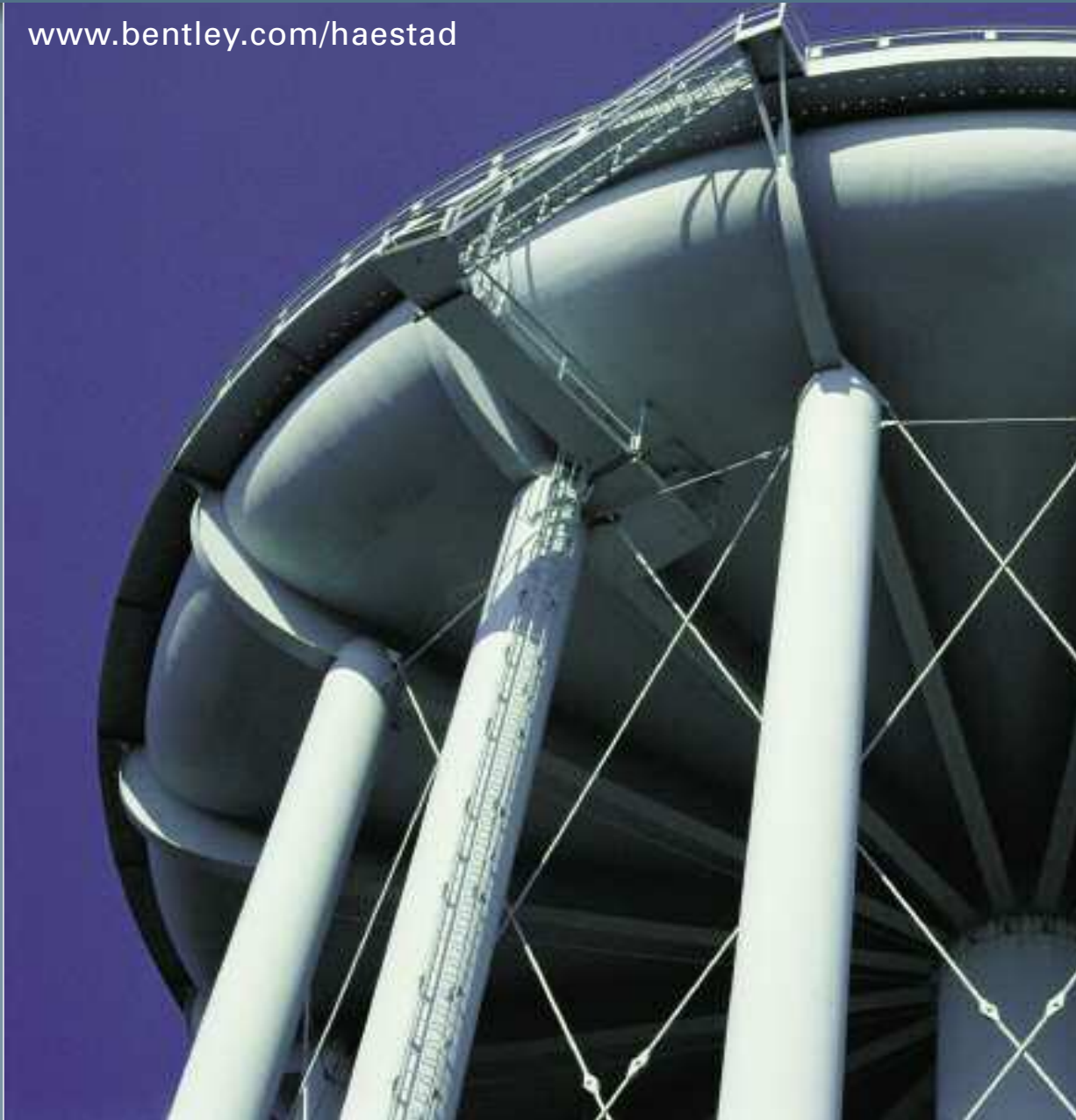


# Water Modeling and Management

[www.bentley.com/haestad](http://www.bentley.com/haestad)



- ▶ WaterGEMS®
- ▶ WaterCAD®
- ▶ HAMMER™
- ▶ SCADAConnect™
- ▶ Bentley® Water
- ▶ ProjectWise®



Solutions by Bentley

# The Bentley advantage...

**B**entley capitalizes on the 25-year leadership of Haestad Methods solutions in water infrastructure modeling, merging talent and resources to deliver real-world solutions for utilities and water professionals.

Our success comes from meeting the challenges of our users, helping engineers become more productive every single day, while empowering organizations and project teams to collaborate efficiently.

## Software

- ▶ WaterGEMS
- ▶ WaterCAD
- ▶ HAMMER
- ▶ SCADAConnect
- ▶ Bentley Water
- ▶ ProjectWise

## Education

- ▶ Training
- ▶ Publications

## Services

- ▶ Bentley SELECT
- ▶ Professional Services



## Work together

We understand a short learning curve and the ability to collaborate make your team more efficient. Our renowned ease of use and multiplatform environments let everyone in your organization contribute.



“Our current model is so hard to learn and use that only one person in the office can work with it. As a result, he is isolated from the rest of the team.”



“I make decisions that impact my customers everyday, but half the time I feel like I don't have enough information to work with. ”

## Know your system

Engineers find knowledge through modeling—knowledge on how their infrastructure behaves as a system, how it reacts to operational strategies, and how it should grow as population and demand increase. Bentley empowers engineers with tools to own and command this knowledge for targeted decision-making.



“Our current pumping costs are huge. Most of our operating budget goes towards the electric bill.”

## Operate intelligently

Our development team creates models with a clear mindset to help our users save time and resources, and safely operate their system. Accurately simulate variable-speed pumping scenarios to minimize energy consumption, and protect your system from the damaging effects of transients.

## Be prepared to respond

Bentley helps you be more responsive to emergencies and complaints. Simulate mock contamination, pipe breaks, and power outage scenarios, and select the best operational strategies to address them.



“We have not been vigilant enough with our emergency planning. If anything serious ever happens we are in big trouble.”

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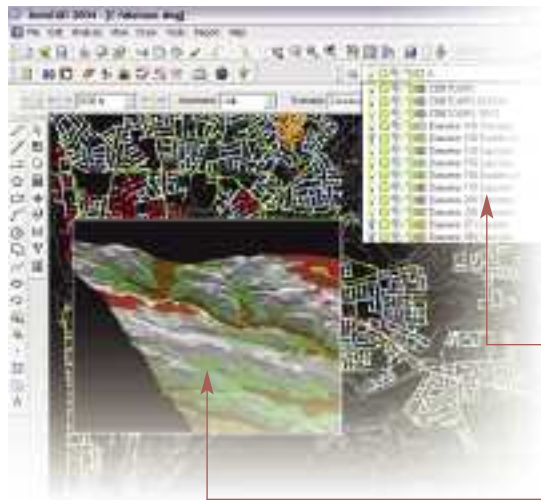
*“Your products are consistently of excellent quality, and have rapidly become the go-to software of choice.”*

—CH2M Hill, U.S.

*“WaterGEMS has allowed us to build and develop complex water network models in less time and using fewer resources to improve our workflow and supply better drinking water to our customers.”*

—Aguas Andinas, Chile





## Convenient CAD layout and drafting

### ● ● AutoCAD interface

Bentley empowers AutoCAD users to perform every hydraulic task in an environment that they know and understand.

Full control over AutoCAD layers gives you unlimited flexibility.

Automatically extract model node elevations from TINs, DTMs, Autodesk Land Desktop surfaces, spot elevations, contour maps, and 2D and 3D points and polylines.

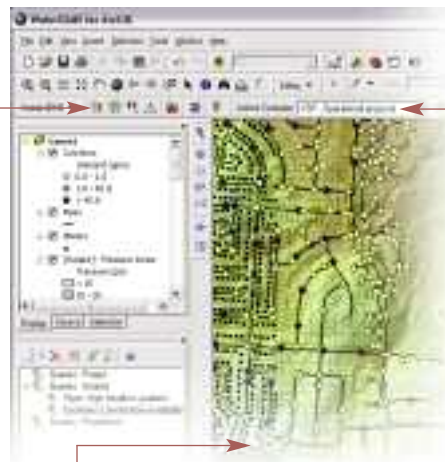
## Seamless geodatabase integration

### ● ArcGIS interface

For users that must leverage ArcGIS capabilities, WaterGEMS provides full geodatabase integration so they can create, display, edit, run, map, and analyze hydraulic models from a geospatial environment.

