

# OptiFacts



**Optimatics**

Water Systems Optimization

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## Water Quality and Operations Optimization

Reducing energy and improving water quality

**LAS VEGAS VALLEY WATER DISTRICT (LVVWD)** faces increasingly complicated and challenging water quality and operations issues. Water age and energy management issues are examples of where optimization could be used to help and to support system operations and management.

### Background

With the Stage 2 Disinfection By-Products Rule coming into effect, the LVVWD (like many other utilities) needs to address potential water quality issues. District staff recently completed a system-wide operations model which they used to get an initial assessment of water age in the system.

LVVWD discovered certain areas were exhibiting high water age, particularly where new storage and pumping facilities have been constructed to serve future demands, which are much higher than current demands.

The District decided their needs would best be served by developing software they could

regularly utilize in-house to revise operations as the system conditions evolved in order to maintain acceptable water quality, while minimizing system operating costs.

### The Project

Optimatics first performed a feasibility study to develop a suitable water age and operations optimization approach, and then proceeded with a proving/demonstration stage.

The challenges were, first, the long genetic algorithm (GA) optimization run times - a hydraulic simulation of up to 28 days was necessary for the water age calculation (compared to one day simulation used on hydraulic

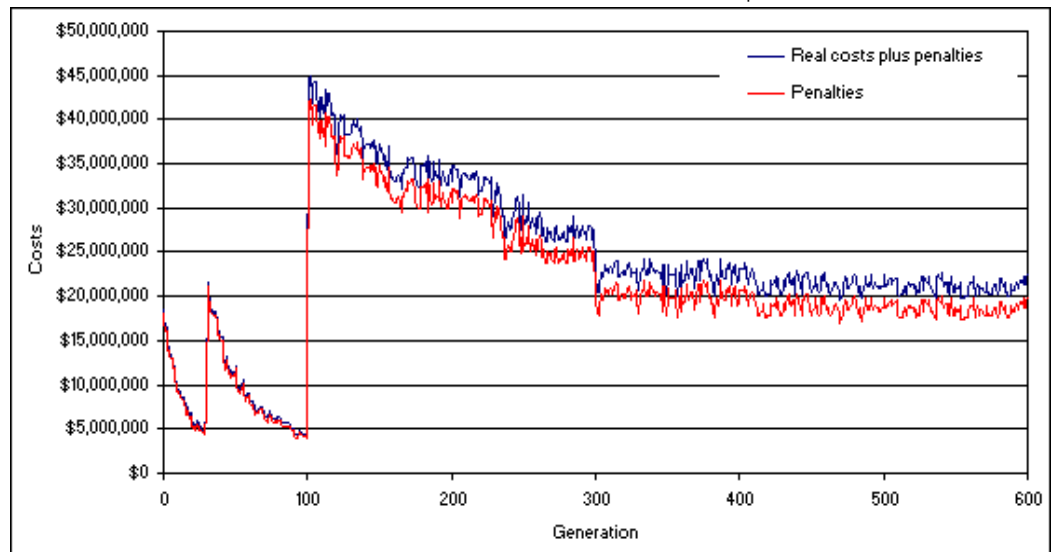
studies). Next, the large number of decision variables needed for operations - turnout flows, pumping hours and valve settings for many facilities.

The objective of the Optimatics GA optimization model was to minimize water age and system operating costs.

The OGA evaluated many thousands of combinations of turnout, pumps and valve set points as it searched for the least cost combination. A high water age translated to a higher solution cost, while system operating costs were calculated over the simulation period. Design and performance criteria specified by the District were input as constraints into the optimization.

### KEY POINTS

- Customized software to develop daily operation plan
- Client able to use software in-house
- Minimized water age and system operating costs



**OGA optimization search - Minimizing water age (represented as a penalty cost) and operating costs**

### Study Objective

The objective of the study was to create a tool that could simultaneously optimize the system for operating costs and water age.

The analysis had to be carried out once per day and it was suggested that over night, the tool could use all the computers at the LVVWD for processing power to be able to carry out the run. This meant creating a tool that would work over a distributed network.

### Key Outcomes

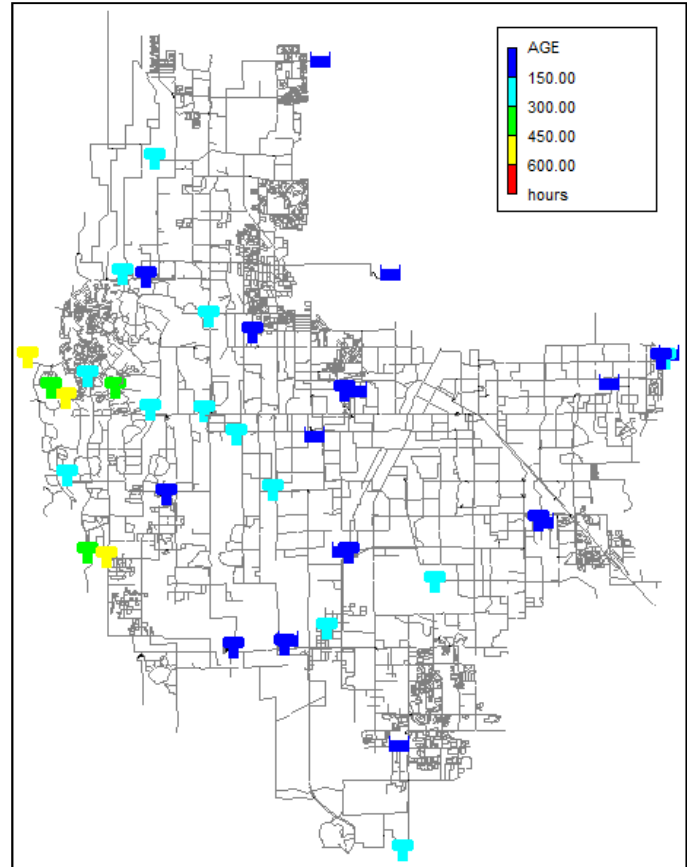
The water age operations software was developed for a typical winter demand case with no groundwater recharge.

System operating costs did not improve in the proving stage results, and this aspect of the optimization will receive much more attention in the subsequent implementation stage.

It should be noted that Optimatics utilized its distributed computing version of its OGA software to enhance the speed of the optimization search. Optimatics later helped the District install and test a demonstration version of the OGA running on a network of Planning Department computers.

### Benefits

The proving stage results showed a 13% reduction in the average age in 28 tanks throughout the system and significantly improved age at many critical nodes compared to the original District model.



**Optimized proving stage solution (above) shows lower water age than LVVWD current solution (below)**

