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optimizing water systems

West of Hills Optimization Study

Master plan optimization for East Bay Municipal Utility District, California

KEY POINTS

- Complex system operations
- Three 24-hour demand cases assessed in one analysis
- Strict operational criteria

Optimizer WDS is a great tool for solving complicated system problems. Operation of the West of Hills distribution system is extremely complex. There are 20 rate control stations that can range from closed to fully open at any time during the day. One misstep on the operation of those valves causes the Claremont Tunnel to drop out or overflow. The Optimization software not only found an operating plan that works, but the plan maximizes the water turnover in the distribution reservoirs.

EBMUD challenged Optimatics to optimize capital improvements and system operations for the WOH system under year 2030 demands. The optimization considered multiple demand cases in developing a preferred solution that met strict operational criteria.

SYSTEM DESCRIPTION

The EBMUD service area is located in the eastern portion of the San Francisco Bay Area providing potable water to 1.3 million people in and around Oakland. The East Bay Hills divide the service area into two systems: the West of Hills area and the East of Hills area. The optimization study considered the West of Hills (WOH) area.

The WOH area receives treated water from four sources. The major treatment plant, Orinda, located centrally in the WOH area, does not have a local clearwell, and two other plants only have small clearwells relative to plant capacity. Large open-cut reservoirs in the distribution system help provide the necessary buffering of peak flows. The fourth source of supply is a connection to the East of Hills system used only in an emergency.

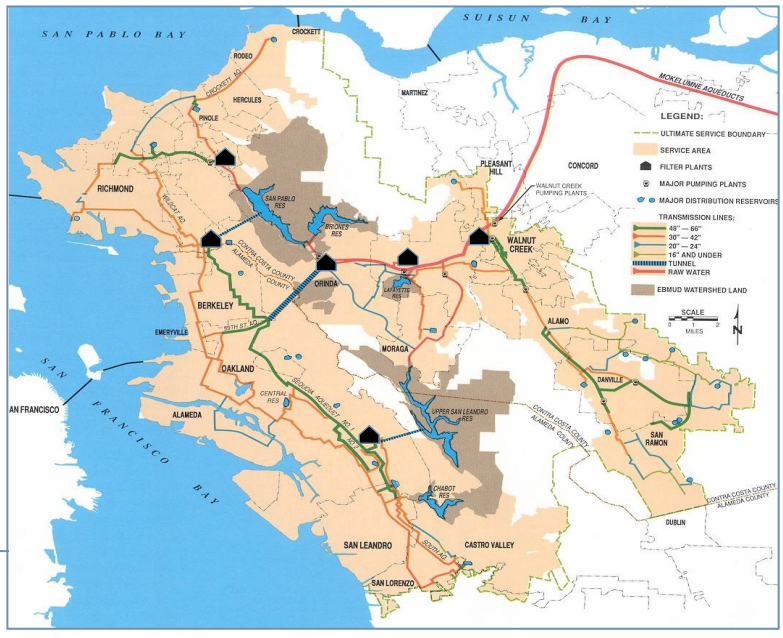
Due to the large variation in elevations throughout the WOH area, the system is divided into 77 pressure zones (PZs). The optimization study focused on the base gravity PZs: Central, Aqueduct and Upper San Leandro (USL). These three PZs constitute a significant portion of the total system.

PURPOSE

The purpose of the West of Hills Study was to plan and optimize the configuration of the water treatment, transmission and distribution system facilities to meet projected 2040 water demands.

Current system challenges facing EBMUD include:

- aging transmission and distribution pipeline, pumping and storage infrastructure,
- excess storage capacity leading to high water age resulting in water quality challenges,
- limited aqueduct or transmission capacity, and
- significant differences in system operation between summer and winter.



EBMUD Service area highlighting location of major treatment facilities and transmission lines

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Multiple demand scenarios were evaluated while locating and sizing supply, pipeline, storage, pump station and flow control capital options, and pumping and flow control station operating decisions

PROJECT SCOPE

The following decision options were considered in undertaking the optimization study:

The cost of building a clearwell at the Orinda WTP versus rebuilding remote clearwell storage volume within the distribution system.

Options to parallel existing pipes or install new pipes within the system to improve transmission capacity, including pipe alignment and diameter.

Modifications to existing storages and options for new storages including the location, water elevation set points and volume of storage.

Modifications to existing pumping plants (PP) and options for new PP, including the location and capacity of the PP.

Suitable set points and operating plans for the rate control stations and pumping plants in the system.

The WOH system operation changes significantly depending on the level of demand. The Orinda WTP is located centrally and operates year-round. As demands increase, WTPs in the north and south of the system are brought online, changing the way the system is operated and water is distributed through the major aqueducts. As a result it was necessary to consider a number of different demand cases when sizing individual facilities and optimizing system operations.

The optimization approach is most powerful when the Utility Planning and Operations staff work together, along with input from Optimatics engineers. Prior to the optimization study, EBMUD Planning and Operations staff collected data related to capital improvement options and developed detailed costs. Throughout the study Planning and Operations staff were heavily involved in review of the solutions generated from the optimization.

RESULTS AND CONCLUSIONS

EBMUD experienced a new level of analysis capability by applying the Optimatics' optimization tools to the WOH Master Plan. The optimization program was formulated to identify a range of alternative near-optimal solutions. Various demand scenarios were evaluated while locating and sizing supply, pipeline, storage, pump station and flow control capital options, as well as pumping and flow control station operating decisions.

Bringing together the knowledge and expertise of staff in the Planning and Operations departments and using this to guide the formal optimization process enabled EBMUD to establish optimized capital improvements while at the same time optimizing operations. EBMUD managers believe the study led to improved solutions including fewer capital works than were initially perceived to be needed.

Feedback from EBMUD Planning staff indicated that without the optimization, the master planning effort would have proceeded assuming future operations matched current system operation. The optimization identified a more efficient system operation for the future conditions with new facilities.

Optimatics' optimization tools and fresh perspective also allowed EBMUD to consider a multitude of options that could not have been evaluated with a traditional design approach in a reasonable timeframe. The transparent evaluation process allowed for unbiased assessment of capital infrastructure options. Unexpected capital improvements were suggested by the optimization results including a major pipeline in the Central PZ and less total storage.

Pardee Reservoir, located in the Mokelumne Area of the Sierra Foothills, captures snow melt runoff which is delivered to the EBMUD system via the Mokelumne Aqueduct