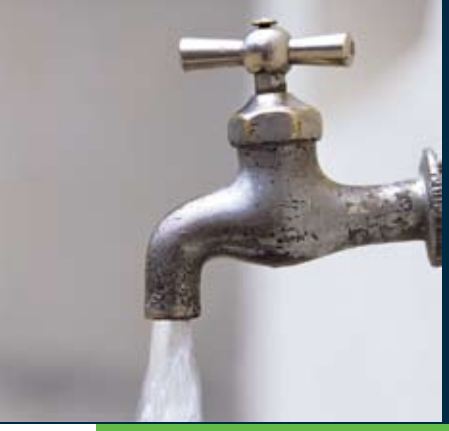
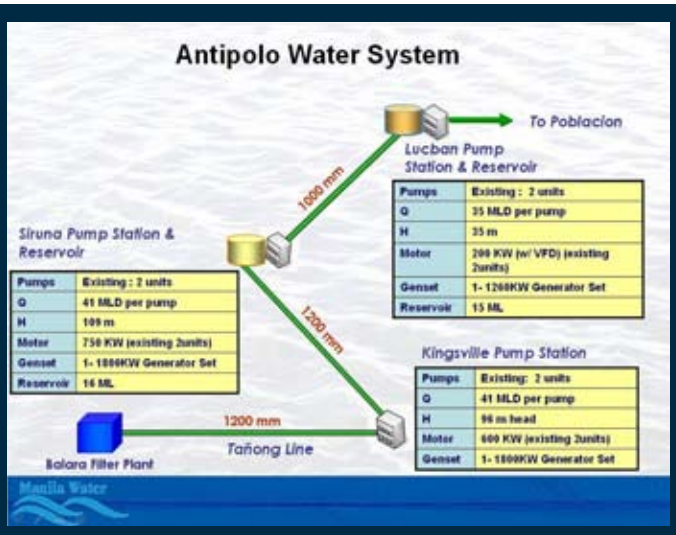


Bentley® WaterGEMS® and Bentley HAMMER™ help Manila Water to improve the reliability and efficiency of the Antipolo Water Supply System

Antipolo City is located in the northern half of Rizal Province which is within the eastern boundary of metropolitan Manila. Antipolo City is the second largest in Rizal Province, with a total land area of 38,575 hectares. The topography of the service area is rugged, rising from the coastal plain at elevations of about 6 to 12 m above sea level in the Mayamot area up to 300m on the eastern border of the service area.

In order to optimize the Antipolo Water Supply System, Manila Water's plan was to:

- Cater for the anticipated rapid growth of the area from a current population of 656,000 people to 2.2 million by 2022,
- Evaluate the steady state and transient hydraulics of the preferred pipeline, pump station and reservoir combination,
- Improve the reliability and efficiency of the Antipolo network system.



The Antipolo network system is comprised of 3 stages of pumping stations located at Kingsville, Siruna and Lucban, and 2 reservoirs at Siruna and Lucban. From the Balara treatment plant, water is being supplied to Antipolo by gravity through the 1200mm Tanong Line, which serves as the suction line to Kingsville pumping station. Water is then pumped from the Kingsville pumping station to the Siruna pumping station and then into the reservoir via the 1200mm primary line, and finally it is pumped to Lucban Reservoir via the 1000mm primary line.

THE CHALLENGE

This project was not going to be easy, since the Antipolo water supply system presented many challenges.

The 1200 mm suction line had limited capacity. It served as a constraint in maximizing the output of the first pumping station in Kingsville.

Table of Elevation Ranges in Antipolo

	Elevation (m)	Area (ha)	Percent (%)
0	<100	4,040.17	10.5
1	100	8,400.16	21.8
2	200	9,584.03	24.8
3	300	6,568.96	17.0
4	400	4,885.86	12.7
5	500	2,767.59	7.2
6	600	1,505.64	3.9
7	700	622.25	1.6
8	800	160.86	0.4
9	900 and above	39.52	0.1
Total		38,575.04	100

The hilly terrain of the Antipolo area presented one of the major difficulties in designing the water distribution system for the area. Its topography has an extreme range of elevations with areas having elevations as high as 300m to a low point of around 20m above sea level. Efforts to overcome this challenge were previously made by maintaining high pressure heads at the pumping stations, but the extreme differences in elevation created intensively high pressure heads in the low-lying areas (areas near the source or downstream of Antipolo) and these high pressures resulted in pipe breakages.

