



# Seasonal Operations Optimization

## Summer & winter operations optimization for City of Bend, OR

### KEY POINTS

- 23% savings achieved against summer baseline energy costs
- Maximized use of surface water and reduced groundwater pumping
- Optimal use of existing infrastructure

The CITY OF BEND engaged Optimatics to review and optimize current system operations. The aim of the optimization was to minimize energy costs, maximize the use of surface water and improve reservoir turn-over. Two distinct scenarios were evaluated representing typical summer and winter conditions.

### SYSTEM DESCRIPTION

The City of Bend, located in Central Oregon, serves approximately 60,000 residents. The City is fortunate to be located near water sources with excellent quality – groundwater from the substantial Deschutes Aquifer and surface water collected from the Cascade Mountains.

Surface water supply is collected 13 miles from the City limits and delivered to the system via the Outback facility. Groundwater is extracted at nine well locations spread across the City.

### PURPOSE

The operation of the Bend system varies throughout the year. During winter, supply is primarily from the surface water source. Under summer demand conditions it is necessary to turn on a number of groundwater wells to supplement the surface supply. The aims for improving

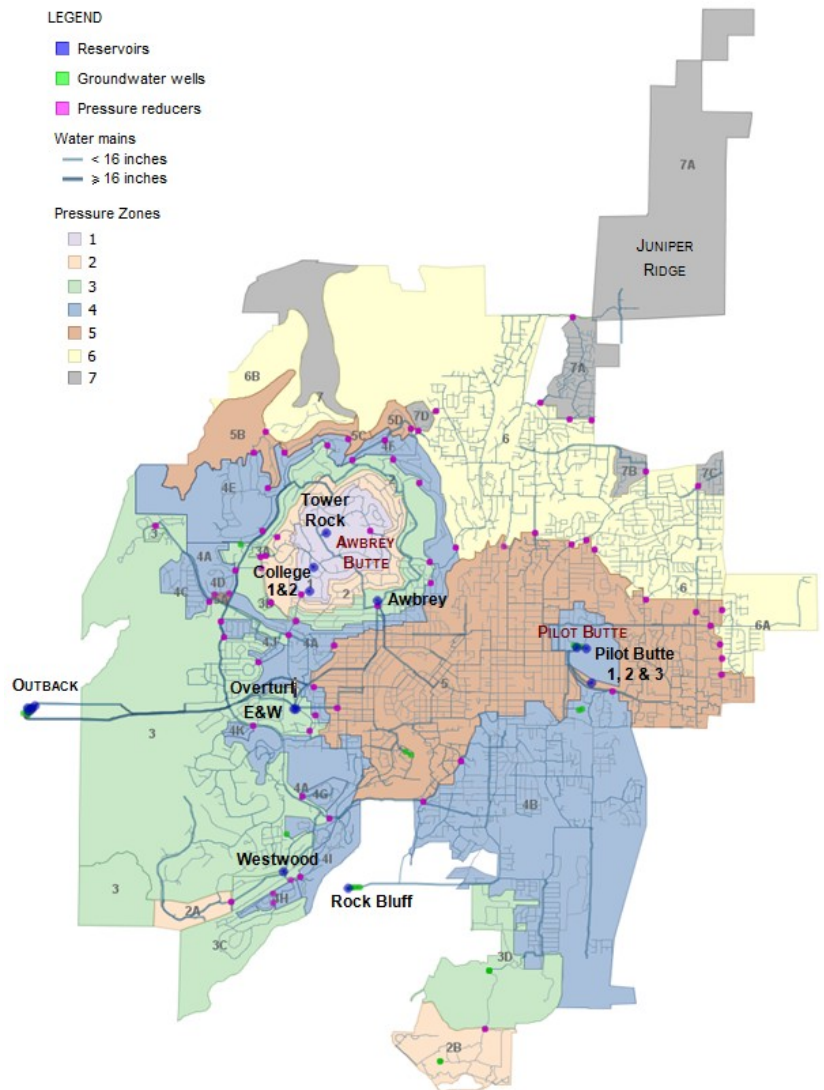
system operations in each season differ considerably.

The focus of the summer operations optimization was to minimize pumping energy costs

by maximizing surface water use where possible.

For the winter operations optimization, improving turnover in key reservoirs was a major aim.

