CASE STUDY

More Than $800,000 Savings Achieved On The MacDonald Avenue Sanitary Sewer Line Upgrade Project

PROJECT SUMMARY

Organization:
Swinerton Management & Consulting

Solution:
Water and Wastewater

Location:
California, USA

Project Objective:

- Excessive precipitation during winter 2005/2006 caused sanitary sewer overflows (SSOs) in the Richmond sewer system, as well as problems at the wastewater treatment plant
- One particular area of trouble proved to be MacDonald Avenue and the need to increase sewer capacity along this road became a priority.

Products used:
SewerCAD ®
SewerGEMS®

FAST FACTS

- The vast majority of the sanitary sewer system in Richmond, CA, suffered from a large infiltration and inflow (I&I) problem.
- Bentley products were chosen for the design of this project because of their ability to perform iterations of a multitude of calculations with greater ease and speed than competitors' software
- Swinerton achieved total savings of $818,118 on the MacDonald Avenue sanitary sewer line upgrade project

Richmond is part of the San Francisco Bay Area in Northern California. Elevations range from sea level to 1,500 feet (0 to 457.2 m) and the annual temperature is 50° to 70°F (10° to 21°C).

SEWER OVERFLOWS AND OTHER CHALLENGES:

The typical annual rainfall in Richmond is 20 to 25 inches (50.8 to 63.5 cm) which falls primarily from November through April. However the 2005/2006 winter season was particularly wet with three months accounting for 26.86 inches (68.22 cm) of rain alone. Excessive precipitation caused sanitary sewer overflows (SSOs) in the Richmond sewer system as well as problems at the wastewater treatment plant.

The Richmond wastewater infrastructure system consists of the following:

Infrastructure	Quantity
Sanitary sewer	187 miles (301 km)
Storm sewer	94 miles (151 km)
Wastewater pump stations	13
Stormwater pump stations	7
Manholes	3,900
Stormwater catch basins	3,300
Stormwater manholes	1,200

The vast majority of the sanitary sewer system more specifically consists of vitrified clay pipe which in many cases has been in the ground for more than 100 years. As one can imagine in an aging sewer system, it suffered from a large infiltration and inflow (I&I) problem, the extent of which is described below.

Wastewater treatment is provided by an activated sludge facility with a design flow rating of 16 MGD (60,567 m3/d). The average daily dry weather flow to the Richmond wastewater plant is 7.25 MGD (27,444 m3/d). During a rain event the flow can quickly increase to the maximum influent pump capacity of 39.2 MGD (148,388 m3/d). Once the maximum influent pump capacity has been reached, the sanitary sewer system begins to surcharge and SSOs result in various locations throughout the system. During the winter of 2005/2006 one particular area of trouble proved to be MacDonald Avenue and the need to increase sewer capacity along this road became a priority.

SELECTION OF SEWER MODELING SOFTWARE:

As a result of the SSOs that occurred in that period, it was determined that hydraulic modeling of the sewer system was required.

Several software programs were evaluated by Swinerton, including MWHSoft's InfoSewer, Pizer's HYDRA, Boss International's StormNET, and both SewerCAD and SewerGEMS from Bentley. After much evaluation, the decision was made to purchase the Bentley products.

DEVELOPMENT OF THE SEWER HYDRAULIC MODEL:

An extensive hydraulic model for MacDonald Avenue was developed using SewerCAD during March 2006. The final model consisted of 204 pipe segments, 196 manholes, 8 junction chambers, and one outlet, representing 59,538

"After carefully evaluating a number of hydraulic modeling software, I determined that Bentley had the best tools for doing this work."

ABOUT BENTLEY

Bentley Systems, Incorporated is the global leader dedicated to providing comprehensive software solutions for sustaining infrastructure. Architects, engineers, constructors, and owner-operators are indispensable in improving our world and our quality of life; the company's mission is to improve the performance of their projects and of the assets they design, build, and operate. Bentley sustains the infrastructure professions by helping to leverage information technology, learning, best practices, and global collaboration – and by promoting careers devoted to this crucial work.

