# Water, Energy & Cost Savings of Silver Bullet AOP Water Treatment Solution Leads to Independent GSA & NREL Deployment Recommendation for Federal Buildings

**GSA/NREL Profile:** The General Services Administration (GSA), an independent agency of the United States government, was driven to initiate a Green Proving Ground (GPG) alternative water treatment (AWT) program because cooling tower-related water consumption is one of largest potable water loads within federally-owned buildings. GSA data shows that over 26% of building water use is associated with heating and cooling. According to GSA, this is by far the dominant water use case in federal buildings, owing largely to the evaporative cooling demands from either water-cooled cooling towers or evaporation-based air conditioning systems.

As part of a federal government-wide mandate to be more cost and resource efficient, GSA, in partnership with the National Renewable Energy Laboratory (NREL), initiated an AWT pilot project as part GPG program to evaluate performance and cost savings related to the water treatment for federal building cooling towers. The final GSA, DOE and NREL report can be found at: https://www.gsa.gov/governmentwide-initiatives/sustainability/emerging-building-technologies/published-findings/water/advanced-oxidation-process-for-coolingtower-water.

GSA manages and supports the basic functioning of federal agencies and manages about $500 billion in US federal property, which includes 8,700 owned and leased buildings totaling 380 million square feet of space.

**GSA/NREL's Water Treatment Pain Points:** Between 2014 and 2017, GSA's water rates increased 41%. In light of this precipitous rise, GSA's Rocky Mountain region commissioned a pilot program to test AWT technologies that reduce water usage in cooling towers, which are among the largest users of potable water in commercial office buildings. The Region 8 Proving Ground team worked with NREL to assess Silver Bullet Water Treatment's patented advanced oxidation process (AOP) technology.

Silver Bullet and competing AWTs were installed and tested at Denver Federal Center's (DFC) Building 95, a 163,206 square foot, two story office/laboratory building that was constructed in 1999. The major tenant is the US Department of Interior. Building 95 currently houses the National Water Quality Laboratory (NWQL)—the flagship analytical facility for the US Geological Survey of the US Department of the Interior. Building 95 has two 250-ton water cooled centrifugal chillers that supply chilled water to the facility. The chiller is rated at 0.5 kW/ton and has a rated evaporator flow rate of 350 GPM and a rated condenser flow rate of 750 GPM. There are two 20 hp centrifugal condenser water pumps, rated at 750 GPM at 75 ft of head, serving the two chillers. The cooling tower is an induced draft cooling tower, with two cooling tower cells and two speed fan motors.

*Silver Bullet AOP Solution Installed at GSA Denver Federal Center's Building 95*

In 2014, Building 95 had installed a non-chemical AWT system that was plagued by algae growth, despite additional biocides. The system was decommissioned, and the O&M had reverted to traditional chemical treatment.

Following the failure of the previous AWT, the Silver Bullet AOP system was installed and an evaluation period commenced. The primary focus of NREL's evaluation was to measure cooling tower makeup water use before and after installation of the AOP system. In addition, annual reductions in cooling tower chemical costs, monthly water chemistry reports, ease of installation, and overall cost-effectiveness were evaluated. NREL used data from the existing metering system and the building automation system (BAS) to quantify the cooling tower makeup water savings for both the baseline and post-retrofit periods.

**The Silver Bullet Solution:** The Silver Bullet AOP technology was nominated to be part of this evaluation by GSA and NREL because the solution is proven to oxidize minerals and contaminants in the water, kill bacteria (including legionella) and break down the biofilm substrate that leads to calcium buildup and scale formation in cooling towers. GSA and NREL support the use of Silver Bullet's AOP solution because the technology has proven to work on buildings where there may not be a full-time mechanic or on-site cooling-tower O&M contractor. GSA and NREL also were impressed by the ease of installation and use of Silver Bullet's AOP system, noting that the small wall-mounted unit was installed at the DFC in a few hours, is not invasive to the balance of the chilled-water system, and needs minimal to no regular maintenance or monitoring.

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TREATING WATER. BETTER.

