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QUARTERLY

Environmental Sense. Business Sense.

BROWN AND CALDWELL

QUARTERLY

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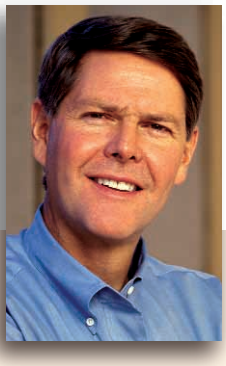
Environmental Sense. Business Sense.

Brown and Caldwell balances both views to design practical, effective solutions

Across the municipal, private and federal sectors, the perspectives of business and the environment are rapidly converging—or, some might say, nearly joined at the hip. Regulation and compliance continue to be significant drivers for environmental protection and the safety of public health, but so are economic forces, like risk mitigation and capital allocation.



Where these viewpoints converge, solutions that satisfy both environmental and business requirements can be found. The reality: the product of "environmental sense, business sense" thinking is usually common sense—a clearer understanding of needs, trade offs and checks and balances.

For example, merging cleanup needs with urban redevelopment through more realistic brownfield legislation just makes sense. And who can argue that better O&M practices on infrastructure—as prescribed under the proposed CMOM (capacity, management, operations and maintenance) regulation—won't help to preserve these buried treasures at least cost?

Convergence is accelerating

As a firm driven to innovate—challenging critical assumptions and textbook answers—this convergence is right up our alley. In many ways, "environmental sense, business sense" has long been a signature of how we think and the results we deliver. Our "brains" are intensely focused on environmental solutions that satisfy business realities while meeting customer needs.

Business sense sets a practical tone, whether it's applying a business approach and measures to public services or recognizing the impact that compliance costs have on a company's bottom line. Our first priority in achieving compliance is cost avoidance, followed by optimization between upfront capital and long-term O&M. Our long-held company values emphasize training and better O&M practices (both having high ROI in our book) before capital-intensive projects. And benchmark business practices, along with information technology and automation, are key parts of our environmental sense, business sense solutions.

At the federal level, policy-makers are moving toward tying funding for public agencies to better planning and accountability. One example: The *Water Investment Act of 2002*, introduced in Congress as this issue of *Quarterly* went to press, proposes that agencies implement asset management plans and migrate to "full recovery" user rates in order to tap into $35 billion of state revolving loan funds (SRFs) for infrastructure improvements. This is a strong indication that the influence of GASB 34 is making itself felt in the regulatory and public funding world. Clearly, agencies that emphasize a business approach to their utilities—with better asset management, appropriate funding of expected replacement needs and effective CMOM programs—will be better positioned to access these funds.

Looking forward, the link between environmental and business priorities will only become stronger

On the other hand, the controversy that has plagued the Superfund program for so many years demonstrates what can happen when there is a lack of convergence among environmental sense and business sense. There is broad acceptance for Superfund's objectives—yet issues regarding program efficiency, unrealistic expectations and funding sources have stalled this important program's progress.

Looking forward—be it brownfields, TMDL and watershed protection, water scarcity or water/wastewater system renewal—the link between environmental challenges and business priorities will only become stronger. This convergence is a compelling trend that provides a realistic context for developing effective, long-term solutions.

— Craig Goehring, P.E., CEO

Environmental Sense	Business Sense
Ratepayer Value	Shareholder Value
Stewardship	Return on Investment
Public Service	Customer Service
Regulatory Compliance	Resource Allocation

Going Farther, Faster

In its rugged service area in southern Alaska, the Anchorage Water and Wastewater Utility (AWWU) is used to tackling tough challenges. Because of Alaska's deep frosts, the utility buries water pipes 10 feet underground, compared to a depth of only 2 or 3 feet in warmer regions of the country. In winter, crews have to steam through 5 to 10 feet of frozen soil before they can even start digging down to reach the pipes. "The work we do up here may be routine, but it's more extreme," says the AWWU's General Manager Mark Premo.

The utility goes farther than most, too, when it comes to improving business practices. Facing competitive pressures from private companies since the late 1990s, the AWWU has identified more than 400 cost-saving ideas and achieved significant gains in efficiency and competitiveness. "Most organizations stop when they reach the level of efficiency that we've achieved, but we want to dig deeper," says Brian Crewdson, assistant to the utility's general manager.

