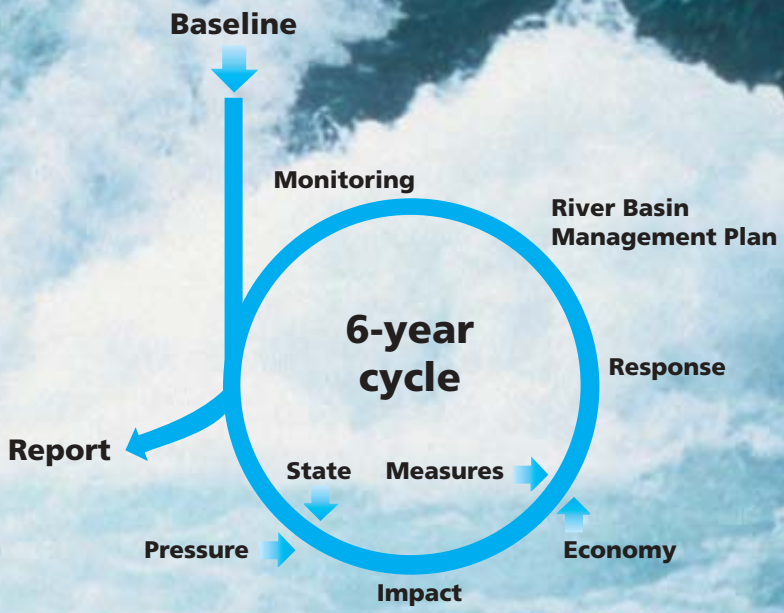
The EU Water Framework Directive

Smart solutions for water management



DHI
WATER & ENVIRONMENT

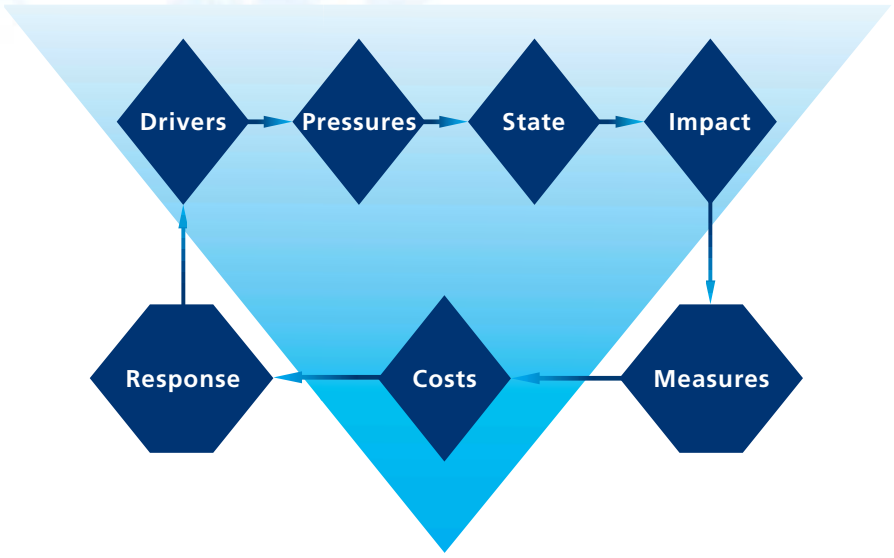
The Water Framework Directive

– A new challenge in EU water policy

The EU Water Framework Directive (WFD) is a milestone in the history of water policies in Europe. The Directive establishes a common framework for sustainable and integrated management of all waters. It covers groundwater, inland surface waters, transitional waters and coastal waters and demands that all impact factors as well as economic implications are taken into account.

The ultimate objective of the Directive is to achieve good status of all water bodies in the EU member states and associated states by 2015. The cornerstone of WFD is the demand for integration. Though integrated water management has been the end goal for a long time, there is now a legislative encouragement to implement this concept fully within a short time frame.

DHI has long experience in the implementation of water management plans. The keywords are integration, cost-effectiveness and state-of-the-art technologies. This brochure presents our major approaches and methodologies. More information is available on www.dhi.dk.

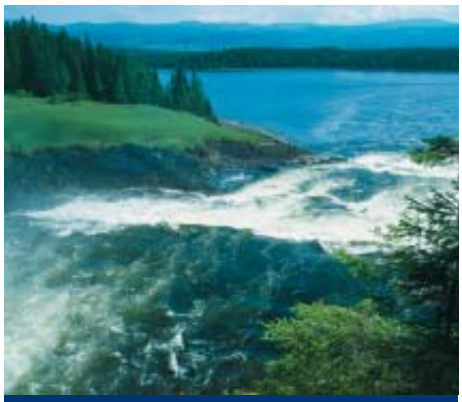


Integrated water management is a key requisite for the implementation of the Water Framework Directive (WFD). This implies a tight connection between technical water body analyses (upper panel in figure) and analyses of instruments leading to decision making (lower panel).
In WFD the Drivers-Pressures-State-Impact-Response (DPSIR) scheme is the core assessment chain. Assessment of the pressure-state-impact interaction and the relation to the economic consequences can be facilitated using GIS and mathematical modelling tools in combination with expert knowledge.

