Assessment of hydromorphological pressures and impacts in Germany

Jörg Janning
Head of Section Waterprotection

Groups of pressures	Pressure factors (examples)	Risk assessment components
Flow regulation	Obstructing installations 6 and 7 Backwaters 7 Non-continuity drops and backwaters	
Morpholo-gical modifiations	- Water body structure class > 5 (river bed); - Obstructing installations 6 and 7 if continuity impaired	**Water body structure** morphological, structural assessment components
Other anthropo-gical impacts	Heat discharges > 10 MW Salt intruder > 1 kg/s Chloride	
Land use structures	Urban areas Industrial areas Agricultural areas Fishery areas Forests	

Published by: Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)
Public Relations Division – 11055 Berlin
E-mail: service@bmu.bund.de Internet: www.bmu.de
Editing: Sandra Richter (Universität Kassel); Volker Mohaupt (UBA)

Figure 1: Comparison of biological water quality (oxygen balance disturbances) and ecomorphological status

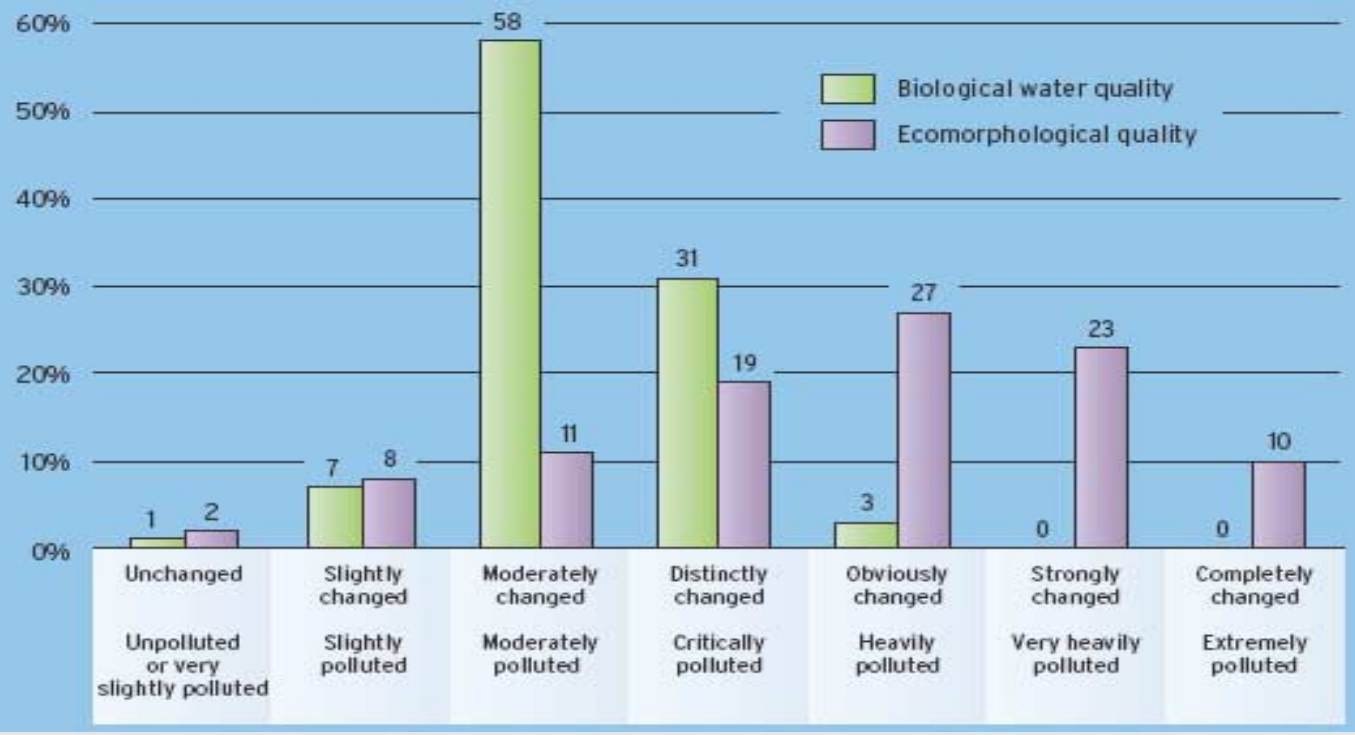


Figure 3: The causes for failing Directive objectives mentioned most frequently in the ten river basin reports