Enlisting outside help

To do that, AWWU opted to bring in an organizational development and reengineering consultant with expert knowledge of utility operations. "We have hundreds of initiatives on the table," Premo explains. "We felt that a consultant's knowledge of water and wastewater industry best practices could speed our progress, help us make those good ideas even better and get our entire organization involved in continuous improvement, down to the grassroots."

Brown and Caldwell was selected for the project and began work in June 2001. "A number of firms proposed," Premo notes, "but Brown and Caldwell has the team strength across the board, in water/wastewater operations and organizational management consulting. We knew they could do the job." According to Project Manager Jack Warburton, Brown and Caldwell's task is to help the utility build on its substantial strengths. "AWWU is one of the best utilities we've evaluated," he explains, "with a clearer focus on service, cost-savings and efficiency than most public utilities."

For more than 80 years, the AWWU has provided water and wastewater services to the City of Anchorage. The utility serves some 215,000 people in a service area that is 80 miles long. It maintains a system with more than 1,500 miles of water distribution and wastewater collection mains, two water and three wastewater treatment facilities, water booster stations, 16 wells, 16 treated water storage tanks and 35 wastewater lift stations.

Although the state regulates the AWWU water and wastewater systems as two separate utilities, with separate certificates and service areas, they are managed as a single operating entity. Currently, the AWWU has some 265 employees, a combined water and wastewater operating budget of $61.8

The Anchorage Water and Wastewater Utility is speeding reengineering and aiming for new levels of efficiency

"Most organizations stop when they reach the level of efficiency that we've achieved, but we want to dig deeper."

million, a combined capital budget for 2002 of $35 million and a plant capital value of more than $875 million. During a recent customer service survey, 96 percent of AWWU customers who responded were either usually or always satisfied with their water and wastewater service.

But competitive pressures have been building since the cities of Anchorage and Fairbanks, Alaska, privatized local telephone exchanges and Fairbanks sold off its electrical distribution, solid waste collection and water and wastewater utilities in the 1990s. "Because of these asset sales," Premo says, "we thought it was important to be the best we could be and build a culture of continuous improvement to optimize business practices and cost savings."

Beginning the Excellence Adventure

In 1997, the AWWU launched the "Excellence Adventure"— an organization-wide program, driven by management, to develop and implement cost-effective ways to deliver services. As one of its first steps, the utility assessed its efficiency and identified a "competitiveness gap" of approximately $2 million a year, equivalent to 7 percent of its $28.8 million operating budget for labor, supplies and services. The AWWU set a goal of closing that gap by the end of 2002, relying on internal reengineering teams and tools developed by the Association of Metropolitan Sewerage Agencies (AMSA) and the Association of Metropolitan Water Agencies (AMWA). The utility already has reached more than half its goal, achieving savings of more than $1 million in its 2001 budget.

"We've already done a number of things that would have been at the top of any utility's list, from implementing a sophisticated maintenance management

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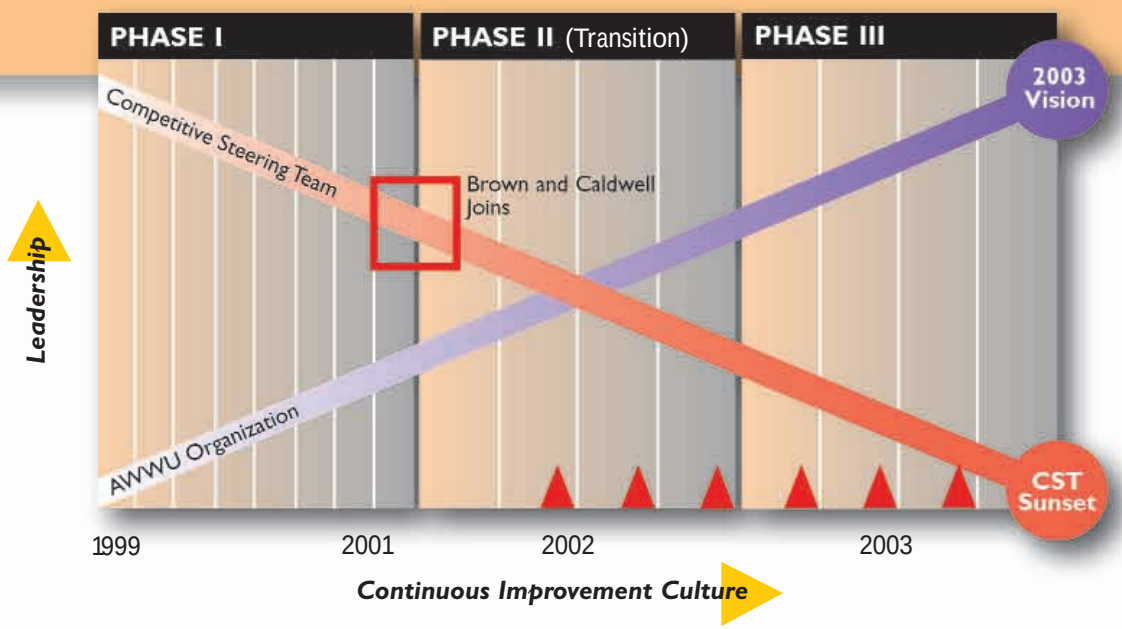

