FACILITATING FULL FLOW

A vacuum pump avoids a major construction project fix

Mark Capron

During a March 2011 thunderstorm, operators at the Hill Canyon Wastewater Treatment Plant (Thousand Oaks, Calif.) noticed the facility's hydraulic capacity was not what it should be. Restoring the full 189-m³/d (50-mgd) flow required figuring out what blocked the pipe and crafting a solution to overcome it.

LESS THAN OPTIMAL FLOW

After a half-day of thunderstorms, Hill Canyon's flow – normally 38,000 m³/d (10 mgd) – approached 113,000 m³/d (30 mgd). During this period operators discovered that the facility's hydraulic capacity was only about 68,000 m³/d (18 mgd) – the excess flow was sent to emergency retention basins.

But, something was blocking the flow from the secondary clarifiers to the filter influent pumps. This caused the secondary clarifiers to rise a few feet above their weirs. Operators should have been able to move more than 151,000 m³/d (40 mgd) through this 1050-mm (42-in.) pipe before the clarifier trough flooded over the weir. Pump capacity was not the issue because the filter influent pumps were holding the water level in their wetwell at the bottom of the set range.

When all the scum that the weir would have removed hit the filters, filter capacity dropped below 57,000 m³/d (15 mgd). Water levels in the emergency retention basin rose to within 152 mm (6 in.) of flooding a 500 kW solar photovoltaic system.

IDENTIFYING THE PROBLEM

After the storm, operators checked the pipe for an obstruction. They tried using a sewer camera with inconclusive results. Then, Robert Richardson, the on-site assistant engineer, borrowed a laser level and used schematic plans to estimate the profile elevation of the 1050-mm (42-in.) pipe.

The elevation revealed that the 1050-mm (42-in.) pipe had been installed over an existing pipe, and the high point was too high. The flow in the pipe was blocked by an air pocket.

The air release valve was at the correct (highest) spot, also let air in. If operators lowered the wet well water level, the air pocket got bigger. With the filter influent wet well drawn down, the pipe was less than half full. The air pocket limited capacity to about 68,000 m³/d (18 mgd) regardless of how much the clarifiers flooded or how low operators kept the filter influent wet well.

FINDING A FIX

The obvious, and expensive, solution is to excavate a few hundred feet of the pipe and other assorted large pipes so that the high point could be lowered 1.2 m (4 ft) to restore the full 189,000-m³/d (50-mgd) capacity.

As an experiment, operators suggested using a vacuum pump to remove the air blockage. A 0.25-hp vacuum pump – the type commonly used to squeeze furniture in a vacuum bag while glue sets – was obtained for about $500 and attached.

When the pipe is full of air, one vacuum pump takes a couple days to remove all the air. After the air is removed, the pump only needs to remove the gas coming out of the clarified water. In this steady-state operation, the vacuum pumps run less than 100 hours per year in 1-second bursts.

Without the air release valve in place, the pump often pulled water. So operators reinstalled the valve as well as a second vacuum pump for redundancy.

So operators avoided a major construction project and reclaimed more than 113,500 m³/d (30 mgd) of pipe capacity with a pair of vacuum pumps.

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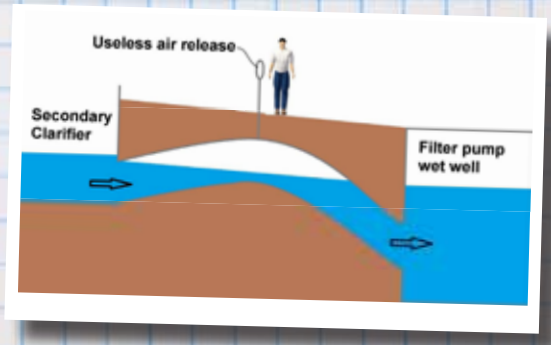
MIKE MANTOR (IN PICTURE) DESIGNED AND BUILT THE VACUUM PUMP CONTROL SYSTEM.



BECAUSE IT WAS BUILT TO GO OVER AN EXISTING PIPE, THIS 1050-MM (42-IN.) PIPE BETWEEN THE CLARIFIERS AND A DOWNSTREAM WET WELL HAS AN AIR POCKET THAT PREVENTED THE PIPE'S FULL 189,000-M³/D (50-MGD) FLOW.

Photos courtesy of Mark Capron