



DHI CASE STORY

SAFE BATHING WATER IN THE HEART OF COPENHAGEN HARBOUR

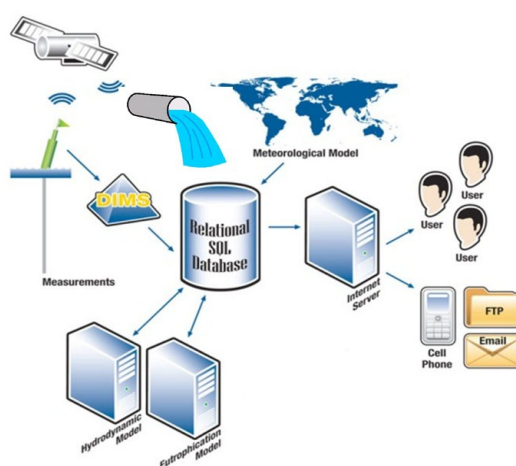
Timely and efficient Bathing Water Quality Forecast System to ensure safe waters

A destination that boasts of attractive beaches and safe waters promises to draw tourists and, thereby, serves to boost the nation's tourism industry. The city of Copenhagen succeeded in providing locals and visitors a recreational bathing area in the very heart of the city, amidst the beauty of its world-renowned harbour.

Copenhagen's harbour faces the same threats to water quality as any other harbour: heavy rainfall, frequent release of sewage water and induced pathogenic bacteria. However, DHI – in collaboration with the City and Copenhagen Energy (the provider of the sewer data) – developed an innovative Bathing Water Forecast [BWF] System. In doing so, we transformed the city's harbour and provided complete value for the investments made by the city for the sewer. Today the down town swimming area is a popular leisure destination where visitors can safely enjoy without the fear of contracting water-borne diseases.

A COMPLEX BATHING WATER FORECAST [BWF] SYSTEM MADE SIMPLE FOR THE USER

The BWF system is a highly complex, integrated piece of technology that DHI adapted and tailored to suit the unique needs of Copenhagen's harbour. Given the system's complexity, it was important that DHI design it with its various end-users in mind. This meant making it simple to operate and delivering various targeted information which is easy to understand for both the general public and the authorities. DHI achieved this key objective by taking an innovative approach to the design. We combined sensory systems, predictive tools and user-friendly dashboards that worked in combination to provide continuous monitoring of the harbour's water quality and real-time information to users.



SUMMARY

CLIENT

City of Copenhagen, Denmark

CHALLENGE

- Bath location exposed to risks of contamination
- Insufficient data on pollution levels and currents
- Meeting the requirements of EU directive
- General public skepticism

SOLUTION

- An integrated Bathing Water Forecast System, combining:
 - real-time water quality monitoring;
 - accurate forecasting tools;
 - user-friendly dashboards;
 - designed to meet the different information needs of stake holders

VALUE

- Dynamic models providing detailed information as and when required
- Early detection of pollution threats
- Reliable forecast of water quality
- Efficient forecasting has reduced unwanted closure of harbour
- Information conveniently accessible across multiple media platforms for those who need it
- Overcome public and political scepticism

LOCATION / COUNTRY

Copenhagen, Denmark

FORMING A COMPLETE PICTURE WITH CONSTANT DATA COLLECTION FROM MULTIPLE SOURCES

The system constantly monitors the harbour's water and predicts the concentration of the indicator bacteria *Escherichia coli* and *Enterococci* at specified locations along the water courses from the city to the harbour. To help forecast frequent pollution threats, DHI also collects meteorological data from forecast suppliers and runs hydrodynamic models to retrieve data. All this information is then used to create models to demonstrate predictive forecasts using DHI's proprietary MIKE and ECO Lab software programs.

CHOOSING THE BEST SUITED METHODOLOGY

Once the on-line data is collected, the BWF system relies on MIKE 11 together with MIKE 3FM to model the inflow of waters from the city into the harbour. These hydrodynamic models, combined with the measured and modelled pollutions, are then processed by ECO lab—our water quality modelling software—to produce a complete predictive pollution forecast.

The software utilises actual information on meteorological forcings and simulates the fate of the indicator bacteria based on various factors like water temperature, salinity, solar radiance, combined with precise hydrodynamic models. Hence, the model system can also be used as a highly effective tool to assess and identify the best method to address solutions to maintain water quality and reduce risk of pollution.



INFORMATION AND WARNINGS MADE EASILY ACCESSIBLE ACROSS MULTIPLE MEDIA PLATFORMS

We created user-friendly dashboards on multiple media platforms to ensure that information is constantly and conveniently accessible to those who need it:

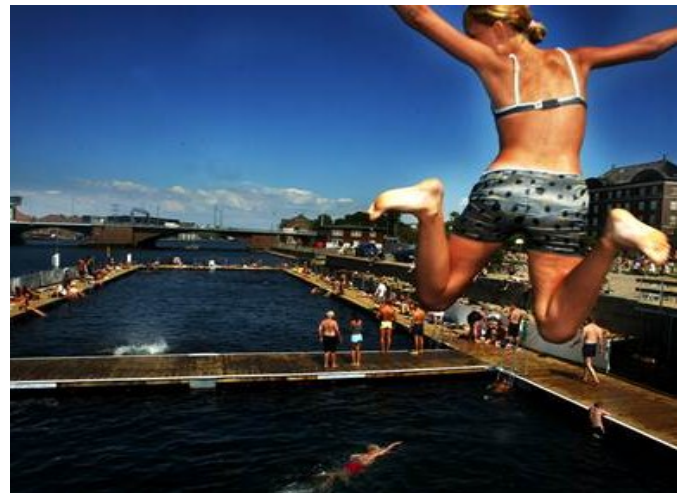
- *Public websites* are updated with the forecasts and can be accessed by anyone who intends to use the harbour bath.
- *Alerts via sms* provides an early warning when water quality drops as well as a notification when the water is safe again
- *Smart phone apps* make updates conveniently accessible via smart phone.

Contact: Anders Chr. Erichsen - aer@dhigroup.com
For more information visit: kbh.badevand.dk

- *Managers' web* gives access to detailed time series for the authorities to help them make informed and timely decisions.
- *Managers' log* pages provides evaluation and quality reports on measurements and model performances

CLEAN, SAFE AND APPEALING WATERS IN THE HEART OF THE CITY

With the BWF system ensuring that the health of the public is never compromised, DHI has helped the general public overcome its scepticism about the water quality in the harbour. As a result, Copenhagen harbour has been transformed from an industrial port to a vibrant cultural and social centre of the city.



Copenhagen's residents can finally take advantage of the natural terraced landscape of the harbour bath with its piers, boat ramps, playgrounds and pontoons, and enjoy a water playground in the heart of the city. This landmark project has enabled DHI to showcase how effective integrated strategies can succeed in delivering safe water quality that people can now, do what used to be unthinkable in Copenhagen—swim in the harbour. In achieving this result, DHI has set the standards for best practices in harbour water quality management worldwide.