BUDAPEST UNIVERSITY OF TECHNOLOGY AND ECONOMICS

DEPARTMENT OF HYDRAULIC AND WATER RESOURCES ENGINEERING

PROJECT SUMMARY

(6.)

Institutional development of the hydromorphological monitoring of surface waters in Hungary

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Project summary

1. OBJECTIVES

The EU Water Framework Directive imposes the elaboration of river basin management plans that make it essential to evaluate existing conditions, establish target (reference) conditions and, once improving measures have been taken, follow their impact and assess their effectiveness. These activities will be founded on data from the national monitoring network operated by the Water and Environmental Directorates. The goal of this project is to develop the hydromorphological monitoring methodology that will satisfy the needs of the WFD in general, in accordance with the EU directive 2000/60/EC.

The accomplished work covers methodology, execution and management. A special database was established and the corresponding processing software was developed.

More specifically the goals were:

- To provide the institutional background for the survey of water flow and storage hydraulics, connected hydrochemical processes and the hydromorphological characteristics that influence the local ecosystem.
- To establish the data storage and processing framework related to the inventory, analysis and statistical tasks of these activities.
- To prescribe well founded and standardised procedures for data entry and processing. Do pilot surveys based on these instructions, then prepare schedules for future comprehensive surveys.

2. ACTIVITIES

The realisation of the project could be divided into three major stages.

1. The first stage was preparatory: methodological instructions and the quality control system were created.
2. In the second stage the pilot surveys were done and, in parallel, the database and software framework was developed.

3. Finally data was evaluated and made available electronically. To support future activities, the involved staff from the Directorates was trained and a documentation was created.

3. SUMMARY OF RESULTS

The main contributions of the project could be summarised as follows:

- Homogenisation of the morphological monitoring methodology of surface waters.
- A methodology for ADCP measurements and bed material sampling.
- Pilot surveys at 172 representative locations across the whole country.
- A central, quality-assured control system.
- New database and data analysis procedures that comply with the requirements of the EU WFD.
- A task-specific information platform with secure data publication at selectively restricted and full access levels.

4. SURVEYED VARIABLES

Hydromorphological surveys explore the runoff, storage, flow hydraulics, related water quality and ecological processes of stream beds and their environment, covering the whole range from large rivers to small streams, steep torrents to lowland canals. The first pilot survey in this project can be considered expeditionary. Revisiting the same measurement location at regular intervals (e.g. annually) exposes the time evolution of the hydro-morphological and environmental parameters.

Hydrochemical and ecological data are collected by the Inspectorate of Environmental Protection, Nature Conservation and Water integrated with the hydrographic network. This means that only a single water quality measurement is done on most water bodies, whereas some water bodies are not even monitored presently.

Besides these pointwise measurements it is necessary to survey the hydromorphological conditions of a longer, characteristic reach of the investigated streams using a description that combines hydrographic and water quality measurements.

An important guideline was that the prescribed instrumentation should be on hand at all Directorates. In preparation to the methodological development, all Directorates were equipped with an ADCP in a previous national project so that these current profilers can fulfil a key role in the hydromorphological survey of medium to large rivers. Special emphasis is put in the current project on enhancing the utility of these measurements.

For a more comprehensive picture of the hydromorphological conditions, those biological and chemical variables are measured at the time of the survey that are expected to have a considerable impact on the ecological state of surface waters or are indicative of such variables. For efficiency, rapid in-situ measurements are favoured against those that require

expensive or not widely available apparatus.

The surveyed variables are listed below.

HYDROMORPHOLOGICAL MEASUREMENTS

- Geodetic survey of the cross section, including the floodplains.
- Discharge and current measurements, using Doppler-based profiler (ADCP) in rivers and using mechanical or electromagnetic current meter in smaller streams. In rivers three types of measurements are performed with the ADCP: transverse profiles; fixed-boat measurements and zigzagged areal survey.
- Measurement of mean longitudinal slope.
- Suspended sediment and bed material sampling, from which weight-percent sediment size distributions are determined in laboratory.
- Measurement of mud thickness.

WATER QUALITY MEASUREMENTS

- General physical and chemical properties (colour, odour, pH, temperature, conductivity).
- Nutrients (ammonia, nitrite, nitrate, orthophosphate ions) and organic constituents (chemical oxygen demand, dissolved oxygen) of the highest concern.

ENVIRONMENTAL SURVEY

- Surrounding topography, bed and floodplain morphology, any human interventions (dredging, vegetation removal, river training works etc.), obvious point sources of pollution in the reach.
- Zonation structure of vegetation, width and land use of the riparian zone, aquatic vegetation, percent vegetation cover over the water surface.
- Detailed map of the reach and its immediate surroundings.
- Photographs.

5. HYDROMORPHOLOGICAL INFORMATION SYSTEM

All monitored data are hosted by the new, purpose-oriented information system that consists of a database, a data entry and data analysis software running in an access-restricted intranet. The database is connected closely with the national OTAR system that manages the hydrographic network structure, taking part of its input from that system. All sampled data are georeferenced in the common EOV coordinate system.

The built-in functions offer a rapid visualisation of the data by plotting ADCP velocity transects, sediment grain size distributions or schematic plan views of the site. Furthermore statistical tools are offered in the information system to analyse correlations between numerical variables measured at various locations within the same short reach. These features help browsing the data series and eliminating erroneous values.

The methodology develops ADCP measurement analysis in several ways. These modern current profilers provide high-resolution data from which valuable information can be derived on fluvial hydromorphologic and mixing conditions, all playing an important role in ecology. The fixed and moving ADCP data is used to determine the spatial distribution of bed shear velocity, bed shear stress and roughness height. Logarithmic profiles are fitted to integral-averaged measured velocities to obtain these parameters. Furthermore the profiles are also used to estimate the turbulent dispersion coefficient, which is an important parameter to predict the fate of various substances in the river, influencing both water quality and ecology. Finally, a characterization of habitat conditions is introduced using the mesohabitat evaluation model based on depth-averaged flow velocity, flow depth and bed shear stress. These methods are illustrated in the final documentation using representative pilot measurement locations on large to medium-size rivers: Danube, Tisza and Dráva.

Certainly, the mission was not to implement all possible visualisation and data analysis functionality within the information system. Instead, all data can be exported from the database in XML format. As this structured file format is standard, it enables data output towards spreadsheets, scientific software and numerical models.

Finally, a web platform was created in this project to make data accessible to the general public over internet once these data have been checked for quality. Queries are facilitated by showing the available data on the map of the country.

The pilot surveys provided altogether 1 GB of ADCP data and sediment samples from 470 locations.

6. OTHER BENEFITS

The implementation of the proposed hydromorphological monitoring methodology will enable the surveillance of our surface waters and the assessment of improvement measures. As measurements are hosted in an easily accessed database, that not only helps its dissemination to experts and to the public, but it also satisfies the data needs of model studies. In fact, a targeted brief measurement campaign preceding a model investigation, however detailed, provides far less information on the longer-term temporal evolution of the morphology than decades of systematic monitoring. Calibrated models help to explore present conditions and to predict future changes, which is essential to support decision makers. In the absence of comprehensive past measurements, models are also relied on to define reference states through a detailed reconstruction of the relevant hydromorphological variables.