Specialized geoprocessing modules help you assign demands and extract elevations.

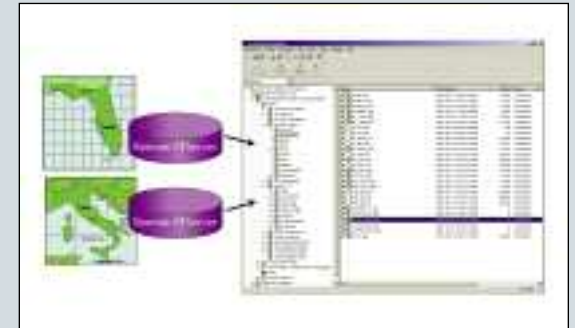
Create, modify, and delete model elements while directly editing your geodatabase.



Input and manage your data through tables and scenarios directly within ArcGIS.

## PROJECTWISE ENTERPRISE COLLABORATION

ProjectWise provides controlled management for every aspect of shared team projects. Modeling files, geospatial data, drawings and other project documents are confidently updated, synchronized and secured; ensuring that project teams can efficiently work on separate project tasks in parallel.



[www.bentley.com/ProjectWise](http://www.bentley.com/ProjectWise)

## BENTLEY WATER ASSET MANAGEMENT

From maintenance to record-keeping, WaterCAD and WaterGEMS users can directly leverage Bentley Water's powerful asset management capabilities.

[www.bentley.com/BentleyWater](http://www.bentley.com/BentleyWater)



### NATIVELY COMPATIBLE

Unlike competing solutions, WaterCAD and WaterGEMS share the same file type across all available environments. So, if you need to collaborate with your contractors, clients or colleagues, just send them your model file. They will be able to work with it and send it back to you with no import, conversion or loss of information in the way.

# Maximum return from your data



“Data reduction for modeling is an expensive manual process. I don't want my professional experts retyping and redigitizing.”

## Featuring WaterGEMS and WaterCAD

When selecting a hydraulic modeling solution, carefully evaluate its ability to utilize all your data sources for model building and maintenance while guaranteeing data integrity.

### Geospatial and CAD Data:

- ▶ Topology
- ▶ Physical attributes
- ▶ Zoning and land use
- ▶ Census polygons
- ▶ Digital elevation models
- ▶ DGN, DXF, & DWG
- ▶ LDD surfaces
- ▶ 2D & 3D polylines
- ▶ Elevation contours

### CIS:

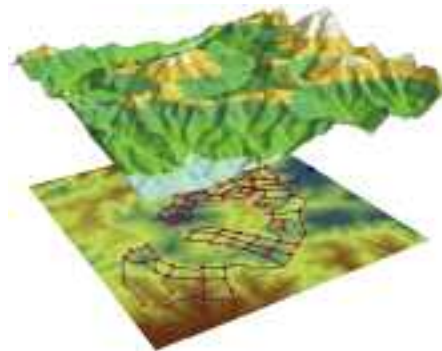
- ▶ Billing meters
- ▶ Usage patterns
- ▶ Unaccounted-for water

### AM:

- ▶ Infrastructure inventories
- ▶ Maintenance records

### SCADA:

- ▶ Control rules
- ▶ Field data acquisition
- ▶ Peak and minimum water usage



## Elevate

Save time and avoid input errors using the Terrain Extraction module (TRex) to feed elevation data for hydraulic modeling automatically.

Extract node elevations from TINs, DTMs, raster datasets, LDD surfaces, and contour maps from CAD and geospatial applications.

## Skip ahead

Already have CAD drawings or GIS files for your water system? If so, your hydraulic model may be only a few clicks away. Easy to use wizards guide you through an automated process that builds a coherent hydraulic network model.



## Place demands

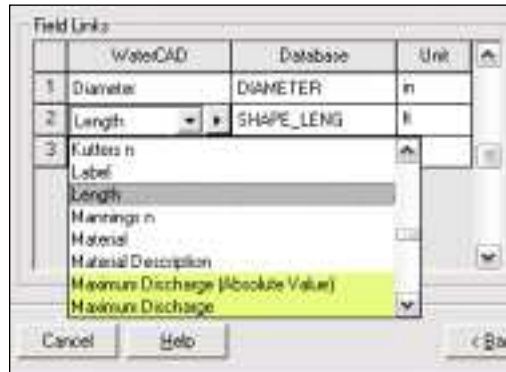
WaterGEMS' LoadBuilder provides an array of integrated tools for distributing demands and predicting future water usage:

- ▶ Assign geocoded customer meters
- ▶ Use nearest node or pipe criteria
- ▶ Allocate demand based on service polygons
- ▶ Intersect with land use, census, or meter routes
- ▶ Forecast using land use and population growth



## Fix bad data

Legacy CAD and geospatial data often present connectivity issues that are unacceptable for the required accuracy of a hydraulic model. Automatically find and fix these issues without time-consuming overhead.



Allocation of demands into the model can be a tedious process. LoadBuilder makes it easier to apply demands by different methods, saving countless man hours.

—Tucson Water, U.S.

## Stay connected

Establish persistent bidirectional links between your hydraulic model and your geospatial and operational information systems. Leverage geodatabases, shapefiles, geometric networks, and coverages; and create links with spreadsheets, Access, SQL Server, Oracle, ODBC and OLEDB databases.



### EXCLUSIVE PATENTED MODELING TECHNOLOGY

Haestad Methods developed and patented exclusive technology for building engineering models from unitized data.

## SUCCESS STORIES:

### SOUTH AUSTRALIAN WATER, AUSTRALIA

South Australian Water needed to upgrade the Copper Coast water supply system in order to face increased demands generated from tourist areas in the summer, and significant development in the region. The goal of this challenging study was to meet the region's requirements for the next 25 years.

With LoadBuilder, the amount of time taken to build and update demands in a model was dramatically reduced. "South Australian Water's use of WaterGEMS has greatly improved the efficiency of building and maintaining hydraulic models. The LoadBuilder tool in particular, has proved to be invaluable in assigning customer demands to the model," says Mathew Baines, water modeling engineer from South Australian Water.

The TRex module is another automated feature that saved South Australian Water considerable time in the model building process and also provided a better estimate of surface elevation in models.

### CHATHAM-KENT, ON, CANADA

In 1998, thirteen communities were amalgamated and the need for an AM/FM system led to the development of a cost effective integrated approach to solve the municipality's various hydraulic water network modeling needs.

This was accomplished through the development of a customized ModelBuilder to import Chatham-Kent's Intermediate Microsoft Access Database seamlessly into WaterCAD using WaterObjects (object-oriented Software Development Kit).

As a result, several errors were uncovered and corrected in the AM/FM system and significant time and money were saved. "By leveraging the existing AM/FM data and integrating it into WaterCAD, the Municipality has an up-to-date functional WaterCAD model which will enable its engineering department to better face the challenges of water system design and analysis to meet future business needs", says Linda Pepper from the municipality's AM/FM Department.

# Organize and understand



“How am I supposed to analyze all this data? I need a way to quickly manage and interpret my results.”

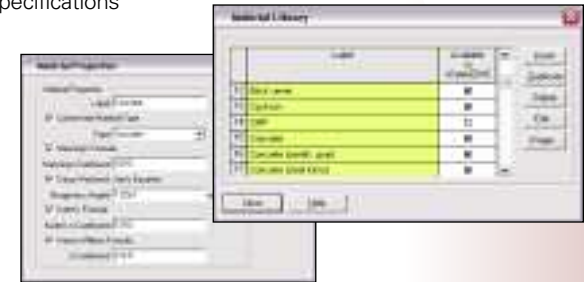
## Featuring WaterGEMS and WaterCAD

A water distribution model is a living asset that grows and expands along with the utility, allowing modelers to explore options and make choices based on engineering results.

