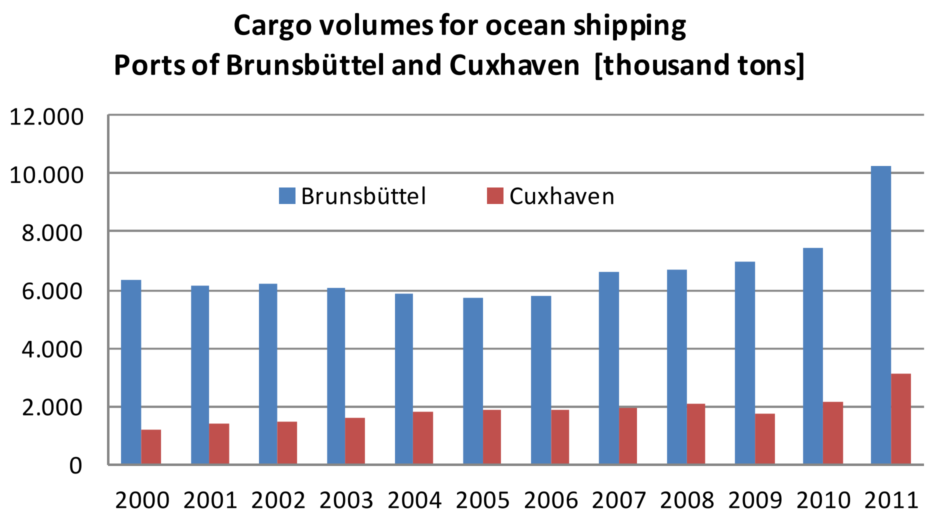

Fig. 2-2 Cargo volumes at the Ports Brunsbüttel and Cuxhaven

The traffic numbers within the port accounts for approximately 2300 container vessels in the year 2011. There is an upward trend regarding the maximum size and the maximum draft of the incoming vessels. In 2011, 300 vessels > 10.000 TEU call for the port of Hamburg.

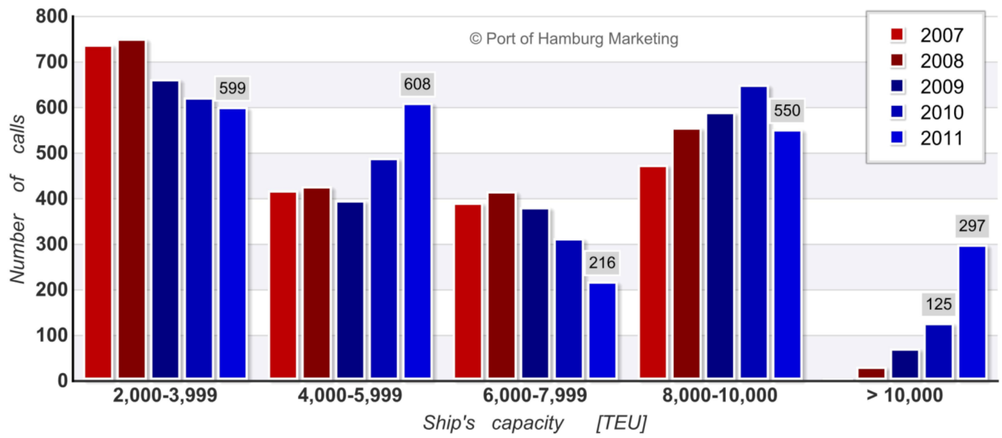

Fig. 2-3 Traffic numbers and vessel dimensions; Port of Hamburg

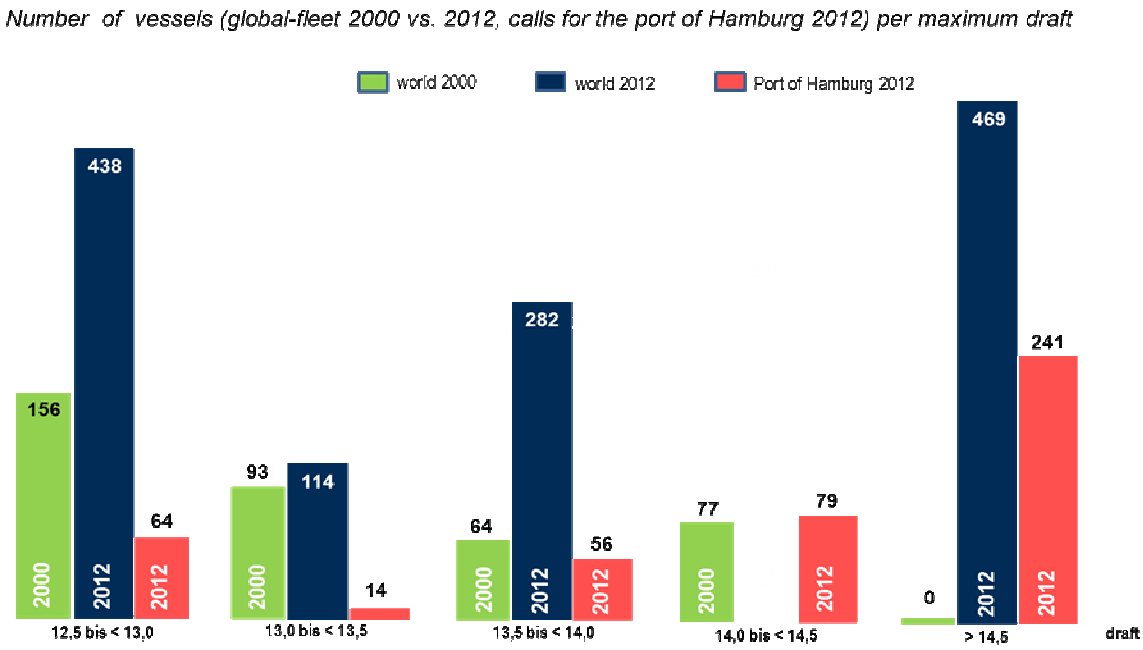

Fig. 2-4 Traffic numbers and vessel draft, Port of Hamburg

3 Shipping channels

Content:
Actual depth, further channel deepening if planned

The fairway channel up to Hamburg assures safe navigation for vessels with a depth up to 12.5 m independent from tidal conditions. Vessels with a depth of up to 13.5 m can access the Port of Hamburg depending on the tide.

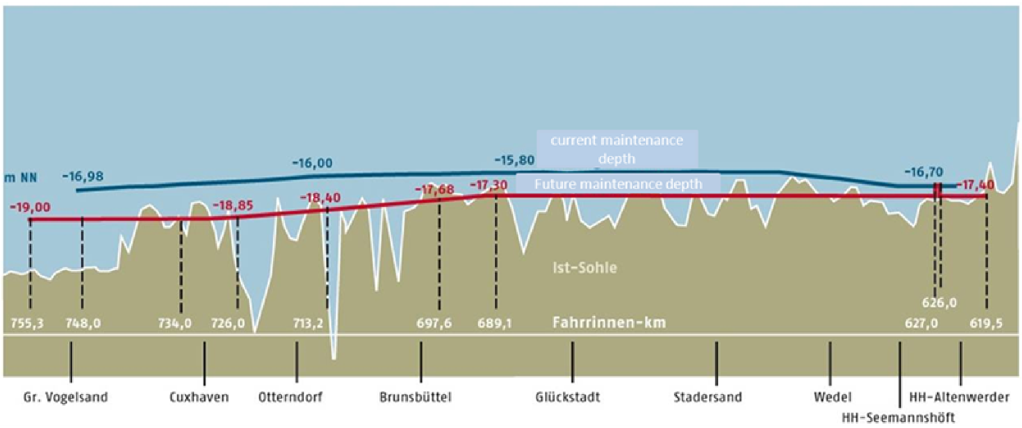

Fig. 3-1 Current and future maintenance depth of the shipping channel; River Elbe

The ongoing fairway deepening will ensure the accessibility of the port of Hamburg for vessels with a depth up to 13.5 m independent from the tide and for the ones with greater draught (up to 14.5 m) dependent on the tide.

