Implementation of
EU Flood Risk Management Directive within the
INTERREG IV B Project LABEL Framework
- Transboundary Flood Risk Management Plan of the Weiße Elster River -

Summary Report

This project is implemented through the CENTRAL EUROPE Programme co-financed by the ERDF

A common project of the Federal States of Thuringia, Saxony - Anhalt and Saxony

Contracting authority:
Saxon State Office for Environment, Agriculture and Geology
(Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie)

Summary Report
August 2012

Implementation of the EU Flood Risk Management Directive within the INTERREG IV B Project LABEL Framework – Transboundary Flood Risk Management Plan of the Weiße Elster -

Summary Report

DHI-WASY GmbH
Niederlassung Dresden
Comeniusstraße 109
01309 Dresden

Tel: +49 (0)351 3161611
Fax: +49 (0)351 3161612
dresden@dhi-wasy.com
www.dhi-wasy.de
www.dhigroup.com

Contracting authority	Contact Person
Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie Pillnitzer Platz 3 01326 Dresden Germany	Mr. Grafe

Project	Project No.
Umsetzung der EU Hochwasserrisikomanagement-richtlinie im Rahmen des INTERREG IV B Projektes LABEL - Grenzüberschreitender Hochwasserrisikomanagementplan Weiße Elster -	14801432
Prepared by DHI-WASY GmbH Niederlassung Dresden Comeniusstraße 109 01309 Dresden	Date 13.08.2012 Person in Charge Dr. Jörg Walther (Head of Branch Office)

Issued	Item	Prepared by	Checked by	Approved by	Date
1	Draft Version	JOW	KKL	JOW	28.6.12

Keywords	Classification
Flood Risk Management Flood Risk Management Directive Flood Risk Management Plan	☐ Open ☐ Internal ☒ Confidential ☐ Research

Distribution	# of Copies
LfULG:	1
DHI-WASY:	1

Contents

List of Figures

List of Tables

1 Summary

1.1 Motive behind a Transboundary Flood Risk Management Plan for the Weiße Elster River

The development of the Flood Risk Management Plans (FRMP) was based on the European Flood Risk Management Directive (FRMD), which is fundamentally analogous to the three levels established by the European Water Framework Directive (WFD):

- International river basin districts (Level A of the WFD), i.e. the International Commission for the Protection of the Elbe River (ICPER) responsible for the Elbe Catchment,
- National sections of the international river basin districts (Level B of the WFD), i.e. the River Basin Community of Elbe (RBC Elbe) responsible for the part of the Elbe Catchment in Germany,
- Regional sub-catchments (Level C of the WFD) under the jurisdiction of the respective states.

The basis for the transboundary collaboration among the involved countries in the EU-INTERREG-Project was formed on the level of the international river basin districts. The FRMP for the Weiße Elster was initiated as a pilot project based on Level C activities, through the collaboration of the three involved states – Saxony, Saxony-Anhalt, and Thuringia. A considerable coordination among these three states took place, taking into consideration the state-specific database and legal requirements. As a start, a regional FRMP referring to the parts of the Weiße Elster that lie in the respective states was established. The individual plans were prepared by DHI-WASY (2011) for the Free State of Saxony, PGSL (2012b) for the State of Saxony-Anhalt, and FUGRO-HGN (2011b) for the Free State of Thuringia. The master FRMP for the overall catchment area in the Weiße Elster was created by consolidating the aforementioned three (DHI-WASY, 2012).

1.2 Methodology and Results

The methodology for developing the FRMP for the pilot catchment of Weiße Elster (DHI-WASY, 2012) was based on the guidelines set for the implementation of the FRMD (LAWA, 2008; LAWA, 2009; LAWA; 2010a; LAWA, 2010b) by the German Federal States' Working Group on Water (LAWA). The results of the FRMP apply only to the management of flood hazards and risks from **rivers**.

The preliminary assessment of flood risks (Section 2) was in accordance with the FRMD on the basis of available or readily derivable information. Only the waterbodies that were at minimum 10 km^2 at the mouth of the catchment were considered. The hydrological network analysis of the Directive was used to ensure this. The determination of the water bodies with potentially significant flood risk depended on the reports and analyses of historical flood events as well as the previously completed Flood Risk Concepts (FRC). In addition to LAWA (2009), the impacts of flood on public health, environment, cultural heritage, and the economic activities were also considered. At the end, the individual results were verified by

water management experts. The result of the assessment carried out at Weiße Elster show that potentially significant flood risks, or, at minimum, the possibility of such risks, exist for the water bodies with the total length exceeding 1166 km (DHI-WASY, 2012).

The preparation of the flood hazard and flood risk maps based on the FRMD (Section 3) was carried out only for the main water course of the Weiße Elster. In compliance with the corresponding LAWA guidelines (LAWA, 2010a), coordination among the involved states took place to agree on a standardized layout for the flood hazard and flood risk maps. For this purpose, Arc-GIS templates (MXT) for both the flood hazard and risk maps were created, to make available the implementation of the FRMD. In addition to the template, the contents of the flood hazard and risk maps were coordinated. The outcome of all the coordination efforts is the consistent technical content of the maps. The pilot catchment of Weiße Elster is covered by 44 map sheets, with every map sheet containing three each of flood hazard and flood risk maps. As a result, a total of 264 maps of the pilot catchment were produced.

The transboundary FRMP for the Weiße Elster was formulated based on the agreement among the involved states (Section 4). First, the areas of action were identified based on LAWA (2010b), after which the flood risk management objectives were defined and the target-current status comparison was carried out to identify the existing shortcomings. In order to achieve the FRMP objectives, total of 166 measures were proposed, and they were then classified under different areas of action, such as: cautionary land use, natural water retention, flood protection using technology, information management, emergency management, Provision and preparation for hazard and disaster control (DHI-WASY, 2012). Through this, the most important areas of action were taken into consideration. Processing all areas of action in full was not required according to the LAWA (2010b) standards. The measures were selected under the assumption that at least the beginning of the implementation of the selected measure can take place by 2021, when the FRMP will be undergoing its next update.

As a Level C sub-catchment was the site for the FRMP pilot project for the Weiße Elster, no Strategic Environment Assessment (SEA) was carried out, and only the general approach to SEA was mentioned in the FRMP (DHI-WASY, 2012). Coordination of SEA with WFD and NATURA 2000 was only carried out on the river basin community level of the Elbe (Level B).

1.3 Evaluation and Conclusion

For this pilot project, it was proven that a FRMP for a regional sub-catchment based on Article 4 and 7 of the FRMD was based largely on existing information and documents, and that, by means of a shared vision along all involved parties, a consolidated method could be devised.

1.3.1 Preliminary Assessment of Flood Risks based on Article 4 and 5

The preliminary assessment of flood risks based on available or readily derivable information does not always deliver the full picture of the risk situation. In both for Saxony and Saxony-Anhalt, the existing data on the Category 1 water bodies was enough to make reliable statements about

the possible flood risks. As for the Category 2 water bodies, oftentimes there was a lack of any or enough reliable information. Therefore, in the FRMP for the Weiße Elster in Saxony-Anhalt, it was proposed that respective municipalities should work closely together on future information acquisition endeavors. For this purpose, a questionnaire was drafted (PGSL, 2012b). In Saxony, the results from a statewide investigation on discharge availability of catchments based on known surface properties was used to improve the currently available data on Category 2 water bodies (WASY und IHI, 2006).

The best set of available data for the preliminary assessment of flood risks was found in Thuringia. In 2009, inundation areas from a 200-year flood event along about a 3400-kilometer-long waterbody was calculated according to a statewide standardized approach. From this information base, a statewide investigation on danger to life and other possible damages was carried out (FUGRO-HGN, 2011a).

Due to the varying availability of information in different states, the specific procedures used for the preliminary assessment of flood risks in each state differed. The hope is that there will be greater uniformity in the information base and the method in the future.

1.3.2 Flood Hazard and Risk Map based on Article 6

The preparation of the flood hazard and risk maps along the Weiße Elster in the states of Saxony-Anhalt and Thuringia were based on technical data, especially the floodplains that were identified during or before the development of the regional FRMP, with the help of a 2-D modeling program (PGSL, 2012b; FUGRO-HGN, 2011b). The floodplains estimated here became the current basis for the maps.

In Saxony, floodplains were not newly designated, but were taken from the Flood Protection Concept (FPC) for the Weiße Elster which was developed after the 2002 Flood. Together with six more FPC's for the tributaries of the Weiße Elster, this concept formed the most important basis for the development of the regional FRMP (DHI-WASY, 2011).

Practical difficulties while working with the Saxon FPC included missing or inadequate database or methodological differences between individual concepts. One such example of missing or inadequate database would be the GIS-data used for estimating the floodplains along the Weiße Elster. In working with two relevant FPC's, no water level position grid in GRID format was available in addition to the shape files with water level classification, a necessity for the reclassification of the water levels. Because of this, even with reasonable amount of effort, it was difficult to incorporate the water level classes of one flood hazard map of the FRMP and another. An example of the methodological difference is shown through the flood hazard maps prepared in the course of the FPC development and the representation of the flood plains. For the catchment in the upper Weiße Elster in the administrative district of Chemnitz, flood hazard maps for HQ_{20}, HQ_{50}, HQ_{100} and HQ_{300} were compiled. For the catchments in the lower Weiße Elster in the administrative district of Leipzig, for the most part, the flood hazard maps from FPC for HQ_{25}, HQ_{50}, HQ_{100} and HQ_{200} are available. As for the flood hazard and risk maps in the FRMP, different load scenarios were considered to an extent (Section 2). This applies to

the maps for a highly probable flood event (HQ_{20} or HQ_{25}) and the maps for not very probable flood events (HQ_{200} or HQ_{300}).

The layouts and the technical content for the flood hazard and risk maps as orchestrated among the different states go beyond the level of information required by LAWA (2008). The level of coordination that was carried out was reflected through the streamlined content and the layout of the maps. References to HEILAND (2010) and others have been made for the delineation of information and coordination.

1.3.3 Flood Risk Management based on Article 7

The regional FRMP was devised based on the joint efforts among the involved states. It consequently became the basis for the transboundary FRMP of the Weiße Elster (DHI-WASY, 2012), and was proven to be a workable plan. On one hand, the stringent guidelines set for the working steps recommended by the LAWA (2010b) in the FRMP planning stage was an advantage. On another hand, it would also have been advantageous to formulate the FRMP based on the target-current comparison and the selection of measures in relation to the areas of action from LAWA (2010b), because it would have given the FRMP a sensible structure, ultimately simplifying the whole procedure.

The availability of existing documents and resources that could be used for the FRMP, especially in the selection of measures, varied in each of the individual states. In Saxony, eight FPD's in total for the water bodies in the area of investigation were proven to be an appropriate, if not fully sufficient, foundation for the FRMP based on FRMD. Most of the restrictions apply to the flood protection measures using technology, and are the result of the spatial division of areas where the FPD for Category 1 water bodies are valid within Saxony, as well as past status and consideration of measures that go back more than eight years from now. In Saxony-Anhalt, only the FPD of Weiße Elster from 1997 was available, which was based on one-dimensional hydrological model with no examples of extreme events; these FPD's could not be the basis for the FRMP. In Thuringia, partial results from the FPD of the Weiße Elster, alongside the FRMP, were available for further development, which included various annual 2-D hydrological calculations as well as technical flood protection measures and considerations for reactivating the natural retention areas.