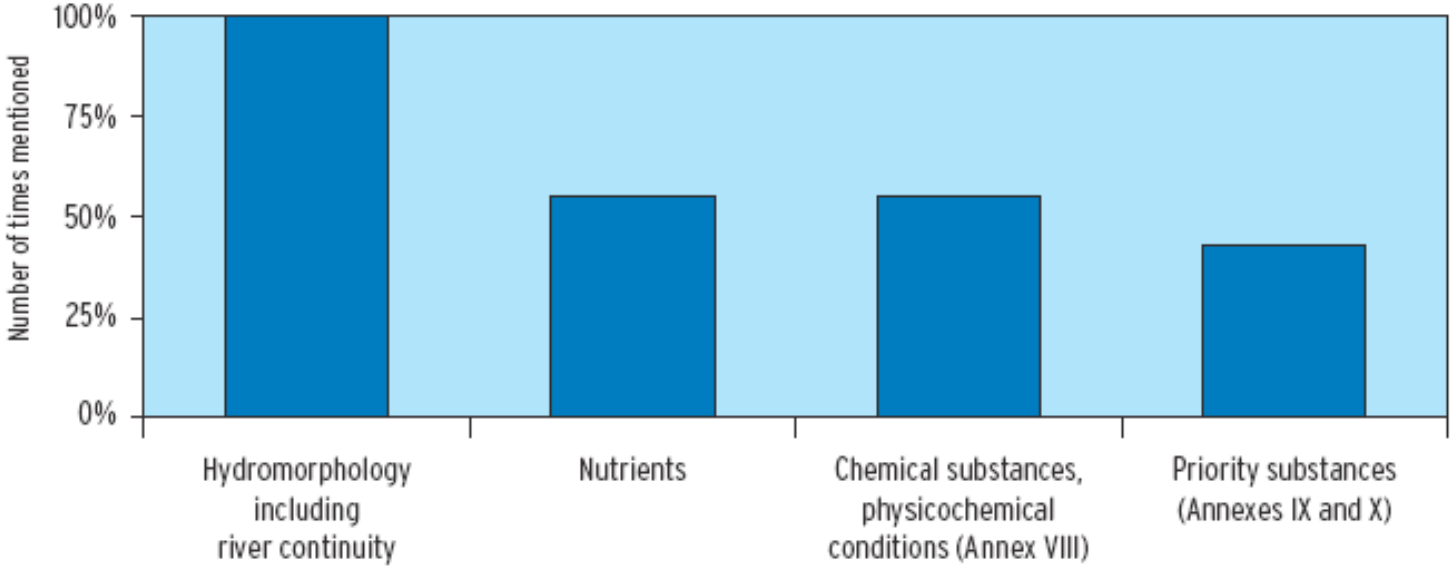


Figure 2: Results of the characterization of surface and ground water bodies

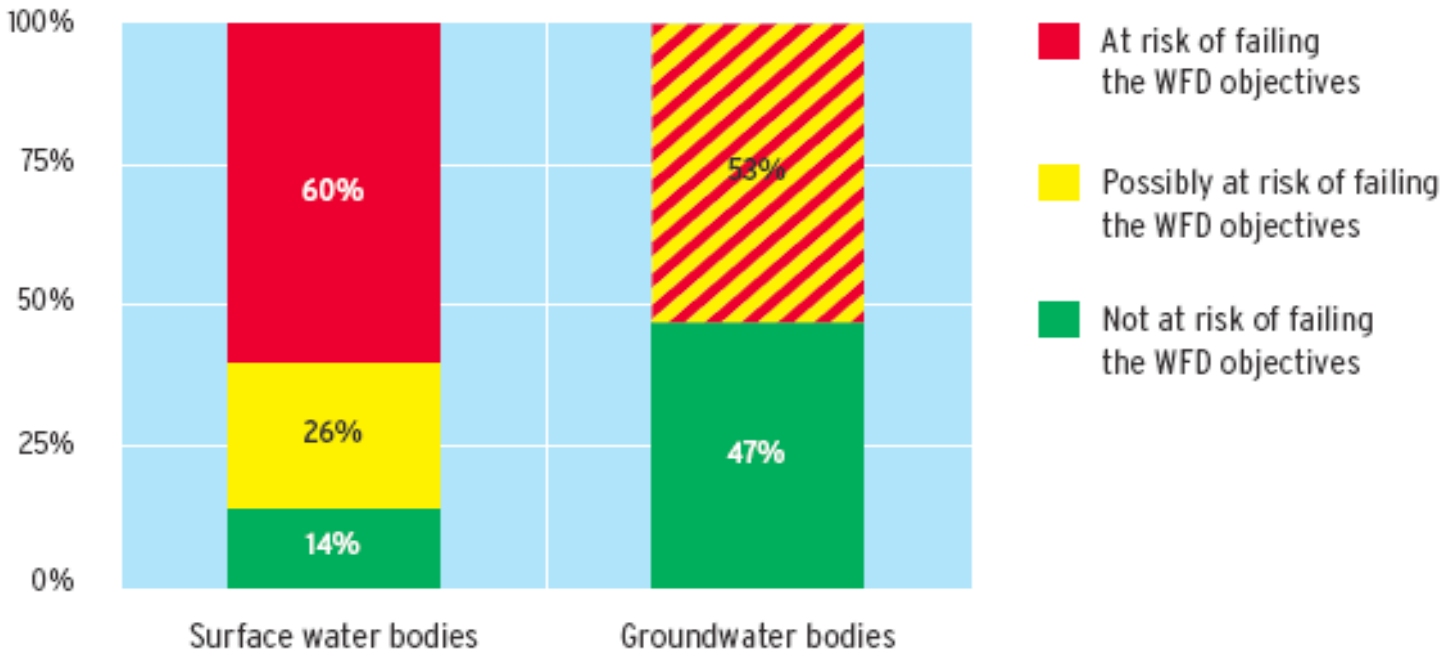
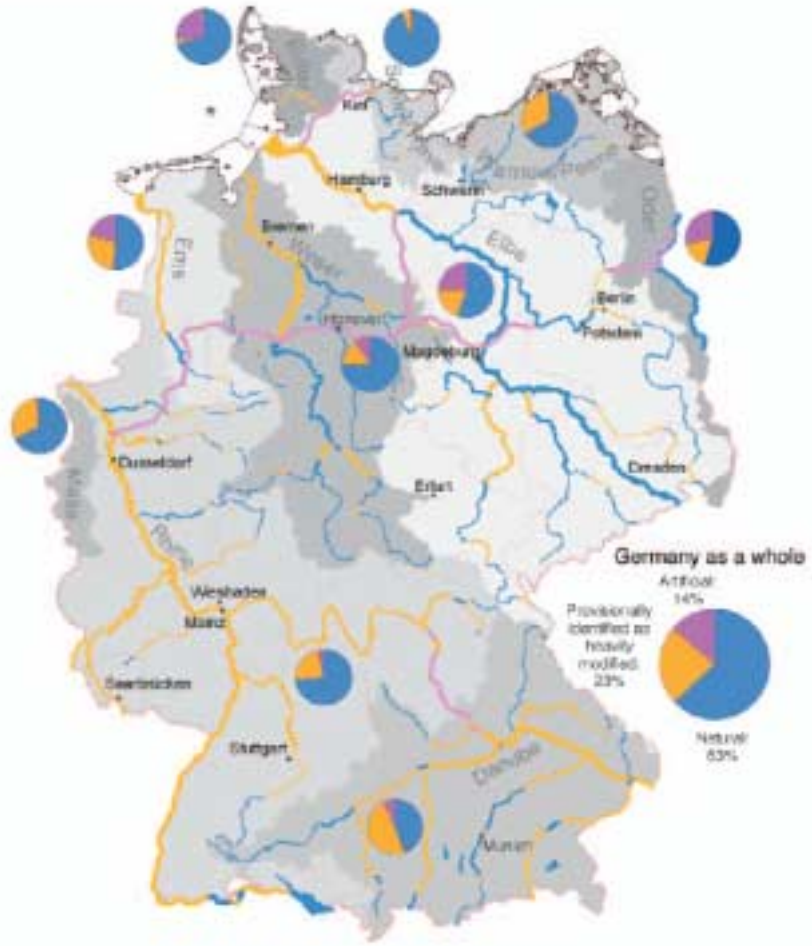


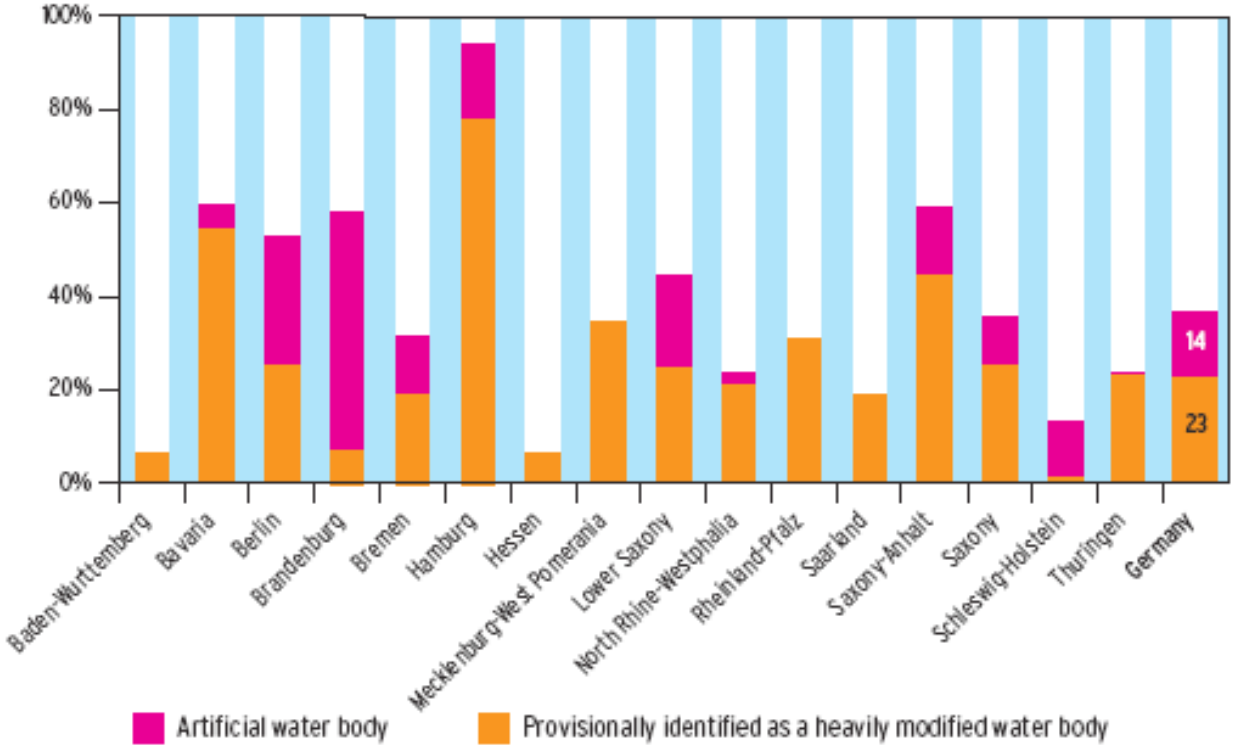
Figure 14: Natural and artificial water bodies and water bodies that have been provisionally identified as heavily modified in Germany



Information valid as at January 2005
For further information see text and Annex

Source: Data aggregated from information provided by German states
Source maps: Umweltbundesamt and Bundesamt für Kartographie und Geodäsie

Figure 13: Artificial surface water bodies and surface water bodies provisionally identified as heavily modified in Germany[1]



[1] In Bavaria, where provisionally heavily modified (HMWB) and artificial (AWB) water bodies were estimated in terms of the length of river streams and number of lakes, 20% of the river length was classified as provisionally HMWB, 31% as "candidates" for HMWB and 3% as AWB, and 23 of the 54 lakes were classified as HMWB (2 lakes) or AWB (21 lakes).

Delineation of waterbodies in DE:

• Surface water	DE	18 km
	BW	85 km
	NW, BB, MV	<5 km
• Ground water	DE	350 km²
	BY	1250 km²
	NW, HE	<200 km²