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Bentley Sustaining Infrastructure

feet (18,147 m) of sanitary sewer pipeline ranging in size from 6 inches (15.24 cm) to 18 inches (45.72 cm). The model was evaluated by analyzing five distinct flow conditions as follows:

- Existing system – no I&I
- Per capita sanitary at 100 gpd
- Per capita sanitary at 100 gpd plus standard I&I flow
- Per capita sanitary at 100 gpd plus standard I&I flow plus peaking factor
- Per capita sanitary at 100 gpd plus high I&I contribution plus peaking factor

Rick Fuller, Senior Project Manager at Swinerton explained: "When the model was presented to the Richmond City Engineer, and as the impact of I&I and increasing flows to the sanitary line became revealed using the thematic mapping functionalities of SewerCAD, the under-capacity of this line became immediately evident. That presentation required less than 10 minutes for the City Engineer to agree this capital improvement project was needed. At that point I was directed to seek bids and develop a cost for the project."

Fuller continued: "But in the meantime, Richmond's Redevelopment Authority (RRA) discovered that a significant portion of MacDonald Avenue was going to be dug up, a portion that in fact was already scheduled to be modernized with new paving, medians, sidewalks, landscaping, and lighting and it was going to start immediately. So, the initial reaction of the RRA was to say "No, you cannot do this work." RRA had already awarded contracts and our work would result in significant costs due to delays. I gave another presentation using the SewerCAD hydraulic model. Again, it took less than 10 minutes for the RRA to realize the sanitary sewer line had to be replaced; if not right now, then very soon. So an agreement was reached between the City Engineer's office and the RRA."

A TWO-PHASE PROJECT:

The agreement called for splitting the MacDonald Avenue project into two phases. The first phase was completed by the general contractor already awarded the redevelopment work on what came to be known as "Upper" MacDonald. Since the general contractor's scope was being increased, even though the original work was going to be delayed, there were no complaints. For the Phase One work, the City allocated $1,494,525 and the general contractor completed the work on time (May – July 2006) and under-budget finishing the job at a total cost $951,050 for savings to the City of $543,475.

A second contractor was hired to perform the Phase Two work. The City allocated $2,812,527 for this portion of the work. Phase Two was completed on time (June – August 2006) and under-budget with a total cost of $2,537,884 for a savings of $274,643. In summarizing the costs, the MacDonald Avenue projected was estimated to cost $4,307,052. The project actually cost $3,488,934. The total savings were $818,118.

WHY DID SWINERTON SAVE SO MUCH MONEY ON THIS SANITARY SEWER LINE UPGRADE PROJECT?

Fuller explained: "Both contractors were very experienced in doing pipeline replacement work. And both contractors knew this work was just the beginning of a lot of work that needed to be done on the Richmond sanitary sewer system. As a result of there being no change orders, no extra, unplanned work, both contractors have done a great job of putting themselves at the top of the list for future work.

The most significant impact on cost control/savings had to do with the details provided by the hydraulic modeling. The contractors knew everything they needed to about what was in the ground and what was going to replace it. The model provided each contractor with pipe length and diameter. The pipe material for the project had been specified as being SDR 26 sewer pipe and availability was never a problem."

Fuller concluded: "In December 2006, the City of Richmond settled a lawsuit with an environmental group called Baykeepers. As part of the settlement, Richmond agreed to spend $20 million over the next five years upgrading its sanitary sewer system. And Richmond has bond money in place allocated just for this purpose. The most important tool for both the City of Richmond, and for Swinerton Management & Consulting, who will manage the bond money for Richmond, is the ability to perform detailed hydraulic modeling on the sanitary and storm sewer systems. Using SewerGEMS, we can utilize the City's well-developed GIS data to identify problem areas in the system. With SewerCAD, detailed design data can be provided to the consulting engineer so that bid specifications can be generated for the work to be done. So everyone will get the documentation they need with the hydraulic model including the City, its consultants, it bond agent, and the environmentalists who are paying close attention to work being done in Richmond."