Consequently, in developing the regional FRMP, it was necessary to conduct additional studies where needed on the current hydraulic models and the areas of action that might not have been explored adequately for the FPD. From this, a target-current analysis and consequent derivation of appropriate measures became feasible for the regional FRMP, which then formed a basis for the transboundary FRMP. Also included in this investigation was the necessary information for the forecasting and risk prevention measures in Saxony-Anhalt from local authorities (PGSL, 2012b), gathered from the questionnaires that were distributed at an earlier stage.

In prioritizing and selecting appropriate measures, different emphases were given in different states. In Saxony, the flood protection using technical measures outweigh any other types, whereas in Thuringia, preventative measures took priority over any other measures. In Saxony-Anhalt, the proportion of the different types of measures was about equal. The

number of measures proposed by individual states reflects the diverse characteristics of the areas along the river basin.

The question remains as to how to effectively coordinate the transboundary FRMP among the involved states. The essential point here is the regular review and fine-tuning of the measures and the objectives. According to Article 7 (4) of the FRMD, the FRMP may "not include measures which, by their extent and impact, will significantly increase the flood risks upstream or downstream … unless these measures have been coordinated." This has implications on supraregional measures, such as the technical flood protection measures. In these cases, collaborative processes between the upstream and downstream areas on building regulations and coordination must be defined. As for the transboundary involvement in the non-technical measures, such as the scope of spatial planning, structured regulations are still lacking at the moment.

Such development of the regional FRMP became the basis for preparing the consolidated FRMP, and later the update of the plans:

- Systemizing the methods for the preliminary flood risk assessments,
- standardizing the return periods for the frequent and extreme flood events between the river basin scale and the federal scale,
- Streamlining the methods for determining the affected areas between the river basin and the federal scale,
- Preparing a catalog of measures based on universal objectives as well as a municipal catalog of expendable measures that can be adapted on a local level when situation allows,
- Continuously updating the implementation of the measures,
- Continuously improving and fine-tuning the database for the FRMP updates, especially on the municipal level (coordinating with responsible organizations),
- Allocating personal and financial capital for the continuous development and implementation of the FRMP as well as the coordination of measures.

In organizing the coordination efforts within the river basin along the Weiße Elster, the experiences of collaborating with various states, municipalities, and local authorities by the flood partnerships, such as the Elbe Flood Partnership, must be considered. The experiences of the states that lie outside of the Weiße Elster catchment area can also be used as a useful guiding tool. In the states of Baden-Wüttemberg and Rheinland-Pfalz, the flood partnerships were used as a tool to facilitate the communication between the water authorities, as a coordinator, and the public and decision makers. One example of such flood partnership for a river basin similar in size as the Weiße Elster is the "Municipal Flood Protection Consortium in the Neighboring Catchment (Kommunale Arbeitsgemeinschaft Hochwasserschutz im Einzugsgebiet der Nahe)" in Rheinland-Pfalz (HÄSSLER-KIEFHABER u. a., 2011).

In principle, the methodology employed to develop the transboundary FRMP for the pilot catchment of the Weiße Elster is applicable to other regional sub-catchments. The application of the method must entail reduction of cost and effort, which, in retrospect, was not the case for the pilot catchment; it would not have been a cost-efficient endeavor on this scale

in the long run. Reduction of invested cost and effort might be possible if a formalized sequence for processing the FRMP can be devised according to the Article 7 of the FRMD. For instance, for every area of action, the respective objectives can be defined in a table, where appropriate measures based on target-current analyses, as well as a step-by-step guideline for implementation, would be available.

2 Preliminary Assessment of Flood Risks

The preliminary flood risk assessment was conducted in accordance to the articles 4 and 5 of the HWRM-RL based on the available or credible background information regarding the risks and the vulnerability of protected commodities due to flood events.

In evaluating the flood risks in the Weiße Elster, the participating project partners in Germany and the Czech Republic reached different conclusions. In the Czech Republic, no significant risk was found in the upper reaches of the Weiße Elster because the criteria used for flood risk assessment were not applicable (MoE, 2010). On the German side of the Weiße Elster, a total of 1166 kilometers of waterways were identified as being under significant flood risk.

As such, specific prevention methods have been implemented in the States of Saxony, Thuringia, and Saxony-Anhalt, as will be discussed later. This report will focus on the administrative boundaries along the Weiße Elster, as shown in Table 2-1. The Weiße Elster originates in the Czech Republic (km 243+514), and from km 231+800, it flows to its mouth into the Saale River in the German territory. Until km 167+700, the Weiße Elster runs through the Free State of Saxony, which borders the Free State of Thuringia. Between km 105+090 and km 71+000, it flows through the State of Saxony-Anhalt, until km 19+850 where it flows back into Saxony. The downstream end of the Weiße Elster (km 19+850 until the mouth) lies in the State of Saxony-Anhalt.

Table 2-1: Location of Administrative Boundaries along the course of Weiße Elster

State	Section Start Point	Section End Point
Sachsen-Anhalt	km 0+000	km 19+850
Sachsen	km 19+850	km 71+000
Sachsen-Anhalt	km 71+000	km 105+090
Thüringen	km 105+090	km 167+700
Sachsen	km 167+700	km 231+800

2.1 Discussion of the Methodology used for the Preliminary Flood Risk Assessment

The methodological basis for the assessment was the recommendations of the German Working Group on Water Issues of the Federal States and the Federal Government (LAWA), closely related to the Flood Risk Management Directive (FRMD), where appropriate procedures and criteria for such assessment are outlined (LAWA, 2009).

The preliminary flood risk assessment in all three states was based on the water network of the WFD. Only the catchments that were at minimum 10 km^2 at the mouth were evaluated.

In carrying on the preliminary flood risk assessment, all three states adopted the three-stage method as shown below:

- Assessment Stage 1. Information on known flood risks were researched and evaluated.
- Assessment Stage 2. In-depth analyses based on floodplain locations and risk potential were conducted.
- Assessment Stage 3. The outcomes from the first two stages were evaluated and validated based on professional expertise in water management.

This method was implemented in all three states based on common principles, however varying database and approaches were used. The methods are shown in more detail in the subsequent section (Section 2.2).

2.2 Application of Preliminary Flood Risk Assessment Method

2.2.1 Research and Assessment of known flood risks

In Saxony, every waterbody in Category 1 was assumed to have a significant potential flood risk, and FPC has already been developed since the flood of 2002. The neighboring waterbodies around the Weiße Elster are all classified as Category 1. Flood risks for Category 2 waterbodies were also taken into consideration, in the cases where the reports and analyses of historical flood events suggested it. The flood analysis of the July 1954 flood event (BAUER, 1956; BÖER u.a., 1959) in the Weiße Elster Catchment, which was the heaviest in history since standardized water measurements became available (DHI-WASY, 2011), was especially valuable in this context.

In Thuringia, publications on historical flood events and flood marks (DEUTSCH und PÖRTGE, 2003; DEUTSCH und PÖRTGE, 2009), as well as historical flood maps (EBERLE, 2010) were used for the analysis. In contrast to the approach in Saxony, the resulting findings in Thuringia were not used until the last assessment stage, where they were needed to fully evaluate the results obtained from the second stage of the assessment. Based on the historical evidence alone, it was decided that there were no significant flood risks in Thuringia (FUGRO-HGN, 2011b).

In Saxony-Anhalt, the State Department of Flood Protection and Water Management (LHW), upon the recommendation of the German Working Group on Water Issues of the Federal States and the Federal Government (LAWA, 2009), took a GIS-based approach for the assessment. Using this approach, water courses with significant potential flood risks were identified. The results of this method alone, however, were not sufficient to determine the risks, and the final analysis similar to that of Thuringia was carried out in the final assessment stage.

In Saxony-Anhalt, in addition to the application of the LHW-developed method, historical flood data and their impact on public health, the environment, and cultural and economic dimensions were assessed. The existing flood defenses and their effectiveness over time were also evaluat-

ed. The main goal of the investigation, among others, was to see if the historical data would be useful in predicting similar patterns in the future (PGSL, 2011).

2.2.2 In-Depth Analysis of Flood Risks based on Floodplains and Vulnerability

In this assessment stage, the question regarding the dangers of the natural hazard - namely flood - was dealt with in terms of vulnerability. Vulnerability encompasses the level of exposure to flood risk elements, their susceptibility to such risks, and the potential damages that might occur (MERZ u. a., 2011). The interaction between the hazard and vulnerability determines the existence and the severity of the risk (GRÜNEWALD u. a., 2003).

The floodplains designated based on §100 of Saxon Water Law formed the primary database for the in-depth analysis of flood risks in Saxony. They were in accordance with LAWA (2009) and were paired with the corresponding geospatial data (Table 2-2), in order to determine the significance criteria in evaluating public health, environment, cultural heritage, and economic activities. One of these analysis points was of concern, as significant flood risk potential was noted (DHI-WASY, 2011).

In Thuringia, the in-depth analysis was conducted based on a state-wide approach (FUGRO-HGN, 2011a). For all the waterbodies and water routes listed under the "Thuringian Regulation on the Determination of Waterbodies and Water Routes according to §80, Paragraph 2 of Thuringian Water Law" and were published on the Thuringian State Gazette (ThürStanz, 2009), floodplains were estimated based on 200-year flood events (IAWG, 2009). Using this as a basis, a statewide investigation of direct danger to people and risks was conducted. In order to achieve this, the floodplains with digitally processed geospatial data (Table 2-2) were incorporated, and, with the help of coordinated assets and use-specific damage functions, the risk potential for the waterbodies from every municipality was assessed. The significance of flood risk potential in Category 1 and 2 waterbodies longer than 10 km was determined to have vulnerability of ≥ 500 T€. For Category 2 water bodies with lengths of less than 10 km, the significance of flood risk potential, represented by the level of potential damage, was diagnosed to be anywhere from 2 million € (FUGRO-HGN, 2011a).

In Saxony-Anhalt, the in-depth flood risk assessment was carried out using the predetermined floodplains designated by § 96, paragraph 1 of the Water Law for the State of Saxony-Anhalt (PGSL, 2011). As in Saxony, the floodplains with digitally-processed geospatial data (Table 2-2) were incorporated, in order to determine possible issues based on the above-mentioned significance criteria (PGSL, 2011).

The significance criteria and the database used for the in-depth analysis of flood risks in all three states are displayed in Table 2-2, along with the investigated floodplains.

