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Hydraulic Modeling Calibration: Best Practices

The calibration of water systems models is relevant to any pressurized water system, whether we're talking about potable water, reclaimed or recycled water, or a water treatment plant. Once your model is built, it is crucial to understand and perform the necessary steps in modeling calibration and understand what your model will accomplish to know how well it should be calibrated.

There are three different analysis types to calibrate on and different parameters that should be adjusted at each step:

1. Steady-State Normal Demands, includes evaluating and/or adjusting the following:

- Tank Water Levels – specifically, initial levels are important
- Elevations of junctions – setting the point to build your model
- Elevations of facilities – namely pumps and valves in InfoWater Pro
- Pump curves – pumps will wear over time and their operating points may change.
- Pressure zone boundaries – areas with similar hydraulic grade lines, normally separated by control values, are important in managing pressure in the system.
- Valve set points – InfoWater Pro has 8 different types of valves which can be modeled, and the valve setting (the pressure, flow, percent open setting depending on the valve type) is important to any calibration.

2. Steady-State High Demands, peak hour or fire flow case includes evaluating and/or adjusting the following:

- Pipe roughness – usually use Hazen-William's equation, sometimes Darcy-Weisbach
- Demand allocation - ensuring water demand is appropriately allocated to the correct junction
- Connectivity – important to double-check intersections or pipes near each other so that pipes that should be connected are connected, and pipes that shouldn't be connected, aren't connected

- Pipe size – making sure the pipe's size is correct between what's in the model and what's in the field
- Excessive skeletonization – less necessary with higher-levels of computing and can lead to higher head loss values than realistic

3. Extended Period Simulation, includes evaluating and/or adjusting the following:

- Pump/valve controls – make sure manual or automatic operations controls are modeled
- Demand Patterns – diurnal curves may vary depending on locations, users, and seasonality
- Tank dimensions – critical as tanks fill and empty

In summary, the parameters adjusted in the normal demand calibration will impact the high demands model run, and the factors adjusted in the high demand calibration will impact the EPS run. The successive approach laid out here will make it easier to calibrate a model instead of overcomplicating the process.

Essential Steps in the Model Calibration Lifecycle:

Field data collection

- Fire hydrant tests
- Pressure loggers
- SCADA data
- System pressure
- Flow rates
- Tank levels

Replicate Field Conditions

- Match boundary conditions (pump/valve on/off status, tank levels)
- Match Demands

Compare Model Results with Field Results

- Monitor and confirm your model design is aligned with what is going on in the field.
- The differences between the field measurements and results from the model should be within a certain range in order to consider the model to be calibrated. The AWWA M32 handbook provides guidelines for these ranges, and they can be different depending on what the model will be used to do.

Adjust Model as Necessary

- Reference the first set of calibration points and evaluate, monitor, and reset settings and design as needed.
- As new development comes in and the system ages, the model will deviate further from reality. Depending on the organization's needs and whether they use the model for planning, design, or operations, the frequency of how often a model should be re-calibrated will change.

Once the model is calibrated it is important to verify the model.

Verification

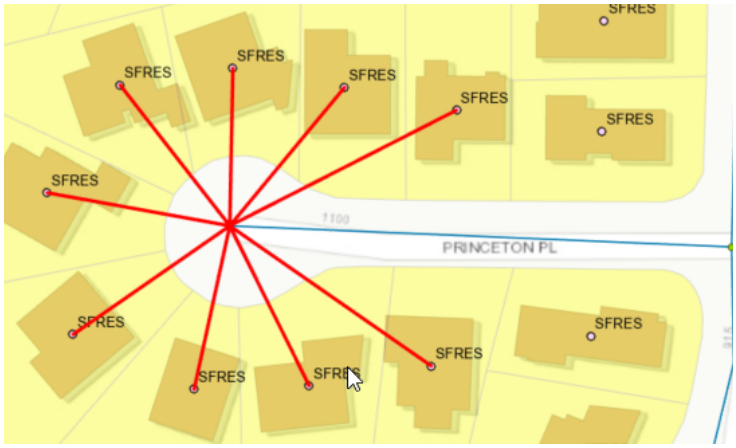
Once you get your model calibrated you might consider the project complete, but there are still a few more things to check. The model needs to be verified under different data and conditions to ensure that the model wasn't calibrated to the point in time from which the data was gathered but can generally be considered accurate enough for all time, data, and conditions.

