

## Saving for the Summer

### VTScada Performs Monitoring & Control of Aquifer Storage and Recovery in Arizona

By Christopher Little

Imagine a quiet ranch in the middle of Arizona, complete with cactus, tumbleweeds, and very little water. Now imagine twenty-five thousand people, a thriving suburban community, four golf courses, three town parks with lush, green grass, all in that same desert and all needing water.

Now imagine that the local wastewater entity which produces a high quality effluent can't find a place for its end product in the winter because of the lack of seasonal demand and can't provide enough reclaimed water to satisfy the demand in the summer. What if there was a way to store the excess water in the ground during the winter months and a way to utilize the stored water in the summer? This process, known as aquifer storage and recovery (ASR), would become the solution to the town's problem.

#### An Ingenious Solution

The Fountain Hills Sanitary District processes up to 2.6 million gallons of wastewater a day. Influent first passes through the District's Wastewater Treatment Plant (WWTP) and then on to the Advanced Water Treatment Facility (AWTF) where it passes through a set of four Pall™ Microfilters.

When distributing its treated water, the district's highest priority is keeping the lake at Fountain Park full. Located in the center of town, this one hundred million gallon lake is home to the town's world famous namesake. This five hundred and sixty-two foot fountain is the fourth tallest in the world. The next priority is making sure that the lakes at the local golf courses are kept full.

Mark Russo is a Wastewater Treatment Plant operator for the Fountain Hills Sanitary District. "In the winter we have more treated water than we know what to do with. It rains more and it's not so hot. The golf courses use very little water."

The key to solving the town's water riddle was finding a practical way to store this extra water for use during the summer months. However, building a structure large enough to hold the enormous volume necessary would be completely impractical. Fortunately, Fountain Hills is located in a valley that forms a natural water collection basin. Below the town, at the bottom of this basin, is the aquifer; a layer of fractured conglomerate through which ground water flows. "We decided to look into injecting this excess water into the aquifer." During the winter months a network of four injection wells store surplus effluent in the aquifer. In the summer, the wells are reversed providing millions of gallons of water a day that are sold to the golf courses and given to the town parks.

#### Monitoring & Control

Interfacing to this closed-loop system is essential to ensure the maximum water storage and recovery while maintaining strict standards of water quality. For this, the District turned to Trihedral for its twenty years of expertise in municipal monitoring and control software. Trihedral developed an interface that placed all control in the hands of the VTScada™, its supervisory control and data acquisition (SCADA) software product. Ordinarily, such control is performed by field devices such as Programmable Logic Controllers (PLCs). However, it was important to the District to avoid the significant short-term expense of replacing all of their existing I/O devices which were incapable of performing their own control.

#### An Open Solution

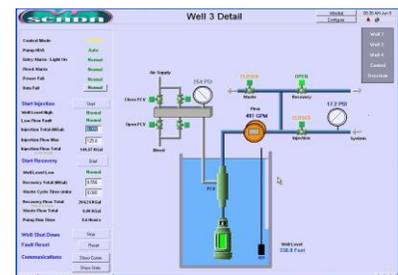
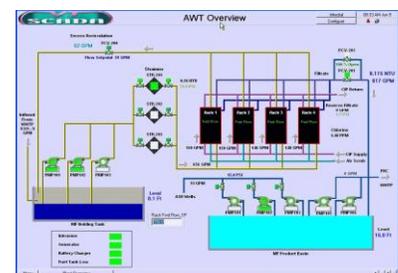
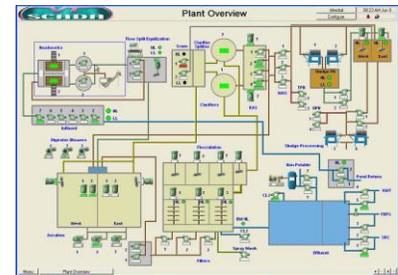
However, the District was by no means limited to this hardware. VTScada includes an extensive library of device drivers that allow them to incorporate other brands of PLCs that meet their specific technical and budgetary needs. Since the implementation of VTScada, the number of PLCs has grown to twenty three and now includes CrosStar ATU-100s and CompactLogix PLCs using CIP.