4 General aspects of dredging and disposal

Maintenance works for the fairway of the tidal Elbe is carried out by three different institutions. Responsibilities are with the Hamburg Port Authority (HPA) and the Federal Navigation and Shipping Administration (1) WSA Hamburg and (2) WSA Cuxhaven. All WSA divisions belong to the WSV, the superior organization. Figure 1-2 shows the complexity of the administrative districts.

4.1 Quantities of dredged material

Content:
Dredging volumes incl. water injection if applicable, dredging sites, physical and chemical quality of sediments, capital dredging
Differentiate between areas behind locks and tidally influences areas of the port, if possible mention the total water area [m²] port and total water area fairway [m²].

Dredging works are necessary within the sedimentation areas along the river. Mostly hopper dredgers are used for this purpose. Smaller equipment for excavation is used only under narrow conditions. Figure 4-1 shows the total dredging volumes throughout the years 1999 to 2009.

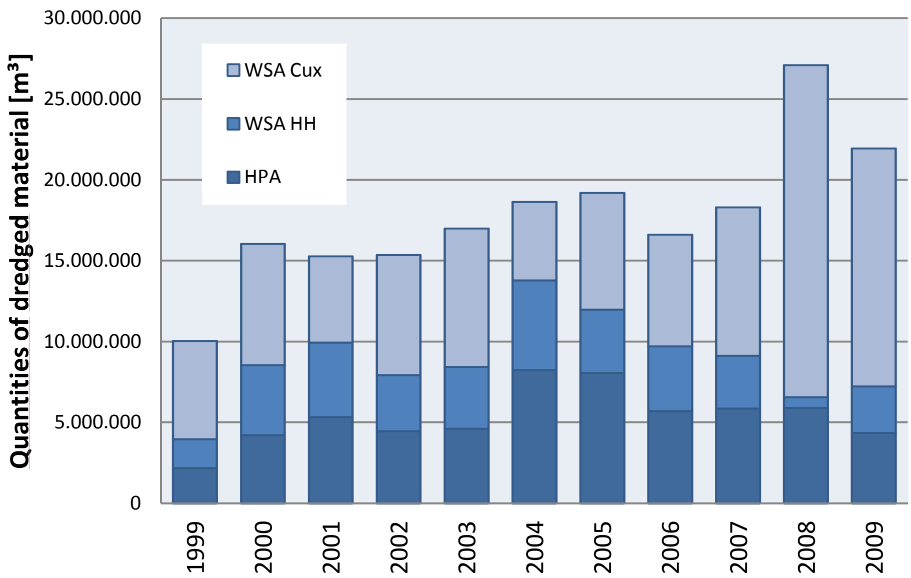

Fig. 4-1 Quantities of material dredged by the Cuxhaven and Hamburg Water and Shipping Authorities and the Hamburg Port Authority from 1999 to 2009 in m³

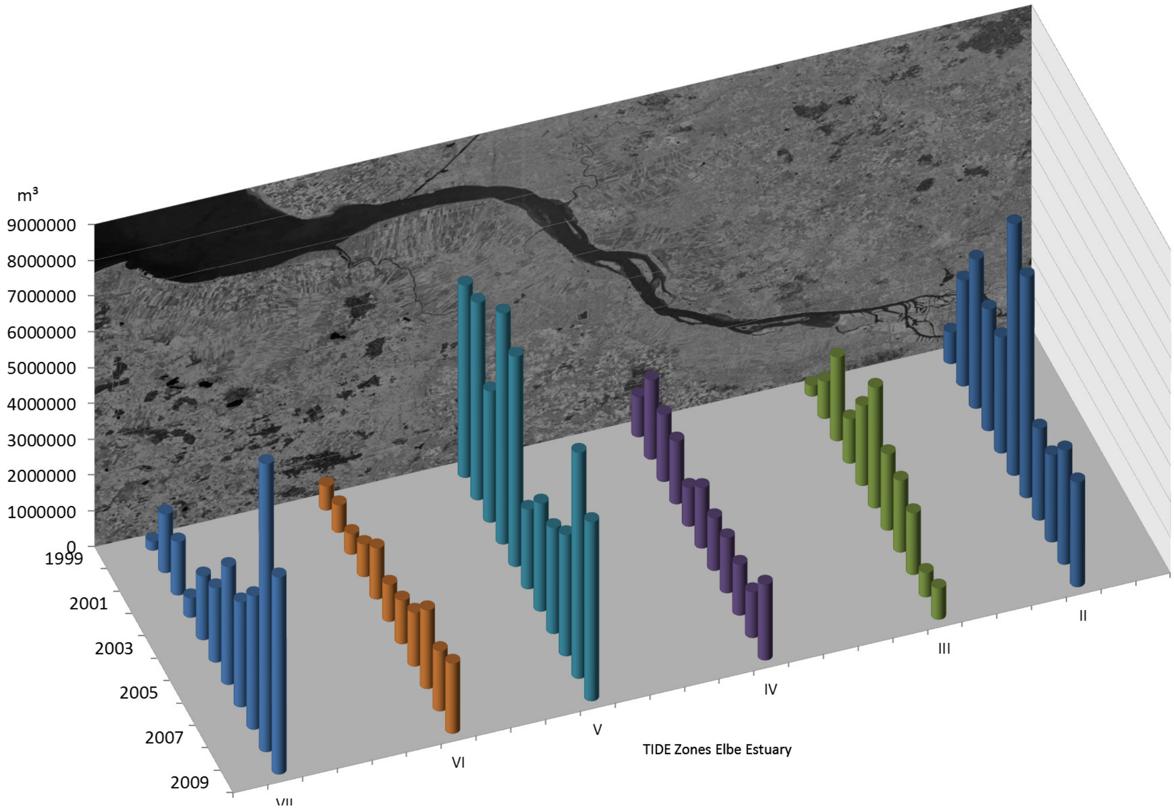

Fig. 4-2 Quantities of material dredged [m³] and relocated in the Elbe estuary from 1999 to 2009; volumes measured by HPA are accounted as bottom profile [m³ PM] in different TIDE Zones. In Zone I no significant dredging occurs.

Capital dredging of the Elbe fairway has occurred in 1998/99; the respective volume is not included in the given figures. Increase of maintenance dredging due to follow up sedimentation during the following years can be assumed, but cannot be quantified.

In addition to conventional dredging, water injection (WI) is also used to eliminate sand ripples in the navigation channel where necessary. Apart from this, also areas outside the navigation channel such as harbor basins and anabranches are in parts maintained by using WI dredgers. This includes also material consisting of silt and fine sand which is dredged with the intention to get transported with the outgoing tide in downstream directions. Water injection can only be implemented successfully in close setting with the tidal conditions.