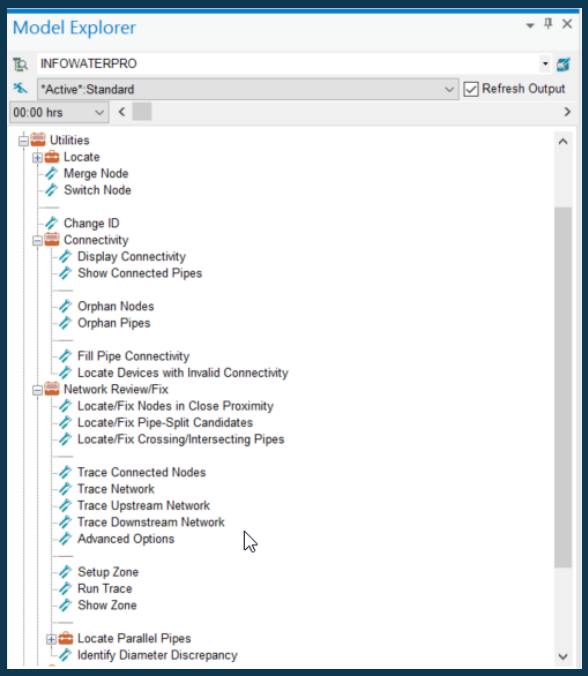
InfoWater Pro and InfoWater Pro Suite come filled with tools and applications to speed the process of model calibration.

A few key examples of these include:

Demand allocation

InfoWater Pro has an extensive demand allocation tool that helps to appropriately distribute demands. When you calibrate, it's an opportunity to look at the demand allocation and see how the demands are distributed and need to be adjusted during calibration.



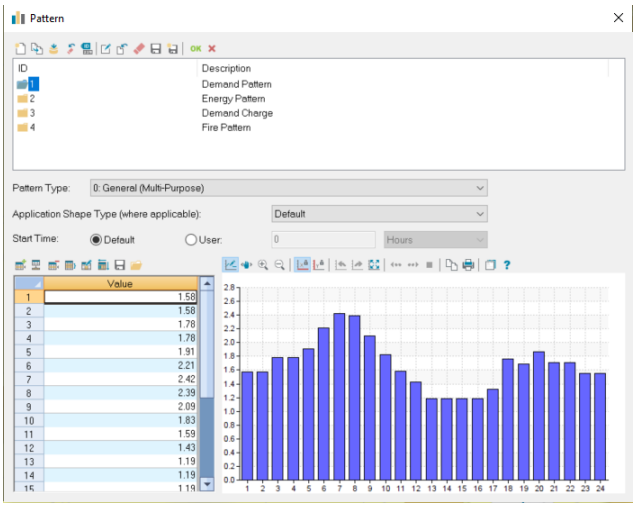


Connectivity

Network connectivity is hugely important to any modeling effort, and InfoWater Pro comes packed with tools to make your review process as easy as possible. Whether your GIS is in standard network configuration or standalone features, outdated or brand new, in ArcGIS Online or on-prem, InfoWater Pro has helpful tools to make it hydraulically accurate.

Demand patterns

Demand patterns should be adjusted during the calibration of the extended period simulation. It's essential to verify if the demand patterns are realistic. The Demand Analyst in InfoWater Pro Suite can analyze historic demands from each meter and quickly extract the patterns and demand values instead of developing these patterns using spreadsheets or other time-consuming methods.



In addition to the tools and applications highlighted above, InfoWater Pro and InfoWater Pro Suite come with many other tools and applications, including Calibrator, Pressure Zone Manager, Water Quality Calibrator, Elevation Extractor, and Live Data Connector to make the process of calibrating a water model much more manageable.

Hydraulic modeling calibration can be a tricky, technical process. At Innovyze, we hope to simplify this process by providing the right tools, like InfoWater Pro and the right people. Innovyze Technical Support consists of fully qualified and experienced engineers ready to help via phone, video call, email, or support portal.