European Commission

NWRM

# Natural Water Retention Measures

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Service contract n°07.0330/2013/659147/SER/ENV.C1

# *Case Study*

## *Elbe Dyke Relocation (Lenzen)*

ACTeon environment research & consultancy

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*http://www.nwrm.eu*

# Table of content

# I. Basic Information

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|---|---|---|---|---|
| Application ID | *Germany_01* | | | |
| Application Name | **Elbe Dyke Relocation (Lenzen)** | | | |
| Application Location | Country: | Germany | Country 2:<br>*In case of transboundary applications* | |
| | NUTS2 Code | | *DE40* | |
| | River Basin District Code | | *DE5000* | |
| | WFD Water Body Code | | | |
| | Description | | *The measures are applied on a stretch of the Elbe river in Germany, next to Lenzen, between the Elbe kilometers 473.5 and 489.5.* | |
| Application Site Coordinates | Latitude:<br>53° 5.839560' (N) | | Longitude:<br>11° 28.711260' (E) | |
| Target Sector(s) | Primary: | Hydromorphology | | |
| | Secondary: | Forest | | |
| Implemented NWRM(s) | Measure #1: | *N3 Floodplain* | | |
| | Measure #2: | *F1 Riparian buffers* | | |
| | Measure #3: | *A1 Meadows and pastures* | | |
| | Measure #4: | *U5 Channels and rills* | | |
| Application short description | In the framework of the large-scale nature conservation project "Lenzener Elbtalaue", a dyke along the river Elbe has been relocated. This created a new retention area with a diverse floodplain, including alluvial forests, half-open pasture landscapes and other typical habitats of lowland floodplains. With 420 ha it is the biggest application of this type of measure in Germany so far. The project successfully combines flood protection and nature conservation objectives. Since the cutting of the old dyke in 2009, the measure could proof its effectiveness during several high water events.<br>The specific measures applied include:<br>- Construction of a new, 6.1 km long dyke which has been shifted backward up to 1.3 km<br>- Opening of the old, 7.2 km long dyke, situated close to the river, in sections of 200-500 m length<br>- Planting of 160 ha of alluvial forest, with further 130 ha of succession areas for alluvial forests<br>- Establishment of half-open pasture landscapes on 85 ha<br>- Profiling of 45 ha of flood channels in the area concerned by the relocated dyke<br>- Implementation of a land re-organization process in order to make areas available for the project | | | |

## II. Policy context and design targets

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| Brief description of the problem to be tackled | The Elbe is regularly subject to (extreme) flood events, and first reflections on dyke relocation in the North of Lenzen were made some decades ago. But only after the German reunification did the discussion become more dynamic. Flood protection (in Germany) is based today on three pillars: Natural water retention, technical flood protection and flood prevention. In specific evaluations and in the public discussion, retention of water in the landscape, and here in particular in the floodplains and retention areas, receives high importance.<br>With the Elbe being also an important water way, acceptable measures required an intensive cooperation between different institutions: integration of ecological, flood protection and navigation objectives.<br>The targets of the project have been:<br>- Re-creation of a near nature floodplain landscape, formed by the dynamic processes of streaming water<br>- Establishment of alluvial forests on former grassland through scattered, small-area initial plantings as well as development and maintenance of a floodplain typical mosaic of habitats with the associated species (e.g. hard- and softwood forests)<br>- Preservation of the groundwater dynamic which is characteristic for a floodplain and the corresponding soil types<br>- Development of half-open pasture and meadow landscapes (periodically inundated grassland))<br>- Removal of a hydraulic bottleneck and the associated narrowing of the flood water flow bed | | |
| What were the primary & secondary targets when designing this application? | Primary target #1: | Flood control and flood risk mitigation | |
| | Primary target #2: | Biodiversity and gene-pool conservation in riparian areas | |
| | Secondary target #1: | Other (please describe in the "remarks" below) | |
| | Remarks | *Development of a landscape which fosters regional development activities.* | |
| Which specific types of pressures did you aim at mitigating? | Pressure #1: | WFD identified pressure | *4.1.1 Physical alteration of channel/ bed/ riparian area/ shore of water body for flood protection* |
| | Pressure #2: | Floods Directive identified pressure | *Natural Exceedence* |
| | Remarks | The planning of the measures and the project started several years before the adoption of the WFD and the floods directive. | |
| Which specific types of adverse impacts did you aim at mitigating? | Impact #1: | WFD identified impact | *Altered habitats due to morphological changes* |
| | Remarks | The altered habitats due to morphological changes which are addressed by the measures are mainly situated in the riparian area (e.g. alluvial forests), not necessarily directly on the water body. | |
| Which EU requirements and EU Directives were | Requirement #1: | Other EU-Directive requirements (Specify) | *Habitats Directive* |