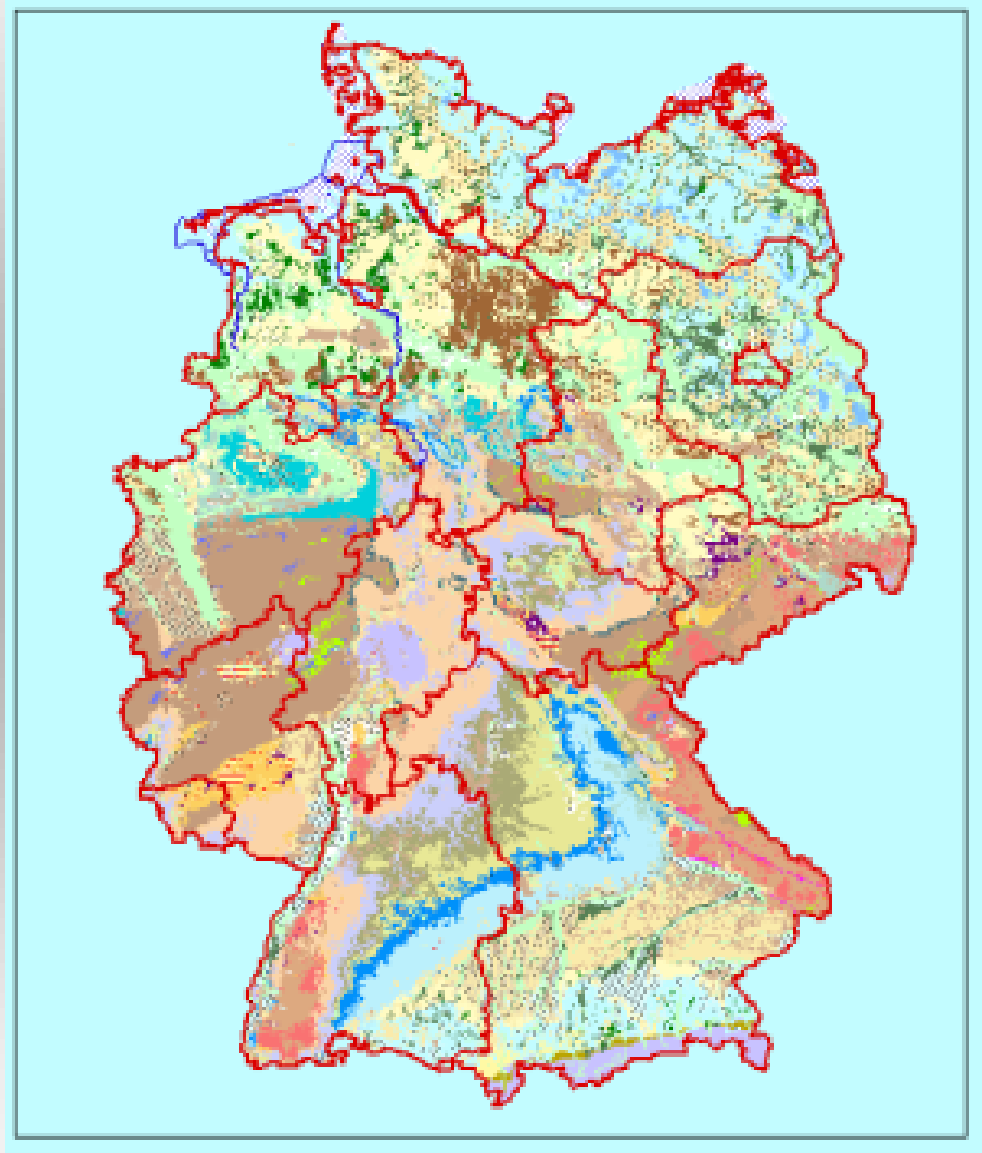
- **Designation of preliminary HMWB in DE:**

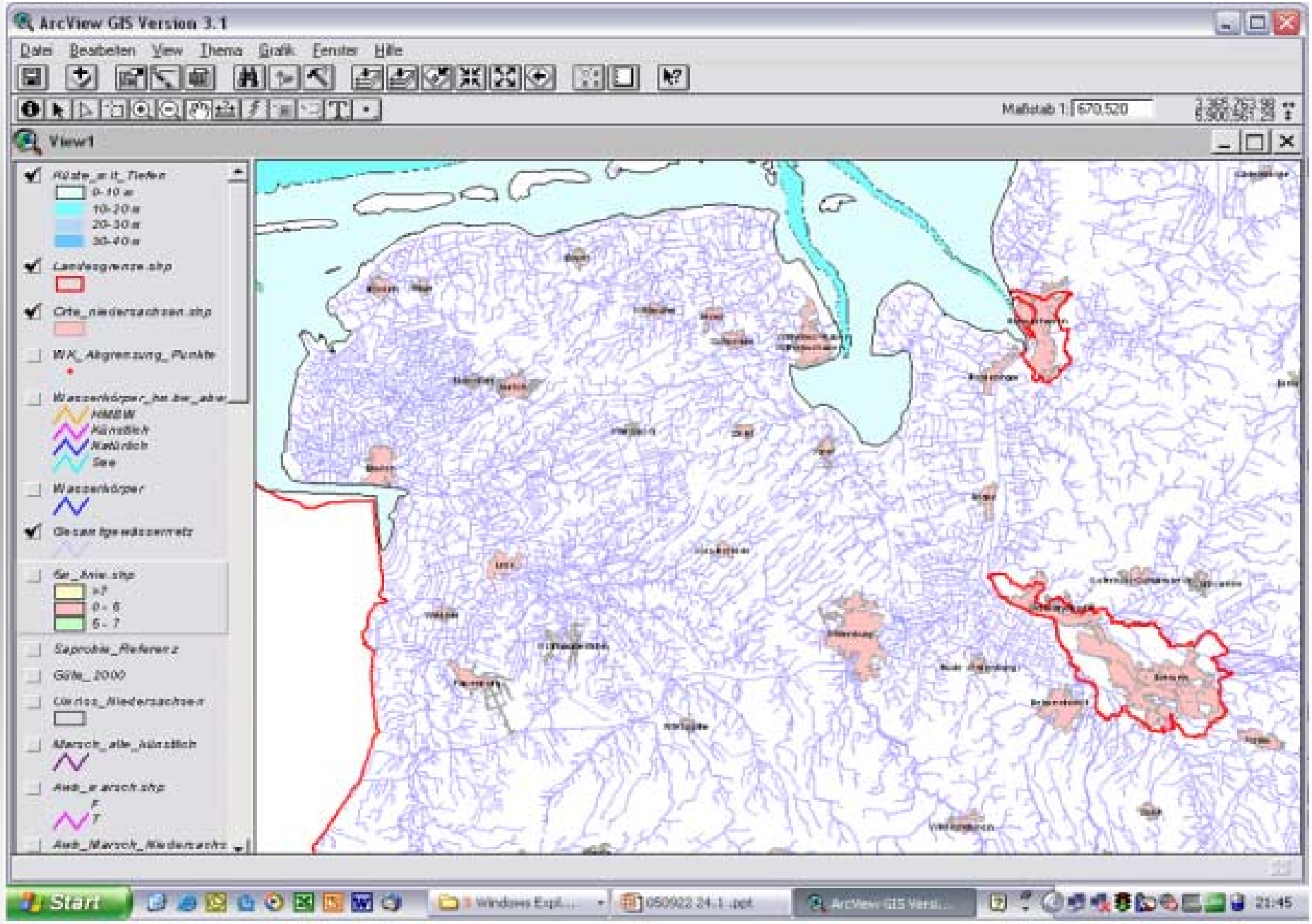
DE	23 %	
BY	55 %	(HH 80 %)
SH	<5 %	

- **of (preliminary) AWB:**

DE	14 %
BB	50 %
BB, BY, HE, MV, NW, RP, TH, SL	<5 %

water landscapes in Germany




ArcView GIS Version 3.1
Datei Bearbeiten View Thema Grafik Fenster Hilfe
Maßstab 1:
View1
Landesgrenze.shp
Orte_niedersachsen.shp
WK_Abgrenzung_Punkte
Wasserkörper
Gesamtgewässernetz
Saprobie_Referenz
Gütle_2000
Marsch_alle_künstlich
Start