During the three-phase project, the leadership role of the Competitive Steering Team will diminish as continuous improvement principles take hold in the organization. AWWU hired Brown and Caldwell to sustain and accelerate its progress.

▲ Interim Progress Reviews

Going Farther, Faster

CONTINUED FROM PREVIOUS PAGE

system to leveraging automation, Intranet communications and employee involvement," Crewdson says. A wide range of large and small cost-saving initiatives have also yielded results:

- flattening the organization to reduce one layer of management saved $420,000 per year
- consolidating the utility's divisions and sections reduced the number of supervisors and saved $270,000 per year
- implementing new meter-reading technology to reduce the number of meter readers saved $140,000 per year
- reducing the number of take-home vehicles for supervisors saved an estimated $4,200 per year in fuel and other expenses
- reducing the number of employees in the utility's standby program saved approximately $78,000 per year
- improving the sulfur dioxide system at one site reduced chemical usage almost 50 percent, for an annual savings of $12,000
- renegotiating cell phone contracts reduced the average cost of cell phones from $32.24 per month to $25.26 per month, with annual savings of about $8,000.

Cultural change

"We've had many successes, but we don't want to stop there," Crewdson says. "Brown and Caldwell can give our teams answers to technical questions about best practices, so our people don't have to spend a lot of time researching and reinventing the wheel. We also want to expand employee involvement.

"Our structured teams have made positive strides, but we want to get to the place where an individual on the front lines can come up with an idea and pull together the resources to get it done. That kind of long-term, cultural change is much more challenging to achieve."

Brown and Caldwell's charge is to help the AWWU assess its organization and "Excellence Adventure" program, including communication efforts and reengineering teams; recommend ways to improve the program; and provide support to implement the recommendations. The team began over the summer by conducting in-depth interviews with more than a third of the utility's staff, as well as individuals outside the organization, to gather ideas, assess what was working and explore areas that needed improvement. "The scope of these interviews was unusual," Warburton notes, as was the fact that they were conducted by team members with experience in utility operations.

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"Brown and Caldwell can give our teams answers to technical questions about best practices, so our people don't have to spend a lot of time researching and reinventing the wheel."

Once the Competitive Steering Team gathers ideas, the decision making, control and accountability for improvements pass to the division level — a key step in cultivating a continuous improvement culture throughout the organization.

Continued from Page 4

The results of those interviews made it clear, he adds, that the AWWU has been benefiting from strong leadership. "The organization also has good teamwork within workgroups and across division lines," he says, "along with well maintained and well-operated facilities, aggressive use of new technology, active communications and a positive image within the community."

Its workforce, too, he says, is unusually skilled. "Alaska, by its very nature, attracts independent, capable and dedicated people," Warburton explains. "Many have experience in the construction trades, in the North Slope oil industry and in small water and wastewater facilities, where they've gained mechanical skills and electrical and instrumentation knowledge." These skills have not only facilitated cross-training and job sharing, but have also contributed to cost-saving innovations.

"The ideas for improvement are already in this organization," he adds. "The challenge is to make it as practical and advantageous as possible to put those ideas into action." A number of key areas, in particular, should yield major opportunities for cost savings and building a culture of continuous improvement. They include:

Leveraging utility-wide learning opportunities

Brown and Caldwell is working with an all-division reengineering team to develop and implement consistent training policies and programs. The goal is to leverage fully both current and proposed investment in new technologies and management support systems, as well as the full potential of all employees.