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| aimed at being addressed? | The planning of the measures and the project started several years before the adoption of the WFD and the Floods Directive. However, links can be made to the two directives today. Creating a retention area next to the river is in the sense of the Floods Directive. The measures furthermore contribute to the ecological improvement of the water body and had effects on nutrient retention. |
| Which national and/or regional policy challenges and/or requirements aimed to be addressed? | The project was integrated in the restoration of the flood protection dykes in the German Federal State of Brandenburg. It has been initiated by the biosphere reserve "Flusslandschaft Elbe-Brandenburg", with the aim to recreate in particular alluvial forests. Furthermore, the manager of a large farm was at the origin of the discussions and further promoted the whole project with the idea to diversify his activities and embed them in a sustainable regional development strategy. |

## III. Site characteristics

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| Dominant Land Use type(s) | Dominant land use | 231 (Pastures) |
| | Secondary land use | 511 (Water courses) |
| | Other important land use | 311 (Broad-leaved forest) |
| | Main land use in the flood plain is pasturing. Forests have been re-initialized in part of the flood plain. | |
| Climate zone | cool temperate dry | |
| Soil type | Fluvisols, Gleysols | |
| Average Slope | nearly level (0-1%) | |
| Mean Annual Rainfall | 300 - 600 mm | |
| Mean Annual Runoff | | |
| Average Runoff coefficient (or % imperviousness on site) | | |
| | The information available for the project specifies the average river flow (Damm, 2011):<br>Average low flow: 307 m3/sec<br>Average flow: 704 m3/sec<br>Average flood flow: 1873 m3/sec | |
| Characterization of water quality status (prior to the implementation of the NWRMs) | No information. | |
| Comment on any specific site characteristic that influences the effectiveness of the applied NWRM(s) in a positive or negative way | *Positive way:*<br>The old dyke had been constructed very close to the river bank. Its relocation had a direct and important effect through the creation of a water retention area. This is in particular true for the stretch of the Elbe called "Böser Ort" (evil place) where the Elbe makes a 90° bend, and where the waterway between the two dykes decreased from 1200m to below 500m. | |
| | *Negative way:*<br>No information. | |