Last but not least, communities living in the area for expansion consist mostly of low income families, who get their water supply from shallow wells, private deep wells and water delivery trucks. This is not only too expensive but these families have to tolerate low water quality which may impose health risks .

To overcome these challenges, a hydraulic model of the Antipolo water system was created. Hydraulic and transient simulations were conducted to analyze network constraints and to identify possible solutions to improve the performance of the Antipolo network.

Bentley Sustaining Infrastructure

Incidents of power failure were very frequent in the area, thus creating sudden shifts in pumping operations, which again resulted in several incidents of pipe breakages and water supply interruptions.

Based on the simulations and intensive field investigation, network improvement projects were conceptualized, designed and implemented.

WATER MODELING PLAN

First, the hydraulic network model was calibrated in WaterGEMS V8 XM Edition, based both on field data and the existing network database. Hydraulic and transient simulations using WaterGEMS and HAMMER helped to locate critical locations in the system.

Strategies to control potential transients were also identified through appropriate flow control operations and the installation of surge protection devices. Pump operation schedules were also simulated using the model to come up with the most efficient scheme.

Manila Water has also successfully implemented a program to develop a water service connection scheme for low income customers. This flagship project is called "Tubig Para sa Barangay" (or TPSB). Sixty-three millimeter HDPE pipes were laid on the narrow streets of the communities that will now receive the new potable water service. Service connections and water meters were installed in groups to save both space and cost. The type of service connection varies from individual, to shared (one meter serving four to five families), to bulk (community service with a mother meter).

WaterGEMS was used in creating and developing the water network model of Antipolo City. The GIS database (Shapefiles) of the existing pipe network was automatically imported into the WaterGEMS model using WaterGEMS ModelBuilder™ to create the network model. Then, the WaterGEMS TRex™ module was used to extract elevation data from the GIS database consisting of contour, topology, and GPS data.

Next, Excel files of the existing and projected demands (Year 2007, 2008, and 2012) and demand profiles and other hydraulic patterns of the existing network were imported into the WaterGEMS model.

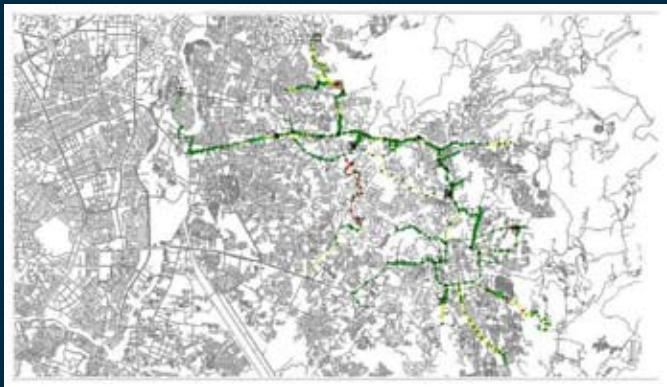
Using the 5-year demand projection, Manila Water's engineers also ran steady state and extended period simulations in WaterGEMS to design the network to supply the mountain communities and expansion areas of Antipolo.

The WaterGEMS model was then opened in HAMMER for transient analysis. Several scenarios were created using different pump operations and different times of power failure, to identify critical areas affected by transients. Based on this, surge protection solutions were proposed, and appropriate flow control operations were identified.

Christine Aubrey Nocum, Network Systems Manager at Manila Water Company said: "With its impressive capability to integrate with our company's existing software applications, the use of WaterGEMS and HAMMER made it much easier for us to design and manage our water network, as we continuously expand our services and improve the lives of our customers."

Antipolo Water System Pressure Zones

The primary reliability strategy for this project was to subdivide the water distribution network into separate pressure zones. Four pressure zones were identified: the Unboosted Zone, the Siruna Pressure Zone, the Lucban Pressure Zone and the Lucban Pump Zone. Since the Unboosted Zone has constraints in maximizing the output of the water system, a parallel line coming from the Siruna Pressure Zone was installed to cover some areas of the Unboosted Zone. The strategy was to minimize the area covered by the Unboosted Zone. Smaller pressure zones will then be created by creating smaller reservoirs (with 1-5ML capacity) in areas of rolling terrain, to break pressure surges due to extreme differences in elevation, and to ensure water availability even if there are interruptions in pumping operations.