It is not possible to estimate the quantity of dredged material moved by water injection due to a lack of definition. If e.g. sand ripples are cut, the material itself is only shifted a few meters in the desired direction. Hence a control survey does not end up with a changed overall ratio compared to the situation before WI came in place. It is only possible to give an estimate of how much volume is moved calculated by the total operating time of the dredger. As a rough estimate, about 50.000 – 200.000 m³ are dredged annually in the area of responsibility of the HPA. Roughly 1.000.000 m³ are moved annually by the WSA in between Wedel und the North Sea.

All areas dredged are under tidal influence. No harbor basins are operated behind locks; therefore a distinction between dredged volumes in harbors and fairways is not made.

4.1.1 Dredging sites and sediment quality in the Port of Hamburg (HPA)

For the maintenance of the fairway and the port, dredging is necessary throughout the entire port. Sedimentation rates differ depending on the location of each harbor basin.

The occurrence of silt and fine-sand materials predominates in most areas. Material which majorly consists of sand is only dredged within the fairway (sand-ripples) and also upstream of the port close to a change in water depth (the maintenance depth of the Elbe upstream of the port is accessible for inland water vessels only).

Sediments that are dredged in the Port of Hamburg differ in quality. Where periodic maintenance dredging takes place, like in the fairway of the river, the basin entrances, etc., sediments stem from current sediment input from up- and downstream. They are called 'fresh' then. In addition in some parts of the port there are areas where dredging was not undertaken since long, thus sediments can be old and more contaminated therefore.

Figure 4-2 shows a map of the major dredging sites and their potential classification. Areas that are dredged once or twice a year accumulate fresh sediments from upstream and downstream. Norderelbe, Köhlbrand and Süderelbe represent a main constituent of the dredging activity and are especially important for the container terminal accessibility. Other areas such as old harbor basins tend to accumulate material over a longer period. Their content differs in contamination depending on the depth and further reflects the quality of suspended solid at former times.

Two types of qualities are outlined in figure 4-3. (1) fresh sediment with a low contamination level that allows relocation and placement, (2) older material with a contamination level that requires treatment and disposal on land.

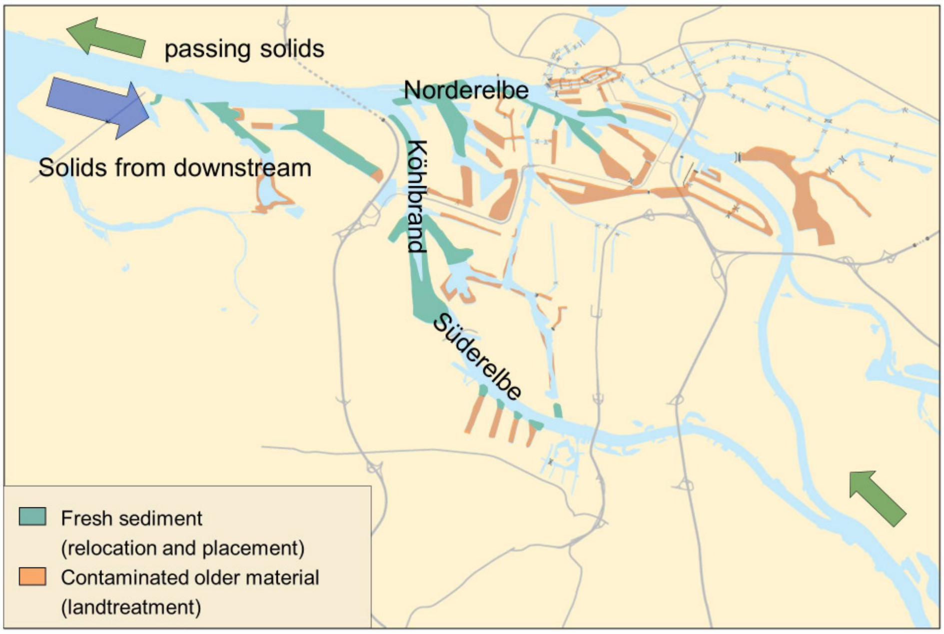

Fig. 4-3 Disposition of solids and movement in the port of Hamburg

Contaminants of concern are heavy metals and organic contaminants mostly affected by upstream input from the Elbe catchment area. Also organ tin components are of concern, mostly caused by the shipping industry and harbor activities.

Tab. 4.1 Contents of pollutants in dredged material from the port of Hamburg (2005-2010, material for relocation n = 410, material for land disposal n = 35)

	Unit	*relocation*		*land disposal*	
Substance		arithmetic mean	min-max	arithmetic mean	min-max
Heavy metals (particle size fraction < 20 µm, dry mass)					
Arsenic (As)	mg/kg	37	20 - 51	110	33 - 352
Lead (Pb)	mg/kg	92	58 - 140	223	82 - 674
Cadmium (Cd)	mg/kg	3,5	1,5 - 8,8	11	2,3 - 36
Chromium (Cr)	mg/kg	77	50 - 128	137	58 - 311
Copper (Cu)	mg/kg	84	44 - 221	251	68 - 745
Nickel (Ni)	mg/kg	44	30 - 91	58	39- 97
Mercury (Hg)	mg/kg	1,8	1,0 - 5,1	8,1	1,4 - 24
Zinc (Zn)	mg/kg	690	310 - 1400	1661	541 - 4680
Organic contaminants (particle size fraction < 63 µm, dry mass)					
PCB sum7	µg/kg	25	10 - 144	225	17 - 3744
a-HCH (Hexachlorcyclohexane)	µg/kg	1,0	<0,05 - 10,9	3,5	0,2 - 30
y-HCH (Lindane)	µg/kg	0,4	<0,05 - 3,5	1,0	0,14 - 4,6
HCB (Hexachlorbenzene)	µg/kg	11	1,0 - 70	4,7	1,3 - 49
Pentachlorbenzene	µg/kg	1,9	<0,5 - 7	16	6,6 - 50
p,p'-DDT	µg/kg	8,6	<0,5 - 217	8,1	0,7 - 54
p,p'-DDE	µg/kg	6,5	<0,5 - 27	17	4 - 110
p,p'-DDD	µg/kg	18	4 - 84	42	11 - 358
Hydrocarbons total	µg/kg	217	<100 - 1038	2315	119 - 13125
PAH (Polycyclic Aromatic Hydrocarbons) sum 16	µg/kg	2,8	0,8 - 22	17	1,3 - 126
Organic contaminants (whole fraction, dry mass)					
TBT (tributyltin)	µg/kg	110	16 - 557	650	47 - 4510

4.1.2 Dredging sites and sediment quality along the tidal Elbe (WSV)

The territory in charge of the WSA Hamburg and Cuxhaven (Waterways and Shipping Offices) is currently divided into 17 dredging sections (Fig. 4-3).

In the WSA Hamburg area of competence (km 638. 9 to km 689.8; BA1 to BA10) the highest volumes need to be dredged in the Wedel (BA1) and Juelssand (BA3) sections, both located far upstream.