Table 2-2: Significance Criteria and Database for the In-Depth Analysis of Flood Risks

Significance Criteria	Basis of Analysis	Saxony	Thuringia	Saxony-Anhalt
Public Health	Criteria	Number of Residents affected by Flood		
	Database	CIR-Land use data with medium-sized municipal population density	Land use data from TLUG (ATKIS-Data) and damage potential of every municipality	Land use (ATKIS Data)
Environment	Criteria	Number of affected PPC (Integrated Pollution Prevention & Control) installations	Number of affected IPPC installations and Drinking water protection zone 1	Number of affected IPPC installations
	Database	IPPC installations	IPPC installations and Drinking water protection zone 1	IPPC installations
Cultural Heritage	Criteria	Number of affected cultural heritage sites		
	Database	Monuments and historical buildings	World cultural heritage sites	Monuments and historical buildings
Economic Activity	Criteria	Affected areas of commerce and industry	Damage potential for each municipality	Affected areas of commerce, industry, and transportation
	Database	Derived from ATKIS-Data	Land use data from TLUG (ATKIS Data), Assets and damage functions	Biotope and Land use mapping (BTNT) Land use of State Authority for Environmental Protection

2.2.3 Summary of Results and Verification based on Water Management Expertise

In Saxony, for all water bodies with the catchment size > 10 km^2, where no potential significant flood risks were predicted in the first and the second assessment stages, the catchment runoff disposition was evaluated (DHI-WASY, 2011). The results from a statewide investigation on the dominant runoff components in Saxony, based on surface properties, such as soil, land use, incline, were used to identify the areas of flood formation (WASY und IHI, 2006). In assessing the flood risks, it was assumed that the runoff disposition increased when at least 50% of the catchment was dominated by fast runoff components, composed of surface runoff, saturated surface runoff and fast interflow. It was assumed in this case as well, that the waterbodies had a potential significant flood risk (DHI-WASY, 2011).

All waterbodies in Saxony with significant flood risk potential based on this assessment were added, in their entire length, to the flood risk management plan.

In Thuringia, the results of this study were used for historical flood events (first assessment stage) in order to verify and validate the results of the second assessment stage regarding the flood risk potential of an individual waterbody or water routes (TMLFUN, 2012a).

The water passability of the catchments under risk in Thuringia were ensured by predefined sections of the waterbody in the communities where

the significance criteria were not reached, and were classified as a risk area, therefore preventing any unnecessary fragmentations. (FUGRO-HGN, 2011b).

In Saxony-Anhalt, expert knowledge in the water courses, where different results between the first and the second assessment stages were given or the flood risk assessment came out negative (i.e. no risks were detected), were brought together. The following factors were considered:

- Topography,
- Location of water courses and their general hydrological and geomorphical characteristics, including floodplains and natural retention areas,
- Location of inhabited areas,
- Areas of economic activities and future developments,
- Effectiveness of man-made flood defense structures and infra-structures.

The water courses that were rated positively twice were considered only once (PGSL, 2011).

2.3 Results

The results of the investigation for the water bodies in all three states along the Weiße Elster are depicted in a map in Figure 2-1.

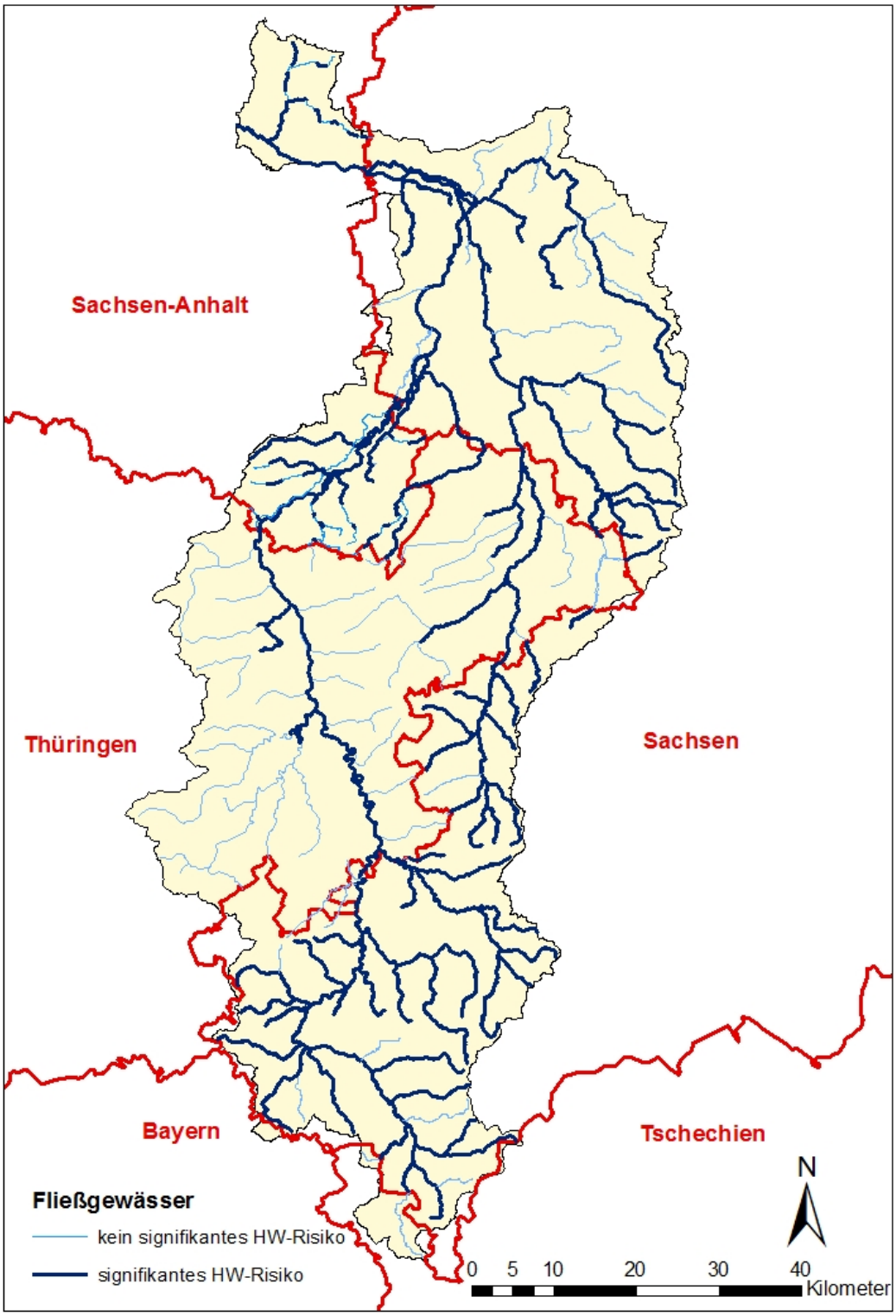

Figure 2-1: **Water bodies with significant flood risk potential in the pilot catchment of Weiße Elster (Last Update: Mid-2011)**

The assessment results showed that in Saxony, the water course from 384 km posed a high flood risk potential, or at least the likelihood for one. In Thuringia, water bodies with total length exceeding 170 km demonstrated high potential flood risks. In Saxony-Anhalt, about 162 km of water courses were assessed as being sources of potential flood risk.

The summary of results is summarized in Table 2-3. Also shown are the specific lengths of the water bodies in the catchments that were assessed: 0.10 km /km^2 in Thuringia, and 0.29 km /km^2 and 0.30 km /km^2 in Saxony and Saxony-Anhalt, to be exact. Despite the differences in the assessment methodologies used in the three states, compatible results were yielded.

Table 2-3: Results of the Preliminary Flood Risk Assessment of the Weiße Elster Catchment

Result	Saxony	Thuringia	Saxony-Anhalt
Portion of the catchment [km²]	2842	1761	538
Total length of the water body with significant flood risk potential [km]	834	170	162
Specific length of water body for every km^2 of catchment [km/km²]	0,29	0,10	0,30

2.4 Conclusion

The evaluation of the waterbody sections for flood risks along the Weiße Elster in the states of Saxony, Thuringia, and Saxony-Anhalt was conducted in accordance with the LAWA guidelines. The assessment bases used were geared towards and comparable to the expected damage that could be caused by floods on the inhabitants and the environment. Deciding the significance of the first-stage part was based on a fixed value. What was indispensible in the end was the expert evaluation of the significant risks. The identified risks must be verified and supplemented by the expertise of a water management professional, who form the basis for reporting to the European Union.

3 Flood Hazard Map and Flood Risk Map

For this pilot project, flood hazard and flood risk maps covering only the main water courses along the Weiße Elster were created.

The maps were prepared based on the methodological guidelines recommended by the German Federal States' Working Group on Water (LAWA, 2010a). In accordance to these guidelines, a standardized layout was used for preparing the flood hazard and flood risk maps in all three states, which employed a consistent system of sheet lines and numbering of map sheets. In order to ensure that the standardized layout was used for all maps, templates (MXT) in ArcGIS 9.3 format were created, one each for flood hazard and flood risk map and distributed to all parties involved in the map production.

3.1 Flood Hazard Maps

3.1.1 Methodology

Three possible flood scenarios considered for the flood hazard maps were:

- Flood of high probability
- Flood of medium probability
- Flood of low probability

The following fields were illustrated on the maps:

- The course of the Weiße Elster River with the chainage in 100 meter increments,
- Current state of the Floodplains of the Weiße Elster for the associated flood scenario with the water depth intensity classification,
- Flood zones for extreme events, current state being the inundation boundary,
- Flood defense measures,
- Gauges at the Weiße Elster,
- State and municipal boundaries.

Greyscaled TK10 or DTK10 served as background maps.

Table 3-1 gives an overview of the scale and other basic technical information related to the flood hazard map of the Weiße Elster. Due to the low flood level of the upper reaches of the Weiße Elster in Saxony, a scale of 1:5,000 was used rather than the 1:10,000 used in the other catchment areas.

Table 3-1: Scale and Other Technical Details included in the Flood Hazard Maps

	Saxony		Thuringia	Saxony-Anhalt
	Upper Weiße Elster	**Lower Weiße Elster**		
Chainage	km 167+700 to km 231+800	km 19+923 to km 71+080	km 105+093 to km 167+700	km 0+000 to km 19+923 and km 71+080 to km 105+093
Scale	1 : 5 000	1 : 10 000		
Flood of high probability	HQ_{20}	HQ_{25}	HQ_{20}	
Flood of medium probability	HQ_{100}			
Flood of low probability	HQ_{300}	HQ_{200}	Maximum out of HQ_{200} with and without flood defenses	HQ_{200} without flood defenses
Extreme events		HQ_{500}		
Classification of water depth, h_w in m, in relation to specific flow[1], $v*h_w$ in m^2/s	3 Classifications in relation to h_w und $v*h_w$: < 0,5 0,5 - 2,0 > 2,0		5 Classifications for h_w: < 0,5 0,5 - 1,0 1,0 - 2,0 2,0 - 4,0 > 4,0	

1) Only relevant in Saxony

The difference in the application of the recurrent interval T for the flood scenarios and the classification of intensity in Saxony was due to the differences in databases, resulted from varying methods of calculation, that were used for the maps.

3.1.2 Maps

The general layout for the flood hazard and risk maps for the Weiße Elster is identical, as illustrated in Figure 3-1. One map is composed of a main map, with annotations on the right hand side, including the legend, water gauge table, database, key map, and title block.

The hazard and risk maps are 83 cm wide and 58.5 cm high, a size which would be easy to plot without having to change the orientation of the map.