ArcView GIS Version 3.1

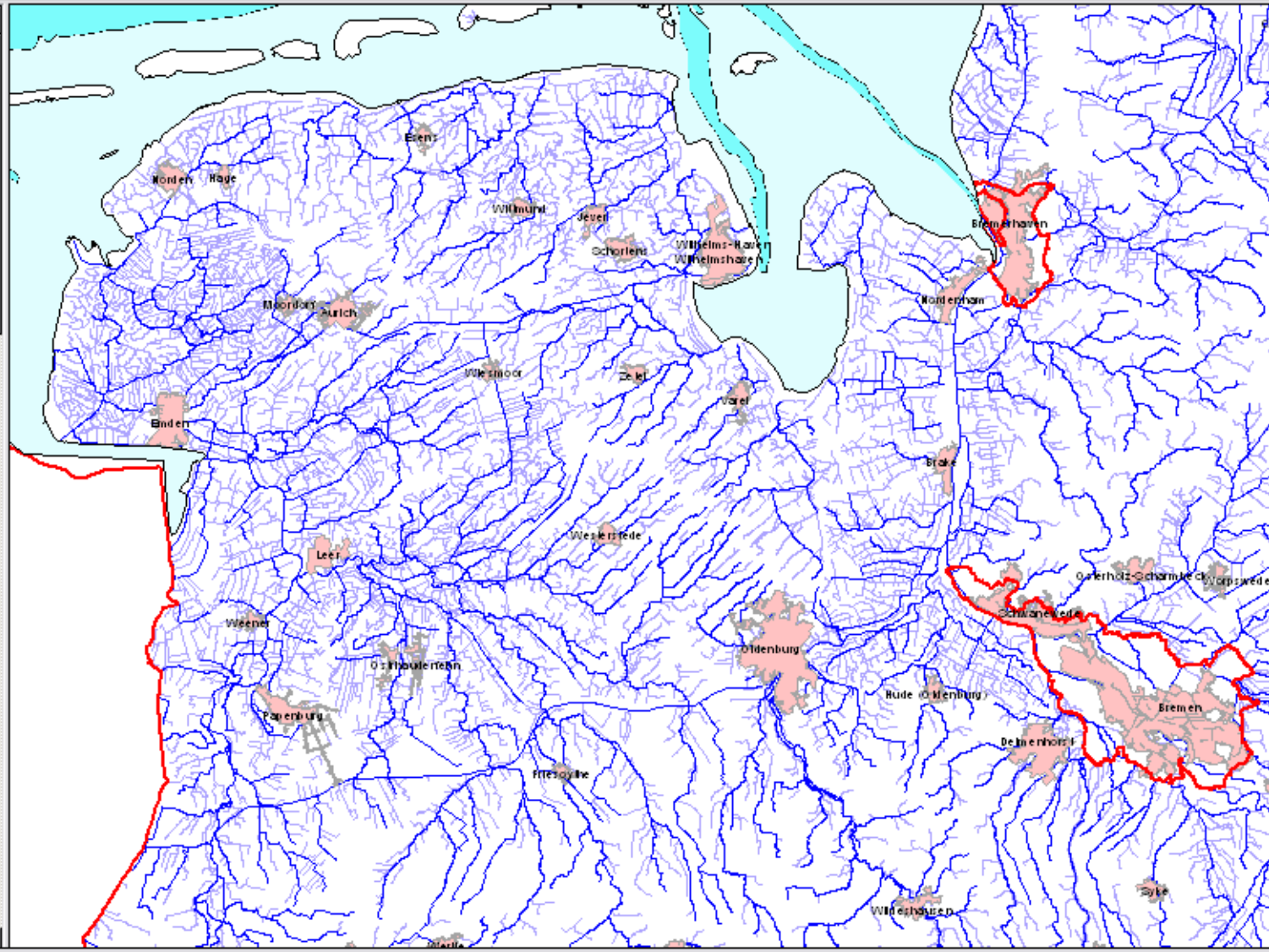
Datei Bearbeiten View Thema Grafik Fenster Hilfe

Maßstab 1: 670,520

3,366,4
5,877,8

View1

- Küste_mit_Tiefen
  - 0-10 m
  - 10-20 m
  - 20-30 m
  - 30-40 m
- Landesgrenze.shp
- Orte_niedersachsen.shp
- WK_Abgrenzung_Punkte
- Wasserkörper_hm bw_abw
  - HMBW
  - Künstlich
  - Natürlich
  - See
- Wasserkörper
- Gesamtgewässernetz
- 5m_linie.shp
  - >7
  - 0 - 5
  - 5 - 7
- Saprobie_Referenz
- Güte_2000
- Umriss_Niedersachsen
- Marsch_alle_künstlich
- Awb_marsch.shp
  - F
  - T
- Awb_Marsch_Niedersachs



Start

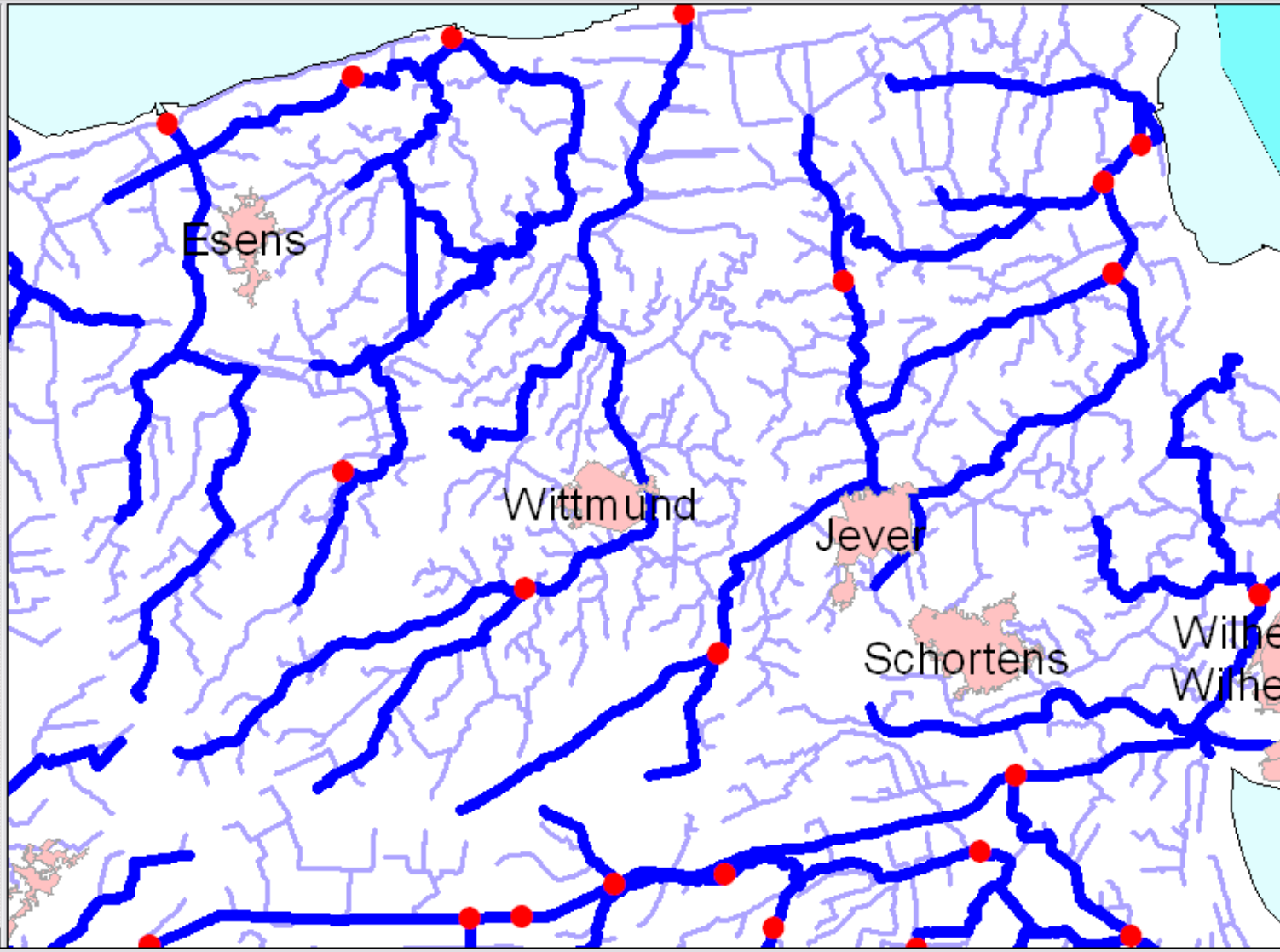
ArcView GIS Version 3.1

Datei Bearbeiten View Thema Grafik Fenster Hilfe

Maßstab 1: 183,907

View1

- Küste_mit_Tiefen
  - 0-10 m
  - 10-20 m
  - 20-30 m
  - 30-40 m
- Landesgrenze.shp
- Orte_niedersachsen.shp
- WK_Abgrenzung_Punkte
- Wasserkörper_hmbw_abw
  - HMBW
  - Künstlich
  - Natürlich
  - See
- Wasserkörper
- Gesamtgewässernetz
- 5m_linie.shp
  - >7
  - 0 - 5
  - 5 - 7
- Saprobie_Referenz
- Güte_2000
- Umriss_Niedersachsen
- Marsch_alle_künstlich
- Awb_marsch.shp
  - F
  - T
- Awb_Marsch_Niedersachs



Ursprung: (3,401,955.42, 5,925,221.14) m Ausdehnung: (38,320.34, 28,562.85) m Fläche: 1,094,538,008.24 m²