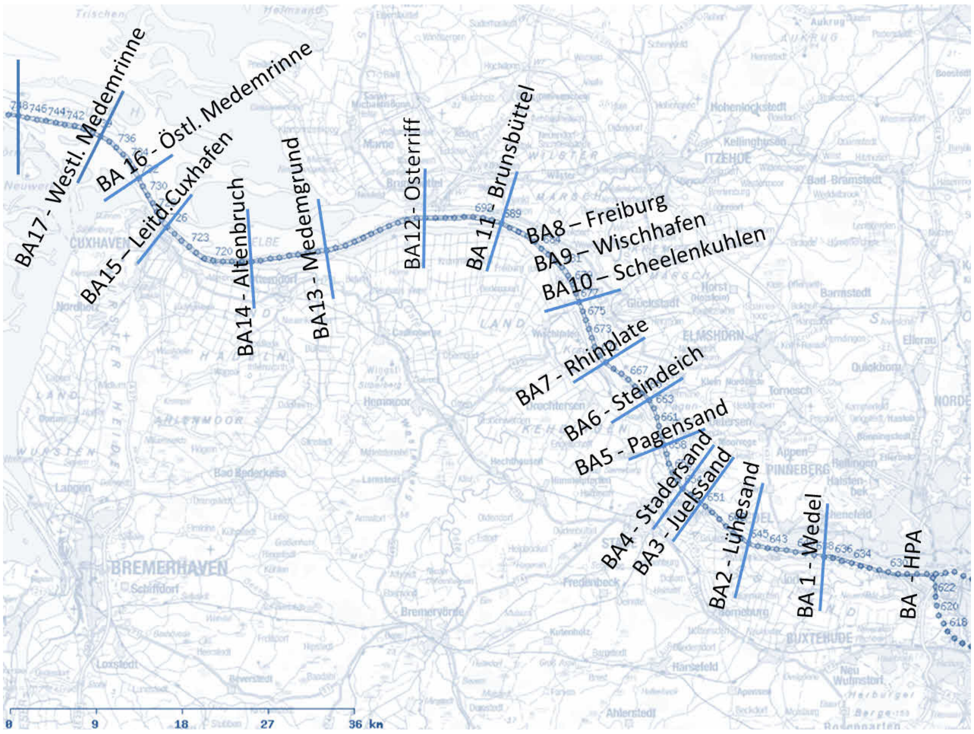

Fig. 4-4 Dredging sections BA1-17 in the Tidal Elbe (WSV)

The material mainly consists of silty fine sand that is excavated exclusively by hopper dredgers. Downstream of Juelssand, sandy bed material predominates.

Tab. 4.1 Overview of the tidal Elbe dredging sections in charge of the Waterways and Shipping Offices Hamburg and Cuxhaven

	Designation/Name	Elbe km	Type of Dredged Material
BA	HPA	Port – 638.9	Silt in most of the port area/sand
BA1	Wedel	638.9 – 644.0	Silt/fine sand
BA2	Lühesand	644.0 – 649.5	Predominantly medium sand
BA3	Juelssand	649.5 – 654.4	Silt/fine sand
BA4	Stadersand	654.5 – 659.0	Predominantly medium sand
BA5	Pagensand	659.0 – 664.5	Fine/medium sand
BA6	Steindeich	664.5 – 670.0	Predominantly (medium) sand
BA7	Rhinplate	670.0 – 676.0	Predominantly medium sand, some fine-sand / silty areas
BA8	Wischhafen	676.0 – 680.5	Almost exclusively (medium) sand
BA9	Freiburg	680.5 – 685.5	Almost exclusively (medium) sand
BA10	Scheelenkuhlen	685.5 – 689.8	Almost exclusively (medium) sand
BA11	Brunsbüttel	689.8 – 698.5	Predominantly medium sand, some fine-sand / silty areas
BA12	Osteriff	698.5 – 709.9	Fine sand/silt
BA13	Medemgrund	709.0 – 717.0	Predominantly (fine) sand
BA14	Altenbruch	717.0 – 726.0	Predominantly (fine) sand
BA15	Leitdamm Cuxhaven	726.0 – 732.0	Predominantly (fine) sand
BA16	östliche Mittelrinne	732.0 – 739.0	Fine to coarse sand
BA17	westliche Mittelrinne	739.0 – 748.0	Fine to coarse sand

4.2 Placement sites

Content:
Overview on placement sites and placement options

4.2.1 Relocation in the aquatic environment – Neßsand

Since 1994 dredged material from the port of Hamburg is relocated to the north of the island of Neßsand in the River Elbe, figure 4-5. The river is deep here, it flows very fast and is very turbid due to the natural turbulence. The riverbed displays a ripple structure, which constantly changes as the tide comes in and goes out. This section of the river is always in motion, and as such has, in all probability, the ability to cope with additional material. To be certain, a study was set out to verify this capacity. The results showed that after a very short time it was impossible to differentiate between the relocated material and the original suspended matter and sediments. The fine-grained dredged material does not remain in one place; instead, it mixes with the naturally occurring suspended solids and is distributed over a wide area by the action of the tides.

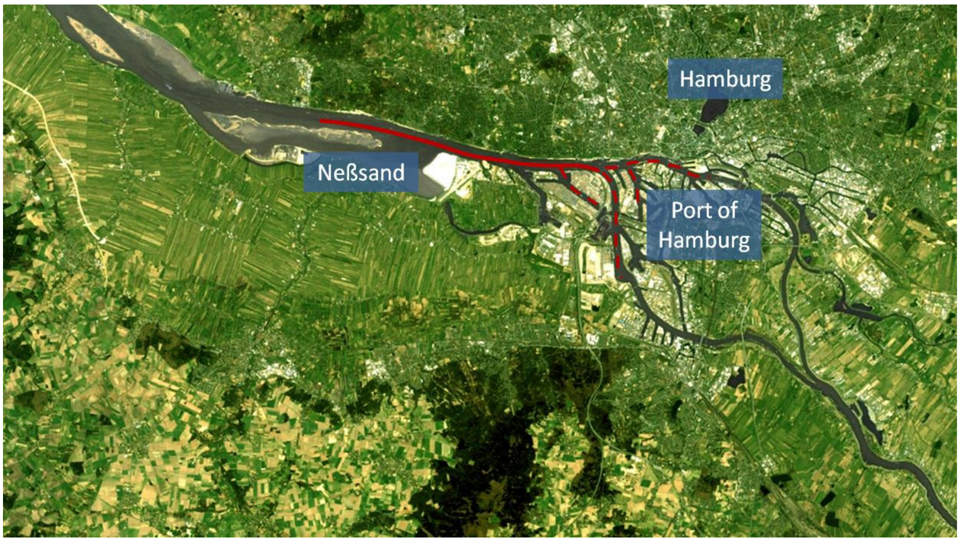

Fig. 4-7 Relocation with the tidal Elbe next to the island Neßsand, distance to the port approx. 10 km (source: BING maps)

The annual amount relocated to Neßsand from the harbor sums up to an average of 2.8 million m³ (average value 2006 to 2009). Specific regulations apply when relocating here. To minimize environmental effects it is not allowed during the summer period of the year, in which effects on juvenile fish may be an issue. This period has also been selected to avoid any negative impact on the oxygen concentration which is particularly low during the warmer time of the year. Technically the process has been studied and the ideal location has been identified leading to a minimized effect on turbidity and also optimizing the downstream transport of the material. To minimize the effect of uncontrolled sediment distribution into shallow water areas, material only gets relocated during ebb flow conditions. The defined timeframe starts one hour before high tide and end two hours before low tide. During low headwater discharge (< 500 m³/s) total amounts should be reduced if possible.

4.2.2 Deposition of sediments at the North Sea – Buoy E3

In the years 2004 and 2005 very high amounts of sediments were dredged in the port. On this background discussions with Schleswig-Holstein started to find a solution, to deal with the re-circulation of sediments between Neßsand and the port of Hamburg. It was considered to be necessary to take material out of the system and bring it to a place outside of the estuary into the North Sea. As placement site an area next to Buoy E3 was identified, compare Figure 4-8. The surrounding area is known as a natural silt deposit; here sediments have similar physical characteristics compared to the sediments from the Port of Hamburg. It was the objective to achieve a stable deposition without interaction of sediment transport to neighboring regions such as the National Park Wadden Sea, distance 22 km, or the island of Helgoland, distance 15 km.