Managing this constant change and being able to quickly identify bottlenecks is a challenge that Bentley solves with a wealth of time-saving editing and result interpretation tools.

## Enter data once, use it many times

Totally customizable engineering libraries allow users to share and maintain specifications across projects, with the ability to manage pipe material, minor loss, and water quality standards.



| ID     | Name    | Length | ... |
|--------|---------|--------|-----|
| P11    | P-1     | 42.29  | ... |
| P12    | P-2     | 18.88  | ... |
| P13    | P-3     | 42.24  | ... |
| P11234 | P-11234 | 15.24  | ... |
| P123   | P-123   | 15.24  | ... |
| P14    | P-4     | 275.42 | ... |

## Edit data your way

Create your own personalized FlexTables to manage data with unlimited freedom. Use dynamic queries and multiattribute filters to edit massive amounts of data with ease.

## Manage consumption

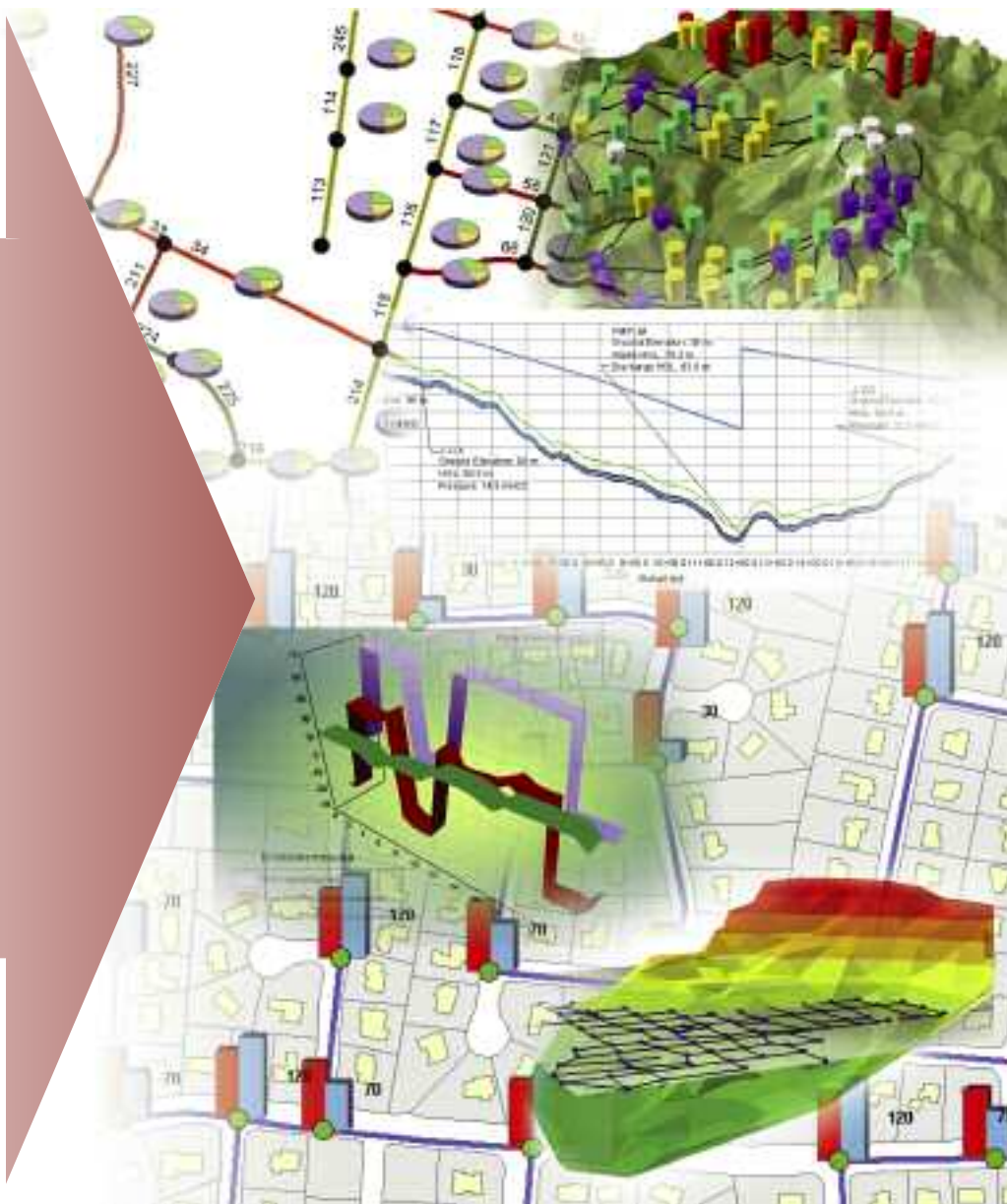
Exercise complete control over water demands, unit- and pipe-based loading, pattern multipliers, and unaccounted-for-water estimation.



## Make informed decisions

Use a single model to evaluate an unlimited number of design, water demand, operation and even network topology scenarios for better decision-making support.





## PASS IT ON

The multiplatform nature of WaterGEMS gives you more creative ways to present and share results with your team, clients and colleagues. Here are some examples.

- ▶ Hand your WaterGEMS native file to anyone that can read an ESRI geodatabase so they can directly map and visualize results.
- ▶ Your colleagues can use the free and downloadable Bentley View to review, comment and red-line your WaterGEMS drawing result files.
- ▶ Use the MicroStation interface to generate customizable PDF reports, including your model layout, scenario results, 3D maps, and other third-party documents that refer to your model.

*"I've been using WaterCAD since version 1, and I've found that the scenario manager is the best, most useful feature..."*

—Agriculture & Agri-Food, Canada

*"GeoGrapher offers great flexibility for reporting and results presentation. The persistent and automated graphs make reviewing multiple scenarios much easier."*

—Camp Dresser & McKee, U.S.

# Plan, budget, and operate intelligently



"I can't believe this pump station is only two years old and it's already under capacity!"

## Featuring WaterGEMS and WaterCAD

**P**lan the improvements and additions to the distribution system that will be necessary to accommodate future customers. Use the built-in capital cost assessment tools to optimize designs for both performance and capital investment.

Hydraulic simulations can also be used to help guide daily operations by demonstrating the effect of candidate pump and valve actions, providing the operator with superior information for decision making.

## FROM MASTER PLANNING...

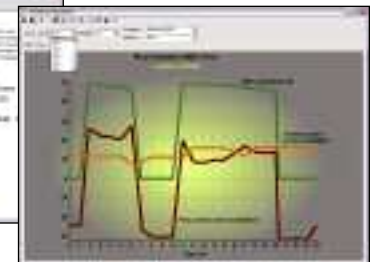
### Plan ahead

Identify potential problem areas, size and locate new transmission mains, pumping stations, and storage facilities—both now and for the future.

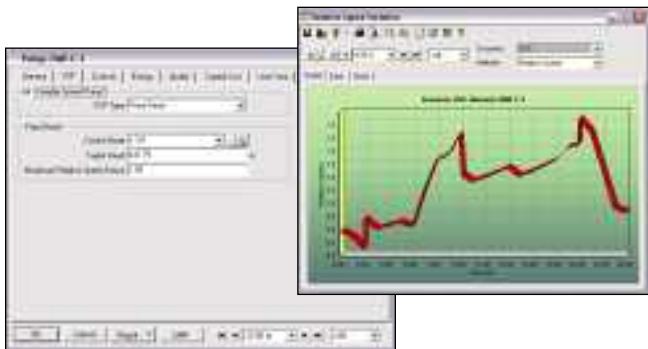


### Understand your choices

Evaluate and compare several design and rehabilitation scenarios to improve system performance, and choose the one that makes the most sense financially.



## ...TO OPERATIONS AND MAINTENANCE



### Change speed

Don't settle with a model that asks you to supply the pump speed. WaterCAD and WaterGEMS accurately model the correct operation of variable-speed pumps continuously and dynamically adjusting speed to maintain target pressures.

