



## PAX Water Technologies Case Study

### *Mixing Eliminates Stratification and Delivers Residual to Upper Layers in 1.5 MG Standpipe*

#### The Problem:

Standpipes are one of the most problematic tank geometries to mix. Inlet velocities are typically small in magnitude and horizontal in direction. The substantial majority of water in the standpipe must remain in the tank to produce and maintain pressure head in the distribution system, so there is often a hard limit (typically 70-90 percent of capacity) below which the operators cannot draw. This takes away the default (yet energy and labor intensive) method of mixing – i.e. the forced draw down and refilling of tanks.

The Spanaway Water Company (Spanaway, WA) discovered the problem of low turnover standpipes first-hand when an operator noticed a layer of condensation on the outside of one of their standpipes. He surmised that the cold water inside the tank was causing this condensation, but worried why the condensation was only visible 20 feet up the side of the tank and did not cover its full height. An investigation of the temperature inside the tank (see Figures 1 and 2) validated his theory – the tank had substantial thermal stratification. The volume and velocity of the incoming water during a regular fill cycle was not sufficient to overcome the thermal loading the tank received on its large, exposed surface area – even in a state (Washington) not known for its thermal extremes. Testing at the top of the tank during normal operation showed almost zero chlorine residual<sup>1</sup>. The warm, low residual water remains trapped in the top of the tank until a period of high demand lowers the water level enough to potentially allow this poor quality water (often with unpleasant taste, temperature and odor – as well as possible high DBP<sup>2</sup> levels) to enter the distribution system.

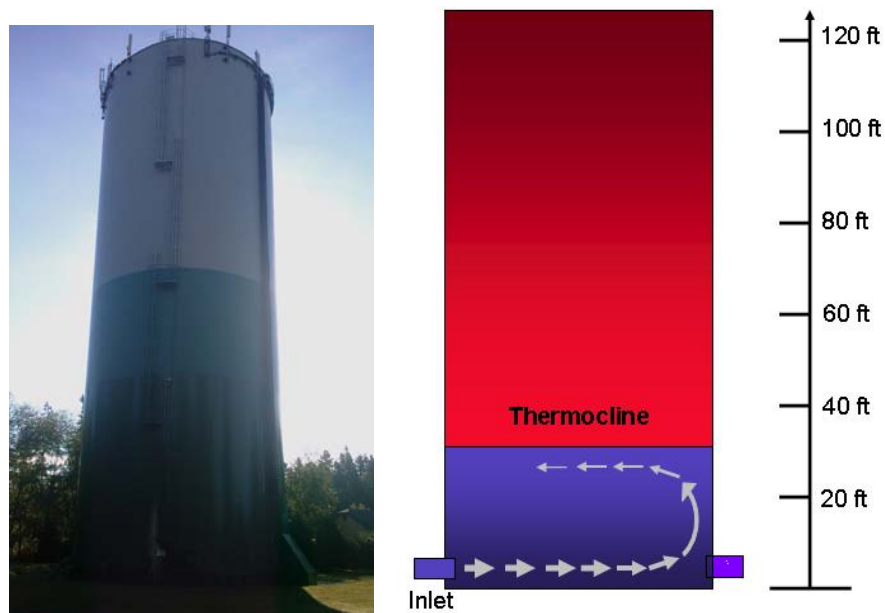


Figure 1: Photo showing the tank (left) and illustration of the thermo cline inside the tank (right).  
 Figure 2 (Below): Shows the temperature data, which was collected to establish the location and strength of the thermo cline.