## IV. Design & implementation parameters

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| Project scale | Large (e.g. watershed, city, entire water system) | So far the biggest dyke relocation project in Germany. |
| Time frame | Date of installation/construction | First project outlines have been made in the 1990s. The project finally started in 2002, the construction of the new dyke in 2005 (finalized in 2008). The project ended in the summer 2011. |
| | Expected average lifespan (life expectancy) of the application in years | Long term |
| Responsible authority and other stakeholders involved | *Name of responsible authority/ stakeholder* | *Role, responsibilities* |
| | 1. Biosphere Reserve "River Landscape Elbe-Brandenburg" | Initiator of the project |
| | 2. Brandenburg State Office of Environment, Health and Consumer Protection | Supported the project from the early beginnings. The state office carried out the construction of the new dyke. |
| | 3. Trägerverbund Burg Lenzen e.V. | Association responsible for running the large-scale nature conservation project. |
| | 4. Manager of a large-scale farm (about 3600 ha) situated in the project area | Early initiator of the reflections (together with the Biosphere Reserve). |
| | 5. Federal Waterways Engineering and Research Institute (Bundesanstalt für Wasserbau, BAW) | Scientific support since 1995, in particular with regards to effects on navigation (e.g. share of discharge between Elbe and the dyke relocation area, impacts on sediment transport) and measuring the hydraulic effectiveness of the dyke relocation during flood events. |
| The application was initiated and financed by | First reflections for this project after the political turnaround in Germany came from the manager of a large-scale farm, which intended to link local ecologically friendly economic activities with the regional development in the Elbe floodplain. He started discussions with scientists, administrations and regional and national agencies.<br>First ideas including potential re-initialization of alluvial forests and dyke relocation have been promoted together with the manager of the new established conservation area (today the biosphere reserve "River Landscape Elbe-Brandenburg"). Also the president of the environment agency of the Land Brandenburg had been involved at an early stage. The project has then been integrated into the restoration of flood protection dykes in the Land Brandenburg.<br>[*for financing see further below*] | |
| What were specific principles that were followed in the design of this application? | Consequent integration of nature conservation and flood protection objectives - as well as the sustainable use of the area through extensive agriculture.<br>Increasing public acceptance by providing a lot of information about the project. | |

<table>
<tr><td rowspan="2">Area (ha)</td><td>Number of hectares treated by the NWRM(s).</td><td>1031</td></tr>
<tr><td>Text to specify</td><td>The project takes place along the river Elbe, between the Elbe-km 473.5 and 489.5. The dyke relocation concerns 420 ha, the core area of the project comprises 1031 ha. The new dyke has a length of 6110 m.<br>Planting of alluvial forest species took place on an area of about 100ha.</td></tr>
<tr><td>Design capacity<br>Briefly describe the design capacity(ies) of the implemented NWRM(s), e.g. maximum volume of runoff water that can be retained per time step, maximum pollutant removal capacity in mg/l, etc.</td><td colspan="2">The newly created retention area of 420 ha between the old dyke and the new one can comprise up to 16 million $m^3$.<br>In times of extreme flood events the measure allows lowering the water level of up to 40 cm in the area.</td></tr>
<tr><td rowspan="6">Reference to existing engineering standards, guidelines and manuals that have been used during the design phase<br>References: active links to specific documents or website(s), and if not available online, provided them on the collaborate platform in the library section and URL here</td><td colspan="2">Reference</td><td>URL</td></tr>
<tr><td>1.</td><td></td><td></td></tr>
<tr><td>2.</td><td></td><td></td></tr>
<tr><td>3.</td><td></td><td></td></tr>
<tr><td>4.</td><td></td><td></td></tr>
<tr><td>5.</td><td></td><td></td></tr>
<tr><td>Main factors and/or constraints that influenced the selection and design of the NWRM(s) in this application?</td><td colspan="2">Some factors and constraints are listed in the following:<br>- In general, giving more space to water in floodplain areas (including through the relocation of dykes) is seen very positively in public discussions. Also the basic principle of taking both nature conservation and flood protection objectives into account influenced the choice of the measure.<br>- The dyke relocation became the central measure of the project, as it was only by this measure that the desired restoration of the floodplain to its original state and function could be achieved.<br>- Intensive research has taken place beforehand on the morphology and dynamics of the river Elbe (research project from 1996 to 2000).<br>- Several alternatives had been examined, models have been elaborated.<br>- Alluvial forests had disappeared largely beyond the project area, and contributing to their recovery formed part of the project's objectives from the beginning.<br>- One alternative which would have led to a bigger retention area has not been retained, as depriving more areas from use wouldn’t have found public acceptance. Furthermore, problems with upward seed had been expected for</td></tr>
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| | this alternative. |