Implementing utility-wide, activity-based cost accounting

Brown and Caldwell will be working with a utility-wide reengineering team to implement activity-based cost accounting and provide all employees with the cost knowledge of their activities.

Developing level-of-service and performance measures

A key objective is to fully align all divisions with AWWU's strategic plan. Brown and Caldwell is working with each division to set customer-based levels of service and division-specific performance measures that, when met, will result in efficient delivery of those service levels.

Improving the sulfur dioxide system at one site reduced chemical usage almost 50 percent, for an annual savings of $12,000.

Reducing travel time

Due to the size of the service area, some work groups spend 20 to 25 percent of their time driving to and from facilities. Decentralizing some functions and reorganizing work assignments to reduce travel should significantly improve productivity.

Taking a team approach to capital projects

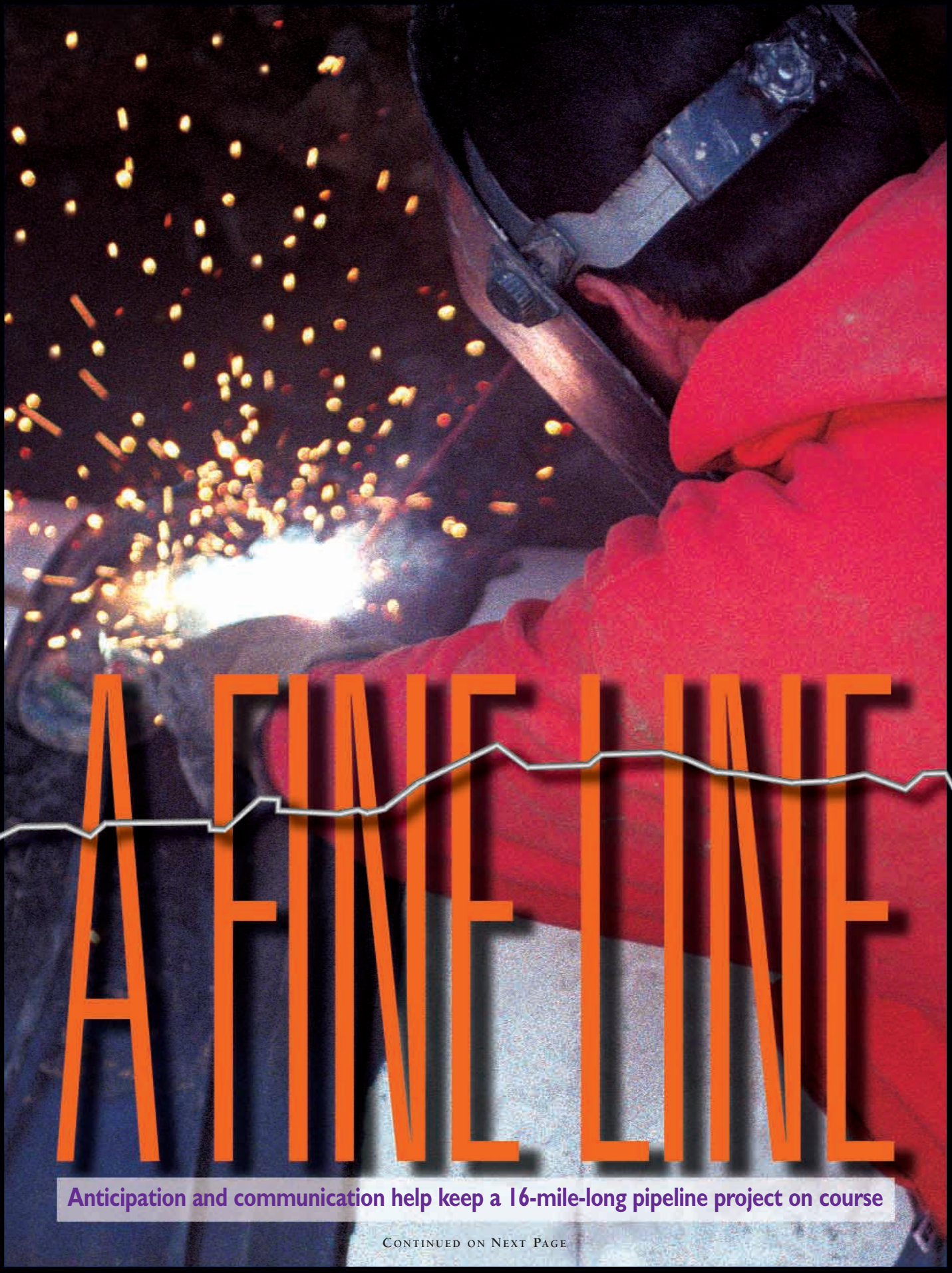
Involving operations, maintenance and treatment staff in capital projects, from planning through start-up, should provide significant opportunities to contain operating and capital costs, reducing start-up time and corrective work.