Fig. 4-8 Location of Buoy E3 in the North Sea, coordinates 54° 03′ N / 07° 58′ E (source: BING maps)

The dedicated site is defined by a 1.000 m radius around the coordinate 54° 03′ N / 07° 58′ E, the placement field itself is dimensioned to 400 m x 400 m in the center of the site.

In between 2005 and today a total of approximately 6,5 million m³ dredged sediments have been transported from the Elbe in Hamburg to Buoy E3. As part of the monitoring program, the placement area gets surveyed regularly after each campaign. A minimum water depth of 25 m has to be assured at all times.

4.2.3 Placement sites along the Tidal Elbe (WSV)

Figure 4-9 gives an overview about placement sites for dredged material in the WSV area of competence.

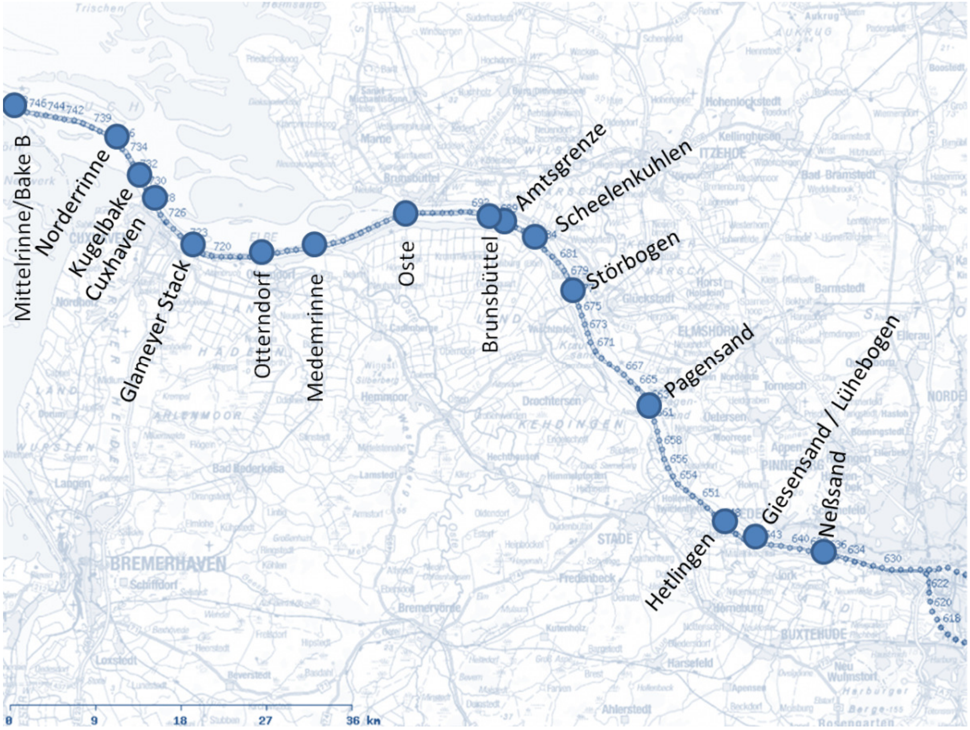

Fig. 4-9 Placement sites along the Tidal Elbe (WSV)

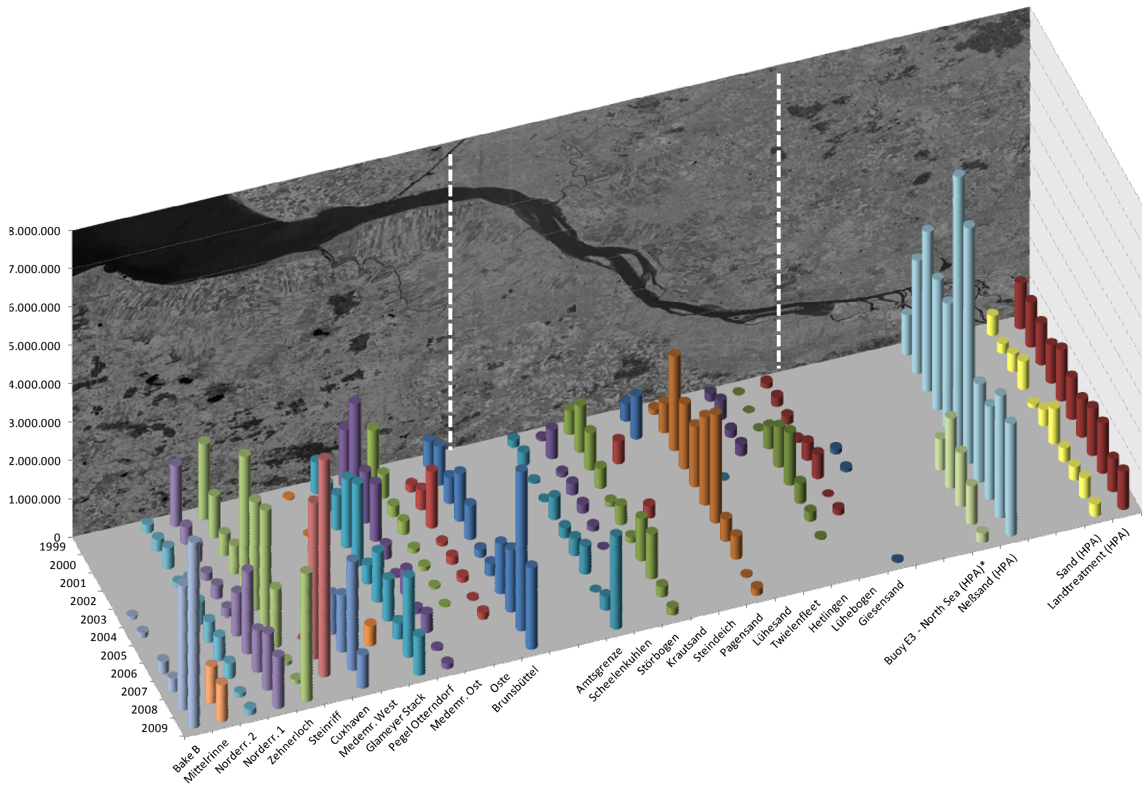

Fig. 4-10 Dredged material [m³] relocated in the Elbe estuary from 1999 to 2009; volumes measured by HPA are accounted as bottom profile [m³ PM], *Buoy E3 is located in the North Sea, dredged material treated on land is not relocated

4.2.3 Land Treatment of Sediments

Content:

Volumes treated and deposited on land, volumes taken to CDF, reason for depositing on land (for instance critical limits and guideline values for toxic substances) and using a CDF, alternative utilisation of the material (i.e. quantities for terrestrial construction purposes)

Today annually 1 million m³ of sediments is treated and disposed of on land. Sophisticated land treatment of sediments was implemented through the METHA-plant (METHA is the acronym of MEchanical Treatment of HArboursediments). By a mechanical process different particle sizes can be separated using hydrocyclons, figures 4-6/7.

Only material not qualified for relocation is taken on land, assessment criteria are given by national guidelines (ARGE-Elbe).