### Be logical

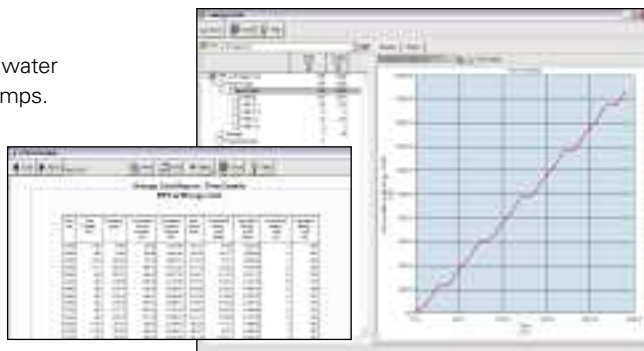
Rule-based controls definition and management give you unprecedented command over your hydraulic model and the ability to emulate the most complex operational strategies.



### Save energy

One of the largest operating costs for water utilities is the cost of energy to run pumps.

Determine the cost of operating your pumps using any energy tariff, while considering the effects of storage on the cost of running the system.



### SUCCESS STORY:

#### ANNE ARUNDEL COUNTY, MD, U.S.

The Anne Arundel County, Maryland Public Works department was looking for a way to leverage their existing GIS investment for water distribution engineering purposes. WaterGEMS integrates the capabilities of GIS with sophisticated hydraulic modeling, allowing the county to support master planning efforts, plan for capital improvement projects, automate pump selection, and perform a range of other tasks.

As one example, the county engineers needed to determine if a proposed residential subdivision would have adequate water pressures and fire protection.

By studying and comparing simulations with proposed pipes under different criteria, they decided to supply the subdivision with a loop that connects on both ends to a main line instead of a dead-end supply as originally proposed.

"Decisions such as this save the county tens of thousands of dollars on a regular basis and would not be possible without the use of WaterGEMS," says Laura Layton, P.E., of the Anne Arundel County Department of Public Works' Planning Section.

*"The versatility, flexibility and logical approach of the scenario and alternative manager has allowed our office to quickly and effectively develop and evaluate multimillion dollar infrastructure improvement alternatives with accuracy and confidence."*

—City of Clarksville, U.S.



#### LOOK UNDER THE HOOD

There is a big difference between a marketing bullet in a brochure and a feature that you can actually use and apply in practice. Be wary of software claiming "true variable-speed pumping". Be sure to determine how the candidate model handles parallel variable-speed pumps and whether the model truly allows you to mimic the behavior of VSPs in the field.

# Keep customers safe and satisfied



"I worry that in the case of a fire or contamination event, we won't be ready to act quickly enough to protect affected customers."

## Featuring WaterGEMS and WaterCAD

Consumers expect a product that is safe to drink and free of taste, color, and odor.

To achieve this level of quality and satisfaction, Bentley's Haestad Methods solutions offer tools to prepare teams for prompt responses, optimize disinfectant usage throughout the system, trace water blending from different sources, and estimate the age of the water as it moves in the system.

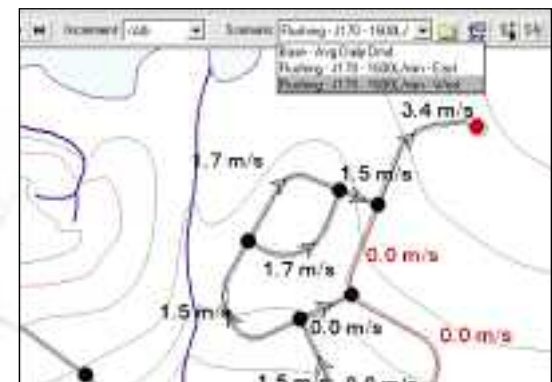
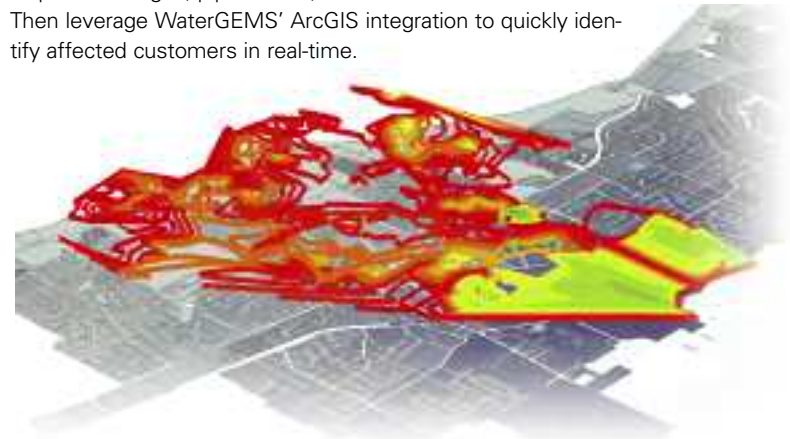
## Fight fire before it starts

Review your system's ability to provide adequate fire protection by establishing how much flow is available at any hydrant while complying with pressure and flow constraints.

| Label | Supply Level | Required Fire Flow | Available Fire Flow | Pressure | Flow |
|-------|--------------|--------------------|---------------------|----------|------|
| 100   | 100          | 100                | 100                 | 100      | 100  |
| 100   | 100          | 100                | 100                 | 100      | 100  |
| 100   | 100          | 100                | 100                 | 100      | 100  |

## Prepare for anything

Assess system reliability under unfavorable conditions, such as power outages, pipe breaks, and contamination events. Then leverage WaterGEMS' ArcGIS integration to quickly identify affected customers in real-time.



## Train operators

Create and store an unlimited number of "what-if" situations for simulating emergency drills and developing a response plan.

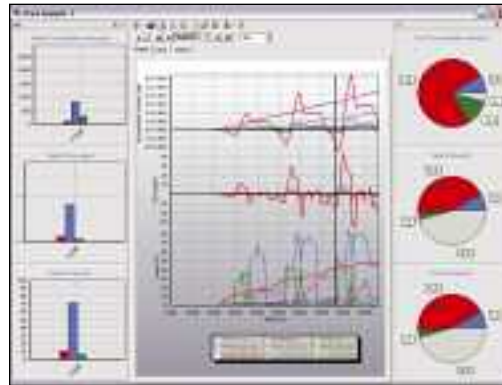
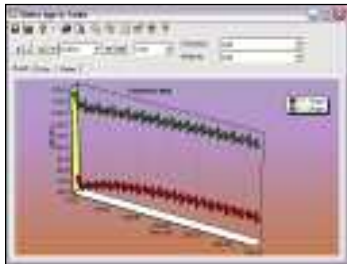
Operators will visualize the impact of an operation through accurate simulations.

## Follow the flow

Visualize zones of influence for every water source, and improve turbidity, taste and odor by identifying water blending problems and recommending solutions.

## Find stale water

Detect long residence times that can lead to taste and odor problems, disinfection byproduct formation, sedimentation, and loss of corrosion control effectiveness.



### REGULATORY COMPLIANCE

Use WaterGEMS and WaterCAD to comply with water quality regulations, such as the U.S. EPA Stage 2

Disinfectant and DBP Rule and the European Commission Drinking Water Directive.

## How much chlorine?

Evaluate different alternatives for chemical dosing, including flushing, source injection, and implementation of booster stations.



## Place booster stations

Simulate different alternatives to position booster disinfectant stations, choosing the one that is most efficient in correcting low disinfectant levels.

### SUCCESS STORY:

#### WALKERTON, ON, CANADA

In May 2000, E. coli contaminated the municipal water of Walkerton. Seven deaths were associated with the outbreak and approximately 2,300 people became ill.

Public health epidemiologists with Health Canada utilized WaterCAD's water quality modeling features in conjunction with human illness incidence data to help identify the source of the water supply contamination in the Walkerton community.

Health Canada created a model that matched the flow patterns at the time of the outbreak. They then ran a series of hypothetical contamination scenarios to track the movement and relative concentrations of well-specific contaminants. Next, data was collected to determine and map the locations of residents stricken with the illness.

