



## Oporto Water Utility Develops Technology Platform for Integrated Management of Urban Water Cycle

Fully-integrated Water Management Efficiently Uses Existing Resources

### Project Summary

#### Organization

Águas do Porto (AdP)

#### Solution

Water, Wastewater, Stormwater Networks and Receiving Waters

#### Location

Oporto, Portugal

#### Project Objectives

- To design, develop, and implement an innovative solution for Smart Water Management by integrating existing IT solutions into a single platform.
- To use technological capabilities to provide operational mobility and the provision of information in real time on any device.

#### Products Used

ACTION Server, WaterGEMS®, SewerGEMS®, OpenFlows FLOOD

### Fast Facts

- ACTION Server was used to put numerical models into an operational model for the entire urban water cycle.
- The daily operation of these numerical models allows them to switch from reactive management to proactive management.

### ROI

- Access to tablets with all the information in real time allows operating gains of 25 percent.
- The occurrence of water supply failures dropped by around 30 percent.
- The increased reliability and stability of information produced based on sensor readings improved decision making and increased the stability and reliability of the data to values close to 99 percent.

### Integrating Disperse Data into a Single Smart Water Management System

Águas do Porto (Oporto Water Utility - AdP) is responsible for the sustainable and integrated management of the entire urban water cycle of the city of Oporto, Portugal, including water supply, wastewater drainage and treatment, stormwater drainage, surface waters, and coastal bathing water quality. AdP is one of the largest Portuguese companies in the sector with over 150,000 clients serving around 500,000 people. AdP delivers an average of 45,490 cubic meters of water to the population daily and collects approximately the same amount for treatment.

The density and complexity of the hydraulic infrastructure and water resources in Oporto drive the need for the integrated management of the urban water cycle, while also raising challenges in the integration of the vast number of existing systems throughout the company. To integrate the data gathered simultaneously from a wide range of systems and sources, spread over dozens of individual software systems, AdP decided to develop the “Technology Platform for the Integrated Water Management of the Urban Water Cycle – H2Porto.”

The goal of H2Porto is to promote a culture of innovation and Smart Water Management for the efficient usage of existing resources. H2Porto integrates territorial information via geographic information systems (GIS), video surveillance of infrastructures, numerical modeling, remote data acquisition, and public reporting with the following firm objectives: (i) integration of all information from the different systems (water supply, wastewater, stormwater, natural channels and coastal areas); (ii) uniformization of all data acquired through remote sensors; (iii) real-time display of all data in user-friendly dashboards; (iv) integration of online and offline numerical models for all systems; (v) modules for automatic alerts and warnings (based on data acquisition and numerical models); (vi) reporting and data mining; (vii) and publishing selected information for the general public.

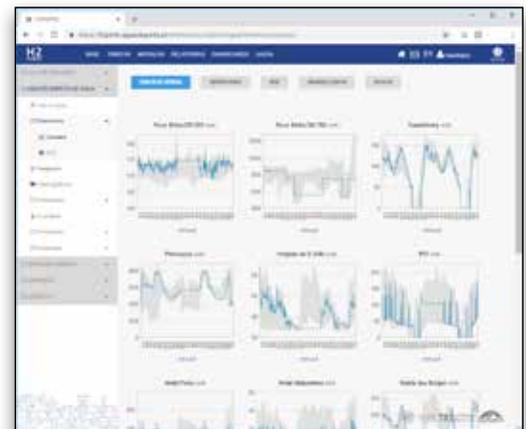
The implementation of H2Porto was acquired by AdP through an international public tender, which has been won by the

consortium of Aqualogus, Bentley Systems, and A20. The contract has a duration of five years, including 14 months for initial implementation and maintenance.

### H2Porto in the Scope of the Smart Cities

The overarching goal of the Oporto water utility was to achieve the holistic management of the water cycle in a smart city context. The organization sought to do this by developing an integrated solution for predictive operational analytics to help predict performance, identify failures early, and prescribe actions based on asset information. An online platform was built, combining all the data sources (GIS, real-time network sensors, household meters, SCADA, laboratory, billing, work orders and logistics, etc.), and integrating them to produce business intelligence in the form of indicators and dashboards. Added modeling ability to forecast network behavior for the entire urban water cycle (from precipitation to bathing waters) is beneficial as well.