#### Redundancy

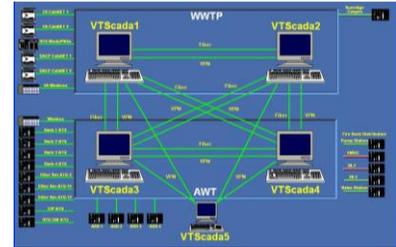
Due to tight water regulations in the state, reliability and data availability were of paramount importance. Trihedral created a network of four redundant servers; two at the WWTP, two at the AWTF. Each is capable of automatically taking control over the entire system in the event of catastrophic computer failure. Redundancy is also built into the communications networks. The four servers are connected via a primary fiber optic network. Should this fail, standard Ethernet networks connect the two servers at each plant while the plants themselves can communicate via two separate internet connections using secure CyberGuard SnapGear VPN devices. "We have a COX Communications™ network and a Quest™ DSL network." A fifth (non-redundant) server located several miles away at the Fire Rock Pump Station connects to the application through a PCM cellular device.

#### System Access

In addition to these five servers, operators and managers have the ability to view and control the entire system both locally, or from anywhere in the world, via heavily secured redundant Internet connections. The maintenance staff is kept abreast of alarm conditions with a sophisticated automated dial-out system that uses voice, paging and email to communicate critical information.



Fountain Hills also uses two (thin) VTScada Internet Clients to provide complete system access in locations where servers are not necessary. "One is in the digester room so when operators are up there they can always see what's going on across the plant. The other is in the electrical room. There is a lot of I/O in there. So when they are out there checking everything they can look at that computer." VTScada Internet Clients automatically failover to redundant backup servers if the primary fails.



**Customized System Pages**

Russo wanted to make sure that the new system pages contained some familiar signposts that operators were used to seeing everyday in the real world. Fortunately, VTScada includes a diverse pallet of drawing methods that allowed him to recreate features of their physical system.

"There is a rock that comes up out of a lake on the far side of town. The operators would drive out to look at it. They could tell by how much of it was showing how much water they would send that day. I often heard them talking about it and I asked if they wanted that rock in the VTScada application." Russo selected a rock image from the bitmap library and added it to the system page. He then added the surface of the water so it partially covered the rock. Finally, he configured the surface to rise and fall according to the value of the lake's water level tag. "Now they can look at that rock on the screen and they immediately know how much water they have."

Russo found other creative ways to make the system pages visually meaningful for the operators who often need to quickly process large amounts of information. "Each of the lakes that we monitor at the golf courses returns a water level and a pump status. The operators always need to know if the pumps are running. Instead of always having to go back to that screen I added fish to the overview page. So when they look at the page and see bubbles coming from the fish they know the pumps are running."

**Reporting**

To protect the integrity of its groundwater, the injection of treated water into an aquifer is strictly regulated by the state. Trihedral worked closely with the District to create an extensive array of custom reports to allow management to closely monitor water quality and demonstrate compliance with regulations. These reports use Microsoft Excel™ templates to extend the data analysis capabilities of VTScada's integrated reporting suite. For example, "There is an instrument that measures the turbidity of water as it leaves the plant" Turbidity is the degree of cloudiness in reclaimed water due to suspended particles. "This is measured every thirty seconds by a PLC that feeds the reading to VTScada. Every month we generate a report that we print out and send to the state to show that the water's turbidity hasn't exceeded the limit; which is about 2.0 NTUs."



Permit regulations specify how much water can be recovered from the ASR wells. "We can't take more water from the ground than we've put in. We have a report that shows how much has been injected and how much has been recovered." Other reports help maintain the health of the equipment.

**Technical Support**

As with all mission-critical applications of this scale, timely access to technical support is no luxury. Mark Russo gives high marks to the support he has received. "The technical support at Trihedral is second to none. They can get to the heart of the problem from almost anywhere. That's the truth. I was having trouble on a Saturday and I didn't know what to do. The operators were all saying that we had to do something. Glenn Wadden, the President of Trihedral had given me his cell phone number. I felt terrible but I had to call. He was vacationing in Florida at Disneyworld with his family. He said, 'Give me 10 minutes.' He went back the hotel, got on his computer and fixed my problem with UltraVNC and went back to Disneyworld. That was pretty amazing that the president of the company would do that. I'm proud of that story." UltraVNC is software that allows one computer to view and control another over a network or the internet. Trihedral is able to provide several levels of support depending on the needs of their customers.