<sup>1</sup> Grab samples of total chlorine were taken periodically at the top and bottom of this tank and although a residual of 0.7 – 0.8 mg/L was found in the bottom layer of the tank, the residual was 0.00 – 0.05 mg/L in the upper-most layers

<sup>2</sup> DBP – Disinfection Byproducts, which include Trihalomethanes and Haloacetic Acids

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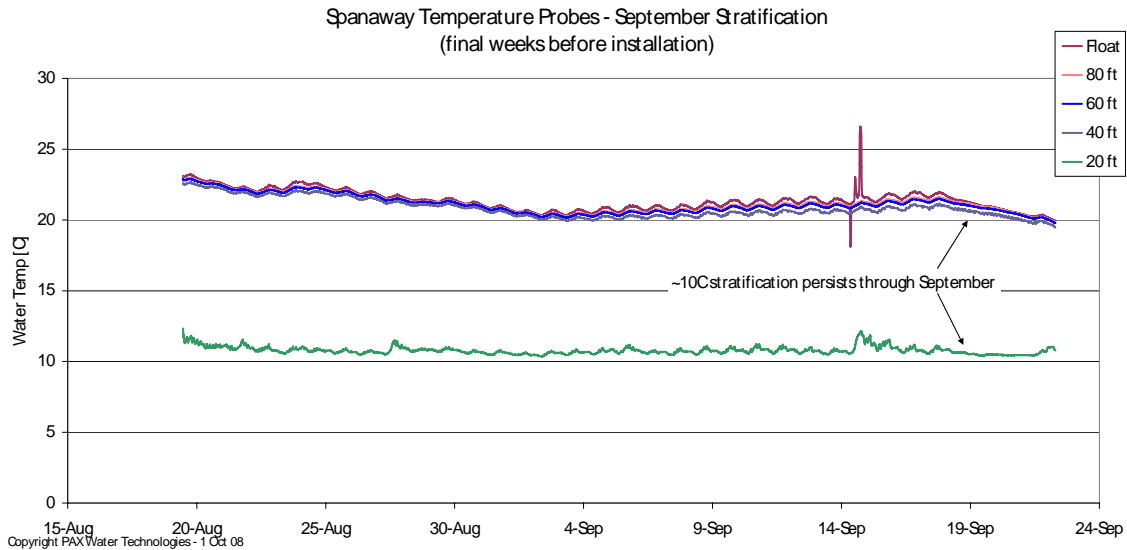


Figure 2: Plot showing temperature stratification during August and September before mixer was installed at end of September. Tank dimensions were 46 feet diameter and 127 ft tall. Water level was up to 120 ft during the time of measurement.

Sudden loss of water quality in standpipes can also occur at the beginning of winter due to “inversion.” Inversion occurs when the old, stagnant water at the top of the tank is no longer warmed by the summer sun. Instead, the water is chilled by the cold winter air. This chilled, colder water suddenly sinks to the bottom of the standpipe which causes the standpipe to suddenly ‘invert.’ After inversion, the first water to be flushed directly into the distribution system to supply customers is the oldest, lowest quality water from the top of the tank, while the good water remains trapped at the top of the tank.

## The Solution:

Standpipes present a particular challenge for most mixing systems because of their height. The PAX mixer has been demonstrated to restore water quality, reduce the need for on-site chemical dosing, and improve reliability and homogeneity in ground storage tanks, but those tanks tend to be wider than they are tall. Our analysis suggested that, despite the unfavorable ratio of height to diameter of this standpipe, the PAX mixer would be able to penetrate an established temperature gradient and completely circulate all 120 feet of the water column.

The installation of the PAX mixer, coordinated by our Northwest Representative, **T M G Services** took less than a day and required no crane or heavy equipment. The only preparation was that the reservoir water level was lowered to 100 feet and isolated until divers could complete the installation. The customer saw an immediate benefit. In contrast, older style mixing systems previously used in standpipes required impractical 120 foot long draft-tubes or tree-like piping structures built into the tank and a long and expensive construction and installation process. These processes also required draining the tank, welding, and recoating the inside surfaces.