Start | Windows Explorer | 050922 24.1 .ppt | ArcView GIS Version 3.1

ArcView GIS Version 3.1

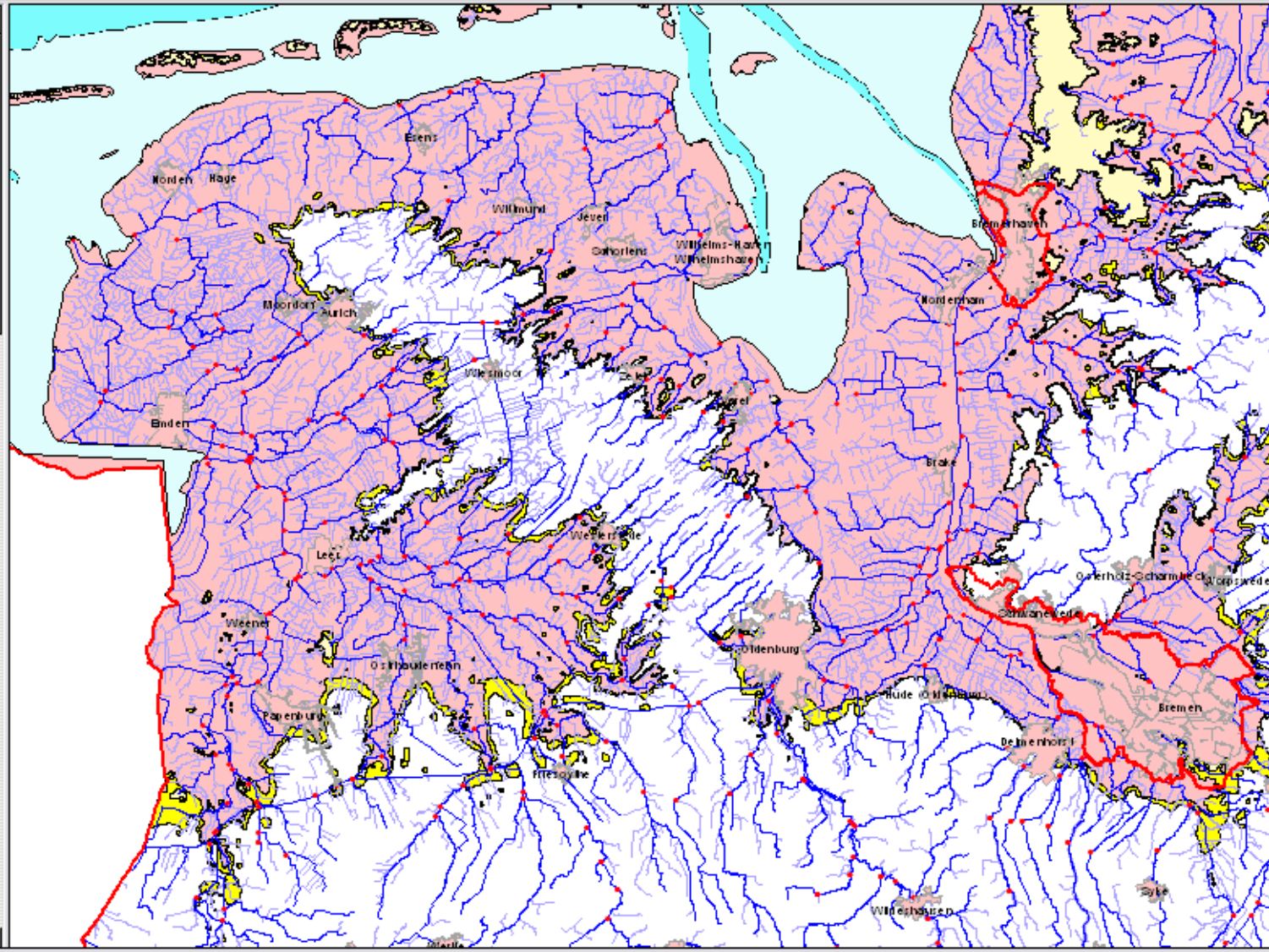
Datei Bearbeiten View Thema Grafik Fenster Hilfe

Maßstab 1: 670,520

3,365,0
5,958,5

View1

- Küste_mit_Tiefen
  - 0-10 m
  - 10-20 m
  - 20-30 m
  - 30-40 m
- Landesgrenze.shp
- Orte_niedersachsen.shp
- WK_Abgrenzung_Punkte
- Wasserkörper_hmbw_abw
  - HMBW
  - Künstlich
  - Natürlich
  - See
- Wasserkörper
- Gesamtgewässernetz
- 5m_linie.shp
  - >7
  - 0 - 5
  - 5 - 7
- Saprobie_Referenz
- Güte_2000
- Umriss_Niedersachsen
- Marsch_alle_künstlich
- Awb_marsch.shp
  - F
  - T
- Awb_Marsch_Niedersachs



ArcView GIS Version 3.1

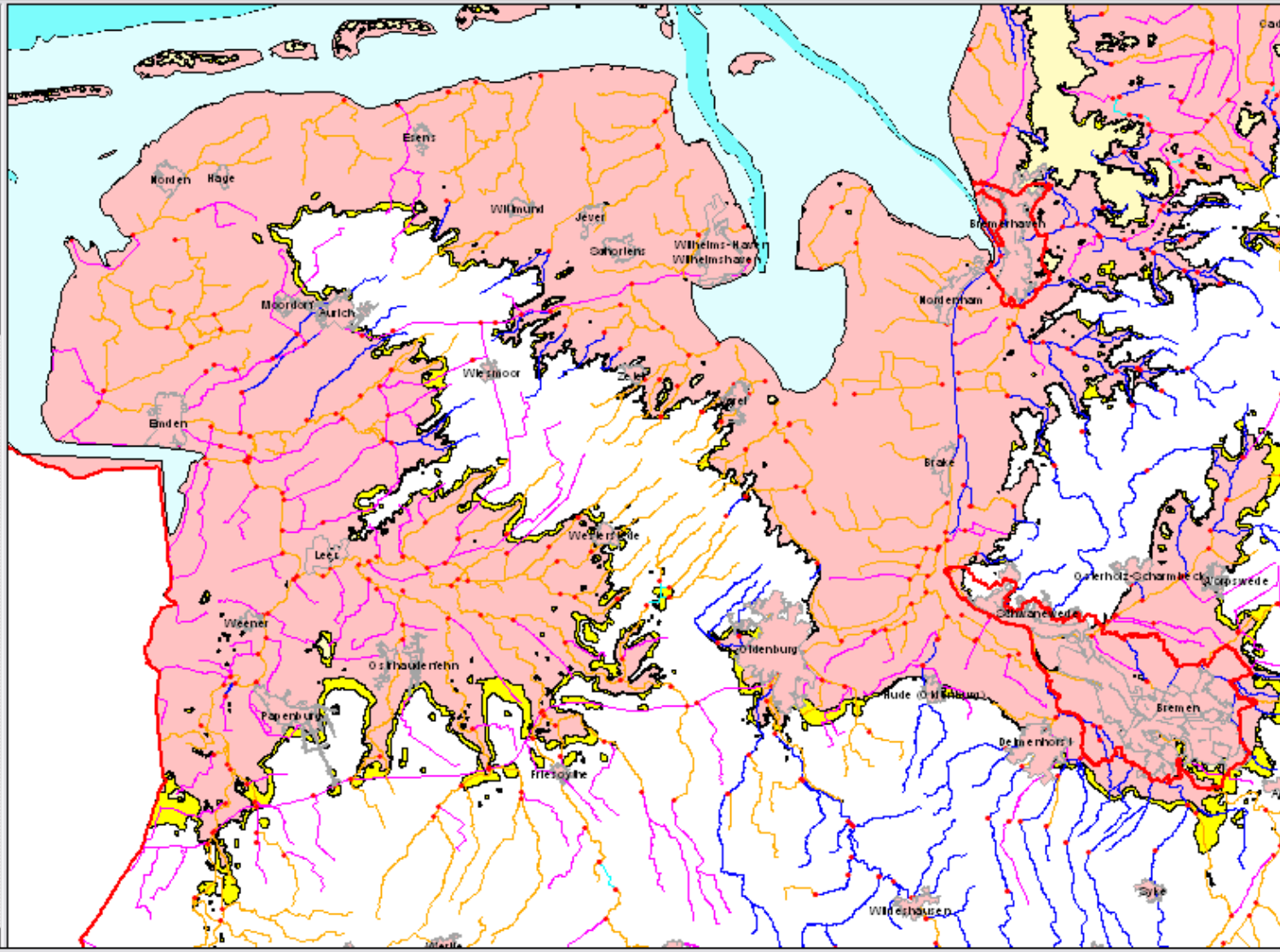
Datei Bearbeiten View Thema Grafik Fenster Hilfe

Maßstab 1: 670,520

3,370,908
5,864,547

View1

- Küste_mit_Tiefen
  - 0-10 m
  - 10-20 m
  - 20-30 m
  - 30-40 m
- Landesgrenze.shp
- Orte_niedersachsen.shp
- WK_Abgrenzung_Punkte
- Wasserkörper_hmbw_abw
  - HMBW
  - Künstlich
  - Natürlich
  - See
- Wasserkörper
- Gesamtgewässernetz
- 5m_linie.shp
  - >7
  - 0 - 5
  - 5 - 7
- Saprobie_Referenz
- Güte_2000
- Umriss_Niedersachsen
- Marsch_alle_künstlich
- Awb_marsch.shp
  - F
  - T
- Awb_Marsch_Niedersachs