Researchers looked for associations between the model data and the spatial and temporal characteristics of those who became ill. Based on the analysis, they were able to pinpoint the contamination source.

*"WaterCAD is a great product and easy to use. With the modeling software we were able to graphically show the District Board why they needed the upgrades to their water distribution system and the potential dangers that they would face if the work was not done."*

—Manning Engineering Corp, U.S.

*"Haestad Methods is making water safe for everyone in the millennium."*

—Kvaerner Cementation, Zimbabwe

# Calibrate



"I know I 'm supposed to calibrate my model continuously, but I don't have the time. It is hard enough to do it every couple of years."

## Featuring Darwin® Calibrator module

- ▶ Included with WaterGEMS
- ▶ Available for WaterCAD

The primary reason for investing in a hydraulic model is to have a reliable decision-support tool on hand.

But model reliability can only be obtained through a rigorous calibration effort, historically a very time-consuming trial-and-error process.

Darwin Calibrator significantly cuts down on the manual work by automatically making hundreds of thousands of adjustments matching your model to real-world conditions.



## WHEN DO YOU STOP?

The final use of the hydraulic model will determine the level of accuracy required during the calibration process. Simple system evaluations do not require the same level of accuracy as does an in-depth water quality analysis.

## SUCCESS STORY: GUAYAQUIL, ECUADOR

The water distribution system for Guayaquil, the largest city in Ecuador faces a significant water supply deficit, interrupted service, low-pressure areas, and approximately 75% unaccounted-for water (UFW).

The city hired Envirosoft Engineering & Science, Inc. to create an effective action plan for addressing these issues. To support their efforts, Envirosoft constructed an accurate hydraulic model of the system using WaterGEMS and Darwin Calibrator.

Darwin Calibrator significantly increased productivity on the

Guayaquil project—allowing Envirosoft to conduct the same level of calibration in a quarter of the time it would have taken with manual methods. And because Darwin Calibrator automatically evaluated hundreds of thousands of trial calibration solutions, it efficiently enhanced the quality of the model.

Using the calibrated model, the city was able to identify locations and causes for significant water loss and plan a comprehensive replacement and rehabilitation program.

*Printed as featured in AWWA Journal, October 2004*

## With Darwin Calibrator:

- ▶ Adjust roughness, demand, and pipe status automatically
- ▶ Maintain a record of calibration trials
- ▶ Manage any number of field data sets
- ▶ Import hydrant flow test data with ease
- ▶ Link to SCADA systems for continuous calibration
- ▶ Define roughness and demand adjustment groups
- ▶ Quantify unaccounted-for water accurately
- ▶ Calibrate for multiple demand conditions

[www.bentley.com/calibrator](http://www.bentley.com/calibrator)

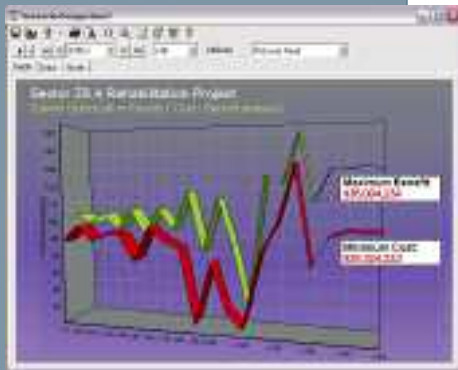
# Design

## Featuring Darwin® Designer module

- ▶ Included with WaterGEMS
- ▶ Available for WaterCAD

Developing sensible design and rehabilitation strategies traditionally involves a methodical try-and-revise process. Due to time or other constraints, the engineer may be hard-pressed to adequately explore all available, reasonable solutions.

Darwin Designer will evaluate hundreds of thousands of alternatives that meet user-defined constraints, and recommend those that minimize construction costs while maximizing hydraulic performance. By eliminating manual design iterations up front, focus can be applied to fine-tuning solutions that deliver better performance with significant cost savings.



## Use Darwin Designer to:

- ▶ Size new pipes and identify cost-effective rehabilitation strategies
- ▶ Evaluate designs for steady-state and extended period simulations (EPS)
- ▶ Expedite master planning
- ▶ Boost comfort level with design decisions
- ▶ Identify optimal locations for new facilities
- ▶ Design tanks and evaluate tank turnover
- ▶ Determine optimal staging for phased capital improvement programs
- ▶ Assess system performance under multiple design conditions
- ▶ Assign unit costs and compare designs
- ▶ Enhance system reliability and integrity

[www.bentley.com/designer](http://www.bentley.com/designer)

*"The inclusion of utilities like Darwin Designer ... makes WaterGEMS an extremely powerful tool."*

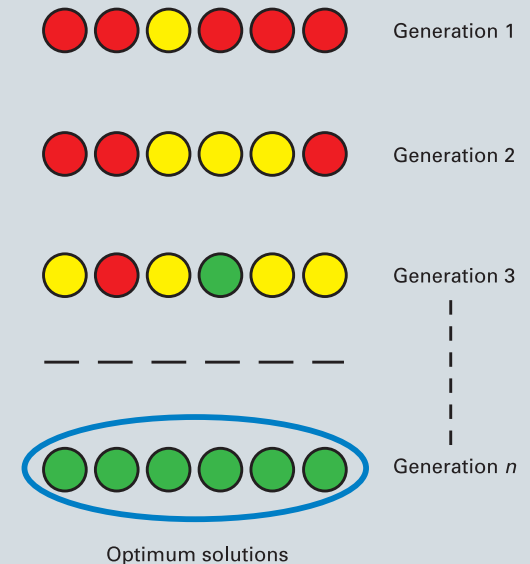
—South Australian Water, Australia

## UNDERSTANDING GENETIC ALGORITHM TECHNOLOGY FOR DARWIN MODULES

Calibrating a model and assessing design and rehabilitation strategies are examples of modeling processes that take a huge number of trial and revision cycles, and consequently a lot of time and money if the most recent optimizing techniques are not used.

This is why Darwin Calibrator and Darwin Designer command the most recent technological advances in the high performance Fast Messy Genetic Algorithm (fmGA), one of the most competent genetic-evolutionary computing technologies.

A Genetic Algorithm (GA) is a search method that emulates the theoretical principals of natural evolution and biological reproduction. It randomly generates a population of solutions to a problem. Each solution is evaluated and quantified by a measure of fitness (fitness is the merit for surviving in biological environment). GA selects better solutions to create the next generation of solutions by mimicking genetic operations such as crossover and mutation. Over many generations, optimal and near-optimal solutions emerge.



# Simplify



“System detail is great, but I’ve got so much data to look through now that I can’t find anything!”

## Featuring Skelebrator® module

- ▶ Included with WaterGEMS
- ▶ Available for WaterCAD

*“Skelebrator is particularly beneficial and is destined to become essential as more models are created from GIS.”*

—Gannett Fleming Inc, U.S.



### REQUIRED NETWORK INTEGRITY

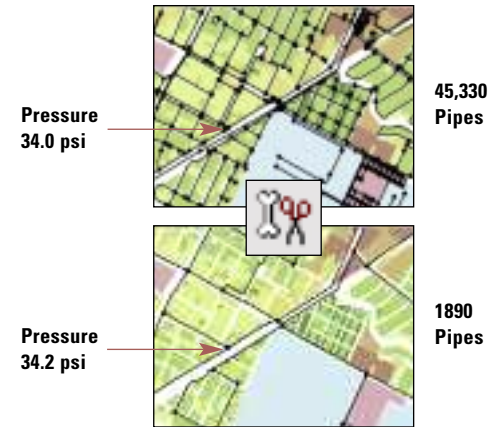
Skelebrator’s approach is vastly superior to competing methods that remove pipes based solely on attributes criteria, compromising network connectivity and removing critical links and nodes.

