Sewer Stories within a Story

Vacuum system for new sanitary sewer.

By Candice Bock, Laurie Fulton, and Scott Slifer

Carnation, WA, (population 1,905) is located at the confluence of the Tolt and Snoqualmie Rivers, in a valley about 20 miles east of Seattle. The city's incorporated area includes about 700 acres and features a downtown core surrounded by residential development and, further out, by agricultural and undeveloped land.

In 2008 the city completed construction of a new citywide sanitary sewer system "from the ground up." Carnation returned EPA 90 percent grant funding for sewers in the early 1970's because the residents wanted to keep the city's rural feel. Neighboring cities used this funding to build sewer systems and saw growth over the years while Carnation saw many businesses disappear and sanitary conditions degrade.

Carnation continued to rely on individual septic tank/drainfield systems. Although some residential area was able to develop during the 1990's by platting half-acre lots conforming to the latest regulations, the small parcels in the older portion of the city were hampered by septic tank/drainfield failures and the inability to upgrade them to meet new regulations.

By the late 1990's, it was apparent to the city council that it was time for action and it began to plan a sewer system. In 2001, the city engaged engineering consultant Roth Hill Engineering Partners (www.rothhill.com) to take the lead managing the process from sewer utility creation to final project completion. The consultant had to plan, design, permit, and help acquire funding to provide sewers for the entire city. This project changed continuously as each new funding source or council decision changed the project's path. This project took far more than just engineering design though, and any city embarking on a similar project should consider the following stories.

Conveyance System Story

The engineer evaluated three conveyance system alternatives: a conventional gravity system with lift stations, a low pressure grinder pump system, and a vacuum sewer system, finally recommending a vacuum system as the best choice. Factors favoring the vacuum system were flat topography, high groundwater table, and reduced surface restoration requirements. The vacuum system recommendation was approved by the city.

Connecting side sewer to valve pit.

Because of Carnation's small size and limited resources, the city negotiated an agreement with King County to design, construct, and operate a local membrane bioreactor (MBR) treatment plant with its effluent discharged either through an outfall into the Snoqualmie River or to a constructed wetland. The county used its own staff and consultants for that project, but both agencies went through the Washington State Department of Ecology and EPA's planning approval process together. The city's engineer prepared a Comprehensive General Sewer Plan and a Facilities Plan. One early task was to obtain accurate topographic information for the city. To save time and money, aerial photogrammetry was supplemented with limited field survey data to obtain finished floor elevations, existing utility locations, and small details. The collection system was laid out primarily in public rights-of-way, but to optimize the piping layout, about 45 easements and many more temporary construction permits still had to be obtained. No condemnations were required.

The city and its engineer worked closely with Airvac, Inc. (www.airvac.com) on the design of the conveyance system. Airvac is the major supplier of vacuum sewer technology in the country.

There were two conveyance system construction contracts, one each for the collection system and the vacuum station. The collection system consists of over 11 miles of four- to ten-in. PVC pipe and 280 vacuum valve pits, each serving from one to four connections. A valve pit is a sump where the gravity flow from a side sewer is collected and pulled into the vacuum line through a

Vacuum tank and pumps.

valve when the liquid level in the sump reaches a set height.

A single vacuum station located adjacent to the treatment plant serves the whole city. The station contains a 7,500-gal vacuum collection tank into which all the vacuum lines are discharged. Four pumps maintain the vacuum for the entire collection system. Two 975-gpm pumps transfer the wastewater from the tank to the treatment plant.

Financial Story

With fewer than 2,000 residents, there were no economies of scale to spread the cost of such a comprehensive project. The initial projections to design and build the citywide sewer system indicated that it would cost each residence about $160 per month, which was unacceptably high. Creativity was required to reduce costs and secure funding to lower this monthly rate.

The city and its engineering and financial consultant investigated many funding sources. After many meetings, grant and loan applications, and city council and consultant effort, the city obtained grants and loans totaling over $28 million. As a result of these efforts, the typical single family residence will pay a $90 monthly sewer bill instead of the original $160. The final cost of the city's projects was about $21 million; so some of the loan money was not required. King County's treatment plant added another $25 million, but is financed by the county. Over 60 percent of the project was grant-funded, not as good as the old EPA 90 percent grants, but excellent for today.

Grant sources included:

- $1.4 million from federal, state, and tribal assistance grants
- $0.6 million Community Development Block Grant
- $4.8 million from Centennial Clean Water Fund
- $1.5 million from Washington Department of Ecology
- $5.0 million from Washington State Legislature appropriations

Loans sources included:

- $5.1 million from State Revolving Fund
- $10.0 million from Public Works Trust Fund loans for costs that were not grant eligible

Community Involvement Story

A public outreach plan was initiated because the project was going to disrupt almost every street and change the community. Some residents were initially opposed to the project. Numerous public meetings were held on topics such as the hidden costs of septic systems, economic and environmental threats, the operating principles of the vacuum system, locating the treatment plant site, construction scheduling, and projected monthly sewer rates. In addition to meetings, the city used bill stuffers, a website, a monthly newspaper article with updates, door hangers, and even a dedicated 24-hour "hotline" during construction so that citizens could reach a project representative.

Environmental/Permitting Story

There is no such thing as free money. Grant sources required extensive environmental assessment along with city, county, state, and federal construction permitting requirements for work near wetlands, streams, and critical wildlife habitats. The permitting was so complex that the city developed a GIS database just to track the status of all the permit activity.

A biological assessment focused on the impacts of the wastewater treatment and discharge facilities and described the baseline conditions and potential effects to fish and wildlife regulated by the Endangered Species Act, such as Puget Sound Chinook salmon. The study recommended conservation measures for the construction and operation of these facilities and created new floodway setbacks from the two rivers.