Start | Windows Explorer | 050922 24.1 .ppt | ArcView GIS Version 3.1

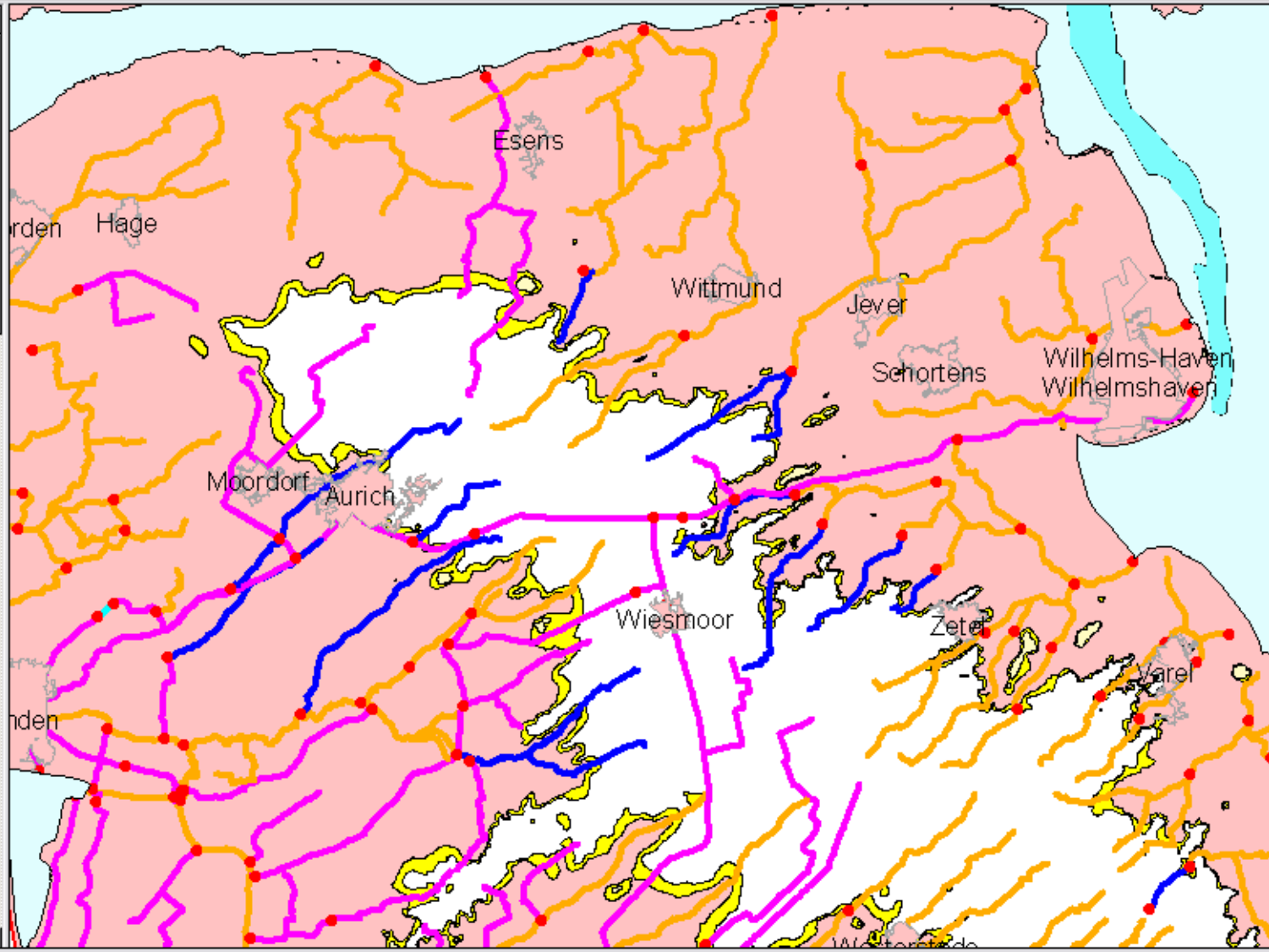
ArcView GIS Version 3.1

Datei Bearbeiten View Thema Grafik Fenster Hilfe

Maßstab 1: 331,262

View1

- Küste_mit_Tiefen
  - 0-10 m
  - 10-20 m
  - 20-30 m
  - 30-40 m
- Landesgrenze.shp
- Orte_niedersachsen.shp
- WK_Abgrenzung_Punkte
- Wasserkörper_hmbw_abw
  - HMBW
  - Künstlich
  - Natürlich
  - See
- Wasserkörper
- Gesamtgewässernetz
- 5m_linie.shp
  - >7
  - 0 - 5
  - 5 - 7
- Saprobie_Referenz
- Güte_2000
- Umriss_Niedersachsen
- Marsch_alle_künstlich
- Awb_marsch.shp
  - F
  - T
- Awb_Marsch_Niedersachs



Ursprung: (3,390,246.42, 5,902,690.20) m Ausdehnung: (51,980.83, 51,448.61) m Fläche: 2,674,341,343.46 m²