## With Skelebrator:

- ▶ Generate accurate water system models ready for analysis
- ▶ Trim insignificant and minor pipe segments, including dead ends, service connections, and hydrant laterals
- ▶ Reduce excessive pipe segmentation created by valves, fittings, and hydrants details
- ▶ Consolidate parallel pipes into one hydraulically equivalent pipe
- ▶ Mark important elements to protect from skeletonization
- ▶ Maintain hydraulic equivalency by reallocating node demands based on user-specified criteria and by allowing pipes with varying attributes to be merged into new pipes that account for the differing attributes
- ▶ Preview skeletonization results graphically before applying them to the model

[www.bentley.com/skelebrator](http://www.bentley.com/skelebrator)

There is a trend towards building sophisticated geospatial system planning tools within water utilities, but for analyses, this level of detail is unimportant or distracting and the additional size and complexity can hinder productivity. Examples include master planning, system rehabilitation studies, and pump scheduling.



With Skelebrator, models reliably reduce network complexity by automating the reduction of network models, saving precious time and enhancing understanding.

## SUCCESS STORY: CITY OF TORONTO, ON CANADA

Toronto’s asset management group is a key user of data, as they must model the water network and manage the capital work plan. However, the increased number of graphic elements and associated database records required to maintain the level of detail of the physical water network presented a risk that it would increase the complexity of the work without adding value to the modeling activities.

The Skelebrator module of WaterGEMS offered a unique integration opportunity to provide an equivalent skeletonized network to the asset management group. It eliminated any associated problem to the modeling activities. “By enabling us to automatically skeletonize our complex water network from a high level of detail to less granular detail, WaterGEMS allowed us to bridge the data needs of two different user groups, while saving the city over \$1,000,000.” says Bob Gaspirc, Toronto’s manager of mapping services.

# Get more from SCADA



“Our new SCADA system cost millions. So why is it so hard for my engineers to use the information we’re collecting?”

Featuring SCADAConnect™ module.  
Available for WaterGEMS and WaterCAD

The deployment of a Supervisory Control and Data Acquisition (SCADA) system is a singular capital investment that offers a veritable data gold mine for a modeler. The more this data is leveraged, the better the return on investment, and the more savings realized. SCADAConnect provides a link to SCADA systems that allows queries of real-time and historical information for maintaining a more accurate model.

## With SCADAConnect:

- ▶ Jumpstart model simulations
- ▶ Increase understanding of system performance
- ▶ Build and maintain demands and patterns
- ▶ Ensure model accuracy
- ▶ Develop real-time response strategies
- ▶ Recreate and troubleshoot system problems
- ▶ Automate data entry workflows

[www.bentley.com/scadaconnect](http://www.bentley.com/scadaconnect)



*“I cannot imagine calibrating my model effectively without SCADAConnect.”*

—City of Casselberry, U.S.

## SUCCESS STORY: CITY OF BETHLEHEM, PA, U.S.

Bethlehem’s existing SCADA system provided operators with a fully functional operational control tool. However, when SCADA data was desired for modeling, the engineers had to contact an operator, who would then retrieve and transfer the information manually—a cumbersome, error-prone and expensive process.

SCADAConnect provided the modelers at the City of

Bethlehem Public Works Department with live access to both real-time and historical SCADA data from within WaterGEMS, enabling them to efficiently accomplish tasks such as initializing models from field conditions, estimating pressure and flow at unmonitored locations, and performing real-time system troubleshooting.

## Compatible SCADA systems include:

- ▶ Aspen
- ▶ Bristol Babcock
- ▶ Citect
- ▶ GE CIMPLICITY
- ▶ Honeywell
- ▶ Intellution
- ▶ Modbus
- ▶ Siemens
- ▶ Wonderware
- ▶ Yokogawa
- ▶ and many more...

# Control surge



"We should have designed a better surge protection system, but our current surge software is impossible to use."

## Featuring HAMMER

Every time a pump or valve is operated, potentially dangerous transients are introduced in your water system.

With a 15-year history of successful application on high-profile projects, HAMMER puts the power to perform this critical analysis in the hands of water system professionals.

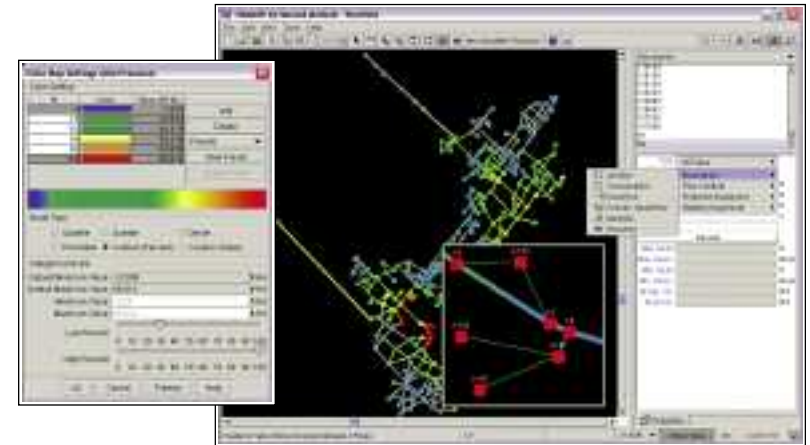


### UNCOMPROMISED HYDRAULICS

HAMMER uses the Method of Characteristics, the benchmark standard and unquestionably the most rigorous and robust algorithm for transient analyses.

*"HAMMER is the most advanced product in a new generation of programs developed for the analysis of transients."*

—Metrica Services Inc., Canada



Unchecked, surges can cause catastrophic damage to pipes and equipment, risk the safety of operators, allow intrusion of dangerous contaminants into the system, and interrupt service to customers. Over time, transients also increase wear and tear on pipes and pumps, leading to premature failure.

How can transients be eliminated or controlled?

The most cost-effective approach is to perform a transient analysis to locate trouble spots and determine appropriate surge control strategies.

[www.bentley.com/hammer](http://www.bentley.com/hammer)

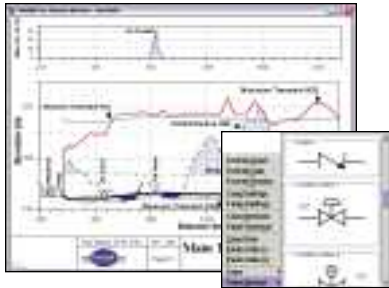
## With HAMMER:

- ▶ Prevent system damage
- ▶ Develop cost-effective surge control strategies
- ▶ Model any surge protection device
- ▶ Minimize wear and tear on pipes
- ▶ Simulate any transient condition
- ▶ Improve water quality
- ▶ Prepare for power failures
- ▶ Design hydropower systems
- ▶ Design and operate with greater reliability
- ▶ Trim construction and O&M budgets
- ▶ Eliminate costly over design
- ▶ Ensure the longevity of a water system
- ▶ Protect system operators
- ▶ Minimize service interruptions

## Interoperability

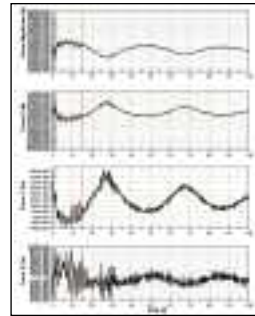
HAMMER is a stand-alone program, able to run both transient and steady-state (for initial condition calculation) analyses.

If you own WaterCAD or WaterGEMS, you can choose to use HAMMER as an integrated module, within the interface of your choice (stand-alone, AutoCAD, ArcGIS, or soon MicroStation).



## Transient force computation

Automatically compute the magnitude and direction of transient forces for each time step. Users can export results for use in structural analysis programs.



## Seeing is believing

HAMMER provides a range of tools to help interpret results, from color maps to dynamic plots and animated profiles that allow visualization of the wave propagation and rebound in slow motion.

## Easy data management

Query the data from totally customizable tables with sorts, filters, global edits, and customizable field labels and units.


| Line | Length (ft) | Diameter (in) | Thick Wall | Head Loss (ft) |
|------|-------------|---------------|------------|----------------|
| P1   | 50.000      | 300.000       |            |                |
| P2   | 250.000     | 300.000       |            |                |
| P3   | 375.000     | 450.000       |            |                |
| P4   | 225.000     | 450.000       |            |                |
| P5   | 450.000     | 450.000       |            |                |
| P6   | 175.000     | 450.000       |            |                |
| P7   | 300.000     | 450.000       |            |                |

The engineering libraries allow you to specify properties for pumps, liquids, and valves that can be reused across projects.