ANTIPOLO WATER SYSTEM NETWORK MODEL

Engineers at Manila Water created four scenarios - Master Plan, 2007, 2008, and 2012 – in WaterGEMS. The Master Plan scenario was used to develop the master plan for the improvement of the water network using demand projections over more than 5 years. The 2007, 2008 and 2012 scenarios were used to identify which network improvement projects or activities should be completed or implemented by the end of each respective year based on the master plan. Demand projections for each scenario were also used in the simulations. The company's customer and technical standards, such as water pressure, flow velocity and water availability were also considered in analyzing the model.

COST AND HEALTH IMPROVEMENTS FOR THE LOCAL POPULATION

Christine Aubrey Nocum explained how this project affected the local population: "This project benefited a total population of more than 709,000 people which equates to more than 140,000 households and it will benefit 3,000 more households upon completion of the network's expansion. The completion of the network improvement project for the Antipolo Water System will not only improve the water supply and pressure in the area but more importantly, the quality of life of the people of Antipolo.

The TPSB project paved the way for low income families of the mountain communities to have their own water service connections at a significantly lower cost. An ordinary water service connection costs at least PhP 7,511 (US $186) while the TPSB service connection costs only PhP 1,800 (US $44.57), and can be paid on installment basis. These families will also save on the cost of their water consumption. Getting water from delivery trucks costs them at least PhP 150/m3 (US $3.7/ m3) compared to an average of PhP 13/ m3 (US $0.32/ m3) with Manila Water.

The project has also improved the health of the people in the TPSB communities, since they no longer drink water from deep wells and water delivery trucks. Statistics show that diarrhea and cholera outbreaks in the TPSB communities have decreased significantly.

In summary, with the network improvements in the Antipolo Water System, the people of Antipolo can now enjoy clean and potable water 24x7."

Christine Aubrey Nocum concluded: "The use of Bentley products has given our company savings in terms of both time and money. With WaterGEMS and HAMMER, the interface to GIS data is already built-in, unlike other brands where you need to buy separate software for the GIS interface. The average time to create the model was 2-3 months using other software, compared to just 2 weeks to 1 month using WaterGEMS and HAMMER. With the creation of the Antipolo Water System's network model using WaterGEMS and HAMMER, network improvements and the associated projects were identified and implemented, which resulted in savings on both capital and operational expenditures.

The installation of surge protection apparatus such as PRVs and SAVs at strategic locations identified from the network model decreased the incidents of water interruption due to pipe breakages from an average of 6 breakages per month to 0-2 breakages per month. This resulted in a decrease in leakages of 6.3 mld, or an equivalent amount of saving of almost US $75,000.

Furthermore, adjustments to the pump operation plan that were developed based on the hydraulic model and field studies, decreased the pump station operating expenditure or OPEX by almost $7,000 per month. Water availability was also improved from 18 hours per day to 24 hours per day."

PROJECT OVERVIEW

Project: WaterGEMS and HAMMER help Manila Water to improve the reliability and efficiency of the Antipolo Water Supply System
Organization: Manila Water Company
BE Awards category: Sustaining Society
Project objectives: Optimize the Antipolo Water Supply System by minimizing cost and improving the health of the local population.

Fast facts:

- The Antipolo water supply system presented many challenges: the limited capacity of the suction line, pressure distribution over rolling terrain, pressure surges as a result of the unreliable power supply, and last but not least, the challenging economic circumstances of people in the areas targeted for expansion.
- Models created in WaterGEMS and HAMMER helped Manila Water engineers identify and implement network improvements, which resulted in savings with both capital and operational expenditures.
- After the network improvements in the Antipolo Water System were completed, the people of Antipolo can now enjoy clean and potable water twenty-four hours a day and seven days a week.

BENTLEY PRODUCTS USED:

- WaterGEMS V8 XM Edition
- HAMMER

To learn more, go to
www.bentley.com

Bentley® Sustaining Infrastructure