ArcView GIS Version 3.1

Datei Bearbeiten View Thema Grafik Fenster Hilfe

Maßstab 1: 328,335

3,401,874.15
5,941,498.26

View1

Landesgrenze.shp

Orte_niedersachsen.shp

WK_Abgrenzung_Punkte

Güte_2000
- I
- I-II
- II
- II-III
- III
- III-IV
- IV

Wasserkörper_hm bw_abw
- HMBW
- Künstlich
- Natürlich
- See

Wasserkörper

Gesamtgewässernetz

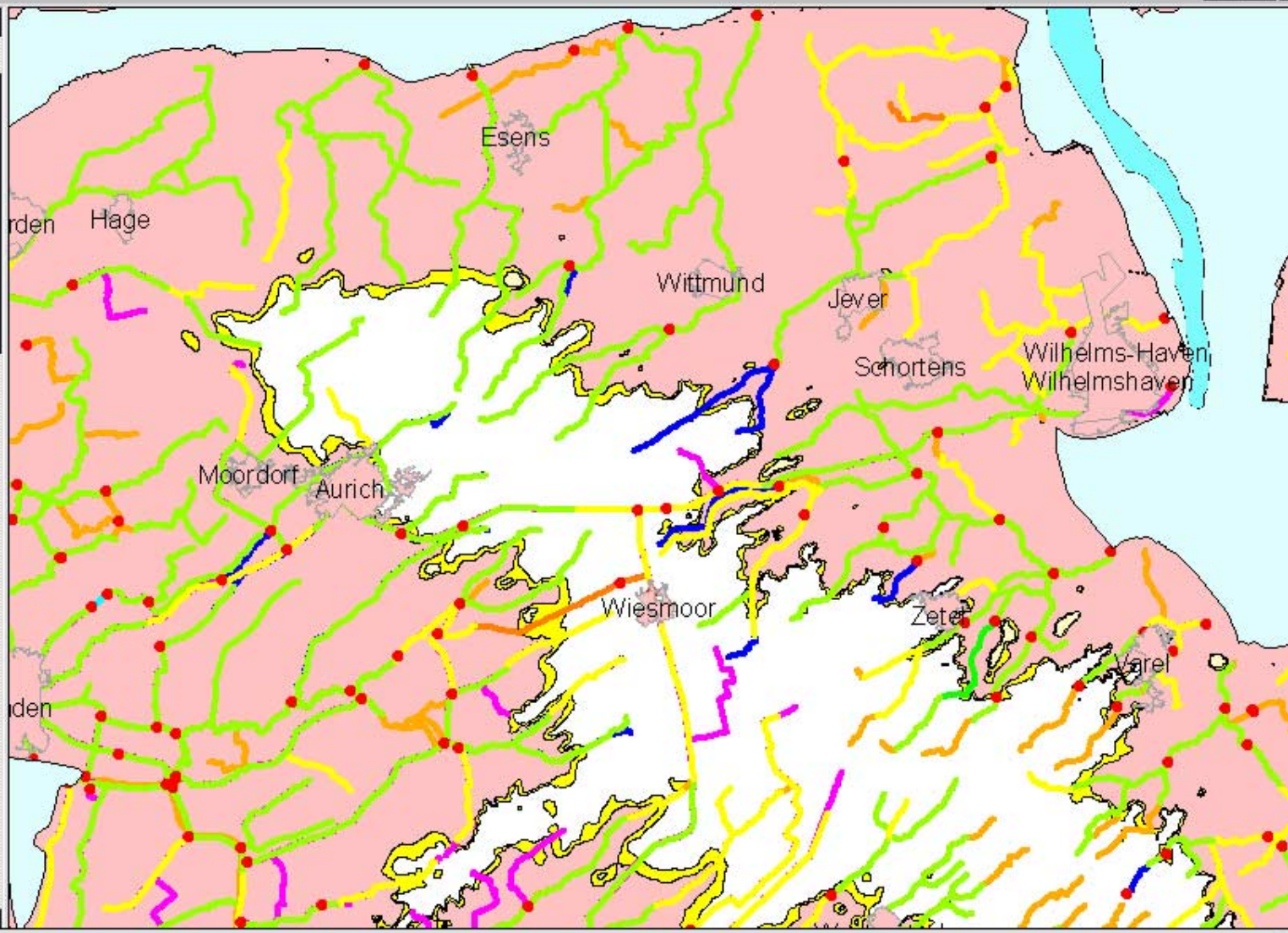
5m_linie.shp
- >7
- 0 - 5
- 5 - 7

Umriss_Niedersachsen

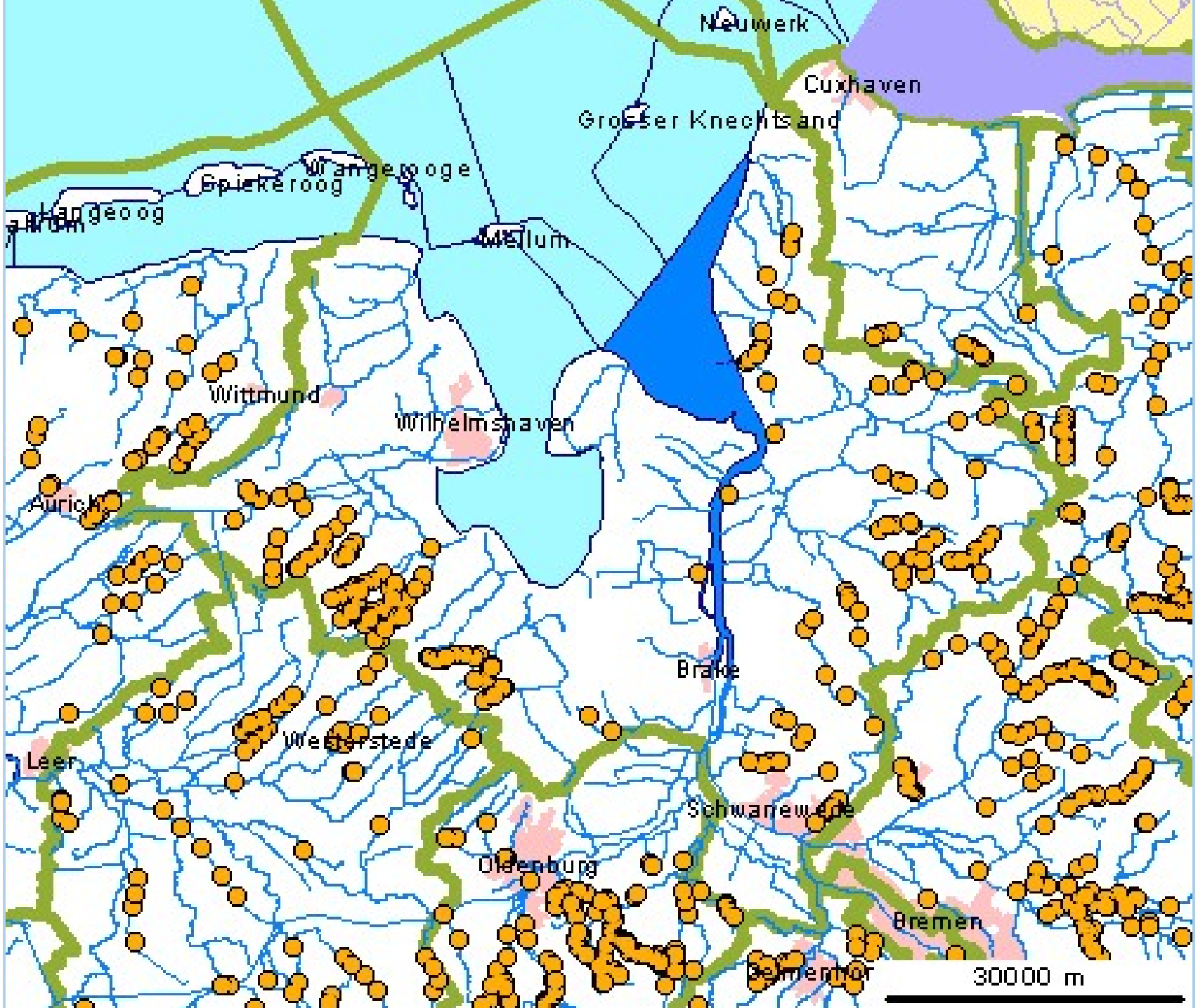
Marsch_alle_künstlich

Awb_marsch.shp
- F
- T

Awb_Marsch_Niedersachs
- Künstlich



Start | Start Apache | 2 Windo... | ArcView GI... | Microsoft P... | 14:3


Neuwerk
Cuxhaven
Großer Knechtsand
Wangerooge
Spiekeroog
Langeoog
Wittmund
Wilhelmshaven
Brake
Leer
Westerstede
Schwanewede
Oldenburg
Bremen
30000 m

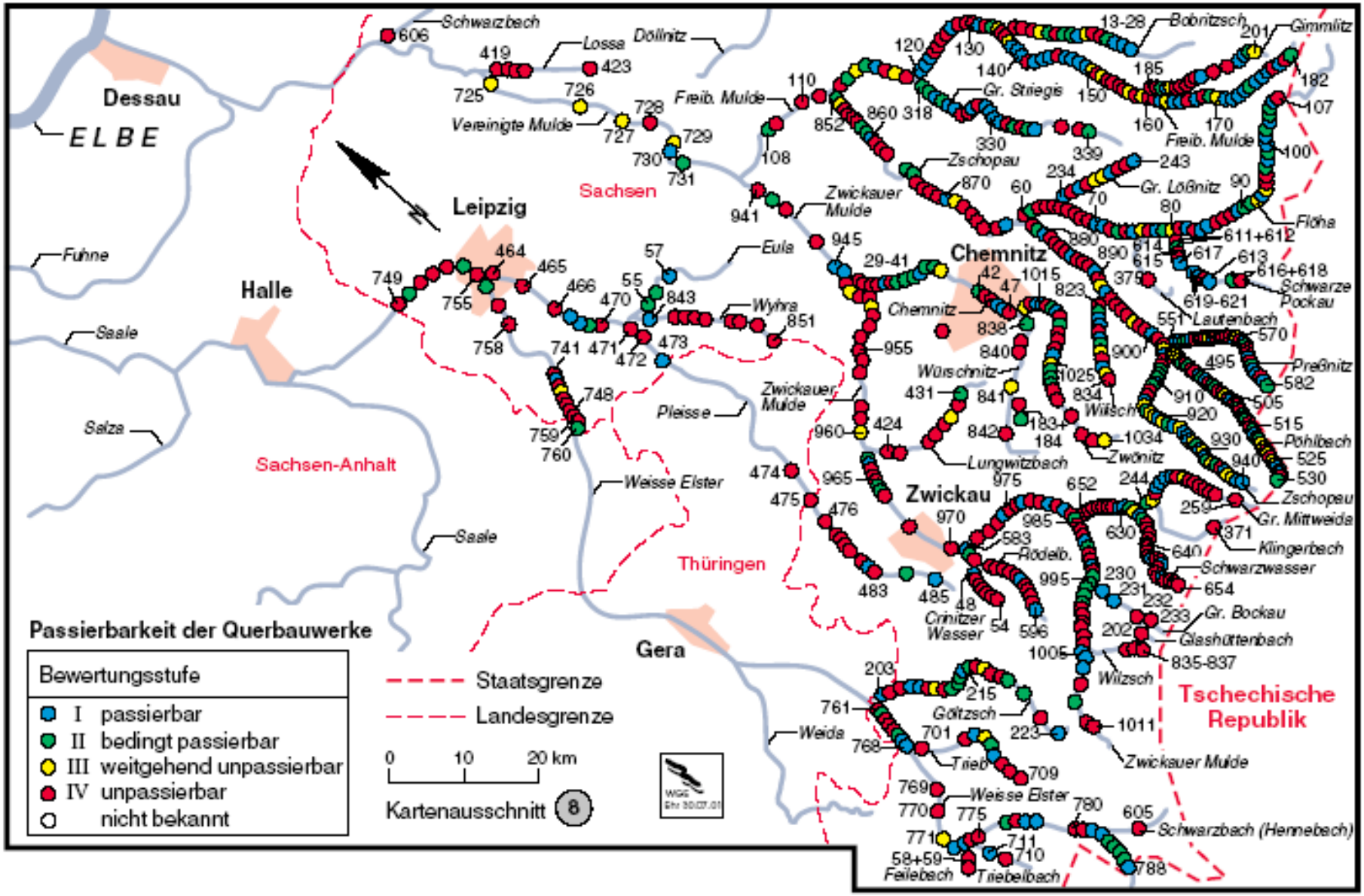


Abb. 22 Passierbarkeit der Querbauwerke in Fließgewässern 1. Ordnung - Sachsen - Teil 2

Assassement of hydromorphological pressures and impacts in Germany

JÖRG JANNING, Environment Ministry Lower-Saxony; LAWA

EU WFD CIS workshop on WFD and Hydromorphology

17-19 October 2005-10-16

Prague

1. Establishing significant anthropogenic pressures

The Member States must compile and archive data on the type and magnitude of significant anthropogenic pressures. In particular, attention should be given to pressures from point and diffuse sources, water abstraction, flow regulation, hydromorphological alterations and land use. The aim is to arrive at an assessment of whether these pressures pose a threat to the good status of bodies of surface water and warrant the implementation of operational monitoring.