Reducing energy costs

Energy is second only to labor as the utility's highest operating cost. Work units should be able to achieve significant savings by understanding rate structures, tracking their energy costs and relating them to work activities.

As the AWWU implements the best ideas for cost-saving opportunities during the next phase, it will also continue to integrate the principles of the "Excellence Adventure" into its organization. "Important change has already taken place," Warburton says. "One staff member commented that employees now feel more comfortable picking up the phone to call someone in another division to get answers to questions or coordinate tasks." As line managers, division managers and supervisors take on a bigger role, the "Excellence Adventure" will become an ongoing effort, not a special project.

Crewdson is optimistic. "Our people have a lot of pride in this organization," he says. "Today, nearly a third of our employees are directly involved in this effort, and that's just the beginning. We're focused on the kind of organization that we want to be in the future, and we intend to get there."



A FINE LINE

Anticipation and communication help keep a 16-mile-long pipeline project on course

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There's nothing simple about the new wastewater export pipeline project of the San Francisco Bay Area's Livermore-Amador Valley Water Management Agency (LAVWMA). Designed by Brown and Caldwell, it will carry treated wastewater 16 miles from LAVWMA's pumping station in Pleasanton to San Leandro, where it meets the East Bay Dischargers Authority (EBDA) outfall pipeline to the bay.

It will traverse a wide range of geological conditions, including steep grades, weak soils, unstable fill slopes, creeks, hard rock, mitigated wetlands and two major earthquake faults; archaeological sites; three railroad, five Bay Area Rapid Transit (BART) and 10 freeway crossings; rural roads; heavily trafficked urban streets; and high-density residential and commercial areas.

Avoiding delays

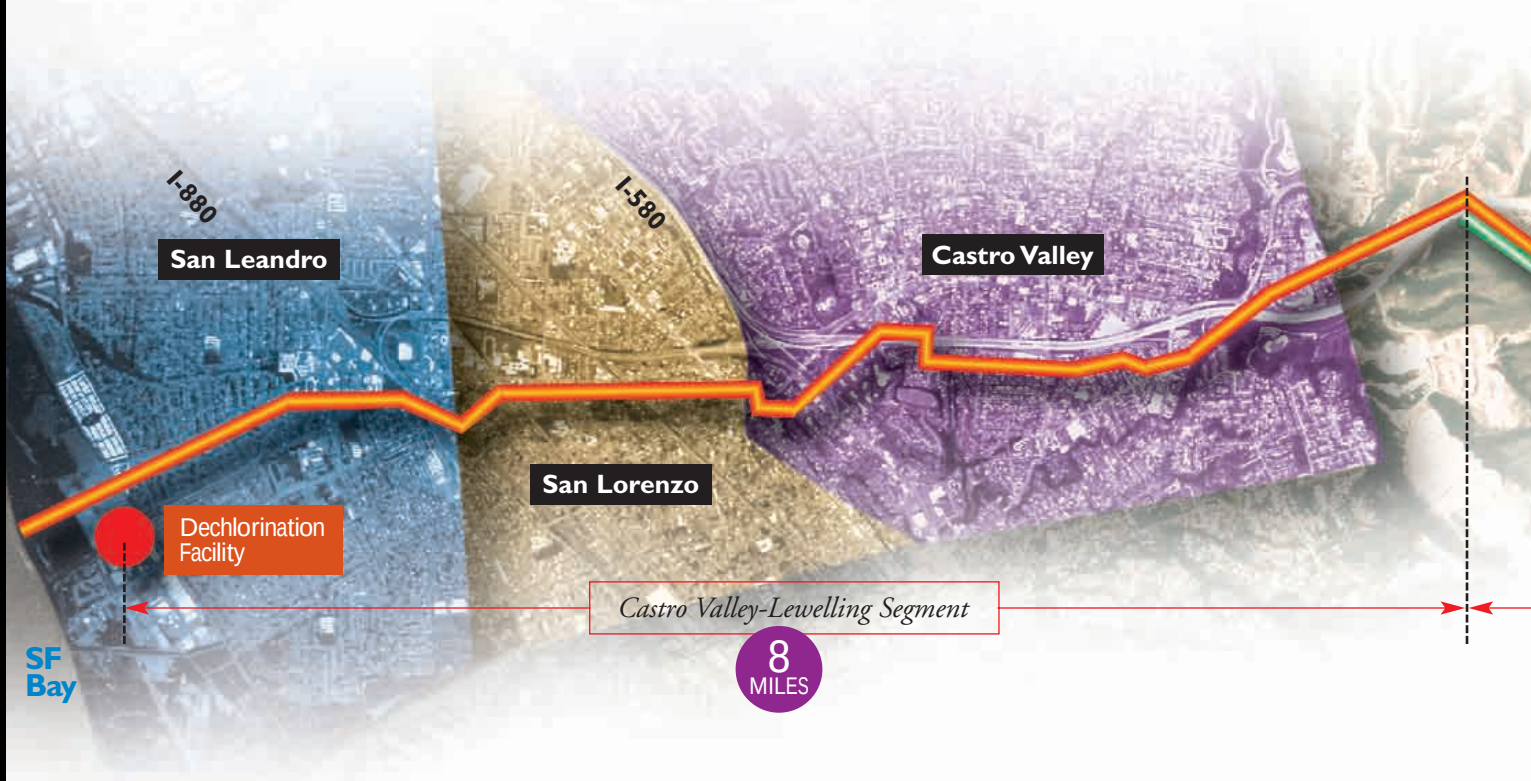
Despite the complex, multi-facted challenges of the project, the first phase is being completed on time and under budget. "Thanks to great planning and teamwork," says Vivian Housen, LAVWMA's general manager, "we've managed to avoid a lot of traps typical of a project this size. We're moving ahead with construction right on schedule."