**The Future**

The success of the original VTScada application in Fountain Hills has led to several expansions of the interface to tie in new functionality such as ultraviolet disinfection and remote pump management. Thanks to the hard work and creativity of District and Trihedral staff, the Fountain Hills Sanitary District now has a reliable and scalable monitoring and control application that provides District management, maintenance personnel and system operators with the timely, accurate information they need to fine tune their system to equalize their supply and demand.

Trihedral thanks Mark Russo and Ron Huber of the Fountain Hills Sanitary District for their assistance with this article. Images reproduced with permission from the FHSD.

Influent Process	Previous Day	<b>Running</b>	Previous Month
Aeration Process	Previous Day	Previous Week	Previous Month
Clarifier Process	Previous Day	Previous Week	Previous Month
Digester Process	Previous Day	Previous Week	Previous Month
Disk Filters Process	Previous Day	Previous Week	Previous Month
Effluent Process	Previous Day	Previous Week	Previous Month
Run Time - Influent, Equalization, Aeration	Previous Day	Previous Week	Previous Month

Fountain Hills Sanitary District Effluent Pump Station Operational Report																			
Effluent Turbidity		Chlorine Residual				AWT Flow (GPM)				Lake 27-8 Flow (GPM)									
Min	Max	Avg	Std	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Max
0.00	0.37	0.00	0.45	0.19	5.01	2.43	120.70	1087.20	1565.45	1.12	0.00	5.00	0.00	0.25					
0.00	0.37	0.02	0.45	0.21	5.01	1.63	241.95	1081.20	1307.05	1.93	0.00	5.00	0.01						
0.00	0.41	0.09	0.47	0.16	5.01	1.61	0.00	1078.20	1299.37	1.78	0.00	5.00	0.01						
0.00	0.40	0.02	0.40	0.12	1.00	1.55	113.00	1078.00	1143.56	1.68	0.00	5.00	0.00						
0.00	0.40	0.00	0.40	0.05	5.01	1.28	348.00	1086.55	1034.84	1.61	0.00	5.00	0.00	1.00					
0.00	0.41	0.00	0.40	0.19	5.01	1.00	0.00	1081.20	1019.96	1.43	0.00	5.00	0.00	1.00					
0.00	0.44	0.07	0.54	0.17	2.00	0.80	0.00	1086.10	1037.20	1.62	0.00	5.00	0.00	1.00					
0.00	0.40	0.00	0.40	0.19	5.01	1.00	0.00	1078.50	1028.00	1.61	0.00	5.00	0.00	1.00					
0.00	0.40	0.00	0.40	0.21	5.01	1.54	0.00	1086.15	1287.03	1.91	0.00	5.00	0.00	1.00					
0.00	0.40	0.00	0.40	0.19	5.01	1.63	208.70	1081.20	1161.00	1.71	0.00	5.00	0.00	1.00					
0.00	0.40	0.01	0.40	0.05	5.01	1.33	111.00	1080.00	1139.70	1.69	0.00	5.00	0.00	1.00					
0.00	0.32	0.73	0.90	0.17	4.00	0.94	0.00	2029.50	1175.49	1.72	0.00	5.00	0.00	1.00					
0.00	0.73	1.30	0.90	0.14	4.00	0.70	0.00	2405.00	1165.73	1.72	0.00	5.00	0.00	1.00					
0.00	0.81	1.96	1.10	0.19	5.01	1.74	0.00	1081.20	1023.19	1.60	0.00	5.00	0.00	1.00					
0.00	0.74	1.00	1.00	0.00	5.01	1.60	0.00	1086.15	1193.27	1.74	0.00	5.00	0.00	1.00					

**TRY IT FOR YOURSELF**

Download the 90-day Trial  
Trihedral.com/demo

VTScada is a trademark of Trihedral Engineering Limited  
Updated: January 8, 2015