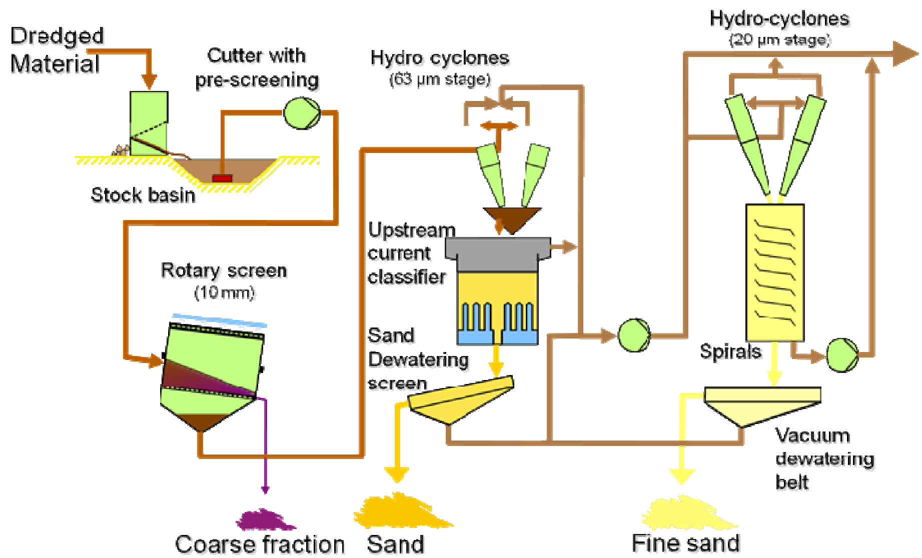

Fig. 4-6 Principle flowchart of the METHA plant – sorting

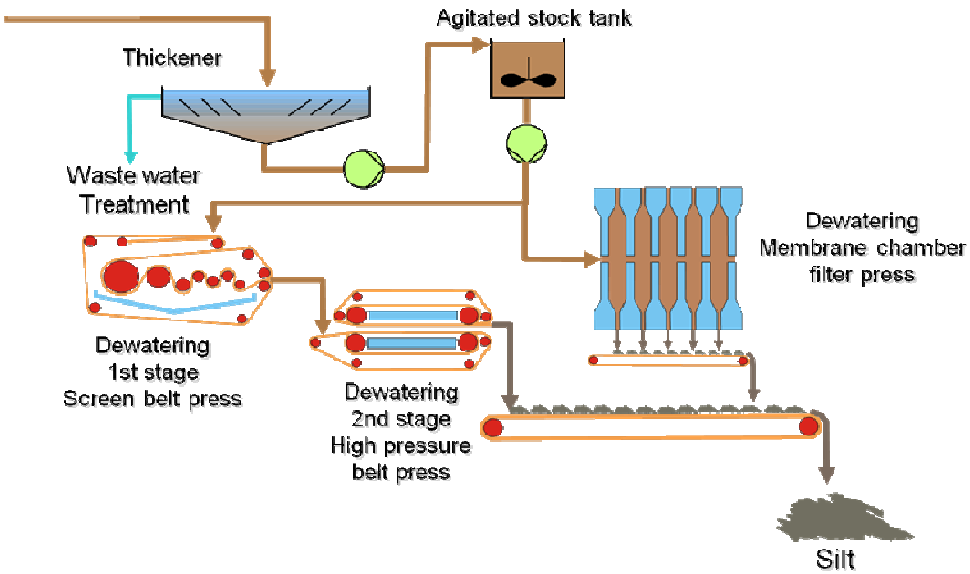

Fig. 4-7 Principle flowchart of the METHA plant – dewatering

Aside from the dewatering in the METHA, dewatering of the silty dredged material is also done in the so-called dewatering fields. These fields exhibit sizes ranging from 2 to 4 ha and encompass a total area of about 100 ha. They were built on old flushing fields, after which they were sealed by means of a silt sealing and an additional drainage layer to protect the groundwater.

Two silt-mound disposal sites are available for environmentally safe landfilling of the treated dredged material that meet all technical and legal requirements: Francop and Feldhofe. The Francop disposal site covers 120 hectares with a storage capacity of 8 million m^3 of dewatered material (corresponding to 16 Mio m^3 of sediment) and is the largest and oldest disposal site in Hamburg. The Feldhofe disposal site covers an area of ca. 80 hectares with a capacity of 9 Mio m^3. The disposal sites higher than 30 m above sea level are shaped as naturally as possible in the otherwise flat marshes by moulding and later recultivation, and are carefully adapted to the environment.

Alternative options have been evaluated in Hamburg including the production of pellets as filter material and also the production of bricks. These options have been developed to an industrial scale, but operation costs turned out to be unfeasible to make it a large scale alternative. Innovative research is still ongoing; currently the use of METHA material in dyke construction is investigated.

A confined disposal facility, comparable to e.g. the Slufter in the Netherlands is not operated at the Elbe.

5 Strategies for dredging

Content:

Strategies for dredging, placement, disposal, alternative utilisation: objectives, forms of realization, monitoring, experience (evaluation)

The Federal Waterways and Shipping Administration (WSV) and the Hamburg Port Authority (HPA) presented a jointly developed "River Engineering and Sediment Management Concept for the Tidal River Elbe" (RESMC) in 2008. The primary source of motivation was the increase in energy input in the delta with disturbed material balance, the rise in the quantity of sediment to be dredged for the maintenance of the water depth, particularly in the Hamburg area and an altered legal framework.

The concept of 2008 specifies a number of causes for the rise in dredged volumes and on this basis not only develops a strategy for sediment management, but also for reduction of the dredged volumes, taking into account sediment composition and contamination. The latter encompasses measures of varying concrete detail and feasibility and to this extent also different time spans. Individual aspects of the concept have already been implemented, others have yet to be commenced. These include the implementation of a new relocation scheme within the Tidal Elbe (compare chapter 5.3.1) and also the construction of a sediment trap (chapter 5.3.2) for maintenance purposes.

5.1 Why we dredge

Content:

- Mention all border conditions of sediment management
- Methods of dredging, placement and disposal

Dredging is undertaken in Hamburg since centuries. The first steam dredger went into operation around 1832. Traditionally the dredged sediments were brought on land for reclamation or agricultural purposes.

In the late 1970's, it was realized that the Elbe sediments are contaminated. Because pollutants stemmed to a large extent from the Eastern Bloc, there was rarely a possibility for action at source. Against this background, a highly technical concept for dredged-material handling was developed in the mid-1980's. A solution had to be found in the very narrow city limits.

The key element was the treatment and dewatering of the dredged material on dewatering fields and in the treatment plant METHA[1] - Mechanical Separation and Dewatering of Port Sediments. This process is capable of separating sand and silt fractions that can be reused; the remaining contaminated silt needs to be stored in special landfills. After 1989 pollution levels in the Elbe went down significantly, and the policy on dredged-material handling was amended accordingly. In 1994 tests started to relocate sediments in the aquatic system, accompanied by thorough monitoring.

Today of the 5-6 million m³ of dredged material being dredged every year during maintenance work in the Elbe in Hamburg, a large proportion is relocated. From an environmental point of view it also makes sense, because the large-scale natural sediment balance should be kept in balance. Fine silt remains in the water, which further is essential for the formation of mudflats.

After the intensive increase of dredging necessity in 2004/05 the relocation was extended also to the North Sea. A controlled placement is under operation since then.
A very basic outline of the handling concept is shown in figure 5-1.