## V. Biophysical impacts

| **Impact category** (short name)<br><br>Select from the **drop-down menu** below: | **Impact description** (Text, approx. 200 words) | **Impact quantification** (specifying units) | |
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| | | Parameter value; units<br><br>*and/or* | % change in parameter value as compared to the state prior to the implementation of the NWRM(s) |
| Runoff attenuation / control | Depending on the importance of the flood event, the effect of the measure has been calculated as being the following (compared to the previous status, prior to the dyke relocation):<br>a) Flood events recurring every 1-2 years = 1500 $m^3/s$<br>b) Flood events recurring every 3-5 years = 2300 $m^3/s$<br>c) Flood events recurring every 20-25 years = 3250 $m^3/s$<br>Share of the flow taking place in the newly created floodplain:<br>a) 8.6 %, b) 27.5 %, c) 36 %<br>Difference of the water level:<br>a) 9.2 cm, b) 28 cm, c) 38.9 cm | | |
| Peak flow rate reduction | Thousands of trees (oaks, elms and willows) which have been planted in the project area slow down the flood waves. | | |
| Impact on groundwater | Groundwater played a role in the project as problems with upward seep were expected in the area next to the relocated dyke. | | |
| Impact on soil moisture and soil storage capacity | *n/a* | | |
| Restoring hydraulic connection | *n/a* | | |
| Water quality Improvements | Nutrient retention effects for nitrogen and phosphorous are reported. | | |
| WFD Ecological Status and objectives | The project is expected to have positive impacts on the biological parameters of the ecological status. | | |
| Reducing flood risks (Floods Directive) | The reduction of (extreme) flood peaks is locally between 25 to 35 cm, depending on the flood flow rate. | minus 25 - 35 cm | |
| Mitigation of other biophysical impacts in | *n/a* | | |

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| relation to other EU Directives (e.g. Habitats, UWWT, etc.) | | | |
| Soil Quality Improvements | *n/a* | | |
| Other | The information sources mention the development of a diversity of bird species. | | |

## VI. Socio-Economic Information

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| What are the benefits and co-benefits of NWRMs in this application? | Benefits of the project have not been specifically analysed. However, the following ones can be identified:<br>- Flood protection (water retention)<br>- Biodiversity benefits<br>- Benefits for the regional development: The project area got quickly established as a regional attraction on the international Elbe bike trail. In connection with a centre for environmental education and a visitor centre for the area a sustainable increase of the number of visitors occurred.<br>- During the construction period there had been some socio-economic effects in terms of employment and local consumption. | | |
| Financial costs | ***Total:*** | *a) 11.5 million €*<br>*b) 1.5 million €* | *a) Construction costs of the new dyke*<br>*b) Costs for opening the old dyke* |
| | *Capital:* | | |
| | *Land acquisition and value:* | | |
| | *Operational:* | | |
| | *Maintenance:* | | *Maintenance costs exist for maintaining the dyke.* |
| | *Other:* | *a) 0.71 million €*<br>*b) 240,000 €* | *Costs for planning (included in the total costs above)* |
| Were financial compensations required? What amount? | *Was financial compensation required: Yes* | | |
| | *Total amount of money paid (in €):no information* | | |
| | *Compensation schema:* | | |
| | *Comments / Remarks:*<br>Compensation payments have been made for the abandonment of agricultural areas, for the herewith induced operating adaptations of the farming activity, the dissolution of current land tenures and the land use difficulties of furthermore cultivated areas. | | |
| Economic costs | Actual income loss: In the newly created floodplain, agriculture has been abandoned on 444.5 ha. It has been replaced by a landscape conservation pasturing (half open pasture landscape). | | |
| | *Additional costs:* | | |
| | *Other opportunity costs:* Hunting rights have been limited in the area. | | |
| | *Comments / Remarks:*<br>The area concerned by the agricultural abandonment lies in the former East Germany. Agricultural activities had been sustained through the communist system, and it was the manager of the large-scale farm system which initiated the discussions about the project, as previous agricultural activities could not compete with the (free) market situation after the German reunification. | | |

