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Modernizing a Water Treatment Plant for the Next 100 Years

To address present-day issues with its water treatment facility while planning for operations and infrastructure that would endure, a Massachusetts water utility carefully designed a sustainability plan with true staying power.

BY ALAN F. TAUBERT JR., BRAD PERRON, AND JOHN FORTIN

THE SALEM AND Beverly Water Supply Board (SBWSB) in Beverly, Mass., has been providing reliable drinking water to nearly 90,000 residents for more than 110 years. As a medium-large water utility in the Northeast, it's considered critical infrastructure that must operate 24-7, 365 days a year. Given its age and the necessity to ensure reliable and resilient operations for the present and into future generations, in 2020 SBWSB approved the executive director's recommendation to create a sustainability manager position, which would help modernize the utility.

Water utilities across the country are implementing best management practices to address aging infrastructure, costs of replacing assets, greater expectations for service levels, and heightened risk to the delivery of safe drinking water. A five-member board of directors oversees SBWSB, with two representatives from each city, led by an independent chairperson. SBWSB manages three watersheds and an 18-mgd water filtration plant. Once the treated water leaves the plant, Salem and Beverly manage the complete distribution system, including pump stations and storage tanks.

OLD INFRASTRUCTURE, NEW STRATEGY

SBWSB's water filtration plant sits on a 25-acre campus in Beverly, adjacent to its terminal reservoir (Wenham Lake). Nearby are

pump stations owned by Salem and Beverly as well as a residential community. In total, including three reservoirs and adjacent watershed land, SBWSB owns and maintains approximately 1,158 acres of water and watershed land in several communities.

The original SBWSB plant was constructed in 1935, with a sizable expansion completed in 1978. Strain on the aging infrastructure prompted the organization to prioritize strategic asset management with a two-pronged approach to sustainability: (1) ensuring the facility reliably delivers water every day and (2) planning for the next 100 years of service, with an eye on renewal and capital improvement projects. The senior leadership team knew that a long-term modernization strategy called for a robust plan.

Aligned with strategic objectives for meeting current and future demand, along with an ever-changing regulatory environment, SBWSB created its Sustainable Water Infrastructure Management program (SWIM) to provide a focus on modernization in four areas: people, assets, standards, and technology. SWIM encompasses the organization's long-term improvement efforts, with an estimated sustainability investment of \$54 million.

PUTTING SWIM INTO ACTION

The senior leadership team established a foundational plan to align the SBWSB board of directors and staff on a vision for