Bentley was responsible for the implementation of the modeling and predictive capabilities of the project. Bentley software produced a digital twin model of the city's water supply, wastewater, stormwater, and bathing water systems, to forecast flooding and water quality issues, thereby improving city response and resilience.



The platform manages all city sensors and data sources.

*"H2Porto is a very important catalyst for the digital transformation paradigm implemented by Águas do Porto, since it supports the change of processes, using technological tools to adapt the work of the people into new realities."*

*— Pedro Vieira,  
IT and Innovation Director,  
Águas do Porto*

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## Overcoming Obstacles of Smart Urban Water Management

Oporto water utility has been incrementing multiple layers of big data collection and generation over the last several years. Most of the time the data has been managed by isolated or noninteroperable user interfaces, which reduces productivity and makes it harder to achieve efficient data management. Moreover, the isolated management of all those available datasets reduces the possibility of generating added-value integrated analysis and forecasts.

The main challenge in the implementation of the system was the city water cycle scale, which requires detailed resolution for many models and domains, including meteorology, water supply, sewer, and storm drainage. The city water scale also required the ability to consume large amounts of data from real-time sensors and consumers' telemetry and billing.



*High-resolution weather forecasting was implemented to provide precipitation forecasts to the combined sewer system.*

## The Implementation of H2Porto

AdP and the consultants from Bentley were responsible for the design, configuration, implementation, and automation of all the modeling and predictive capabilities. All predictive models automatically generate daily forecasts and publish the results in the project platform. Bentley developed further online services for on-demand online simulation analysis of network changes due to pipe burst, valve closure, and pumping stations' shutoff scenarios (e.g. run model with changes, compare with base solution, and return effected pipes and consumers).

*The main implementation points:*

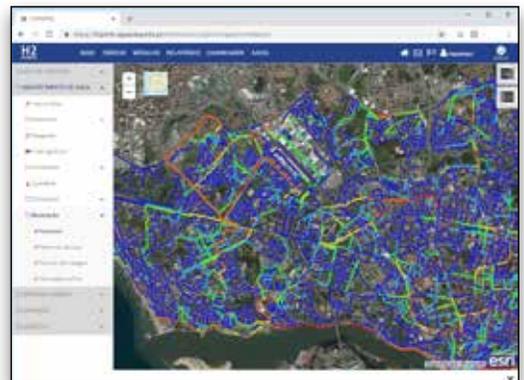
- Twenty-two DMA models (entire Oporto city)
- Three meteorological models in a nesting approach to have high-resolution meteorology forecast at 1-kilometer scale (e.g. precipitation driving factor for drainage and wind patterns in coastal areas)

- Combined sewer and storm model for the sea front part of the city (1/3 of the city where infrastructure data was reliable)
- Estuary, coastal area, and wave models for the detailed description of the bathing area circulation and water quality (coliform bacteria)
- Calibrated/validated results for all the domains with the automated network sensors and historical data
- Models were configured to run operationally daily and produce forecasts for the next three days, automatically updating boundary conditions from water consumption and network sensors
- Bottom-up approach for IWA water balance for all DMA's using network sensors and consumers' telemetry for real losses estimation
- Network scenario analyses for pipe bursts and valve and pump shut-downs
- Results published via web map services (e.g. flows, velocity, water level, meteorology, and currents) and RESTful API (e.g. time series of the same properties and requests for online services as IWA water balance or online scenarios) to the project interface.

Bentley also developed online services to compute on-the-fly DMA IWA water cycles, at request, using billing, real-time network sensors, and consumer telemetry.

## The Factors that Contributed to Success

Implementing all the modeling domains and the plug-in-based server capabilities were the main factors that contributed to the success of the implementation at the city scale. This eased the integration of new models, data sources, and tools, as well as helped to seamlessly put these components into operation and publish results.



*All water supply, drainage, and coastal systems are modeled in an integrated way and visualized in a web GIS environment.*