Key challenges

- A cohesive water legislation
- Solid environmental objectives
- Integration of water uses, function and values
- Integration of ecological state, drivers, measures and economy
- To obtain good ecological status in the most cost-effective way
- Transparent decision making
- Interaction between water use sectors
- Interaction between politicians, authorities, private sectors and civil society

Key WFD deliverables	Deadline no later than	Key DHI competences
YEAR 16-27		
Special action plans for water bodies not in compliance with the Directive.		Pollution source identification, monitoring, detailed modelling, cleaner technology, non-emission scenarios, groundwater and surface water management.
YEAR 15		
Programmes of measures reviewed and updated with subsequent reviews every six years. River Basin Management Plans follow the same procedure. Good groundwater status achieved. Good surface water status achieved. Compliance with any standards and objectives.	**December 2015**	Professional integration of monitoring and modelling to support and improve cost-effective restoration of natural resources and maintenance of economic growth. Tools for environmental impact assessment and decision support.
YEAR 13		
Review of baseline analyses with subsequent updates every six years.	**December 2013**	In-depth analyses of eutrophication, priority substances, physical alteration, flood and drought problems.
YEAR 12		
Programmes of measures into force. Combined approach for point and diffuse sources ensured. Interim progress report on implementation of measures with subsequent updates every six years.	**December 2012**	Assessment of point and diffuse sources and establishment of limits and standards, catchment modelling, land use characterisation, cleaner technologies, wastewater treatment.
YEAR 10		
In absence of agreement at community level, member states should establish environmental quality standards and control programmes for priority substances for all surface waters.	**December 2010**	Identification of pollution sources, cleaner technologies, risk assessment of chemical substances, fate and exposure modelling, water quality standards, ecotoxicological tests.
YEAR 9		
Programmes of measures established. River Basin Management Plans published.	**December 2009**	Cost-effective measure programmes, water basin modelling, drivers-pressures-impact analyses.
YEAR 8		
Draft River Basin Management Plan published (summarising baseline, monitoring, economy measures, etc).	**December 2008**	Establishment of management plan, public participation, stakeholder involvement.
YEAR 7		
Interim overview of significant water management issues published.	**December 2007**	Integrated cross-sector and interdiscipline assessments and identification of key water issues. Integrated water resources management .
YEAR 6		
Monitoring programmes operational. Time table and work programme to be published, including consultation measures.	**December 2006**	Cost-effective tailor-made monitoring programmes, modern techniques, modelling, databases, information systems.
YEAR 4		
Baseline analyses (characterising water bodies, review of human impact, economic analyses of water use).	**December 2004**	Environmental analyses of water bodies, pressures and impact assessments, presentation in GIS, simple economic analyses.
YEAR 3		
Implementation in the national legislation, establishment of water districts, appointment of water district authorities.	**December 2003**	Implementation of sustainable water policies, institutional strengthening, capacity building.



Elements of the Water Framework Directive

Holistic thinking

The WFD requires holistic thinking and approaches to water resources management and represents the Integrated Water Resources Management (IWRM) approach of Europe. It calls for integration and interaction between water use sectors (agriculture, water supply and sanitation, industry, energy, recreation, etc) and between stakeholders (government, private sector, civil society). Implementation of WFD is possible only when technology and society interface. It requires compromises be reached in dialogue between informed stakeholders. Such dialogue obviously calls for decision support tools, including what-if and scenario analysis tools, which in understandable terms relate actions to consequences in a river basin.

Classification of water bodies
All water bodies must be characterised and assigned a number of classification criteria. The human impact on the environment have to be explained. This implies overview and, at the same time, highlighting of specific interests and problems. The task must be completed at the end of 2004, and the classification will guide the future work.

Integrated surface water and groundwater
Groundwater and surface water interact in several ways. Solute transport from the surface is enhanced in wet areas, drain water is generated from the top of the groundwater, and wetlands and riparian zones are strongly influenced by the groundwater dynamics. Models that integrate surface water and groundwater are necessary for a proper analysis of such issues.

Monitoring
Cost-effective tailor-made monitoring programmes integrating modern techniques from data acquisition to assessment shall establish a coherent and comprehensive overview of the water status. Ecological and chemical status as well as environmental flow and groundwater quantity are important factors. The facilitation of the use of monitoring results in decision making is especially crucial.

Public participation
Information systems, which store data and support-transparent decision making and stakeholder engagement, are essential for the implementation of the Directive. Measure programmes, management plans, etc must be exposed to public and stakeholder discussions. Modern web technology is an important aid in this process.