Along with the delineation of HMWB, flow regulation and hydromorphological alteration for discrete water bodies as well as land use in survey areas have to be taken into consideration.

Extensive data on flow regulation and hydromophological pressures are available in Germany as well as data on land use, providing a basis for a sound risk assessment. For such water bodies / survey areas the pressures are collated as a basis for determining their significance in failing to achieve the objectives. As a rule, this assessment is made locally. An attempt to derive universal rules here is of little use because the most varied sets of relationships have to be considered.

The announcement and designation of significant pressures is the starting point for public discussion, in particular, and for an initial estimate of the measures that may be needed.

The general approach to determining the anthropogenic pressures significant to risk assessment can be summarised in three steps (cf. the schematic chart below):

Groups of pressures	Pressure factors (examples)	Assessment components Risk assessment
Point sources	• Local community > 2000 inhabitants • Industrial direct discharger (EPER, pollutants) • Food processing plants > 4,000 inhabitants • Combined sewer input from hardstanding	**Fish, benthos, ...** biological quality components
Diffuse sources	• for N: taken from data on groundwater pressures • for P from erosion data • [Arable land > 40%, root crops >20%, special culture > 5%, • Urban areas > 15%, • Animal stock>=1,5 GVE/ha] • Contaminated sites with proven impact	**Substance lists eco, chem ...** substance quality components
Water abstraction	• Element with abstractions > 1/3 MNQ Abstractions without minimum water regulation	**Migration obstacles** biocenotic assessment
Flow regulation	• Obstructing installations 6 and 7 • Backwaters 7 • Non-continuity drops and backwaters	**Water quality** saprobial, trophic assessment components
Morphological modifications	• Water body structure class > 5 (river bed) • Obstructing installations 6 and 7, if continuity impaired	**Water body structure** morphological, structural assessment components
Other anthropogical impacts	• Heat discharges>10 MW • Salt intruder > 1 kg/s	
Land use structures	• Urban areas • Industrial areas • Agricultural areas • Fishery areas • Forests	**Other/chem.-phys. data** Other findings on impairment of water biology from ongoing environmental monitoring

Using existing data

Data on flow regulation measures are collected for the water registers and the systematic river morphology mapping procedures.

Data on morphological modifications are collected through the systematic river morphology mapping.

In addition, there may be other anthropogenic impacts that can be determined and evaluated using local knowledge on site.

Land use structures can be seen from the CORINE Landcover layers and ATKIS data, and fishery use from, from example, the figures on the implementation of the Directive on fresh water fish and shellfish waters.

Collation of data on signification pressures

From this data pool, data are to be extracted on those factors that might have a significant impact on the biological and chemical status. In addition land use implications have to be determined as irreversible because achieving good ecological status would have significant adverse effects on sustainable land use i.e. human development activities.

These data are collated for hydrological areas (sub-basin areas, sub-basin survey areas).

Estimation and identification of significant anthropogenic pressure due to water flow regulation, including water transfer and diversion, on overall flow characteristics and water balances

An estimation and identification of the impact of significant water flow regulation, including water transfer and diversion, on overall flow characteristics and water balances have to be provided.

The engineering structures and measures designed to achieve flow regulation will include above all dams, flood retention basins, obstructing features (weirs, river-bed constructions) and river hydropower stations. Water transfers and water diversions can occur between different sub-basin areas or as a transfer of water between rivers and navigation canals.

A key criterion for estimating the impact of morphological modifications on the ecological condition of a water body is continuity enjoyed by aquatic biological communities. It is therefore important to identify any artificial obstructing features causing high drops and smooth slides and to assess their effect on the continuity of aquatic fauna (upstream and downstream movement).

The pressures on surface water bodies mainly caused by flow regulation measures must be designated in accordance with the aforementioned criteria taken from the systematic river morphology mapping data.

Establishing significant anthropogenic pressures from morphological alterations to bodies of surface water:

Morphological alterations affect the channel patterns, width and depth variations, flow velocities and substrate conditions as well as the structure and conditions of riparian zones.

Data on the morphological modification are collected via the systematic river morphology mapping exercise.

Evaluation of land use patterns, including identification of the largest urban, industrial and agricultural areas, and also, where relevant, of fishery areas and woodlands:

The evaluation of land use provides a rough guide to the environmentally relevant activities (driving forces) of the river basin. Assuming the land use is irreversible, it becomes an aspect of high importance in determining the feasibility of measures.

2. Results on assessing the impacts of pressures, defining water bodies at risk of failing to meet objectives and areas with irreversible land use (i.e. groups of water bodies with unique type of pressures).

An assessment is to be made of how the pressures affect surface water bodies and estimate the likelihood that these pressures will cause waters to fail to meet the required good status.

The risk assessment must include an evaluation of the sensitivity of surface water bodies to the anthropogenic influences already identified. This risk assessment entails:

- data on discharges and quality must be collated to describe the existing situation;
- data evaluated integrally (interrelating all the components) and aggregated at the level of a water body or, where appropriate, a larger unit (spatially);
- morphological structure data, usually including data on the biological continuity.

Inasmuch as anthropogenic activities can heavily, in some cases irreversibly modify water body morphology, the Water Framework Directive defines dedicated objectives for such “heavily modified water bodies”.

The designation “heavily modified” will be provisional until the end of 2004, since a definitive designation cannot be adopted until a comprehensive economic analysis is carried out and until a determination is made as to whether the beneficial objectives can be obtained by other means. The definitive designations are to be decided upon by 2009.

Provisional identification entails determining whether the various water bodies are likely to achieve good ecological status.

In Germany, the results of mapping ecomorphogical data and data regarding current uses of water bodies formed the basis for provisional “identification of heavily modified water bodies”. The criteria for this assessment were not uniformly interpreted in every case, however.

> For example, some German states provisionally classified only shipping lanes and dams as heavily modified waterbodies, while Lower Saxony and Mecklenburg-West Pomerania also placed in this category water bodies that play a key role in farmland whose morphology has been permanently and significantly altered to facilitate water abstraction. The state of Bavaria provisionally designated the section of the Danube between Straubing and Vilshofen as a heavily modified water body. This stretch of river is the final freely flowing section of the navigable Danube in Germany. In contrast, the freely flowing stretch of the Elbe between the Czech border and the Geesthacht weir near Hamburg was identified as a natural river. Mecklenburg-West Pomerania combined “artificial water bodies” and “water bodies provisionally identified as heavily modified” into a single category, while Bavaria added a category, “Potentially classifiable as heavily modified”, which is combined with the “provisionally identified as heavily modified” category. Moreover, already during the initial phase of the characterization process several German states assessed the hydromorphological changes in water bodies not on the basis of good ecological status but rather on the basis of good ecological potential, which has less stringent requirements.

Approximately 2,250 water bodies (23%) in Germany have been provisionally identified as “heavily modified” and 1,400 (14%) have been identified as “artificial”. The assessment results for the various German states and Germany’s river basin districts are shown in Figures 13 and 14 [1] respectively.

Water flow regulation is realized in Germany for purposes of flood protection, hydropower, commercial shipping and land reclamation, among other applications. Transverse structures that have used for flow regulation are deemed to exert considerable environmental pressure when they have more than 30 cm water level

[1] Summary of River Basis District Analysis 2004 in Germany
Published by: Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)
Public Relations Division – 11055 Berlin
E-mail: service@bmu.bund.de; Internet: www.bmu.de
Editing: Sandra Richter (Universität Kassel); Volker Mohaupt (UBA)

differences and thus impede the upstream migration of myriad fish species and other aquatic organisms.

In short, virtually all of Germany's catchment areas are studded with dams, weirs and the like, despite the various natural and use oriented features that dot the same landscape. Thus, migration barriers and altered ecomorphology constitute a significant risk factor for the ecological status of Germany's water resources.

The morphology of Germany's water bodies is in many cases the product of extensive socioeconomic use. For example, rivers are truncated, riverbanks are built up, dams are constructed, water is diverted into canals, and dikes are built for purposes of flood protection. Larger rivers are used by commercial vessels and power generation, weir sand locks are built, and floodplains are for the most part segmented by dikes. Structures are also built on most smaller rivers and streams for power generation, flood protection and agricultural purposes. The results of the morphological investigations that have been conducted reflect these conditions. LAWA has elaborated a classification system that allows for the assessment of waterbody morphology. Of 33,000 km of watercourses assessed, only 20% are in a nearly natural state (ecomorphological classes 1, 2 and 3), while 33% are in a strongly or completely changed state (ecomorphological classes 6 and 7). The morphology of waterbodies in urban and intensively cultivated areas has been most drastically changed. For example in the state of Bremen, only one water body was identified as "moderately changed", while over 60% of the state's water bodies were designated as "strongly or completely changed". This same pattern is repeated elsewhere in Germany, and the hydromorphology of virtually all of the country's river basin districts have been altered by anthropogenic activity along broad stretches of watercourse.