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| | Starting landscape conservation activities and fostering the regional tourist activities seemed more beneficial. |
| Which link can be made to the ecosystem services approach? | Through the measures:<br>- maintenance and improvement of ecological functions<br>- increased flood protection through natural retention<br>- maintaining the function of the river Elbe as an important waterway<br>- amenities: restoration measures had been linked to public communication activities, and tourist management activities |

## VII. Monitoring & maintenance requirements

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| Monitoring requirements | The following aspects are monitored:<br>- Hydrology: 12 groundwater gauges are supervised by the association carrying the project<br>- Hydraulics: Construction of 4 dyke gauges through the large-scale nature conservation project, steady reading of the meter by the state office, analysis through the Federal Waterways Engineering and Research Institute<br>- Soils: Two permanent observation plots of the Land Brandenburg, complemented by an evaluation at the end of the project<br>- Forestry: Examination of the planted alluvial forests in 2009 (evaluation)<br>- Fishes: Examination of the flood channels in 2009 and 2010, in time intervals further observations in cooperation with research institutes<br>- Birds: Examination in the framework of the evaluation of the project continuously 2007-2010, continued by the state of Brandenburg<br>- Vegetation: surveys through cooperation between the project management association, the state of Brandenburg and different research institutes |
| Maintenance requirements | The new dyke needs to be maintained, which is done by the state environment agency of Brandenburg. |
| What are the administrative costs? | No information. |

## VIII. Performance metrics and assessment criteria

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| Which assessment methods and practices are used for assessing the biophysical impacts? | In the project planning phase, different alternatives have been considered and compared.<br>Substantial modeling exercises and numerical calculations had been undertaken to predict the effect on flood peaks. A two-dimensional, hydro-dynamic numerical model has been used (it compares the previous situation without dyke relocation with the one with dyke relocation).<br>The impact of the measures with regards to flood protection could be directly observed during the extreme flood event in January 2011. |
| Which methods are used to assess costs, benefits and cost-effectiveness of measures? | Benefits and cost-effectiveness have not been assessed. |
| How cost-effective are NWRM's compared to | With regards to the flood protection objective, the restoration of the old dyke wouldn't have been the better alternative. Flood protection up to the level given today was only possible through creating a floodplain. |

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| "traditional / structural" measures? | |
| How do (if applicable) specific basin characteristics influence the effectiveness of measures? | As the old dyke had partly been constructed very close to the river bed, its relocation increased significantly the water retention area. |
| What is the standard time delay for measuring the effects of the measures? | The only delay for measuring the effects of the measure is the implementation delay (construction of the new dyke - opening / removal of the old dyke). Furthermore, the possibility to measure effects depends here on the occurrence of flood events - as only then the effect of the measure can be observed. |

## IX. Main risks, implications, enabling factors and preconditions

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| What were the main implementation barriers? | Reflections on a dyke relocation for purely hydraulic reasons had started in the 1960s - but had not been further followed up mainly due to financial reasons, as well as the frontier status of the area (between Eastern and Western Germany).<br>The issues of hunting and fishing as well as the accessibility of the area had been the main controversial issues coming up in the public participation process (but they could be solved to a large extent).<br>Financing had been a problem at some point, but could be resolved. |
| What were the main enabling and success factors? | Different enabling and success factors are worth mentioning and listed in the following:<br>- The project wouldn't have taken place without the continuous commitment of the main stakeholders. The process of the relocation project was initiated by a few individual regional stakeholders, and was continuously extended, receiving support from various funding and research projects. It took nearly a decade from the first project outline and the start of the large-scale nature conservation project in 2002. Over the years the project idea met with increasing approval and finally brought about the implementation of the federally funded large-scale conservation project.<br>- The temporal coincidence of the project idea and the necessity to adjust the old dyke to current requirements (in terms of height and construction technique) represented a very favorable occasion.<br>- The project combines both nature conservation and flood protection objectives, which facilitated the identification of financing sources.<br>- The project receives high public and scientific interest. The project benefitted from an intensive public participation process in collaboration with a centre for environmental education specialized in floodplain ecology ("Burg Lenzen").<br>- Intensive research has taken place beforehand on the morphology and dynamics of the river Elbe (research project from 1996 to 2000). The initiation of research and financing projects is seen as strategic for the success of the project.<br>- The process of re-allocation of land has taken place in a common process with farmers, in a very constructive way.<br>- Through past flood events, the public has been sensitive to the subject of flood protection, which contributed to the will to find a solution. |