## GSA/NREL's Findings and Conclusions on Effective Treatment and Value of Silver Bullet Water Treatment:

**Silver Bullet's Annual Cost Savings and Economic Benefits to GSA's Denver Federal Center Building 95**

| | Baseline (Before) | Silver Bullet AOP (After) | Difference with Local Sewer + Water Rate ($7.14/kGal.) | Difference with GSA Avg. Water Rate $16.76/kGal. |
|---|---|---|---|---|
| **Annual Maintenance** | $5,855/yr. | $3,333/yr. | $2,522/yr. | $2,522/yr. |
| **Annual Water Consumption (Gallons/yr.)** | 2,003,273 | 1,475,482 | 527,791 | 527,791 |
| **Annual Water Cost ($/yr.)** | $14,303 | $10,535 | $3,768 | $8,846 |
| **Annual Energy Costs ($/yr.)** | $0 | $1,041 | $1,041 | $578 |
| **Simple Payback** | *Years* | | 6.2 | 2.1 |
| **Savings-to-Investment Ratio** | *Integer value between 0 and 100* | | 2.4 | 7.2 |

**Sources: GSA, DOE, NREL**

**26% ESTIMATED WATER AND SEWER SAVINGS!** GSA's utilization of the Silver Bullet AOP water treatment system in a temperate climate (Denver, CO) resulted in an estimated annual cooling tower makeup water savings are 527,791 gallons/year, with a range of estimated savings from 433,288 gallons/year to 622,307 gallons/year. This corresponds to an estimated total annual cooling tower makeup water savings of 26.3% and a higher bound estimate of 29.7%. Hot and dry climates will achieve larger savings especially when used in cooling-intense applications such as data centers.

**SIMPLE AND NON-INVASIVE INSTALLATION!** Installation of the relatively small device took only a few hours, including the simple tie-in process, which consists of connecting the injector hose to the cooling tower basin.

**IMPROVED CHILLER OPERATIONS!** Silver Bullet AOP technology helps decrease energy use by reducing scale and biofilm, which negatively impact heat-transfer efficiency. A borescope view of the two chiller tube condenser bundles, captured after Silver Bullet had been running for more than two years, revealed a significant decrease in condenser tube fouling.

**WATER CHEMISTRY MET GSA STANDARDS!** All of the tower-water chemistry values were within the GSA designated ranges. No additional water-treatment chemicals were added during the testing period, other than periodic, small doses of biocides to prevent biological growth. GSA and NREL noted that Silver Bullet's solution helped to significantly reduce the environmental impact of the chiller plant operations. Follow-up water-chemistry analyses indicate that the Silver Bullet system is performing well and that the additional biocides are not necessary.

**INCREASED CYCLES OF CONCENTRATION (CoC)!** Typical CoC for GSA facilities range between 3 and 6. For 2017, the annual average conductivity-based CoC) was 9.54. GSA modeling indicates that the majority of the water savings are achieved by a CoC of 10; an average of 84% of the savings achieved at 30 CoC were captured at 10 CoC.

**SIGNIFICANT REDUCTION IN O&M!** The new cooling tower O&M contract for Silver Bullet water treatment solution saved GSA Building 95 $2,522 per year, due to reduced chemical expense and a 50% reduction in annual O&M hours.

**3 YEAR PAYBACK AT AVERAGE GSA WATER/SEWER COSTS!** At the combined water/sewer cost in Denver of $7.14/kgal ($4.82/kgal for water and $2.33/kgal for sewer), payback for a retrofit was 6 years, with a Savings-to-Investment Ratio (SIR) of 2.4. At GSA's average water/sewer cost of $16.76/kgal, the retrofit payback was 3 years with an SIR of 4.6. Note that if the two towers share a basin, the installed cost would be half as much because only one system is required.

**SILVER BULLET EARNS GSA/NREL'S RECCOMENDATION FOR FUTURE DEPLOYMENTS!** GSA and NREL concluded that the simplicity of this product, reduction in water and onsite chemical use, and positive ROI all make it a good candidate for future deployments. GSA and NREL noted that the technology can be retrofitted to any process water system, boiler, or other hot water system. For future installations, GSA's Denver Federal Center and NREL staff also recommend the Silver Bullet service contract as part of implementation given that the installation is very quick, and the water treatment solution is not invasive to the balance of system.