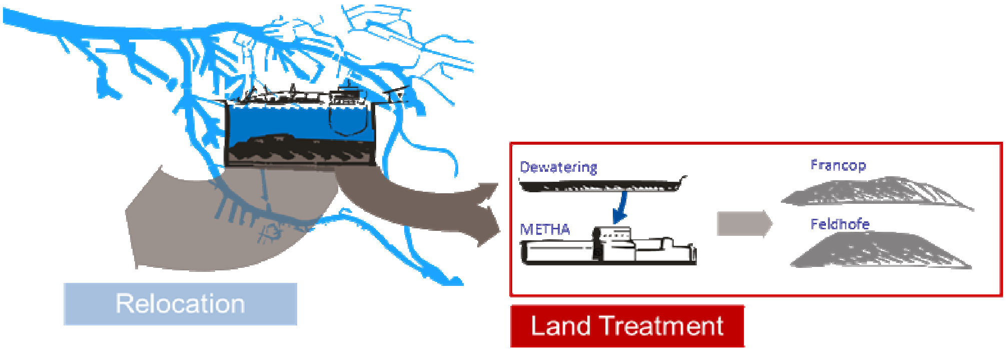

Fig. 5-1 Hamburg dredged material management concept

Extensive dredging is necessary in between Hamburg and the North Sea to assure the accessibility of the port. The Waterways and Shipping Administration manages to maintain the Tidal Elbe through relocation of the dredged material within the river system. Material is not brought on land for further treatment.

5.2 Capital dredging of fairways

Content:

- Fairway depths, Avoidance of maintenance dredging, Dredging methods, Construction periods, Special aspects referring to ecology/water quality/habitats and species protection, Additional estuary specific strategies according to capital dredging of fairways

The fairway of the Elbe is in its current state since the last adjustment in 1999/2000. The ongoing fairway deepening will ensure the accessibility of the port of Hamburg for vessels with a depth up to 13.5 m independent from the tide and for the ones with greater draught (up to 14.5 m) dependent on the tide. The strategies for dredged material are

[1] METHA: Mechanische Trennung und Entwässerung von Hafensedimenten

complex and include the construction of underwater placement sites to deal with the volumes to be dredged. This process is completely different from regular maintenance dredging works, since the material excavated is different from settled sediments. It consists of sand and heavy soil that needs specific management.

The reduction of measure-related impact being a major planning objective, also the limitation of additional maintenance dredging will be achieved by implementing an integrated concept of river engineering measures. By means of five underwater deposition sites for dredged material, designed by size and position with the assistance of hydro numeric modeling, the increase in the amount of dredged material from maintenance dredging will be limited by 10 % maximum. However, there will be a disproportionally high local increase just downstream the Port of Hamburg in a special area for two way navigation.
As this specific area is important for spawning fish (e.g. twaite shad) the impact of maintenance dredging on spawning fish will be monitored and dredging may be discontinued in case of unjustifiable disturbance.

5.3 Maintenance dredging of fairways

Content:

- General strategy, Avoidance of maintenance dredging , Construction periods, Special aspects referring to ecology/water quality/habitats and species protection, Sustainable aspects, Additional estuary specific strategies according to maintenance dredging of fairways

5.3.1 An optimized relocation pattern within the Tidal Elbe

For large sections of the Hamburg area of competence (area of responsibility: Elbe-km 638.9 to km 689.8) it can be assumed that upstream transports of sediments not only dominate in shallow-water zones but also in the navigation channel. This applies in particular to fine-sand and coarse-silt material. As upstream of Störbogen (area around km 677) residual transport rates towards the port of Hamburg are presumed to be considerable ("tidal pumping"), a changed relocation strategy for hopper dredging was implemented there in 2006 (Figure 5-2), aimed at breaking sediment cycles. The relocation of the sediments dredged in the area of competence, of which on average around 50% originate from the Wedel section (km 638.9 to km 644.0) and around 15% from the Juelssand section (km 649.5 to km 654.5), to areas located downstream of Störbogen is to prevent potential upstream transports after the dredged material has been relocated and/or reduce upstream-headed residual transports. Since 2008, almost all of the dredged material has been relocated between km 686 and km 690, in the area of the turbidity zone's main maximum.

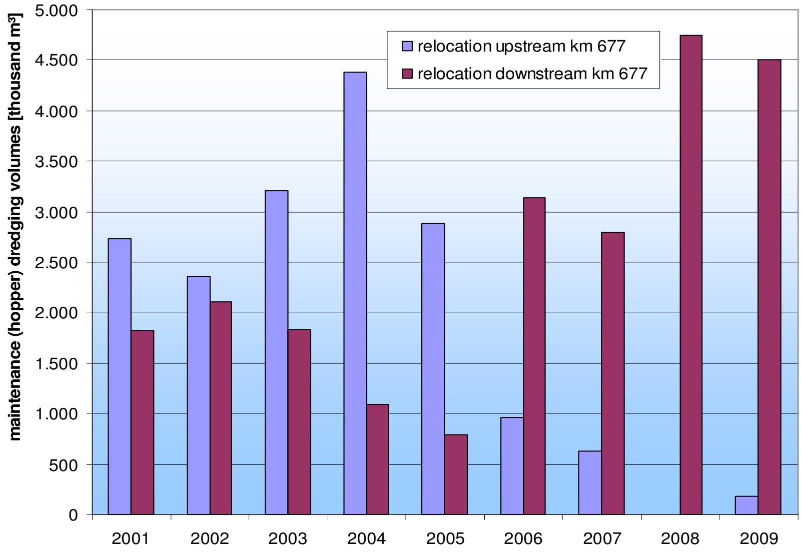

Fig. 5-2 Relocation of maintenance dredging volumes (hopper dredging) in the area of the WSA Hamburg (2008 and 2009, incl. installation of the Wedel sediment trap) – since 2006, volumes have primarily been relocated to areas downstream of Störbogen (km 677)

The entire hopper-dredged material from the Hamburg competence area is currently being relocated between Elbe-km 686 and km 690. The concept developed for this section aims at creating a balance between relocation/sedimentation and erosion at the disposal sites. Further it serves as a long-term basis for accompanying morphological and environmental investigation programs.

5.3.2 Operation of a sediment trap

As pilot project and first step to keep upstream sediments from mixing with those coming from sea a sediment trap was constructed in 2008 downstream of the Hamburg port, located next to Wedel (Figure 5-3). Central objective is also to reduce the dredging amounts in the Port of Hamburg. A deepening within the fairway, length 2 km, depth 2 m, width 300 m was dredged (Figure 5-4). The intention is to enhance the sedimentation and hold back downstream sediment through tidal pumping before it reaches the Port of Hamburg. The trapped sediment will be dredged out of the basin and relocated further downstream out of the flood current dominated part of the estuary. This measure was implemented in 2008 and it comes along with an extensive monitoring program to enhance the system knowledge.