## Hydraulic components

HAMMER allows you to precisely simulate the impact of a wide range of surge protection devices and rotating equipment, including:

- ▶ Pumps (4 quadrant)
- ▶ Pressure relief valves
- ▶ Air valves
- ▶ Vacuum relief valves
- ▶ Vacuum breaker valves
- ▶ Surge anticipator valves
- ▶ Surge relief valves
- ▶ Gas vessels
- ▶ Surge tanks
- ▶ Rupture disks
- ▶ Turbines
- ▶ and more...

 HAMMER is based on technology originally created by Environmental Hydraulics Group, Inc. ([www.ehg-inc.com](http://www.ehg-inc.com))

## SUCCESS STORIES: AMERICAN WATER, U.S.

American Water, the largest U.S. water utility, selected HAMMER for an American Water Works Association Research Foundation study on the susceptibility of distribution systems to negative pressure transients.

The project is significant because of the potential for distribution system contamination when non-potable water is drawn into the system during negative pressure conditions.

American Water is applying HAMMER to as many as 15 distribution systems to determine the characteristics that make them most vulnerable to negative pressure transients.

The goal is to provide guidance to water utilities on applying surge models, selecting optimum pressure monitoring locations, and implementing effective mitigation strategies.

## CHESTERVILLE, ON, CANADA

Within 3 months after a new pump station was commissioned, over 20 pipe leaks were recorded and more were found daily. It was thought that the leaks were caused by excessively high transient pressures.

To the contrary, HAMMER predicted that severe sub-atmospheric pressures were occurring after each pump shutdown. This meant that during the normal pump-off cycle, groundwater, air, sand, and debris were being drawn into the pipe, damaging the seals, and compromising system integrity. This was confirmed through an investigation of the leaking pipe. HAMMER accurately identified the location and cause of the leaks and was used as a basis for implementing successful remedial measures that stopped the leakages.

# Reference books, training, and services

**R**eference books from Bentley are an essential component of any water resource professional's library, and are known for explaining complex concepts in clear, easy-to-read language.

These are not how-to guides for using software. They instead teach the concepts of applying hydraulic models and provide practical guidance based on the experiences of industry experts.

And, as a bonus, they provide complete study programs to earn Continuing Education Units (CEUs) and Professional Development Hours (PDHs).

*"The most helpful modeling book, period."*

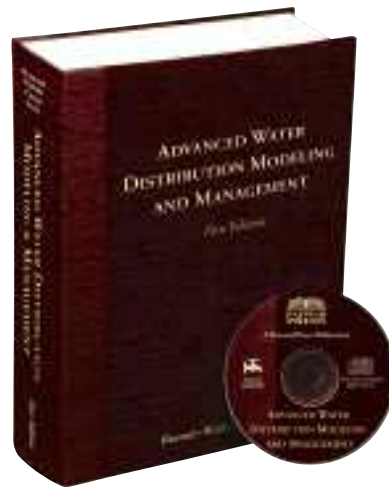
—Parsons Brinckerhoff, U.S.

*"A must have reference for any engineering library."*

—Spokane County Public Works, U.S.

*"A real masterpiece in water distribution modeling."*

—COPASA, Brazil



**5-Star Rating**  
\*\*\*\*\*  
**amazon.com.**

## Advanced Water Distribution Modeling and Management

Advanced Water Distribution Modeling and Management has become the **definitive resource** for water system professionals worldwide and is the perfect companion for WaterCAD and WaterGEMS.

A truly unique book, it addresses the challenges that engineers face in their day-to-day practice and walks the engineer through the modeling process from start to finish.

### Topics include:

- ▶ Water System Security
- ▶ Transient Analysis
- ▶ System Design and Operations
- ▶ Water Quality Analysis
- ▶ Modeling Theory
- ▶ Model Calibration
- ▶ Water Consumption
- ▶ Assembling a Model
- ▶ SCADA Systems
- ▶ GIS Integration
- ▶ System Optimization

**Includes WaterCAD**

[www.bentley.com/library](http://www.bentley.com/library)

## Professional Services



Bentley Professional Services is dedicated to helping you get the most of your investment in Bentley software by delivering customized solutions that enhance efficiency and make the best use of your people and IT resources.

Services offered range from custom software development, to model conversion and data pre- and post-processing, to systems integration and implementation. Let us help your organization achieve greater success using Bentley's technologies.

[www.bentley.com/hmprofessionalservices](http://www.bentley.com/hmprofessionalservices)

## Training from the Bentley Institute

While we endeavor to develop products that are so intuitive they can be used right out of the box, the best way to maximize the benefit from your modeling investment is with training from the Bentley Institute.

Through a unique blend of theory, software instruction, and practical know-how, our industry expert instructors will teach you to confidently apply hydraulic models in your day-to-day decision making.

### Training topics include:

- ▶ Building new models
- ▶ Automating system design
- ▶ Calibrating models
- ▶ Running fire flow analyses
- ▶ Modeling and evaluating water quality
- ▶ Assessing water security issues
- ▶ Determining energy consumption
- ▶ Analyzing pump and valve controls
- ▶ Sizing and analyzing tanks
- ▶ Handling transient problems
- ▶ Building models from GIS and other sources
- ▶ Developing model demands



For training locations and a complete list of Bentley Institute course offerings, visit:

[www.bentley.com/training](http://www.bentley.com/training)

## Flexible training options to accommodate your schedule

### LOCAL TRAINING

The Bentley Institute<sup>SM</sup> offers a comprehensive range of water distribution modeling and transient analysis courses every month in locations around the world.

Developed for engineers and managers of all experience levels from the public and private sectors, these two to five day courses take a unique approach that combines a review of hydraulic theory, in-depth software instruction, and hands-on workshops.

### ON-CAMPUS TRAINING

On-campus training focuses on one thing—maximizing your software modeling capabilities in the shortest period of time possible.

These one- and two-day courses are directed toward engineers who are already familiar with hydraulic modeling concepts. They are held at the Haestad Methods Solution Center's new, state-of-the-art software training facility in Watertown, CT (USA).

### ON-SITE TRAINING

With on-site training, we will provide customized instruction when you need it and where you need it. For one package price, you can train multiple employees on multiple software packages in your own environment.

Our training experts will work with your organization to tailor content to fit your specific needs. On-site training is particularly useful for project managers who require training but can't afford to be away from the office.

# Bentley SELECT® subscription

**B**entley SELECT is more than a service contract that supports Bentley products. It is a comprehensive technology and service subscription program that includes exclusive licensing privileges, continuous product upgrades, comprehensive technical support, discounts on training and software, and more.

*"As usual great software coupled with great tech support = extremely satisfied customer—me!!!"*

—Schneider Consultants Inc., U.S.

*"It had to be one of the easiest technical support calls I ever had to make."*

—Woolpert LLP, U.S.



## ATTENTION CLIENTCARE® SUBSCRIBERS:

To automatically convert your subscription online and start enjoying the benefits of SELECT, visit:

[www.bentley.com/CCtoSelect](http://www.bentley.com/CCtoSelect)



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Install your products on an unlimited number of computers on a local area network for no additional charge.

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**Evaluation Licenses**—Test drive any Bentley product through a 30-day expiring license.

**Home-Use Licenses**—Enhance your expertise by extending the use of Bentley products to the comfort of your home.

**SELECTServer®**—Simplify license management with a server-based site administration utility.

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[www.bentley.com/SELECT](http://www.bentley.com/SELECT)

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### Online account management

Manage all aspects of your company's account via the web, including licensing Bentley products, tracking support calls, setting user permissions, and running reports on online activities.



## WaterGEMS

[www.bentley.com/watgEMS](http://www.bentley.com/watgEMS)

**F**or consultants and utilities who need all the additional modules or a high level of data integration in order to get the most from their existing GIS resources.