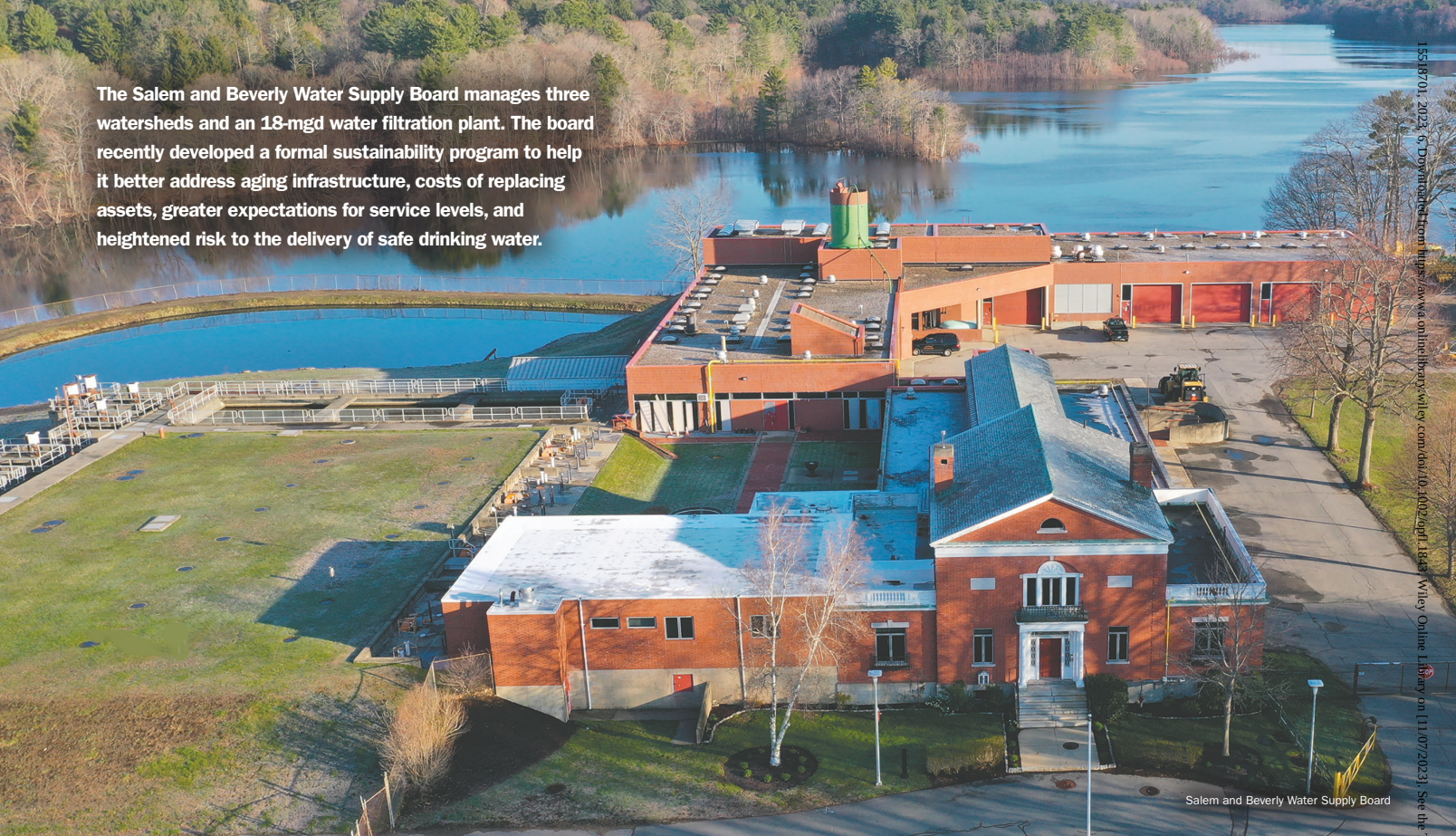
the future. In a series of workshops, the team refreshed the organization's mission, vision, and values statements; changed the management focus from that of a public to a private utility; and made a commitment to communications and training.

Emphasis was placed on adopting best management practices in line with five "swim lanes," which compose the Reliability; Asset Management; Capital Renewal; Energy, Environmental, and Regulatory; and Safety (RACES) framework illustrated in Figure 1.

Reliability. The existing plant needs to be sound enough to handle daily demand, ready to withstand starts, stops, and extremes in demands associated with renewal and capital improvement projects. An effective, regimented preventive maintenance program helps ensure existing equipment is reliable, with breakdowns and emergencies practically nonexistent.

SBWSB needed a refreshed organizational chart, formal job descriptions, and training for best management practices. The new job roles have helped staff understand desired behaviors around additional training, improved communications, and a focus on adopting best management practices. The organization is working with local educational institutions and internship programs to provide training and entice new graduates to seek employment in the water sector.

The Salem and Beverly Water Supply Board manages three watersheds and an 18-mgd water filtration plant. The board recently developed a formal sustainability program to help it better address aging infrastructure, costs of replacing assets, greater expectations for service levels, and heightened risk to the delivery of safe drinking water.



Asset Management. It's important to understand all aspects of critical assets to determine risk and risk mitigation strategies. This information is also needed to build short-, medium-, and long-term asset management strategies.

Capital Renewal. SBWSB compiled an initial capital renewal plan that includes 10 phases of work. Phase A is underway, with the design of immediate needs to address high-risk plant, pipeline, and process control functions. Future capital renewal plans will include sustainable design concepts.