The key, according to Brown and Caldwell Project Manager Charles Joyce, has been careful planning, communication and results-oriented thinking. Joyce and Project Engineers Dan Drew, Kevin Calderwood and Eric Petrel have tried to anticipate every potential problem and coordinate proactively with every other public and private activity in this densely populated area. "For each of the many technical, permitting or community relations challenges that have come up," Joyce says, "we've focused on finding the best possible solution."

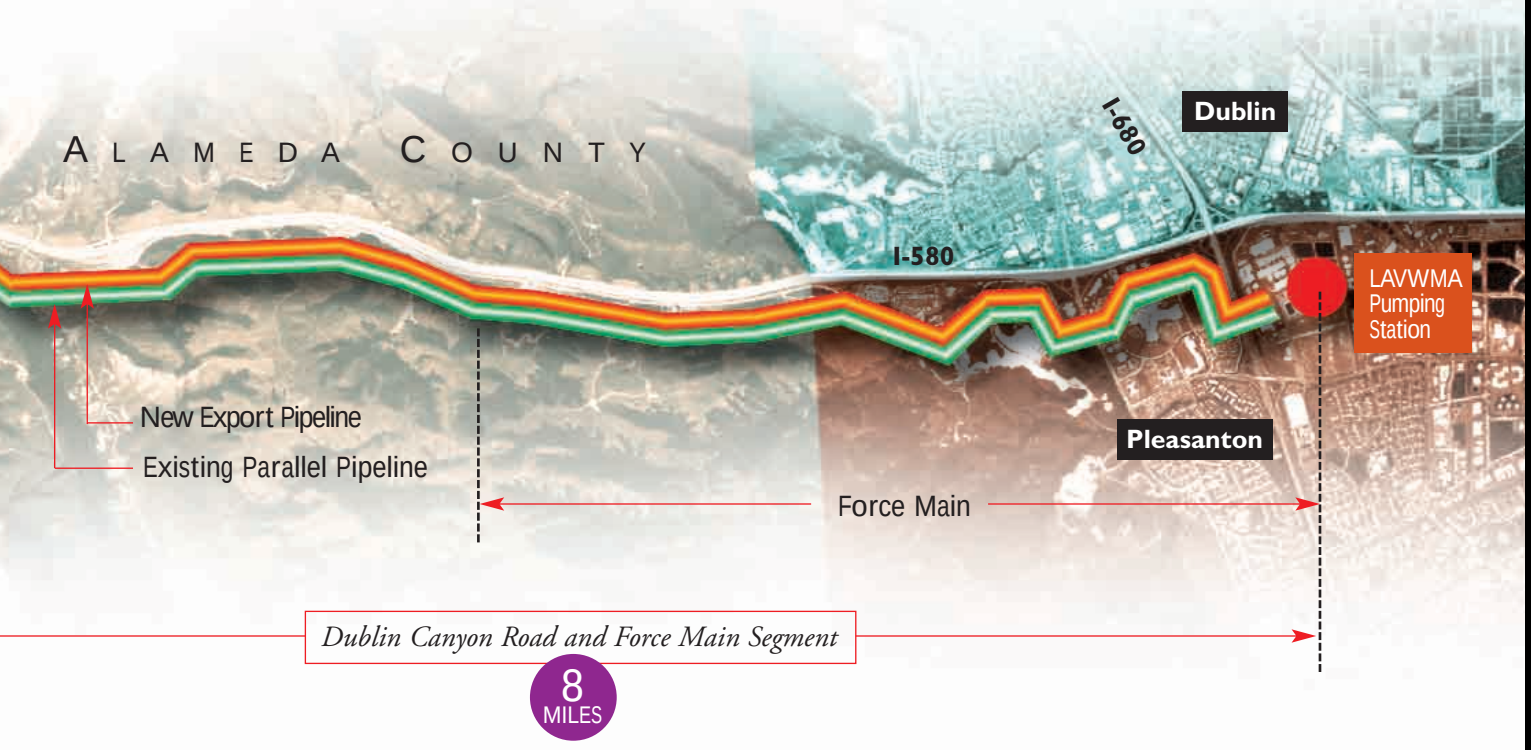
Complex Technical Challenges

LAVWMA's existing pipeline, installed in the late 1970s, has suffered from corrosion and failures—a problem that has become increasingly acute as the region's population has expanded. To accommodate planned growth in the East Bay, the agency is installing the 16 miles of replacement and relief pipe, mostly parallel to the existing pipeline. The work is part of a $160-million, 6-year infrastructure project that will expand capacity from 20 mgd to 41.2 mgd. Brown and Caldwell will also upgrade the capacity of the agency's emergency dechlorination and bypass facilities, including new flow bypass valves, dechlorination chemical storage, pump facilities and outfall pipe.

The pipeline is designed to handle complex hydraulics, since it transitions from a force main to a gravity sewer at the top of a high grade, with extremely steep slopes and pressurized flow condi-



The team is using tunnel-boring machines and microtunneling to lay nearly three miles of the pipeline.



tions. Velocities will exceed 20 feet per second in some areas, fast enough to potentially strip the lining of the pipe. Joyce and his team performed extensive hydraulic modeling to simulate conditions with varying peak flows and tidal, velocity and surge conditions—checking design criteria, verifying diameters for the multi-barreled export pipeline and selecting the best interior wall coating for the pipe.