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| | - Background from the agricultural side - which was the initiator at the very beginning: there is a local (negative) experience of large-scale melioration works in the early 1970s. In spite of important efforts, this measure only led to the use of the areas as meadows and pastures, and did not allow the cultivation of land. After the political turnover, the free market economy made a diversification of the operational concept of the local large-scale farm necessary - towards utilizing and promoting the development potential of the floodplains in the Biosphere Reserve "River Landscape Elbe-Brandenburg". This included amongst others landscape management measures and tourism. This particular situation led to the commitment of the farmer for the dyke relocation.<br>- From an institutional point of view it had been advantageous that the responsible nature conservation authority and the water authority are part of the same state environmental agency. They coordinated internally their position. |
| Financing | The new dyke has been financed by the Land Brandenburg, supported by national and European means (money from the German Joint Task program of the Federal government and the states for the improvement of the agrarian structures and coast protection; GAK).<br>The opening of the old dyke has been 75 % financed by the German government, and 18 % by Land Brandenburg. The remaining 7 % came from the carrying organization Burg Lenzen e.V., in alliance with different nature conservation NGOs.<br>The large costs of the project led to important financing problems. Thanks to the multifunctionality of the measures applied (nature conservation, flood protection), financing from different sources was possible. However, none of them was sufficient on itself and only a combination of different sources led to sufficient funds. Furthermore, to benefit from all financing sources, a private body was needed as applicant, and an association (Trägerverbund Burg Lenzen e.V.) has been created with different stakeholders for this purpose. |
| Flexibility & Adaptability | The dyke relocation as such is not a flexible measure, nor is the development of the alluvial forests. |
| Transferability | The preconditions in terms of stakeholder engagement were quite particular - going back to changes in the framework of the political turnover in Germany. However, from a technical point of view, dyke relocations can be implemented in any other area were sufficient settlement free areas exist. |

## X. Lessons learned

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| Key lessons | - The project shows a successful combination of nature conservation, flood protection and other objectives (agricultural, regional development, and others).<br>- The continuous persuasion works from a few – and over several years – is highlighted as one key factor for the successful implementation of the project. The prior implementation of research projects ensured the effectiveness of the measure design, but was also very useful for providing support for public discussion.<br>- The measures are suitable to be applied also elsewhere. However, areas free of settlement are needed.<br>- The highest effect of the measure can be located next to the first opening of the dyke (on the "evil place") and it decreases towards the downstream part of the dyke relocation. Further downstream from the dyke relocation, the measure does not have any effect anymore on the water level. Upstream, the positive effect diminishes with an increasing distance. This shows that the measure has a very clear, but mainly regionally working impact. In order to solve the important flood problems of the Elbe river, it is indispensible to carry out other dyke relocation measures.<br>- Public communication activities should have been made in a more intensive way, in particular at the beginning of the project.<br>- From an ecological perspective, an earlier / deeper connection to the Elbe would have been better to improve the lateral connectivity and morphological dynamic of the river. The latter would have also helped to minimize sedimentation processes in the new floodplain area - which can be expected in the middle and long term. |

## XI. References


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| Year of publication | 2011 |
| Editor/Publisher | Bundesamt für Naturschutz |
| Source Weblink | http://www.bfn.de/0324_veroeffentlichung_download.html |