Energy, Environmental, and Regulatory Management. Managing costs and meeting regulatory requirements require staff to develop solid energy, environmental, and regulatory strategies and plans. From a sustainability perspective, SBWSB wants to use natural resources in a thoughtful way that includes safely and properly managing hazardous materials. The organization supports and participates in a variety of regional planning projects.

Safety. Underpinning the SWIM program is a well-organized culture with a two-pronged focus on safety and well-being on the job. Refreshed guidelines and an ongoing training regimen will ensure staff and visitors return home safely every day.

Each practice in the SWIM program requires formal, living plans to document the current situation, along with a formalized future work plan. SBWSB has developed a two-year look-ahead master schedule to serve as a road map, guiding implementation through changes. The master schedule is posted in central locations, so staff and the board of directors are kept abreast of the work plans and schedule on a bimonthly basis.

SBWSB's primary focus is on sustainability, with an eye toward the reliability and resilience of its present-day asset base, ensuring nonstop delivery of drinking water to customers. The organization is also thinking about future generations, developing a 100-year sustainability plan.

SUCCESSES

While elements of the SWIM program and its RACES practices have been in play only since the fall of 2020, significant benefits have already been realized with the following achievements:

Policies, Financial, Risk Control, and Organizational Modernization. SBWSB has reviewed and updated all key policies, investments, and insurances; established a formal risk management framework; and approved a new organization chart. All

positions now have a formal job description and are linked as appropriate, with a focus on best management practices.

Preventive/Precision Maintenance Program. A computerized maintenance management system (CMMS) has been selected, and a phased implementation plan includes development of proactive preventive/precision maintenance.

Asset Inventory. Updates to all critical physical assets have been identified, and attribute information has been collected for input into the CMMS. Critical spare parts inventory has been through multiple reviews; this practice is ongoing.

Capital Renewal. SBWSB has developed and continues to update its phased capital renewal plan, with a current estimated investment of \$54 million. An immediate-needs design contract is underway. Inspections have been conducted of critical infrastructure that includes a 36-inch transmission pipeline (circa 1895) and a 4-million-gallon underground clear well (circa 1935).

Energy and Environmental Management. Multiyear electricity and gas energy contracts have been secured at costs well below current market pricing. The review and removal of hazardous materials were completed in 2020. SBWSB follows all regulatory requirements and supports regional

projects such as emergency response planning and drought management.

Safety Program. SBWSB has created a formal health and safety manual comprising 16 individual safety plans. A rigorous training program is being developed, and a Safety Committee is in place to keep alive the discussion of risk and safety.

The board of directors is pleased with the plan and progress to date and has requested that SBWSB leadership staff share their sustainability plans with other regional organizations to encourage similar action plans, share experiences, and build coalition partners in the discussion and execution of sustainable development.

A DUTY TO STAKEHOLDERS

SBWSB understands its duty to its stakeholders throughout the region as well

as its obligation to be strategic and fiscally responsible through best management practices. With challenges of a limited workforce, aging infrastructure, and an estimated \$54 million in capital investments, total buy-in to drive sustainable measures into the planning phase of life-cycle delivery is imperative for optimal, continued asset performance. Crafting a vision and having a single voice from leadership have proved to be effective communication and change tools.

It's clear that staff engagement is key to maintaining reliability and resilience as a master plan takes shape. Engaging and training staff on best management terminology and practices contribute to a common language that allows them to actively participate in required culture change.

The SBWSB leadership team has learned that to successfully employ best management practices, it's important to have a formal work plan, ongoing communications, adaptability, trust, and openness among all parties. Perhaps most important is having patience with the process of change. By creating a formal sustainability program, SBWSB can plan for the facility's reliable service now and for the next 100 years.

Editor's note: This article is based on "SBWSB Modernization and Sustainability—The Next 100 Years," published by the Journal of the New England Water Works Association. Printed with permission. To access the original article, visit <https://newwa.org/Publications/TheJournalandArchives.aspx>.