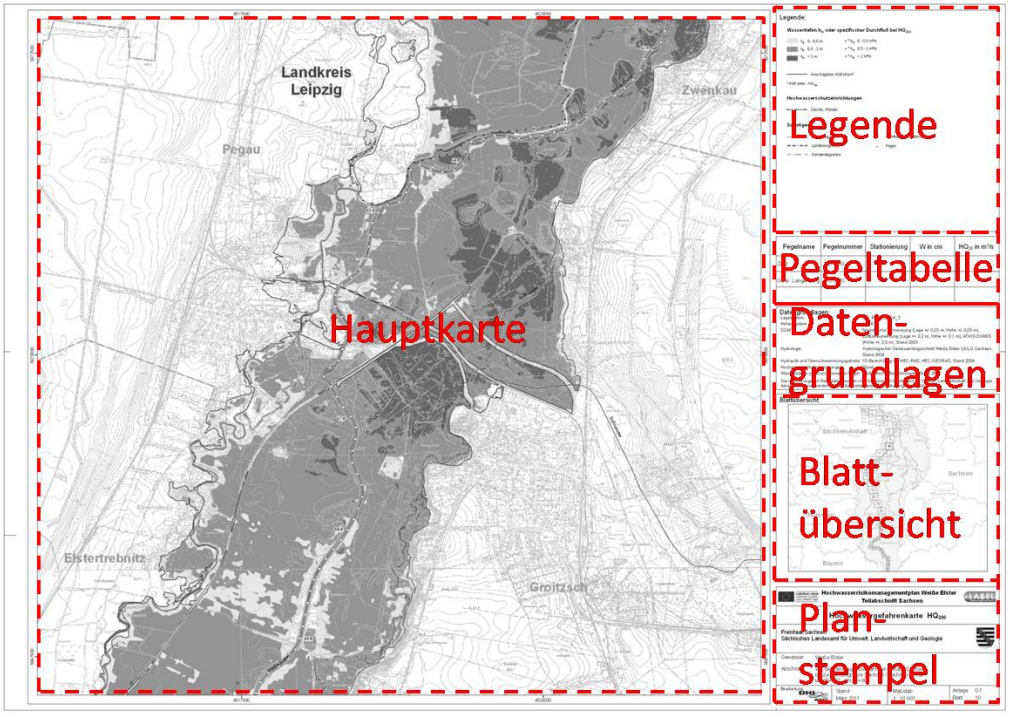

Figure 3-1: General Layout of the Hazard and Risk Maps

On the **Main Map**, which is 60 cm in width and 56 cm in height, a 1:10,000 scale can be used for a map section of 6,000 m in width by 5,600 m in height, or a 1:5,000 scale for a section covering up to 3,000 m width by 2,800 m height.

The **Annotations** for the map, including the legend, water gauge table, database, key plan, as well as the title block, are located near the main map on the right hand side in an 18.5 cm wide block, and summarizes the content of the map in one place.

The **Legend** contains all the symbols used in the hazard map, such as the shapes, lines, and points (cf. Figure 3-2). When the river network became subjected to the EU-Water Framework Directive, only the water bodies with significant flood risk potential were selected to be represented. The chainage from the mouth of the river network was set at every 100 m. For general orientation, state and municipal boundaries, as well as topographical information, are represented.

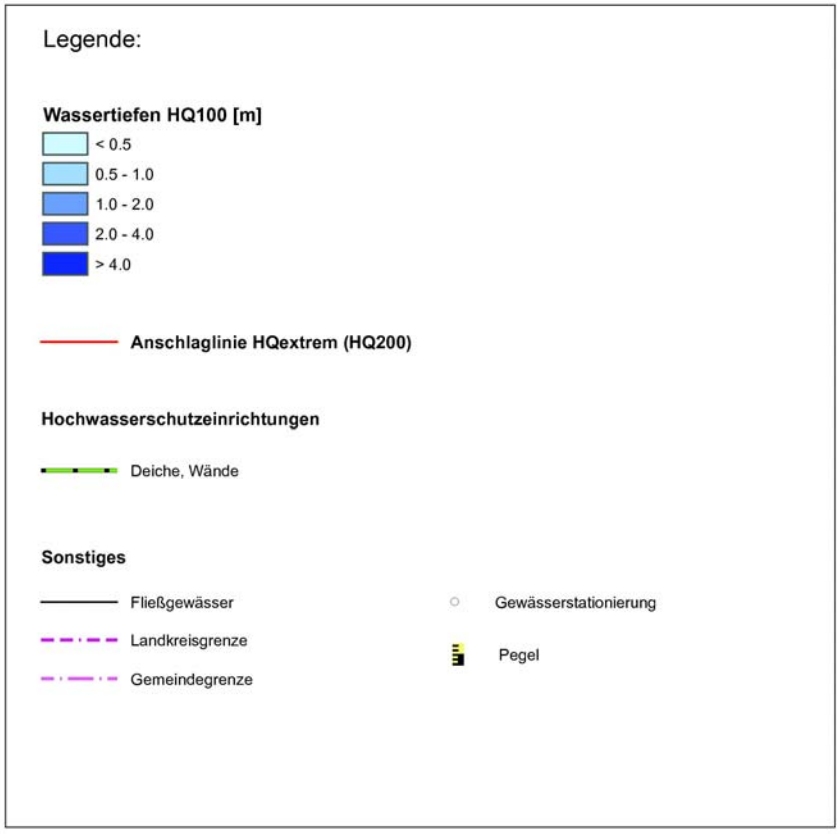

Figure 3-2: Flood Hazard Map Legend

The **Water Gauge Table** contains the name, number, and the chainage of the nearest flood alert stations (in the upstream direction). The flood alert stations are represented on the map sheets themselves in addition to the gauge table. For every gauge, the water level and the flow for the extreme flood events are specified in cm m^3/s.

The individual **Database** are described and named in terms of their origin and status. Table 3-2 presents the database for all sections of the Weiße Elster.

Table 3-2: Database for the Flood Hazard Maps

	Saxony		Thuringia	Saxony-Anhalt
	Upper Weiße Elster	**Lower Weiße Elster**		
Altitude system	DE_RD/83/GK_3		LS 120, PD 83	DE_RD/83/GK_3
Height system	HN76		DHHN92	
Digital Terrain Model DTM	Terrestrial surveying, Digital aerial photo analysis, ATKIS-DGM25		Terrestrial surveying, Digital aerial photo analysis, ATKIS-DGM5	Terrestrial Surveying, DTM from Laser scan, DGM1
Hydrology	Weiße Elster Hydrological Profile			Discharge hydrograph HQ_T at Zeitz gauge, Peak runoff HQ_T at Oberthau gauge
Hydraulic and floodplains	1D-Estimation with WSPWIN	1D-Estimation with HEC-RAS	2D-Estimation with HYDRO_AS 2D	
Water level and Flow at the gauge	From hydraulic calculation database			

The **key plan** (cf. Figure 3-3) shows the individual areas that are depicted in the current sheet by red markings. The sheet lines for the key plan are arranged along the mouth of the river towards the source and are consecutively numbered. The sub-catchments of the Weiße Elster are color-coded and saved accordingly to the database. For orientation purposes, the state and municipal boundaries of the three states and the important tributaries of the Weiße Elster have been highlighted and labeled.

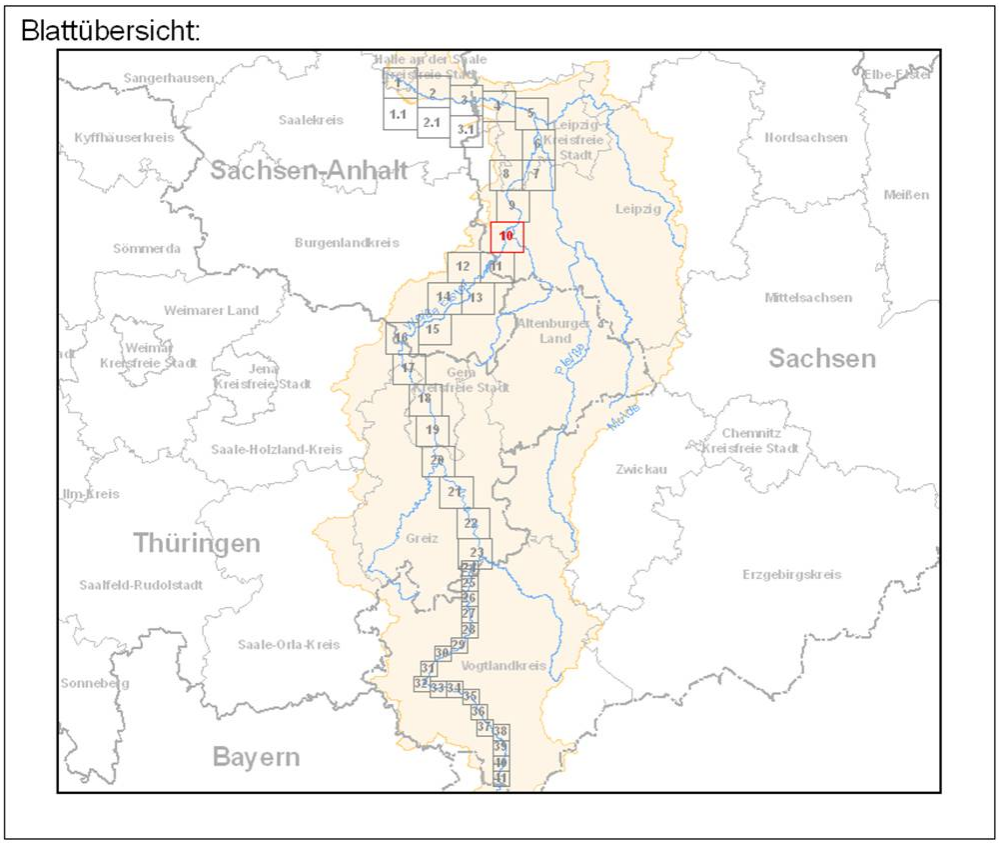

Figure 3-3: Key Plan

The **Title Block** (cf. Figure 3-4) contains:

- Project title,
- Logos of the EU and LABEL,
- Name of the map with the HQ_T represented,
- State where the depicted area belongs to,
- Client's name,
- Name of the depicted water body,
- Description of the depicted section of the water body,
- Logos of the contractors,
- Project status,
- Map scale,
- Reference number, and
- Sheet number.

The reference number was assigned to each HQ_T based on the following:

G1 floods of high probability (HQ_{20} or HQ_{25})

G2 floods of medium probability (HQ_{100})

G3 floods of low probability (HQ_{200} or HQ_{300})

EUROPEAN UNION
EUROPEAN REGIONAL DEVELOPMENT FUND

Hochwasserrisikomanagementplan Weiße Elster
Teilabschnitt Sachsen

LABEL
LABE-LLIE Adaptation to flood risk

Hochwassergefahrenkarte HQ_{100}

Freistaat Sachsen
Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie

Gewässer:	Weiße Elster
Abschnitt:	von der Landesgrenze Sachsen-Anhalt / Sachsen bis zur Landesgrenze Sachsen / Sachsen-Anhalt km 19+842 - km 71+000

Bearbeitung:	Stand:	Maßstab:	Anlage: G2
DHI WASY	Mai 2011	1 : 10.000	Blatt: Blatt 5

Figure 3-4: Sample Title Block of a Section in Saxony

Figure 3-5 shows Sheet 18 as an example of a flood hazard map prepared for a flood of medium probability (HQ_{100}).