Cultural Resources Story

Both the Tolt and Snoqualmie Rivers are prime fish and wildlife habitat and the river confluence is the historical home of the Snoqualmie Tribe, so there was a likelihood of discovering or disturbing cultural resources, such as bones, tools, and artifacts. The Nisqually Tribe also hosted fishing expeditions in the area. The city selected an archaeological and cultural resource

Typical side sewer installation job site.

consultant trusted by the Snoqualmie Tribe to conduct investigations and to play a key role on the team negotiating an agreement with the Washington Department of Archaeology and Historic Preservation, King County Department of Natural Resources and Parks, EPA, and the King County Historic Preservation Program. This agreement included action plans in the event human or cultural remains were found. Fortunately, the only discoveries were minor tools and artifacts in one localized area.

Side Sewer Story

As the collection system construction projects progressed smoothly and money was available, it was possible to consider a comprehensive program to assist property owners with private side sewers. The side sewer program was unique because all of the work was accomplished on private properties and much of it with public assistance. The city developed and executed side sewer access agreements for each parcel in the city. Phase 1 of the side sewer construction consisted of building the gravity pipes for 625 side sewers from the property lines up to the building connection points, many of which were unknown locations. These pipes were privately owned at the end of the project.

Phase 2 consisted of switching each connection to the new sewer system. Phase 3, the septic tank abandonment process, involved pumping out tanks, breaking lids, backfilling each tank, and property restoration.

Carnation's new citywide sanitary sewer system became operational in May 2008. A new story for the city has already begun. The availability of the sewer system has alleviated a public health hazard and stimulated development plans that are now bringing positive changes. GE

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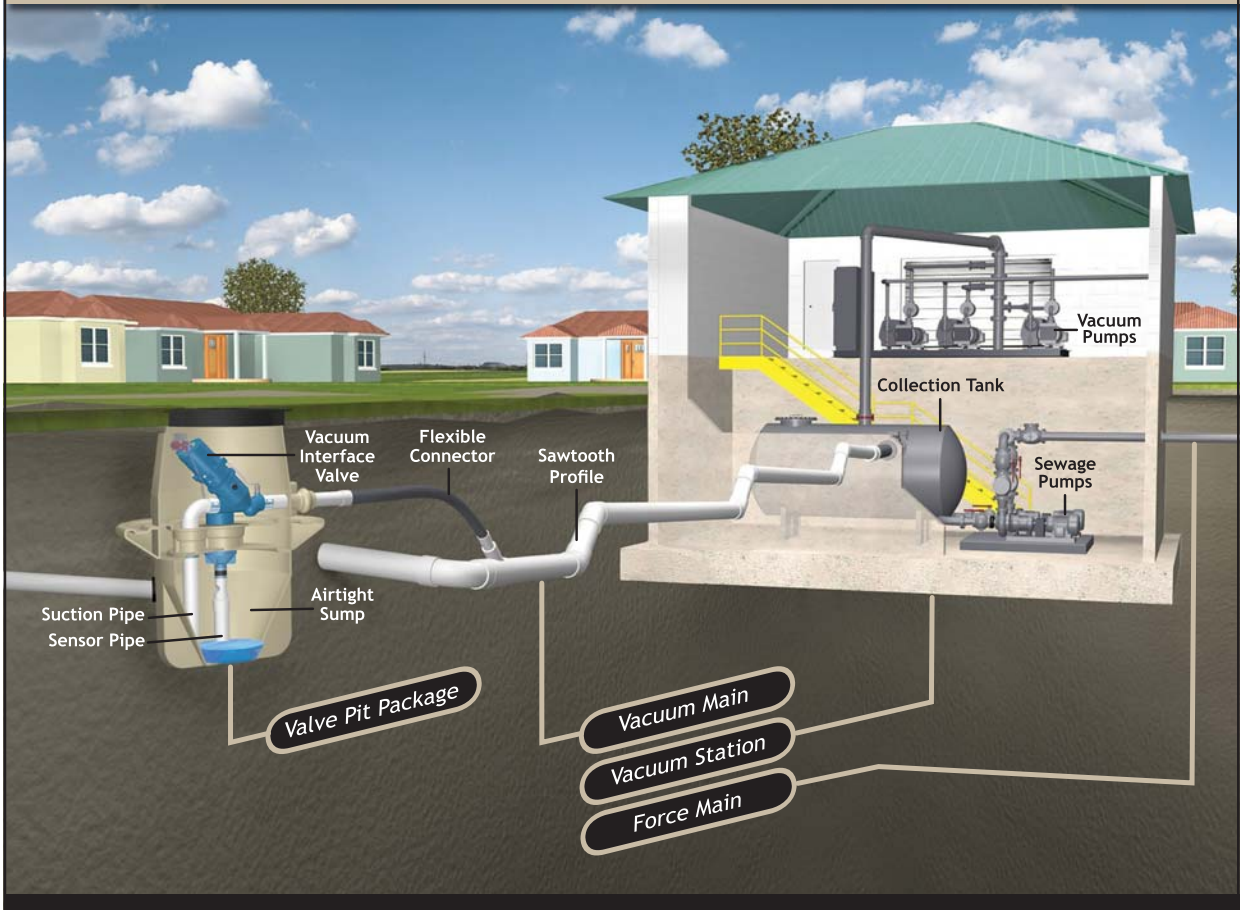
AIRVAC Vacuum Sewer System



See this sytem in action at www.airvac.com and learn how the AIRVAC Vacuum Sewer System works. You may also request a copy of the animation on DVD.