Figure 1. SBWSB's Sustainable Water Infrastructure Management Program

SBWSB adopted best management practices in line with five "swim lanes," which compose the RACES framework.

	Reliability Plan	Asset Tracking/Inventory	Capital Renewal Plan	Energy, Environmental, and Regulatory Management	Safety and Well-Being Focus
	Timeline	Timeline	Timeline	Timeline	Timeline
Goals	- Ensure reliable water plant and system - Maintain customer service levels—a resilient water supply is our 24x7 mission.	- Understand: - What do I own? - Where is it? - What is critical? - Understand: - People assets - Skills inventory and workforce development	- Understand condition of critical assets - Ensure there are short- and long-term funding and improvement plans	- Use natural resources in a thoughtful way - Manage hazard materials in a safe and proper manner - Meet regulatory requirements	- Target 0 safety incidences - Return home safely every day - Ensure staff well being included
Deliverables	- Current and living (formal) Operations and Maintenance (O&M) plans - Process, performance, and management plans - Risk and resilience plans	- Current and living (formal) master asset register / map - Current and living (formal) organization chart, job descriptions, succession planning, training	Current and living (formal) capital improvement plan and adequate funding plans to maintain customer service levels and demand projections	Current and living (formal) energy, environmental, and regulatory management strategies and plans	- Current and living (formal) safety and well-being plans underpinning daily focus on safety for everyone - The discussion of risk is alive
Specifics	- O&M manual updates - Emergency Response Plans - Performance management (PM) program - Computerized maintenance management system (CMMS) review/implementation - Geographic information system (GIS) expansion	- Updated organization plan - Plant, reservoirs/watershed, pipe, pump stations, fleet - Information, records management - Technologies such as SCADA, GIS	- Capital renewal plan (CRP) - Financial plans - Condition assessments - Plant expansion - Watershed protection	- Freedom energy management/NGRID programs - HAZMAT review for storage and disposal - Regulation 310 CMR 22 - DEP Sanitary Survey, 2021	- H&S Plan & Safety Committee - Personal protective equipment - Housekeeping (i.e., SS) - Arc flash - Confined space - Reliable YOU for self care
Background Documents	- PM program development (MC CMMS, Jacobs and Lubrication Survey, 2021) - AWIA Risk & Resilience Assessment, CDM 2020 - Putnamville emergency action plan (EAP), CDM 2020 - Emergency response plan, SBWSB Staff 2019 - O&M Manual, CDM 1979 and Updates by M. Tricoli 2017-2019 - Vulnerability assessment, CDM 2003	- New organizational chart and job descriptions, 2021 - In-house plant and fleet asset inventory for PM programs, 2021 - Document control process, 2021 - In-house valve tagging project and filter plant valve database (Excel), 2019 - Valve information—cards and tags last dated ~1998 (wooden box) - Spares inventory cards last dated ~1998 (metal box)	- CIP/Engineering/Maintenance task lists, SBWSB staff Initiated 2020 and ongoing 36" raw water pipeline CA, Phase 1 Canal to Wenham Lake, CDM 2021 - Budget analysis and updates 2021 25-year water supply and treatment master plan, CDM 2007 - Watershed sanitary survey and process management report, W&S 1988 - Water supply study, CDM 1969	- Multiyear electricity/gas contracts/CAPTAG and demand response programs, 2021 - NPDES best management practices plan and certification, CDM 2021 - EPA sustainability report 2020 - DEP sanitary survey, 2019 - Monthly and quarterly regulatory reports via SBWSB PWS ID #	- W&C H&S program manual creation and training, 2022 - W&C unofficial H&S walkthrough applicability assessment, 2020 - Jensen & Hughes OSHA walkthrough report, 2019 - REF: SEDS H&S program, 2017 - AET over system engineering analysis for short circuit, coordination, and arc flash, 2021 - AWWA Let's Talk Safety handbook