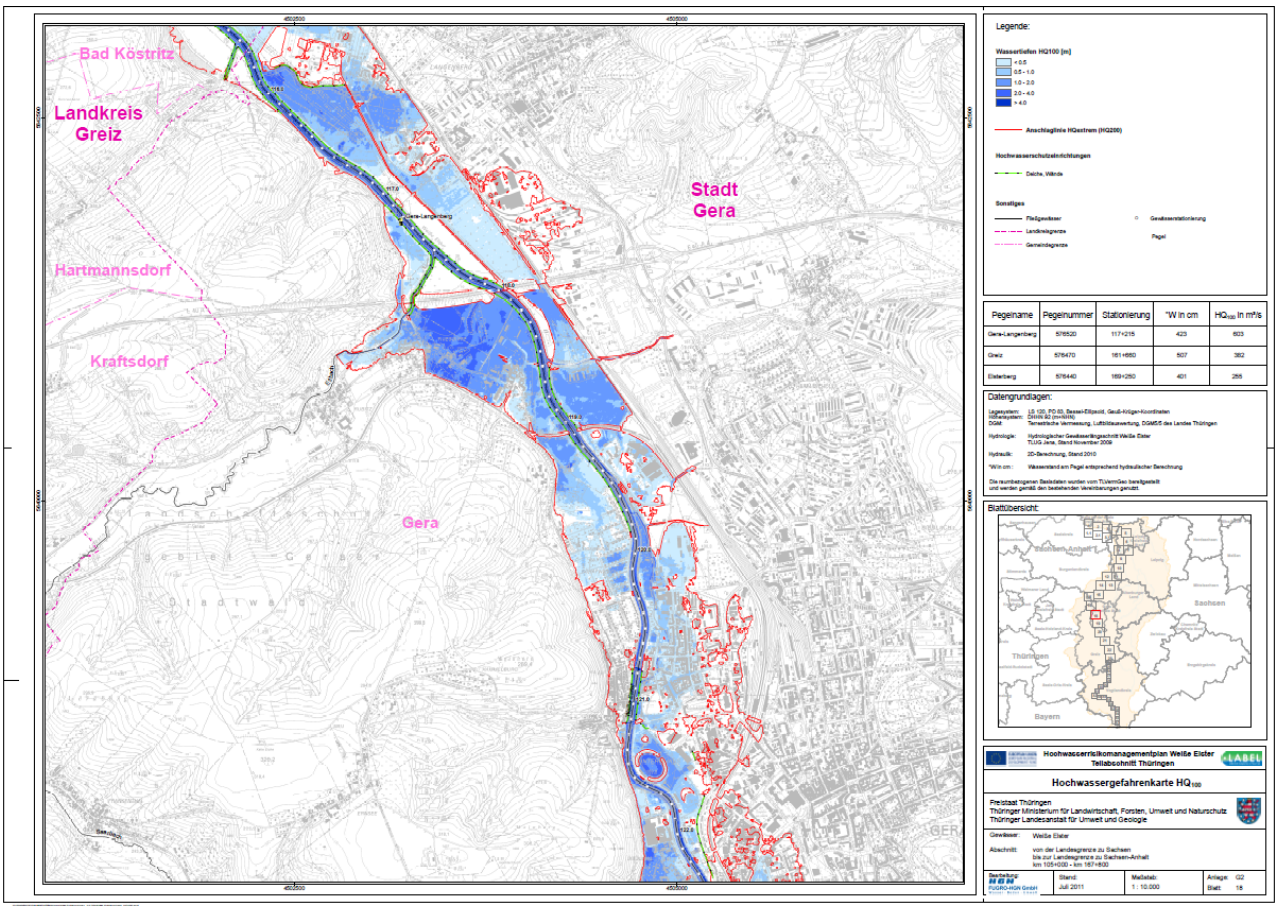

Figure 3-5: Example of a Flood Hazard Map

3.2 Flood Risk Map

3.2.1 Method

The flood risk map shows the potentially adverse impact of the three flood scenarios as discussed in Section 3.1.1. The general layout of this map is the same as the flood hazard map (Figure 3-1). In the flood risk maps, the following information is covered:

- The course of the Weiße Elster River with the chainage in 100 meter increments,
- Reference value of potentially affected people per municipality, rounded up to the nearest 10^{th} digits,
- Values at risk,
- Risk source,
- Type of economic activity affected in the catchments with flood risk potential,
- Protected areas,
- Flood defense measures,
- Gauges at the Weiße Elster,
- State and municipal boundaries.

Greyscaled TK10 or DTK10 served as background maps. The difference between the hazard and the risk maps of each section of the Weiße Elster, resulted from different calculation methods or different representational requirements, have previously been explained in Figure 3.1.1.

In order to illustrate the **Land Use** within the floodplain, the ATKIS data was combined with the three flood scenarios of the floodplains, and the ATKIS object numbers were categorized into six relevant classes according to the LAWA (2010a) standards (cf. Figure 3-6).

The number of **Potentially Affected Inhabitants** per municipality was estimated based on the population data, which indicated the number of inhabitants in each municipality, from the State Statistical Office of the respective state. In order to estimate the affected inhabitants in Saxony-Anhalt and Thuringia, the following ATKIS object types were used:

- 2111 – Residential Area
- 2113 – Mixed Use Area

And in Saxony, the following ATKIS object types were consolidated:

- 2111 – Residential Area
- 2113 – Mixed Use Area
- 2114 – Area of Special Functional Character

These areas were selected and paired with the floodplains of the applicable HQ_T, so that the inhabited areas affected by all three flood scenarios could be represented. Based on the number of inhabitants of each municipality and the ratio between the floodplain and total inhabited areas, the percentage of affected inhabitants was calculated using the following formula:

$$PBE = \frac{EW * A_{HQ}}{A_G}$$

Where,

PBE - Number of potentially affected inhabitants

EW - Number of inhabitants in the municipality

A_{HQ} - Inhabited area affected by the specified HQ_T

A_G - Total inhabited area

Using this estimation in Thuringia brought to attention the fact that the mixed-use areas were occupied only one-third times as much as the inhabited areas. Therefore, the mixed-use areas in Thuringia, unlike in Saxony or Saxony-Anhalt, were calculated as one-third of their actual count.

3.2.2 Maps

The flood hazard and the flood risk maps have an identical layout, as already described in section 3.1.2. Figure 3-1 shows the general organization of the maps. The legends of the flood hazard and the flood risk maps differ due to the differences in the types of information they need to convey. Figure 3-6Figure 3-1 shows the legend of the flood risk map, where the symbols used in the map, in forms of shapes, lines, and dots, have been itemized.

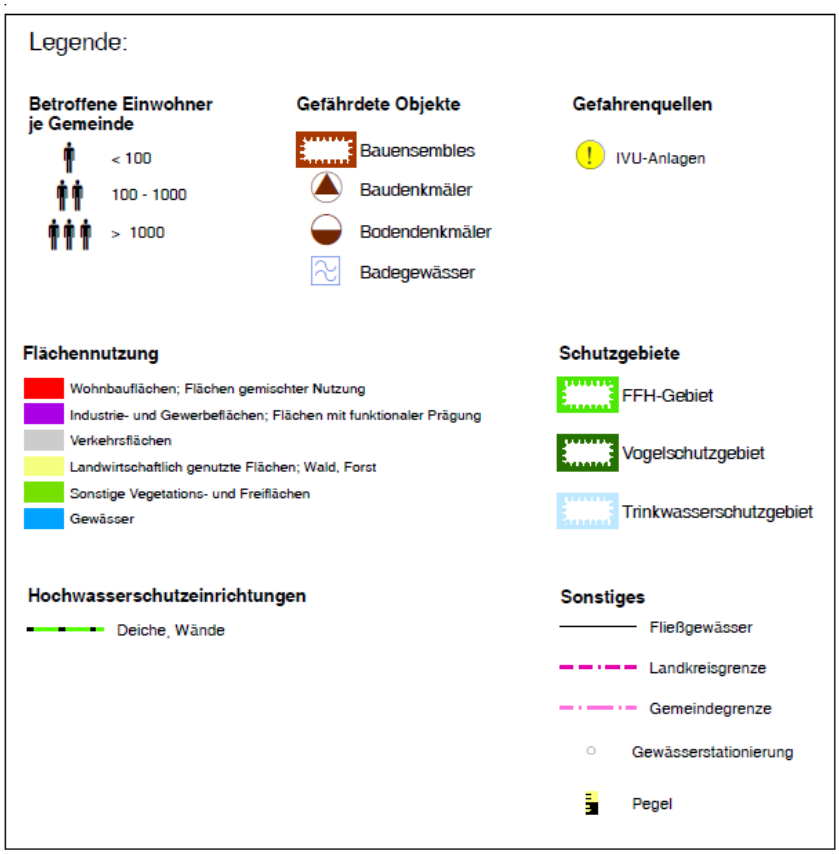

Figure 3-6: Flood Risk Map Legend

In Figure 3-5, Sheet 10 of the flood risk map is shown as an example that depicts a flood of medium probability (HQ_{100}).