### Included interfaces:

- ▶ Stand-alone
- ▶ AutoCAD
- ▶ ArcGIS
- ▶ MicroStation

### Included modules:

- ▶ Darwin
- ▶ Darwin Scheduler Calibrator
- ▶ Darwin Designer
- ▶ SCADACONnect
- ▶ Skelebrator

Available sizes range from 250 to unlimited pipes



## WaterCAD

[www.bentley.com/waterCAD](http://www.bentley.com/waterCAD)

**F**or consultants and utilities who need a very easy to use and powerful tool for analysis related to their water distribution system, such as cost assessment, system capacity and water quality studies.

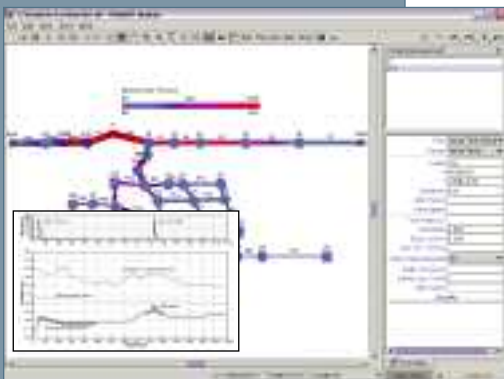
### Available interfaces:

- ▶ Stand-alone
- ▶ AutoCAD
- ▶ MicroStation

### Available modules:

- ▶ Darwin Calibrator
- ▶ Darwin Designer
- ▶ Skelebrator
- ▶ SCADACONnect
- ▶ Darwin Scheduler

Available sizes range from 10 to unlimited pipes



## HAMMER

[www.bentley.com/hammer](http://www.bentley.com/hammer)

**F**or any organization involved in pressurized piping systems where damages caused by transients are likely to happen.

### Included interfaces:

- ▶ Stand-alone
- ▶ ArcGIS
- ▶ AutoCAD
- ▶ MicroStation

### Calculation:

- ▶ Steady-state simulation
- ▶ Methods of Characteristics for transient analysis

Available size is unlimited pipes

# Contact us

Don't hesitate to contact us for any question, quote request, or to talk with a sales person.

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## The following is a partial list of clients who use Haestad Methods solutions

Abu Dhabi Distribution Company (UNITED ARAB EMIRATES) • ActewAGL (AUSTRALIA) • Acueductos y Alcantarillados CA (DOMINICAN REPUBLIC) • Aguas Argentinas (ARGENTINA) • Aguas De Niteroi S/A (BRAZIL) • Aguas Del Café S A (COLOMBIA) • Aguas del Gran Buenos Aires SA (ARGENTINA) • Alabama DEM • Alaska Native Tribal Health Consortium • Alexandria Water General Authority (EGYPT) • Alyt Water Company (LITHUANIA) • American Water • American Water Works Company • Anne Arundel County Public Works • Arlington County • Artesian Water Company • Arup (ENGLAND) • ASAV spa (ITALY) • Augusta Water District • Austin Utilities • Authority Hong Kong (HONG KONG) • Bay County • BCEOM (FRANCE) • Beaufort-Jasper Water & Sewer Authority • Bechtel Corporation • Bena Consulting Engineers (AUSTRIA) • Berkeley County Water & Sanitation • Black & Veatch • Bonnard & Gardel SA (SWITZERLAND) • Boyle Engineering • Brown & Caldwell • Bureau of Indian Affairs • Burgess & Niple • Burns & McDonnell • Buski Water & Sewerage (TURKEY) • Cabanatuan City Water District (PHILIPPINES) • Caboolture Shire Council (AUSTRALIA) • Camp Dresser & McKee • Caribou Utilities District • Carter & Burgess • CEGERTEC (CANADA) • Central Arkansas Water • Central Utah Water Conservancy District • CH2M Hill • Champlain Water District • Charleston Commissioner of Public Works • Charlotte County Utilities • Charlotte-Mecklenburg Utilities • Charter Township of Grand Blanc • Chemonics Egypt • Chester Water Authority • Chevron Chemical Co • Cheyenne Board of Public Utilities • Chicago Department of Water • China Engineering Consultants, Inc (TAIWAN) • Christchurch City (NEW ZEALAND) • CID (MOROCCO) • City of Albany • City of Alexandria • City of Annapolis DPW • City of Apache Junction • City of Auburn • City of Baltimore • City of Bethlehem • City of Bloomington Utilities • City of Boca Raton • City of Boise • City of Bloomfield • City of Buffalo • City of California City • City of Casper • City of Charlottesville • City of Chesapeake • City of Clemson • City of Columbia • City of Evanston • City of Falls Church • City of Farmington Hills • City of Flagstaff • City of Flint • City of Fort Wayne • City of Germantown • City of Grand Junction • City of Great Falls • City of Greater Sudbury (CANADA) • City of Harrisonburg • City of Huntington Beach • City of Independence • City of Ithaca • City of Jackson • City of Kansas City • City of Kent • City of Kissimmee • City of Klamath Falls • City of Kotka (FINLAND) • City of Lodi • City of Lynchburg • City of Midland • City of Nampa • City of Niagara Falls (CANADA) • City of North Myrtle Beach • City of Northampton • City of Oakdale • City of Odessa • City of Olympia • City of Pasadena • City of Peoria • City of Portland • City of Portsmouth • City of Poughkeepsie • City of Redmond • City of Richmond • City of Roanoke • City of Rockville • City of Round Rock • City of Salt Lake City • City of Savannah • City of Schenectady • City of Sparks • City of Springfield • City of St Louis • City of St Paul • City of Sunnyside • City of Tampa • City of Toronto (CANADA) • City of Tucson • City of Tulsa • City of Vero Beach • City of Virginia Beach • City of Warwick • City of Whitefish • City of Wilmington • Collier County Public Works • Colorado Municipal Water District • Columbus Water Works • Comision Estatal de Servicios Publicos Tijuana (MEXICO) • Comision Federal de Electricidad (MEXICO) • Comision Nacional del Agua (MEXICO) • Compagnie Générale des Eaux (FRANCE) • Compania de Aguas de Puerto Rico • Consorzio di Bonifica Adige Garda (ITALY) • Consulaqua Hamburg Beratungsgesellschaft (GERMANY) • Cooperación Técnica Alemana (BOLIVIA) • COPASA (BRAZIL) • Cordon y Merida Ings (GUATEMALA) • CORSAN (BRAZIL) • CORSAN (SPAIN) • County of Hawaii • County of Kauai • County of Los Angeles • County of Maui • County of Roanoke • County of Sacramento • County of Yakima • CSD Ingenieurs Conseils SA (SWITZERLAND) • CTGI Lda (PORTUGAL) • D.C. 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(VENEZUELA) • Hidrogradnja (LIBYA) • Hydrograaf • Hobart City Council (AUSTRALIA) • Hydretudes (FRANCE) • HydroConseil (KOREA) • Iberinsa - Iberica de Estudios e Ingenieria SA (SPAIN) • IBG Ltd (SWITZERLAND) • Health Service • Indiana-American Water Company • Instituto Costarricense de Acueductos y Alcantarillados (COSTA RICA) • ITT Flygt (SWEDEN) • Jackson Utility Division • Jerusalem Jacksonvile Electric Authority • Jefferson Parish • Jenin Municipality (ISRAEL) • Jerusalem Goulding • Joseph John & Associates Ltd (GRENADA) • Jurutera Perunding Primareka Sdn Bhd (MALAYSIA) • Kauai Department of Water • Kelllogg Brown & Root Services • Khatib & Alami (LEBANON) • Kimley Horn & Associates Inc • Kuwait Ministries (KUWAIT) • Lahmeyer International GmbH (GERMANY) • Lake County • Las Virgenes Municipal Water District • Lehigh County Authority • Libanconsult (LEBANON) • Los Alamos County Utilities Dept • Lower Colorado River Authority • Madera Valley Water Company • Madison County Water Department • Mahindra Water Utilities Ltd (INDIA) • Malcolm Pirnie • Male Water & Sewerage Company Pvt Ltd (MALDIVES) • Metaferia Consulting Engineers (ETHIOPIA) • Metcalf & Eddy • Metro Iloilo Water District (PHILIPPINES) • MidCoast Water (AUSTRALIA) • Mina Pública d'Aigües de Terrassa, S.A. 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