Figure 3 shows the final days of stratification before the mixer was activated, and the impressive results immediately following. Approximately every hour another vertical foot of the stratified water column was blended with the cool, fresh, chlorine residual-rich water. After seven days the entire water column was completely blended and the

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temperature of the upper layer had fallen from 19°C (~66°F) down to below 16°C (61°F). The reduction in temperature allows the residual to last longer in the upper layers and lowers the rates of reaction and DBP formation. Grab samples taken after one week of mixer operation showed a dramatic increase in residual at the top of the tank: from 0.00 mg/L to 0.31 mg/L.

With the active mixing provided by the PAX mixer water quality throughout the tank has been improved and the entire volume of water is now available for regular or emergency use. There is no chance of an inversion while the mixer is operating in the tank. The reliability and quality of Spanaway's distribution system has been significantly improved by this simple infrastructure upgrade and minimal interruption of tank use was required.

The Water Programs Manager from Spanaway, Tim Tayne, describes the implications of the PAX Mixing system in this way: "Consistency in the quality of water provided is the key to customer satisfaction. This also ensures the drinking water always meets the drinking water standards, even during high demand such as fighting fires or abnormally hot weather. The volume of water in this reservoir with high water quality went from 0.25 million gallons (MG) to almost 1.5 MG by installing the PAX mixer. We will be evaluating our other reservoirs in the near future."

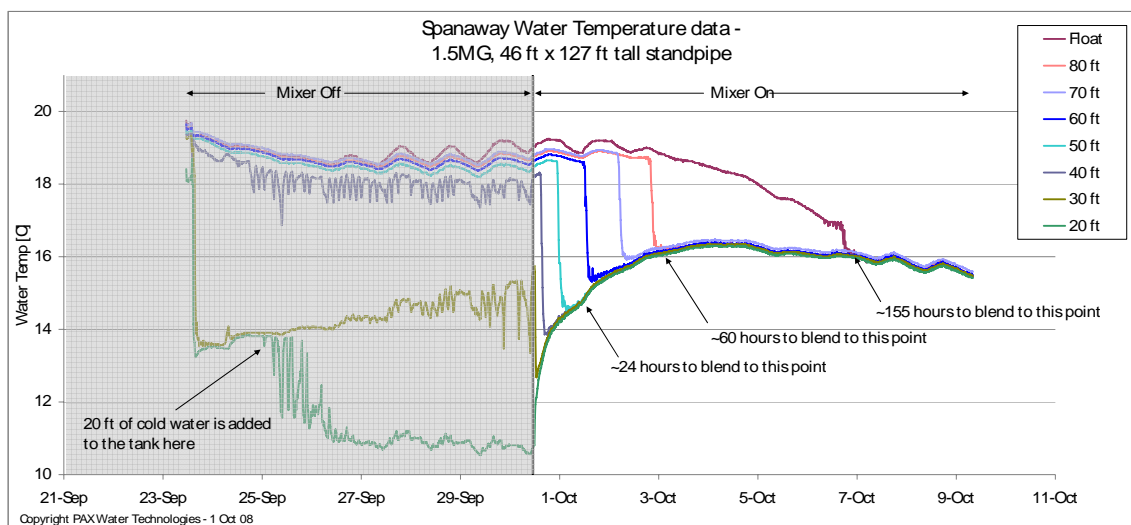


Figure 3: Temperature probes at intervals in the standpipe show the mixer steadily overcoming the thermal stratification in the tank.

### Conclusion:

With this breakthrough case study, PAX Water Technologies has proven that their innovative technology (which has proven successful in rectangular and circular ground storage tanks) can now offer a solution for utilities seeking to improve water quality and reliability in their standpipes.

The PAX Mixer is an active mixing solution that completely eliminates stratification on a continual basis and does not rely on operator-adjusted drain or fill cycles. This continual operation and independence from the pressure in the system makes the PAX Mixer well-suited for standpipe owners who often find themselves constrained in how much they can drain and fill those tanks. For operators in colder climates, the continual movement of water in the tank caused by the mixer can also help to prevent freezing and the damage that ice formation typically can do to tank interior coatings and linings.