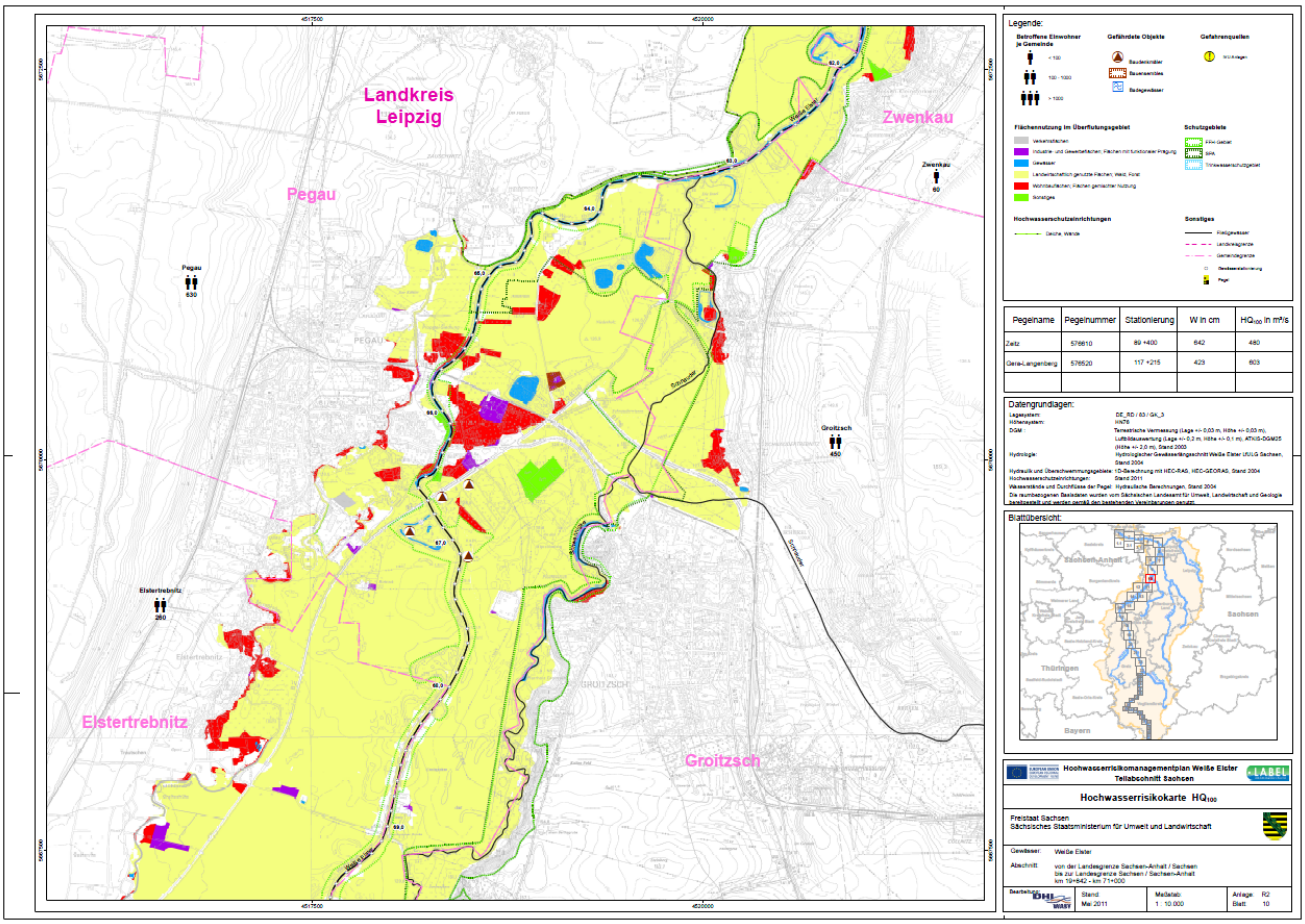

Figure 3-7: Example of a Flood Risk Map

3.2.3 Conclusion

In order to ensure the use of a standardized layout for the maps, two templates – one for flood hazard and another for flood risk map - in ArcGIS 9.3 format (MXT) were created and distributed to the participating states. The draft templates for both were created and modified based on the agreement among the main contractors of the project, namely DHI-WASY for the Free State of Saxony, FUGRO-HGN for the Free State of Thuringia, and the planning office of Scholz + Lewis GmbH for the State of Saxony-Anhalt, then were circulated to other contributors to the project. The templates were documented under the authority of the State of Thuringia (FUGRO-HGN, 2011c). Both templates are ready to be dispensed as part of the implementation of the EU Directive on the Assessment and Management of Flood Risks. In addition to the standardized layout, the content of the flood hazard and the flood risk maps were also coordinated. The result of these coordination efforts ensured that the level of technical detail conveyed in every map is compatible.

The pilot catchment of Weiße Elster has been divided into 44 sections of map sheets. Each map sheet is a set of three flood hazard and three flood risk maps, totaling to 264 maps for the entire project.

The total area of inundation along the Weiße Elster under the HQ_{100} flood in the three states investigated totaled at 86.8 km^2. According to the applied methodology, approximately 29800 people were affected.

4 Methodology for Preparing Flood Risk Management Plans

4.1 Background

In the States of Saxony, Saxony-Anhalt, and Thuringia, a pilot project of devising a flood risk management plan along the Weiße Elster Catchment, which flows through all three states, was launched. A tailored plan for each state was created, DHI-WASY (2011) being responsible for the Free State of Saxony, PGSL (2012b) for the State of Saxony-Anhalt, and FUGRO-HGN (2011) for the Free State of Thuringia. The assessment of the FRMP was based on the Article 7 of the EU-Flood Risk Management Directive.

For the upstream area of the Weiße Elster, which lies in the Czech Republic, no such plan was devised as the assessment method used for the other areas indicated no significant flood risk in this part of the catchment. The risk threshold would not be reached (MoE, 2010) in terms of public health (affected) or economic activities (potential for damage).

The methodological background for devising the FRMP in the States of Saxony, Saxony-Anhalt, and Thuringia was based on the Flood Risk Management Directive set by the German Federal States' Working Group on Water (LAWA, 2010b). Defined sequence of steps was taken in all three states for the FRMP (Figure 4-1).

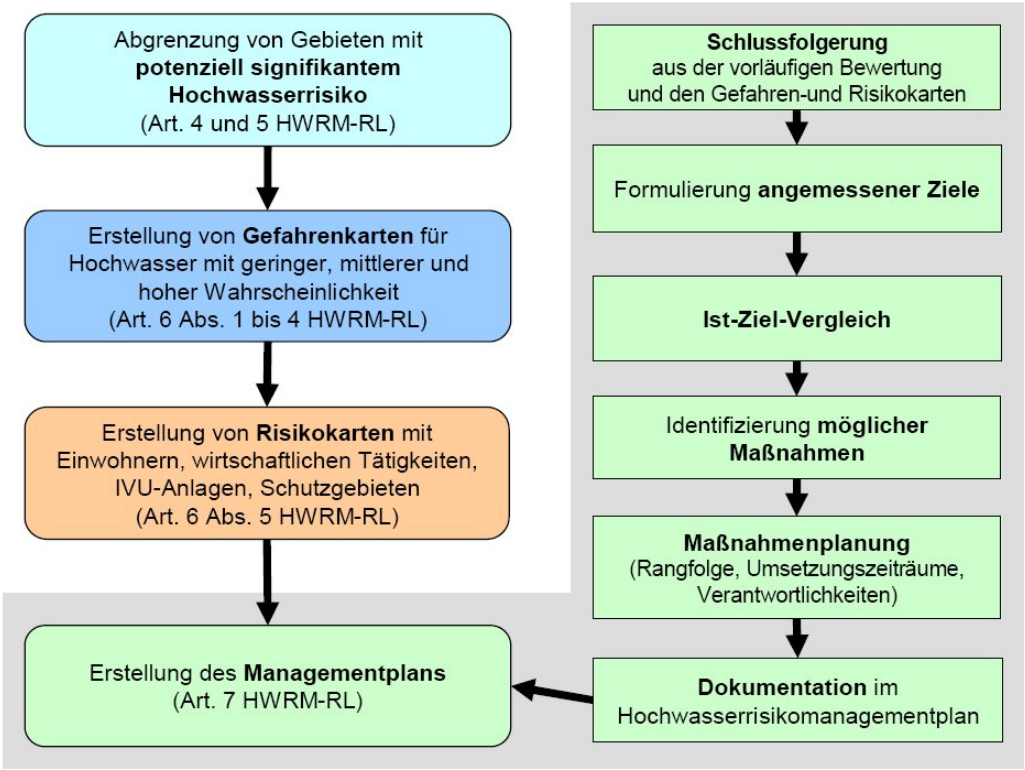

Figure 4-1: Diagram of Procedures for a Flood Risk Management Plan (LAWA, 2010b)

Based on the guidelines set by LAWA (2010b), a standardized outline for the FRMP was coordinated among the three states that were involved (Table 4-1). The consensus among the partners was that not all points have to be fulfilled by the involved states. The points that were not applicable to a specific state were simply be noted as not applicable in the FRMP.

Table 4-1: Outline for the FRMP up to Level 2

Chapter	Chapter Heading
1	Introduction
1.1	Flood Risk Management (general)
1.2	Geographical Scope of the FRMP
1.3	Responsible Authorities
2	Preliminary Assessment of Flood Risks
2.1	Description of Catchments
2.2	Review of Previous Floods
2.3	Description of the Preliminary Flood Risk Assessment Methodology
2.4	Application of the Preliminary Flood Risk Assessment Methodology
2.5	Map of Catchments with Significant Flood Risk Potential
3	Flood Hazard Maps and Flood Risk Maps
3.1	Flood Hazard Maps
3.2	Flood Risk Maps
4	Flood Risk Management Objectives
4.1	Areas of Action
4.2	Determination of Appropriate Targets
4.3	Description of Current States and Target-Current Comparison
5	Flood Risk Management Measures
5.1	Possible Measures
5.2	Assessment of Measures
5.3	Planned Implementation and Prioritization of Measures
6	Strategic Environmental Auditing and Public Participation
6.1	Information to the Public
6.2	Public Consultation
7	Coordination
7.1	Coordination within Sub-Catchments
7.2	Transboundary Coordination (upstream / downstream)
7.3	Coordination with Water Framework Directive and NATURA 2000
8	Conclusions

4.2 Flood Risk Management Objectives

The objectives of all three states were defined based on LAWA (2010b) and were described in the **Areas of Action** for Flood Risk Management (Table 4-2).

Table 4-2: Fundamental Objectives and Areas of Action for Flood Risk Management (LAWA, 2010b)

Fundamental Objective	Area of Action	Timing in relation to the Flood
Avoiding New Risks	Precautionary Land Use	before
	Natural Water Retention	
Reducing Existing Risks	Flood Control with Technology	
	Precautionary Building Practice	
	Risk Management	
	Information Management	
	Emergency Measures	
	Provisional and Preliminary Hazard Prevention and Emergency Management	
Reducing Adverse Effects	Flood Response	during
	Rehabilitation (Aftercare)	after

Because the fundamental objectives for the areas of action in Table 4-2 have only been generally outlined and therefore are not sufficient for practical application, more concrete objectives for individual areas of action had to be defined. Rather than fully processing all areas of action, defining these goals according to LAWA (2010b) became a priority.

A substantial number of the individual objectives for specific areas of action that were formulated for implementation in Saxony were adopted by Saxony-Anhalt:

Cautionary Land Use: Preventing the increase of potential damage in the areas that can be seriously affected by floods.

Natural Water Retention: Improving the natural retention capacity of precipitation in catchments and floodplains.

Flood Control with Technology: Reducing flood hazard for selected properties or catchments from the existing potential damage while taking into account the ecological and economical sustainability.

Cautionary Building Practices: Damage prevention or alleviation of buildings from flood events or damage prevention of flood-prone buildings and sites by hazardous substances transported by flood water.

Risk Management: Individual provisions through savings and insurances.

Information Management: Coordination of flood warning systems and streamlining of methods and procedures for flood forecasting in Saxony, Saxony-Anhalt, and Thuringia.

Emergency Measures: Educating the population of the hazards and risks involved with floods, flood warning system, flood behavior, and offering opportunities for the general public to alleviate the risks, for example by raising awareness.

Provision and Preparation for Hazard and Disaster Control: Reviewing and finalizing the emergency warning and operational procedure and having the necessary materials and human resources for hazard control in all municipalities involved.

In addition to the aforementioned objectives, target protection level for several land uses was defined in Saxony and Saxony-Anhalt based on the flood return period and relevant flood control measurements using technology. For example, the critical limit for the relevant statistical return period for no settlement areas is 100 years.