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| Source Type | *Journal* |
| Source Author(s) | Bundesanstalt für Wasserbau (BAW) (ed.) |
| Source Title | Die Deichrückverlegung bei Lenzen an der Elbe |
| Year of publication | 2013 |
| Editor/Publisher | BAW Mitteilungen Nr. 97 |
| Source Weblink | http:// vzb.baw.de/publikationen.php?file=mitteilungsblaetter/0/BAWMitteilungen_97_Gesamtausgabe_INTERNET.pdf |

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| Source Type | *Website* |
| Source Author(s) | n/a |
| Source Title | Naturschutzgroßprojekt Lenzener Elbtalaue |
| Year of publication | |
| Editor/Publisher | Trägerverbund Burg Lenzen e.V. |
| Source Weblink | http://www.naturschutzgrossprojekt-lenzen.de/index.html |

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| Source Type | *Website* |
| Source Author(s) | *n/a* |
| Source Title | Hochwasser: Rückverlegung des Deichs bewährt sich |
| Year of publication | 2013 |
| Editor/Publisher | Karlsruhe Institute for Technology (KIT) |
| Source Weblink | http://www.kit.edu/kit/pi_2013_13562.php |

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|---|---|---|---|
| Source Type | *Interview* | | |
| Source Author(s) | Dr. Christian Damm | | |
| Source Title | | | |
| Year of publication | 2014 | | |
| Editor/Publisher | | | |
| Source Weblink | | | |
| Key People | | *Name / affiliation* | *Contact details* |
| | 1. | *Dr. Christian Damm (project director) / KIT - Karlsruhe Institute for Technology* | *christian.damm@kit.edu* |

| | |
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| Source Title | Landwirtschaftliche und touristische Nutzungsänderungen im Naturschutzgroßprojekt "Lenzener Elbtalaue" (2005 – 2009) Sozio-ökonomische Evaluierung (I) |
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| Source Type | *Other (specify)* |
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| Source Title | Floodplains in Germany – Synergies with nature conservation, WFD and flood protection |
| Year of publication | 2014 |
| Editor/Publisher | Federal Agency for Nature Conservation, workshop presentation |
| Source Weblink | http://nwrm.eu/resources/workshop-n%C2%B02-western-region-all-presentations |

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| Source Type | *Journal* |
| Source Author(s)<br>*Provide the Name of the author(s)* | Promny, M., Hammer, M. and Busch, N. |
| Source Title<br>*Provide the Tile of the reference* | Untersuchungen zur Wirkung der Deichrückverlegung Lenzen auf das Hochwasser vom Juni 2013 an der unteren Mittelelbe |
| Year of publication<br>*Provide the year in the format (YYYY)* | 2014 |
| Editor/Publisher<br>e.g. Journal/Volume/Issue | KW – Korrespondenz Wasserwirtschaft, Nr. 6, S. 344-349, DOI: 10.3243/kwe2014.06.004. |
| Source Weblink<br>Direct weblink(s) of the reference | |