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Bend Service area showing pressure levels and major supply and storage facilities

### OPTIMATICS

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# Optimatics

optimizing water systems

## The optimization modified operating set points to improve water transmission, reduce energy costs and improve reservoir turnover under summer and winter scenarios with only minor capital upgrades

### BASELINE SCENARIOS

The optimization analyses were based on evaluation of a calibrated hydraulic model, developed for the City by Murray, Smith and Associates, Inc (MSA). Summer and winter models developed in the extended period simulation calibration effort were used as the baseline cases for comparison as they represent typical operating conditions for the existing system.

Optimatics studied historical water production and energy cost data to determine the relationship between customer water use and energy costs. Annual operating costs over the last few years for water facilities (wells, booster pumps, surface water facilities and disinfection) is on the order of \$700,000.

The City is not subject to 'time-of-use' tariff rates, so the key to reducing energy costs is minimizing overall energy consumption. This aligns well with the City's desire to maximize surface (gravity) supply.

#### Problem Formulation

Optimatics formulated the

optimization to consider a wide range of decision options aimed at achieving the objectives of reduced energy costs and improved reservoir turnover while maintaining hydraulic performance throughout the system.

Decision options included minor capital improvements such as short piping connections and small booster pump stations, changes to existing control valve settings, modification of zone boundary locations and introduction or modification of well and booster pump controls.

Hydraulic design criteria were considered in the optimization and included establishing the required minimum pressure at customer connections and also how storage levels should vary throughout the day.

### RESULTS AND CONCLUSIONS

The results of the optimization runs demonstrated that there is opportunity to significantly reduce Bend's summertime operating costs with only minor capital upgrades. In addition, the solutions demonstrated operating

strategies that could be used to maximize use of surface water in the existing system and improve reservoir turnover in the winter.

Three recommended strategies were presented to the City – two Summer Strategies with different wells operating but similar costs, and one Winter Strategy. Both Summer Strategies were shown to be 23% less costly than the Baseline Summer Scenario, while the Winter Solution is 67% less costly than the Baseline Winter Scenario.

Study recommendations included:

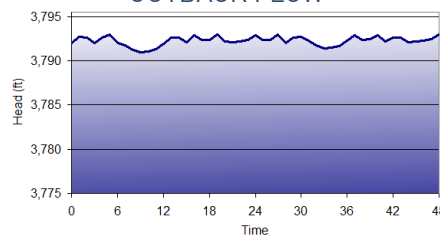
Restricting flow into key reservoirs during periods of high demand to reduce peak flows in transmission lines

Adjusting PRV settings to facilitate transfer of flow from west to east, thus maximizing surface water supply

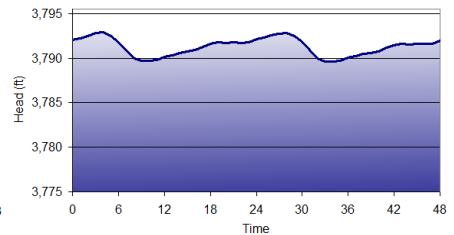
Boosting surface water between zones rather than pumping groundwater at higher heads, when possible

Addition of strategically placed control valves to force reservoirs to draw down during low demand periods.

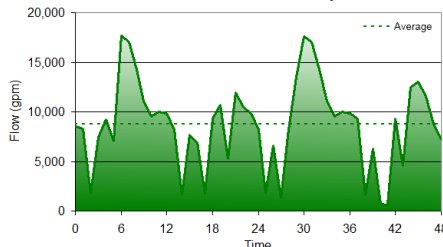
AWBREY RESERVOIR LEVEL & OUTBACK FLOW



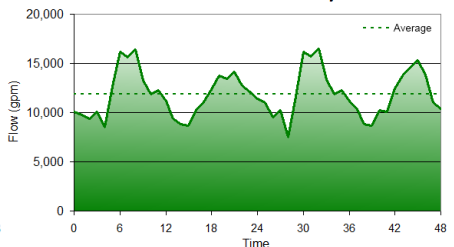
AWBREY RESERVOIR LEVEL & OUTBACK FLOW



Flow from Outback Facility



Flow from Outback Facility



These charts demonstrate how restricting flow into the Awbrey Reservoir and forcing the level to vary over a wider range minimizes peak flows from the Outback facility and increases the overall average output