In Thuringia, a different approach from Saxony and Saxony-Anhalt was taken in defining the main objectives. The general objectives outlined in Table 4-2 were reinforced through a series of working objectives, where hazard reduction was considered based on the assets to be protected, such as public health as well as environmental, cultural and economic activities. Further conformity to the plans in Saxony and Saxony-Anhalt was ensured by the subsequent assignment of these working objectives to the flood risk management areas of action.

Description of the current state and the **target-current comparison** in all three states took into consideration the regional and local characteristics. Areas that require improvements between the current states and the objectives in the FRMP of at least two of the three states are:

- Insufficient official identification and designation of floodplains,
- Insufficient knowledge of flood-risk areas,
- Inadequate consideration of floodplains and flood-risk areas in regional planning and building ordinances, and lack of local knowledge,
- Non-existent agricultural management on site,
- Lack of attention paid to revitalizing the natural water retention plains through demolition, reconstruction, and relocating of existing dykes,
- Lack of stability and protection of the existing dykes,
- Insufficient information available for the general public regarding flood hazards and risks,
- Inappropriate building practices,
- Lack of public awareness on flood risks,
- Absence of comprehensive flood forecasting model.

4.3 Flood Risk Management Measures

4.3.1 Identification and Assessment of Possible Measures

In order to select the appropriate measure for all areas of action, a procedure based on LAWA (2010b) consisting of two stages – survey of current situation and determination of measures - was suggested. The sur-

vey stage is carried out based on the description of the current state and the target-current comparison (Section 4.2). Areas that required action were identified by the survey, which then became the basis for the flood risk management measures. The fundamental idea came from LAWA (2010b), where it called "…for the FRMP, feasible measures to be listed and targeted steps for their implementation to be prescribed. The goal is to prioritize the urgent fields of action rather than to formulate a complete action plan for all fields. The measures should be identified for a manageable period of time, ideally until the next update of the FRMP in 2012."

In Saxony and Saxony-Anhalt, possible measures for the objectives defined in Section 4.2, while being in agreement with the LAWA (2010b) guidelines, were selected. In Saxony, the Flood Protection Concept for all Category 1 water bodies of 2004 became the basis for selecting the appropriate flood risk protection measures, particularly for those involving technology. The fact that the assessment and the prioritization (Section 4.3.2) were already taken care of in the Flood Protection Concept was helpful in selecting the appropriate measure. In addition to the FRMP in question, further Flood Protection Concept measures were selected and developed in the areas of land use provisions, natural water retention, information management, emergency measures, such as provision of resources and preparation for hazard prevention. In Saxony-Anhalt, cautionary building and construction practices were considered in addition to the measures that have been selected and developed in Saxony.

In Thuringia, regional and local measures had some differences, and, as such, the two were published in two separate catalogs of measures. The municipal catalog of measures for the so-called flood hotspots were detailed in total of nine profiles of measures, and contain the measures for one or more neighboring municipalities. In the tabular overview shown in Table 4-2, corresponding to FUGRO HGN (2011b), the individual measures of the fields of action "precautionary land use," "natural water retention," "flood protection using technology," and "flood forecasting" were indexed. The assessment of the municipal measures were based on the following criteria: implementation (based on effort), effectiveness (based on achievement of objectives), and economic soundness (based on the financial demand). All regional measures were evaluated based on these criteria as well as their ecological compatibility. Relevant municipal FRMP measures were selected following the implementation of the regional FRMP by the Thuringia Ministry of Agriculture, Forest, Environment, and Natural Protection (Thüringer Ministerium für Landwirtschaft, Forsten, Umwelt und Naturschutz). The measures for the general areas of action for flood prevention were organized following the outlines shown in Table 4-2.

4.3.2 Planned Implementation and Prioritization of Measures

To achieve the flood risk management goals that were identified, the measures in the FRMP that would be ready to be implemented between now and the next update of the plan, in 2012, were adapted in all three states. The measures that cannot at least start being implemented by 2012 were not considered.

As already mentioned in Section 4.3.1, the FPC measures in Saxony were already evaluated and prioritized, and served as the basis for formulating the FRMP. This was done using a standardized, nationwide method (SMUL, 2005), where the following criteria were considered: damage potential, cost-benefit ratio, supralocal water management impact, and the vulnerability of ecological assets. All these four criteria were determined separately and subsequently assessed on an equally-weighted point system where 25 was the maximum possible point to be reached in each criterion. The measures with at least 65 points were categorized as "high priority," whereas the measures that scored between 35 and 60 points were of "medium priority" and the ones below 30 points had "low priority" (SMUL, 2005).

The nationwide prioritization of the FPC measures in the Weiße Elster Catchment resulted in 60 measures with "high" priority, 108 measures with "medium" priority, and 56 measures with "low" priority. The measures with "high" priority had the highest possibility of implementation by 2021, and based on this, the measures with higher priorities that were not yet implemented have been included in the FRMP; they belonged exclusively to the area of flood protection using technology. For further measures involving the other areas of action, the feasibility of implementation by 2021 was considered.

In Saxony-Anhalt, the measures were first prioritized by estimating their chance of implementation. The FRMP measures were classified into four categories based on the length of time until implementation: short-term, medium-term, long-term, and constant. It was essential that the implementation of all these measures could at least begin by 2021.

In Thuringia, a decision was made that the measure that would protect people's lives to take priority over all other criteria. Additional criteria for the prioritization were feasibility and the cost-benefit ratio. Measures achievable in the short-term with small financial input had a higher priority over the measures requiring longer time and more financial means to achieve. Therefore, the areas of action formed the basis for the general prioritization:

- High Priority: Measures such as cautionary land use, information management, and organizational measures that would prepare for and prevent the adverse effects of flood events, or measures in the scope of "enforcement of legal provisions,"
- Medium Priority: Technical and organizational measures for preventing the adverse effects of flood events in advance, i.e. establishing a reliable flood forecasting system and disaster management plans,
- Low Priority: Measures related to building/construction technology for preventing the adverse effects of flood events.

4.3.3 Overview of Measures

Table 4-3 gives an overview of how the FRMP measures were distributed based on individual areas of action.

Table 4-3: Number of FRMP measures tabulated based on the areas of action

Area of Action	Saxony	Saxony-Anhalt	Thuringia	
			regional	municipal[1]
Cautionary Land Use	2	6		
Natural Water Retention	5	4	1	8
Flood Protection using Technology	56	6	4	6
Cautionary building Practices		3	25	2
Cautionary building Practices	3	4		
Emergency Measures	3	3		4
Provision and Preparation for Hazard and Disaster Control	5	6		
Summe	**74**	**32**	**30**	**20**

1) According to TMLFUN (2012b)

Most of the suggested measures had limited local or, at best, regional impact. The measures with panregional influences that required the agreement of all involved states in order to take effect were:

- The flood retention in Lake Zwenkauer, a post-mining lake located south of Leipzig (proposed by Saxony, agreement of Saxony-Anhalt required),
- The flood retention in Lake Haselbacher, a post-mining lake southeast of Leipzig (proposed by Saxony, agreement of Thuringia and Saxony-Anhalt required),
- The development of unified, transboundary flood hazard management and information systems (proposed by Thuringia, agreement of Saxony and Saxony-Anhalt required),
- The preparation and implementation of optimized control and operational process for the existing dams in the catchment (proposed by Thuringia, agreement of Saxony required).

The measures mentioned were also for the Elbe River Basin and therefore is relevant for Level B of the FRMP.

Based on previous evaluations (PGSL, 2012b), no transboundary measures were planned to take effect in Saxony-Anhalt.

4.4 Strategic Environmental Assessment and Public Participation

Because the existing FRMP deals with a pilot activity on regional subcatchments represented by Level C of the WFD, no Strategic Environmental Assessment (SEA) was carried out, but rather, a general description of the SEA approaches in applicable sections were included in the FRMP. A SEA is only carried out on the river basin community level (Level B) of the Elbe.

4.5 Coordination

4.5.1 Transboundary Coordination

According to LAWA (2008), the management units to be shared by all member states of the international river basin districts are:

- Exchange of information on the preliminary assessment of the flood risks,
- Coordination of the flood risk area designation,
- Exchange of information for the flood hazard and flood risk maps, and
- Coordination of the FRMP development.

Regarding the agreements with the Czech Republic, the method used for the preliminary assessment and determination of the significance criteria, it was decided that the upstream area of the Weiße Elster, located in the Czech side, was not exposed to any significant flood risks (Section 4.1). Therefore, specific agreements with the Czech Republic, the upstream riparian country, were not necessary.

The above-mentioned requirements allude to the fact that official agreements among the states of Saxony, Saxony-Anhalt, and Thuringia are required. As such, the first three points can be considered as fulfilled (DHI-WASY, 2012).

A question remains in regards to the structure for the transboundary FRMP coordination among the involved states. It is essential that the measures and the objectives are frequently reviewed and adjusted. According to Article 7 Section 4 of the FRMD, the FRMP shall "not include measures which, by their extent and impact significantly increase flood risks of other countries that lie upstream or downstream of the same river basin… unless these measures have been coordinated in advance." This relates to issues, which have supraregional implications, such as flood protection measures using technology. For these, coordination efforts between the upstream and downstream regions in the building law approval and participation procedures are needed. As for the transboundary collaboration on non-technical issues, such as the scope of spatial planning, there still remains a need for structured regulation.

4.5.2 Coordination with the WFD and NATURA 2000

In accordance to the Article 9 of the FRMD, the implementation of the FRMD and the application of the WFD had to be coordinated. The WFD within the hydrological units (river basins) would also be implemented, as with the FRMD. LAWA (2008) recommended that the flood hazard and flood risk maps in particular to be adjusted based on the information from the implementation of WFD, and the FRMP to be coordinated based on the review of the management plans for the WFD. The objectives of the WFD were to take into consideration the areas of action in cautionary land use and natural water retention, and to develop and implement them in an appropriate manner (LAWA, 2010b). With this in mind, improving the current status of the aquatic and ecological systems, as well as the related terrestrial ecosystem and wetlands, would prevent further damage and

provide protection, which would be consistent with the WFD in terms of water resources.

In principle, the FRMD has adapted the definitions of "river," "catchment," "sub-catchment," and "river basin unit," as outlined in Article 2, as well as the eligible area requirement for the catchments in WFD, to be greater than 10 km^2. This provided an opportunity to explore the mutual advantages of and synergy between the two directives.

Article 9 of the FRMD calls for the coordinated implementation between the WFD and the FRMD. The goal is to encourage efficiency and information exchange while achieving synergies and common benefits in regards to the environmental targets.

That is to say that the measures must be identified and, preferably, executed where appropriate in the implementation of both the WFD and the FRMD.

In implementing the directive, conflicts among the different objectives, alongside the synergy effects, can occur. These conflicts are especially likely in the execution of the technical flood protection measures. While the WFD conforms to the good ecological status for natural water body and the slightly lesser goal of good ecological potential for heavily modified and artificial waterbody, flood defense facilities, to a lesser or greater degree, affect the waterbody structures; the cumulative effects can endanger the achievement of the WFD targets.

