



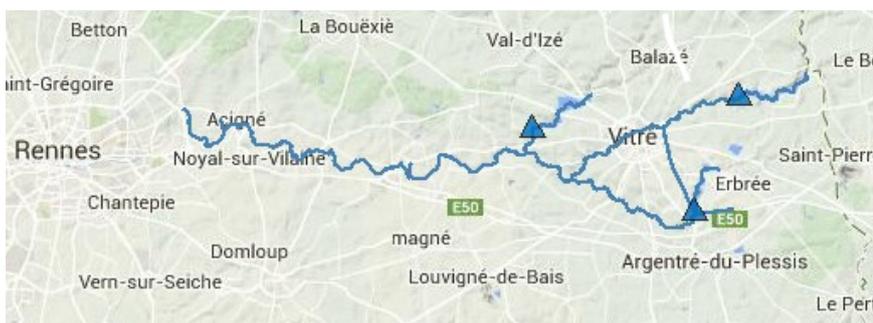
## MANAGING THE DAMS OF HAUTE-VILAINE

A real-time decision support and forecasting system for effective management of dams between stakeholders

The three dams built in the Haute-Vilaine region in the 1970s serve two purposes: to protect the area against the flooding of the Vilaine section upstream of the city of Rennes, and to create a drinking water reservoir for the eastern sector of the region. These three dams — the Haute-Vilaine barrage, the Cantache barrage and the Valière barrage — are managed by the Department of Ille-et-Vilaine department and Veolia, and have a total maximum capacity of about 20 million m<sup>3</sup>. Using MIKE OPERATIONS, DHI has developed a decision support system that allows effective daily management between the different stakeholders of these dams.

### LIMITATIONS OF A STATISTICAL MANAGEMENT SYSTEM

The dams in the Haute-Vilaine region balance two conflicting needs: water reserve (drinking water supply and low water levels) and flood-peak attenuation. The conflicting management objectives coincide with a particular period in the hydrological year. During the filling period, it is necessary to maintain a minimum volume of water in the dam for flood control, while at the end of this period, the water level in dams must be kept high to ensure sufficient water supply.



Location of the three dams upstream of Rennes © DHI

Originally, the dams were managed daily in accordance with the planned filling water levels. Rule curves defined the optimum level of water to obtain each day of the year and enabled the infrastructure manager to control the dams. The water levels were calculated using statistical data of historical measurements based on the probabilities that the different objectives would be met. However, this system did not take into account the current and expected rainfall that can contribute to the water levels in the dams on a daily basis.

### CLIENT

Department of Ille-et-Vilaine administrator

### CHALLENGES

- Optimisation of management guidelines for the three dams, taking into account the rainfall forecasting
- Creation of a new system to be used by administrators of department of Ille-et-Vilaine and operator, Veolia

### SOLUTION

Implementation of a real-time decision support system incorporating an integrated water resources management model.

### VALUE

- Real-time forecasting of water inflows into dams
- Optimisation of the management guidelines for the three dams
- Compliance with biological and regulatory laws
- Simulation of water demand and rule curves scenarios

### REGION/COUNTRY

Department of Ille-et-Vilaine, France

### SOFTWARE

- MIKE HYDRO BASIN
- MIKE OPERATIONS

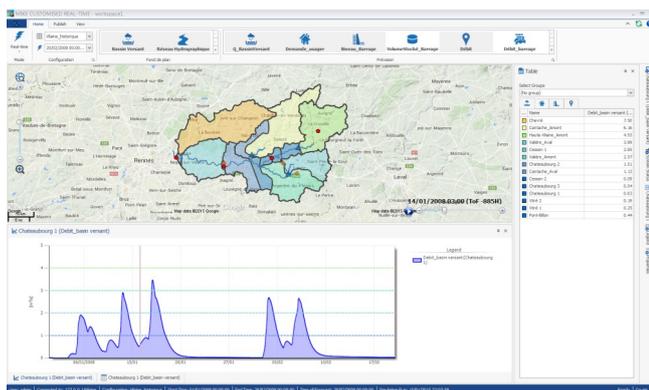
## INTEGRATED MANAGEMENT TO OPTIMISE DAM OPERATIONS

Using our MIKE Powered by DHI's MIKE HYDRO BASIN software while integrating the modelling system of our MIKE OPERATIONS software, we were able to model the dams' system to optimise operations. MIKE HYDRO BASIN is used in the Vilaine river basin up until the upstream of the city of Rennes. It integrates the operations of the three Haute-Vilaine dams (volume, outflow structure, rule curve), drinking water demands and the biological and regulatory laws on river flows. It also includes a hydrological model allowing rainfall-runoff transformation on river basins.

## MODELLING SYSTEM

The real-time forecasting system contains several tools from the MIKE by DHI Powered software suite:

- A hydrological module with NAM, a conceptual rainfall runoff model, for a 860 km<sup>2</sup> surface area
- The MIKE HYDRO BASIN software for integrated resource management
- A data assimilation program unit providing real-time calibration from the data observed on the three dams



Visualisation of hydrological simulation results in MIKE OPERATIONS © DHI

## TESTIMONY



Thanks to the solutions provided by DHI, the department has now an effective decision support tool for the management of its three dams. In special hydrological events, the tools allow us to strengthen our analysis through modelling. We now make faster and more informed decisions for flood management. It has helped us forecast the volume available in the dams before the arrival of a precipitation event and anticipates possible overflows downstream of the dams. With this, we can quickly and easily simulate different rain scenarios including different spatial and temporal distributions for each of the dams and then compare the results. This tool is useful and is efficient in taking into account all our management constraints.

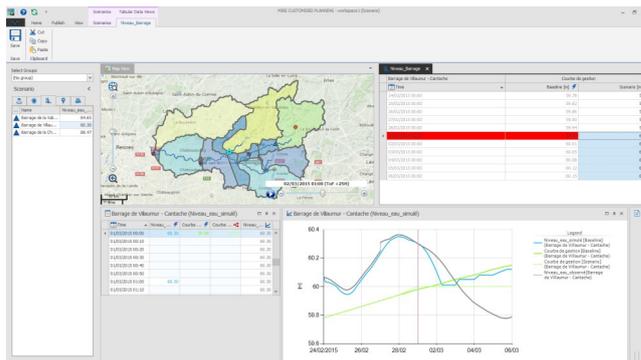
Régis Bouvier —Management of Haute-Vilaine dams—Department of Ille-et-Vilaine

Contact: [france@dhigroup.com](mailto:france@dhigroup.com)

For more information, visit: [www.dhigroup.com](http://www.dhigroup.com)

## REAL-TIME MANAGING TOOL AND SCENARIO MANAGER

The complete system of MIKE OPERATIONS collects real-time data (rainfall, level measurement in dams and flows) which enables the user to know the system status on the day of the analysis. With the help of observed rainfall and rainfall forecasts, the tool can calculate real-time water releases for the next five days downstream of the dams. As a result, the manager has at his disposal a decision support tool for the operation of the dams which takes into account all of the system rules in an integrated way - objective curves, regulatory requirements, water extractions and controlled flow.



Managing scenario analysis in MIKE OPERATIONS © DHI

By allowing scenario options into the system, different water demands and deviations as a result of inflow of rainfall, can be tested. This enables the site manager to customise scenarios to fit current conditions and determine flows and water depth in the dams.

With MIKE OPERATIONS, it is possible to anticipate alert procedures for the next 5 days of forecast for flood-peak attenuation, low water levels or safe drinking water supply.