By Jon Steele, Technical Assistant

City of St. John Adds Nitrate Removal Plant

The city of St. John has added a nitrate removal system to their water supply system to serve the 1,295 customers.

Present St. John, Kansas was originally settled in 1875 by a man named William Bickerton, as a religious colony called Zion Valley. By 1879, Zion Valley had grown into a small town and the residents renamed it St. John after the governor, John P. St. John. It later became the seat of Stafford County.

St. John has numerous small businesses, schools and churches. The most recent addition to the local commerce is a Dollar General store. The town is famous for the downtown city square, fountain and small-town friendly atmosphere that can be found there. In 1909-1913 some of the local ladies of the Hesperian Club raised $5,000 to purchase a very popular style three-tier fountain that stands in the center of the square; it is enhanced with ornate stonework.

Also of interest, although I haven't been there myself, but plan to visit sometime, is the St. John Science Museum or Hood's Haven. It was recently featured in *American Profile* magazine. It attracts visitors from school groups and other individuals from across the Midwest. The museum has a trove of information and exhibits relating to the Industrial Revolution, covering everything from loadstone to fiber optics. It is operated by museum curator James Hood, who performs live demonstrations of technology from Tesla coils and Jacob's Ladders to a hydrogen-powered engine.

Three, 600 GPM high service pumps in the new water treatment plant at St. John, KS are controlled by variable frequency drives.

Increasing nitrate levels

The city's drinking water began having nitrate samples that exceeded the 10 mg/L maximum contaminant level (MCL) in 2007. One well tested 16 mg/L; use of that well was discontinued. The remaining two wells also slightly exceeded the limit so quarterly monitoring and public notification were required by KDHE. Public meetings were held to discuss the problems. When I inquired about those meetings, long-time City Clerk Johnna Stanford stated that those meetings were "exciting". I can only imagine, especially when you read further in this article about the rate increases that were necessary to pay for the new treatment system.

I can recall meeting with a former city employee more than ten years ago to discuss the city's increasing nitrate levels. We drove around to survey the outlining area to look for another possible well site, hoping to find a large native pasture that had never been cultivated. All we found was irrigated cropland, primarily in corn. That meant lots of nitrogen fertilizer was being used to boost crop production. The local light sandy soil provides an easy avenue for nitrate to leach into the shallow groundwater.

The rising nitrate levels concerned city officials. They began to look at the options for providing water that met the 10 mg/L MCL. In 2011, city officials registered for the KRWA Annual Conference and attended a special training session discussing nitrate contamination of Kansas' groundwater. Also by attending the annual conference the council members were able to meet with other industry professionals and individuals from other public water supply systems to gain valuable insight into their problems and how best to address them. After attending the 2011 Conference the city council returned home more prepared to address the problem.

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The photo at left shows the four, skid-mounted treatment vessels to remove nitrate from groundwater. Incoming nitrate is 12 mg/L. Water is treated and then blended to provide a finished water in the 7 to 9 mg/L range.

The valve shown below is manufacturered by Val Matic; it cushions operations immediately upon any loss of power.

Prior to hiring an engineering firm, the city worked on the problem themselves for some time by hiring a groundwater geologist to try to locate a new source and/or correct the problem in the existing wells by reducing the pumping rate. There was some success but not enough to be considered a fix. A series of test holes was drilled in hopes of finding a better supply but that too was unsuccessful.

In-home treatment devices were discussed but were discouraged by KDHE, so the idea was quickly abandoned. A removal plant was eventually agreed on by the city council as a long-term solution for the increasing nitrate issue. City council members and some of the locals toured the plants at Lewis and Belpre, Kansas prior to making their decision.

The project

Two new low production wells were drilled at the plant site in order to allow the system to be totally self-supporting; backup power was also included.

The city's three original wells had to be re-piped directly to the new plant site. That project included 10,250 feet of 6-inch line, plus 2,500 feet of 8-inch and 2,300 feet of 10-inch C-900 PVC pipe in addition to 24 new valves.

The treatment plant is a totally automated Layne Christensen Ion Exchange System with four, skid-mounted treatment vessels, capable of treating over 1 MGD. The treatment filters are self-regenerating every 300,000 gallons; one is always on standby ready to take over while another is regenerated through a high efficiency, low-waste salt brine process. With automated valves, alarm dialers and warning systems, it seems as though every possible scenario has been carefully accounted for, ensuring a continuous supply of water that meets the MCL standard.

Raw water currently enters the plant with nitrate levels up to 12 mg/L; finished water is between 7 to 9 mg/L. Fifty-five per cent of the raw water is blended back with the treated water to provide an acceptable blend. The treated water is pumped into a new 80,000-gallon glass-lined ground storage tank. From there it is pumped into the distribution system by three 600 gpm high service pumps controlled

by variable frequency drives that cycle based on water tower level. Two, half-acre, double-lined stabilization ponds were constructed to handle the waste generated by the treatment process.

A point of particular interest to me is the strange looking valves just on the downstream side of the high service pumps. Variable frequency drives are a great feature for eliminating water hammer. However, there has always been a problem if power is lost while under full pumping capacity, because there is no ramp down. The drive stops instantly, the check valve slams shut, often resulting in damage to the facility or piping. A valve with a dampening device was installed to overcome this potential problem. Val-Matic is the manufacturer of the valve. It utilizes oil and compressed air to accomplish the task of a cushioned, closing operation.

The project cost was just under $3 million. KDHE awarded a 30 percent loan forgiveness because of meeting a compliance issue; the balance ($2.1 million) was financed over a twenty-year term at 2.42 percent through the Kansas Public Water Supply Loan Fund. The council was also very adamant about paying down the debt quickly; the city used $40,000 out of cash reserves during construction. Also through a very noble budgeting and planning process on the part of the city officials and a rate increase in the early planning stages two years prior to completion, extra revenue has been set aside and a hefty $750,000 payment is planned toward the loan.

Rate shock

Rates were adjusted to meet the expected need based on a rate study in the early planning stages. The result was a shock to the customers since there had been no increase since 1995. The previous water rates were a mere $5 minimum with 3,000 gallons included and $1.60 per 1,000 gallons thereafter. The new rate structure is $17.45 minimum with 3,000 gallons included and the charge for water is $5.58 per 1,000 gallons thereafter. Although that is a pretty significant increase, it is still very reasonable at $28.61 for an average of 5000 gallons.

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The design consultant was Evans, Bierly, Hutchison & Associates of Great Bend; the contractor was APAC Shears of Hutchinson, Kansas. The project began construction December of 2012 and went on line in July 2013.

Jon Steele has been employed by KRWA as a Circuit Rider since 1995. Jon is certified as a water and wastewater operator. He has more than twenty-five years experience in public works, construction and industrial arts.