In the case where the agreement on the shared objectives is not possible, exceptions from the WFD standards can be made under certain conditions. Required for such exceptions is the examination of possible alternatives and appropriate courses of action, as well as a directive-conforming justification. Due to the high level of aggregation in the plans prepared for Level B and the programs of the FRMD and the WFD, this level does not appear suitable for such approaches. The Level C, on the other hand, presents a possibility to position sufficient enough technical measures of the FRMP, to localize the area of conflict, and to predict the impact of achieving the objectives on the waterbody. The evaluation process is to decide which aspects must be withdrawn. The result of the evaluation process is binding, and is utilized for the composition and enhancement of the next management plan and the program of measures (Bewirtschaftungszeitraum 2015-2021). The procedure ensures the exchange and the comparison of fundamental, directive-specific data and information, and offers the different stakeholders involved an efficient, lateral, and consistent procedure to execute the measures within the scope of their competency.

The guidelines used for coordinating with the WFD were applied equally to the coordination with NATURA 2000, a network of protected areas initiated by the EU. The basis for implementing NATURA 2000 was formed by Directive 92/43/EEC (Fauna-Flora-Habitat Directive, abbreviated FFH Directive) and the Directive 2009/147/EC (Wild Birds Directive). The EU member states have committed themselves to restoring, preserving, and evolving particularly important species and habitats through necessary measures. The depiction of the FFH and WBD designated specie and bird protection areas on the flood hazard and risk maps ensured that the protected areas will be considered as a part of the flood risk management.

The Strategic Environmental Assessment and coordination with the WFD and NATURA 2000 would only take place in the level of the river basin community of the Elbe (Level B).

4.6 Conclusion

Based on the LAWA guidelines, FRMP for each sub-catchment within the pilot catchment of Weiße Elster was devised, then consolidated into a comprehensive FRMP for the states of Saxony, Saxony-Anhalt, and Thuringia. The pilot project demonstrated that a transboundary FRMP for each regional sub-catchment was formulated largely based on the information and documents that already existed, and that, with a shared vision, an orchestrated method towards a regional FRMP could be formulated.

5 References

Bauer, L. (1956): Hochwasserabfluss und Landschaftswasserhaushalt – Geographisch-landschaftskundliche Probleme des Hochwasserabflusses, dargestellt am Beispiel des Julihochwassers 1954 der Weißen Elster. Hermann Haack Geographisch-Kartographische Anstalt Gotha.

Böer, W., H. Schubert und O. Wilser (1959): Das Sommerhochwasser der Elbe im Juli 1954. Besondere Mitteilungen zum Deutschen Gewässerkundlichen Jahrbuch Nr. 19. Akademie-Verlag, Berlin.

DHI-WASY (2011): Umsetzung der EU Hochwasserrisikomanagementrichtlinie im Rahmen des INTERREG IV B Projektes LABEL - Pilotgebiet „Weiße Elster Sachsen". DHI-WASY GmbH im Auftrag des Sächsischen Staatsministeriums für Umwelt und Landwirtschaft.

DHI-WASY (2012): Umsetzung der EU Hochwasserrisikomanagementrichtlinie im Rahmen des INTERREG IV B Projektes LABEL - Grenzüberschreitender HWRP Weiße Elster. Abschlussbericht, DHI-WASY GmbH im Auftrag des Sächsischen Landesamtes für Umwelt, Landwirtschaft und Geologie.

Deutsch, M.; Pörtge, K.-H. (2003): Hochwasserereignisse in Thüringen. Schriftenreihe der TLUG Nr. 63, 2. überarbeitete Auflage, Jena.

Deutsch, M.; Pörtge, K.-H. (2009): Hochwassermarken in Thüringen. Thüringer Ministerium für Landwirtschaft, Forsten, Umwelt und Naturschutz, Erfurt.

Eberle, H. (2010): Archivrecherche zu historischen Überschwemmungskarten für Fließgewässer Thüringens. Halle, unveröffentlicht.

EG-FFH-RL (1992): Richtlinie 92/43/EWG des Rates vom 21. Mai 1992 zur Erhaltung der natürlichen Lebensräume sowie der wildlebenden Tiere und Pflanzen.

EG-HWRM-RL (2007): Richtlinie 2007/60/EG des Europäischen Parlaments und des Rates vom 23. Oktober 2007 über die Bewertung und das Management von Hochwasserrisiken.

EG-VS-RL (2009): Richtlinie 2009/147/EG des Europäischen Parlaments und des Rates vom 30. November 2009 über die Erhaltung der wildlebenden Vogelarten.

EG-WRRL-RL (2000): Richtlinie 2000/60/EG des Europäischen Parlaments und des Rates vom 23. Oktober 2000 zur Schaffung eines Ordnungsrahmens für Maßnahmen der Gemeinschaft im Bereich der Wasserpolitik.

FUGRO-HGN (2011a): Erstellung einer landesweiten Übersicht der Hochwasserschadenspotenziale auf der Basis der vorhandenen Daten für den Freistaat Thüringen als Grundlage für die vorläufige Bewertung des Hochwasserrisikos und Erstellung einer landesweiten Übersicht der Risikogebiete. FUGRO-HGN im Auftrag der Thüringer Landesanstalt für Umwelt und Geologie.

FUGRO-HGN (2011b): Hochwasserrisikomanagementplan (HWRM-Plan) der Weißen Elster im Teilgebiet Thüringen. Ergebnisbericht. FUGRO-HGN im Auftrag des Thüringer Ministeriums für Landwirtschaft, Forsten, Umwelt und Naturschutz.

FUGRO-HGN (2011c): Erstellung einer ArcGIS-Vorlagedatei (MXT) für die Herstellung der Hochwassergefahren- und Hochwasserrisikokarten in Thüringen – Beschreibung des Kartenlayouts und der Karteninhalte. FUGRO-HGN GmbH im Auftrag des Thüringer Ministeriums für Landwirtschaft, Forsten, Umwelt und Naturschutz.

Grünewald, U., B. Merz, W. Streitz u. a. (2003): Hochwasservorsorge in Deutschland – Lernen aus der Katastrophe 2002 im Elbeeinzugsgebiet. BTU Cottbus, Geoforschungszentrum Potsdam und Cristian-Albrechts-Universität Kiel im Auftrag des Deutschen Komitees für Katastrophenvorsorge e. V.

Hässler-Kiefhaber, D., K. Knittel und H. Webler (2011): Pilotprojekt HWRM-Plan Nahe. Berichtsreihe des Forums zur Europäischen Hochwasserrisikomanagementrichtlinie, Band 3, S. 75 - 80, Shaker Verlag Aachen.

Heiland, P., K. Dapp, A. Garmann, M. Gierk und C. Hornemann (2010): Anforderungen an die grenzüberschreitende Hochwasserrisikomanagementplanung. II. Bund/Länder-Workshop zur Umsetzung der EG-Hochwasserrisikomanagementrichtlinie. INFRASTRUKTUR und UMWELT Professor Böhm und Partner im Auftrag des Bundesministeriums für Umwelt, Naturschutz und Reaktorsicherheit, Darmstadt.

IAWG (2009): Ermittlung und Darstellung von überschwemmungsgefährdeten Gebieten an ausgewählten Gewässern des Freistaates Thüringen. Dr. Winfried Willems, IAWG Ottobrunn.

LAWA (2008): Strategie zur Umsetzung der Hochwasserrisikomanagement-Richtlinie in Deutschland. Bund/Länder-Arbeitsgemeinschaft Wasser. September 2008.

LAWA (2009): Vorgehensweise bei der vorläufigen Bewertung des Hochwasserrisikos nach EU-HWRM-RL. Bund/Länder-Arbeitsgemeinschaft Wasser. März 2009.

LAWA (2010a): Empfehlungen zur Aufstellung von Hochwassergefahrenkarten und Hochwasserrisikokarten. Bund/Länder-Arbeitsgemeinschaft Wasser. Februar 2010.

LAWA (2010b): Empfehlungen zur Aufstellung von Hochwasserrisikomanagementplänen. Bund/Länder-Arbeitsgemeinschaft Wasser. März 2010.

Merz, B., R. Bittner, U. Grünewald und K. Pieroth (2011): Management von Hochwasserrisiken. Schweizerbart, Stuttgart.

MoE (2010): Proposal of preliminary flood risk assessment methodology in the Czech Republic. Czech Ministry of Environment (Contracting authority).

PGSL (2011): Umsetzung der EG-HWRM-RL für die Weiße Elster. Stufe 1 – Vorläufige Bewertung des Hochwasserrisikos, Planungsgesellschaft Scholz + Lewis mbH, im Auftrag des Landesbetriebes für Hochwasserschutz und Wasserwirtschaft Sachsen-Anhalt, März 2011.

PGSL (2012a): Umsetzung der EG-HWRM-RL für die Weiße Elster. Stufe 2 – Erstellung der Hochwassergefahren- und -risikokarten, Planungsgesellschaft Scholz + Lewis mbH,im Auftrag des Landesbetriebes für Hochwasserschutz und Wasserwirtschaft Sachsen-Anhalt, Januar 2012.

PGSL (2012b): Umsetzung der EG-Hochwasserrisikomanagementrichtlinie (Stufe 3) - Hochwasserrisikomanagementplan Weiße Elster in Sachsen-Anhalt. Planungsgesellschaft Dr. Scholz + Lewis mbH im Auftrag des Landesbetriebes für Hochwasserschutz und Wasserwirtschaft Sachsen-Anhalt, April 2012.

SächsWG (2004). Sächsisches Wassergesetz in der Fassung der Bekanntmachung der Neufassung vom 18. Oktober 2004. SächsGVBl. S. 482.

SMUL (2005): Verfahren zur HWSK-übergreifenden Priorisierung von Hochwasserschutzmaßnahmen. Sächsisches Staatsministerium für Umwelt und Landwirtschaft sowie Landestalsperrenverwaltung des Freistaates Sachsen.

ThürStanz (2009): Thüringer Staatsanzeiger Nr. 42/2009 Seite 1685 bis 1688, Thüringer Verordnung über die Bestimmung der Gewässer und Gewässerabschnitte nach §80 Abs. 2 Thüringer Wassergesetz.

ThürWG (2009): Thüringer Wassergesetz in der Fassung der Bekanntmachung vom 18.8.2009.

TMLFUN (2012a): Zur Verwendung von Erkenntnissen aus den Recherchen zu historischen Hochwasserereignissen. E-Mail an die DHI-WASY GmbH vom 13.3.2012, Thüringer Ministerium für Landwirtschaft, Forsten, Umwelt und Naturschutz, Erfurt.

TMLFUN (2012b): Maßnahmetabelle für den HWRM-Plan Weiße Elster. E-Mail an die DHI-WASY GmbH vom 3.8.2012, Thüringer Ministerium für Landwirtschaft, Forsten, Umwelt und Naturschutz, Erfurt.

WASY und IHI (2006): Entwicklung einer Methodik zur Identifizierung von Hochwasserentstehungsgebieten. Abschlussbericht, WASY Gesellschaft für wasserwirtschaftliche Planung und Systemforschung mbH und Internationales Hochschulinstitut Zittau im Auftrag des Sächsischen Landesamtes für Umwelt und Geologie.

WG LSA (2011): Wassergesetz für das Land Sachsen-Anhalt vom 16.3.2011.