## XII. Photos Gallery

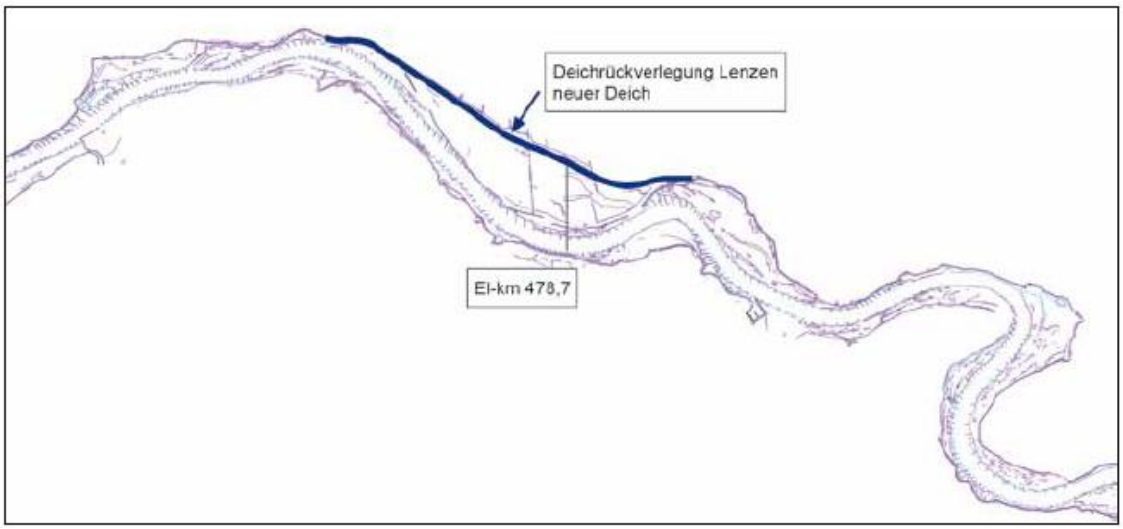


**Figure 1 Location of the Elbe kilometres (El-km) 465 to 490 with the dyke relocation Lenzen (BAW, 2013)**

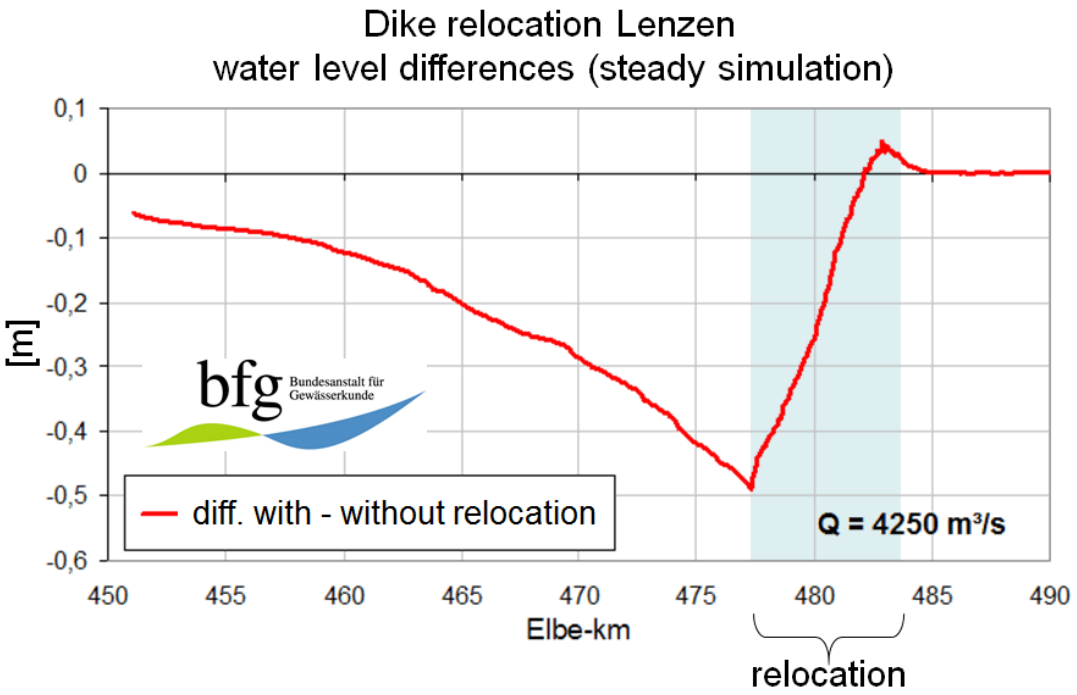


**Figure 2 Effects of the dyke relocation by Lenzen during the flood of 2013 (steady simulation) (Promny et al., 2014)**