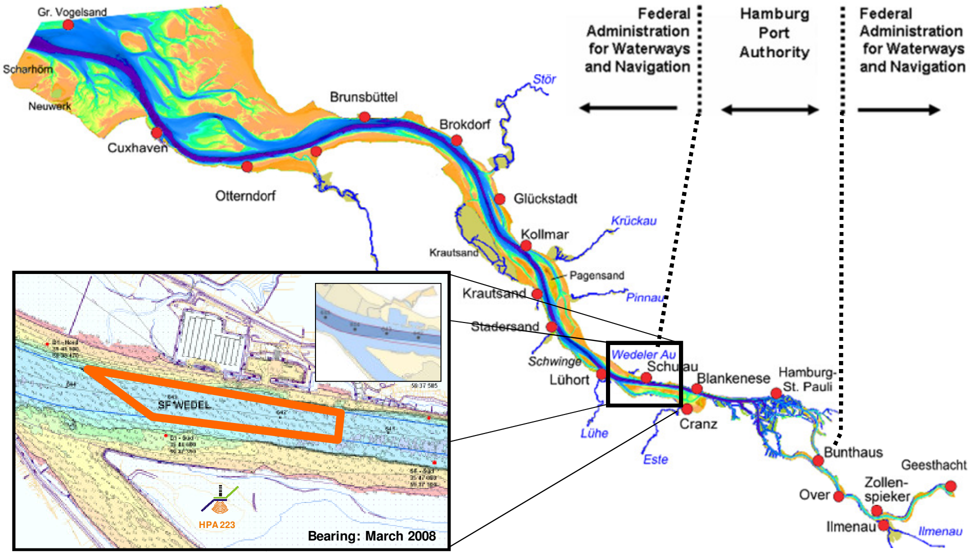

Fig. 5-3 Location of the sediment trap Wedel and administrative boundaries

The local deepening of the riverbed enlarges the water body cross-section which causes a reduction of both current velocity and turbulences. These reductions, in turn, enhance the sedimentation of suspended sediment.

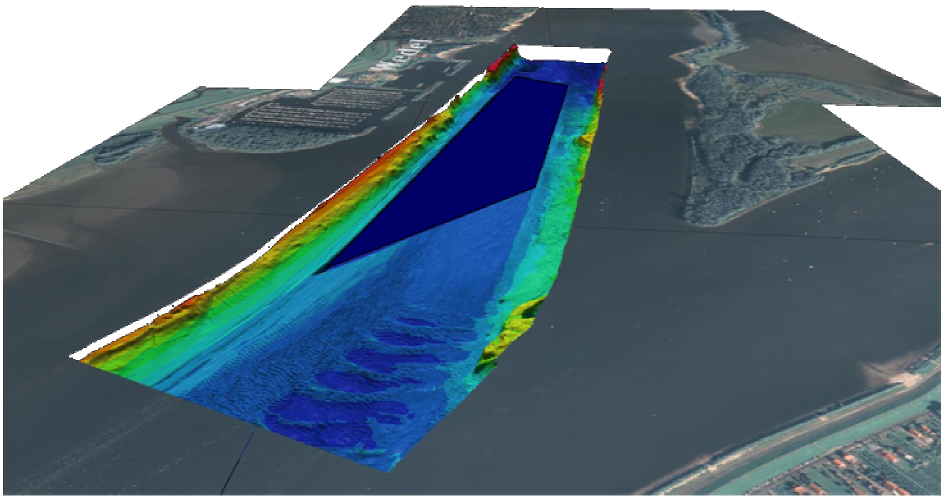

Fig. 5-4 Sediment catchment basin in Wedel, the deepening is shown in dark-blue, 2 m deeper compared to the fairway

Further most of the sediment transported to Hamburg is bed load moving upstream during the flood phase from the North Sea to the direction of Hamburg. The coarse sediment will be trapped once reaching the basin and filling it successively up from down- to upstream (Figure 5-5).

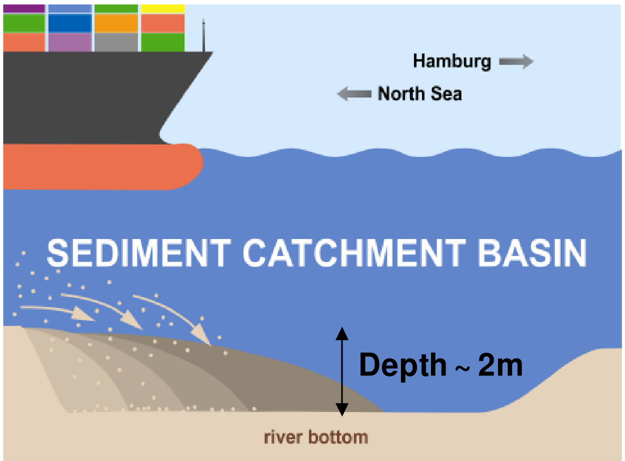

Fig. 5-5 Effect on course sediment bed load successively filling up the sediment trap

Additionally non-contaminated marine sediment from the North Sea direction will not get in contact with fluvial contaminated material from the upstream catchment of the river Elbe.
Beside these qualitative advantages the sediment trap has additional advantages in regard to maintenance works of the fairway due to a higher flexibility. Since sediments are collected in one defined place they can be dredged more efficiently through the use of optimized equipment, e.g. larger hopper dredgers can be used resulting in a cost-benefit. Another optimization possibility can be found in the higher densities that can be dredged through a longer period of consolidation, resulting in higher hopper densities. In contrast to these advantages, a cost increase through preparation of the sediment trap in the first place needs to be considered.
Additional advantages result in campaign-oriented maintenance possibilities for the handling of fine material. The most favorable months February to April with ideal headwater discharges can be used for dredging the sediment trap and relocating the dredged material during this time of the year. For this purpose the WSV is already investigating the possibility of constructing a second sediment trap in the Juelsand dredging section.
To evaluate the concept and further to gather additional knowledge of system functioning, an extensive monitoring program has been developed. It includes the examination of the impacts on morphology as well as on ecology during the set-up of the trap and during the maintenance phase.
In detail, following aspects are investigated as part of the monitoring program implemented and evaluated by the Federal Institute of Hydrology (BfG):

- Hydrology and morphology
- Nutrient and oxygen content
- Contamination
- Eco toxicological impacts
- Biology in the surroundings of the sediment trap

5.4 Maintenance dredging of harbors (open)

Content:

- General strategy, Avoidance of maintenance dredging, Construction periods, Special aspects referring to ecology/water quality/habitats and species protection, Sustainable aspects, Additional estuary specific strategies according to maintenance dredging open harbours

The general strategy for dredging works in the port of Hamburg is described in chapter 5.1. Specific strategies for assuring the water depth in the ports of Brunsbüttel and the port of Cuxhaven are not specifically relevant due to their sizes. The problem of contamination from upstream sources does not have a significant impact for sediment management in these areas. Hence no material is brought to land.
However, driven by requests for cost-reduction and nature conservation regulations, dredging and relocation activities are restricted to the economic necessities.

5.5 Placement in open water

- General strategy, Placement time, Special aspects referring to ecology/water quality/habitats and species protection, Sustainable aspects

Due to the increase in dredging demand in the port of Hamburg it was decided to take some of the access material, which has been accumulating in this region for year, to a location outside the estuary. The decision was made to establish a placement site in the North Sea for dredged material, compare chapter 4.2.2.

Dredging and translocation in the inner estuary is subject to the river engineering and sediment management concept for the Elbe, which is presently being updated.

5.6 Land treatments, Confined disposal facility (CDF), alternative utilization

- Land Treatment and CDF, Alternative utilisation, Sand exploitation in the estuary, Special aspects referring to ecology/water quality/habitats and species protection, Sustainable aspects

Compare chapter 5.1 and chapter 4.2.3

6 References

2005 – 2010 Annual report “Relocation of dredged material Neßsand”, http://www.hamburg-port-authority.de/presse-und-aktuelles/umfragen/162-monitoringberichte-ueber-elbesediment-umlagerungen.html

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