Good ecological status
The core objective of the Directive is to obtain good status of groundwater and surface waters. The status is compared to the reference condition, which is best determined using a combination of modelling, analysis of historical data and expert judgement. Good indicators of status are robust and describe essential characteristics of the ecosystems. Empirical and dynamic modelling are useful tools for the identification of operationel indicators.

Priority substances
The Commission shall prepare a list of priority (hazardous) substances and proposals for quality standards in surface water, sediments and biota. Proposals for appropriate initiatives must be made with a view to obtain progressive reduction, phasing out or cease of use. Source tracking in sewer systems, risk assessment, fate and exposure modelling, substitution guidance and monitoring are essential in this process.

Pressures and impact analysis
Identification and quantification of impacts of human activity on groundwater and surface water require analysis of monitoring data in relation to variation in climate and other external factors. Mass balance and dynamic modelling are strong tools for such evaluations. Risk of failure of meeting defined environmental objectives is to be identified. Moreover, the analysis will form the basis for the calculation of costs related to obtaining the goals.

Economy
Economic analyses of cost-recovery of water services and cost-effectiveness of measures to achieve the environmental objectives are indispensable in the baseline analyses and for the definition of measure programmes. A close link between environmental and economic analyses is necessary to get the best value for money.

Programme of measures
Plans to achieve the environmental objective must be described. This requires identification and quantification of the effect of possible measures.
For this purpose, powerful modelling tools with GIS interfaces can be utilised to analyse the effect of, for instance, change in land use, water usage and water abstraction, or point and diffuse pollution. Legal, administrative, economic, education and other instruments are also to be included.




Smart solutions for WFD implementation

Addressing complex problems

The Water Framework Directive demands comprehensive knowledge of the many complex interactions between natural processes and human activities - a major challenge with a multitude of facets. DHI offers a suite of tools that integrate and simplify these complexities - tools that help water managers determine the environmental objectives, assess the state, predict impacts and decide upon feasible measures and management plans. The tools ensure transparent decisions.





A stepwise approach

To achieve the optimal environmental solution DHI suggests a stepwise approach. A primary screening will identify the problematic water bodies and the main pressures. Thus, efforts can be concentrated on major concerns. Detailed analyses to identify the most suitable and cost-effective measures so as to ensure a good and high quality of the groundwater and surface water bodies can be made.

Driving Forces

Pressure, State and Impact Assesment

SCREENING

Monitoring and Survey

Integration of modern techniques in monitoring and dissemination of environmental data ensures optimal benefit

Tailor made programmes and EIS database

Catchment

Overview of environmental issues and problem areas saves both time and money

MIKE BASIN

LOAD

Estimation of point and nonpoint load in the catchment area is a prerequisite for the assessment of pressures on groundwater and surface waters

MIKE LOAD

DETAILS

Soil

Assessment of impact of land use and fertilising plans on loss of nutrient and pesticides is an important issue of WFD

DaisyGIS

Groundwater

Analysis of the impact of water and land use on groundwater quantity and quality is crucial for good water management

MIKE SHE

Surface Water

The cornerstone of WFD is the assessment of the ecological state, the objectives and analysis of the impact caused by human activities

MIKE 11 / **MIKE 21** / **MIKE 3** and **ECO Lab**

Response

River Basin Management Plan

Environmental objectives, compliance and risk of noncompliance, cost-effective solutions, programme of measures.

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Tools for WFD

- **MIKE BASIN** - a GIS-based decision support tool for integrated water resources management and planning.
- **MIKE LOAD** - a GIS-based assessment tool to estimate point and nonpoint load in catchments. Provides an overview of the load sources and the magnitude.
- **DaisyGIS** - for modelling nitrate and pesticide leaching from agricultural areas and changes in crop yield under various agricultural management practices.
- **MIKE SHE** - a modelling tool for integration of the entire hydrological cycle. Provides a flexible and robust GIS environment.
- **MIKE 11** - a 1D modelling tool for the optimisation of the management of inland waters. Flow and water quality simulation, impact assessment, flood simulation, discharge evaluation, etc.
- **MIKE 11 Reservoir** - a modelling tool for the optimisation of reservoir management. Water quality simulation, impact assessment etc.
- **MIKE 21** - a 2D modelling tool for the optimisation of management of surface waters. Flow and water quality simulation, impact assessment, flood simulation, discharge evaluation, etc.
- **MIKE 3** - a 3D modelling tool for the optimisation of management of surface waters. Flow and water quality simulation, impact assessment, discharge evaluation, etc.
- **ECO Lab** - a numerical laboratory for all DHI flow models enabling definition of the ecosystem exactly to the degree of complexity required. Provides facilities for ecological classification.
- **EIS database** - an environmental information system providing a database tailored to WFD (incl uncertainties and socio-economic data) and web presentation facilities. Offered in full or as subsystems tailored to the needs of the user.

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