Focus on solutions

"We've designed the pipeline and material to work most effectively with the conditions," he explains. Four miles of the 36-inch-diameter force main will be constructed using welded steel pipe with an operating pressure of 300 psi. The remaining 12 miles will be comprised of 24- to 36-inch-diameter pipeline of varying materials, including welded steel, high-density polyethylene and reinforced concrete cylinder pipe.

To accommodate frequent railroad and freeway crossings and unstable geological conditions, the team is using tunnel-boring machines and microtunneling to lay nearly three miles of the pipeline. Seismic safety is another big concern. To enable the pipe to withstand a major earthquake on the two fault lines it crosses, the team is installing flexible joints that permit the pipe to move approximately 20 inches underground without damage. "The Brown and Caldwell team," Housen adds, "has done a good job coming up with creative approaches to our technical issues."

Solutions-oriented thinking has also extended to important details such as the size of the pipeline's manway access vaults. "The original pipeline only had access points every 3,000 or 4,000 feet, and the manholes were only 48 inches in diameter," Joyce explains. "Those vaults were very small and hard to work in, and they were too far from many areas of the pipeline." To improve monitoring and repair conditions in the new pipeline, the team solicited ideas from maintenance staff and designed square, 8-by-8-foot manway vaults, spaced every 1,500 feet along the line, that provide safe working

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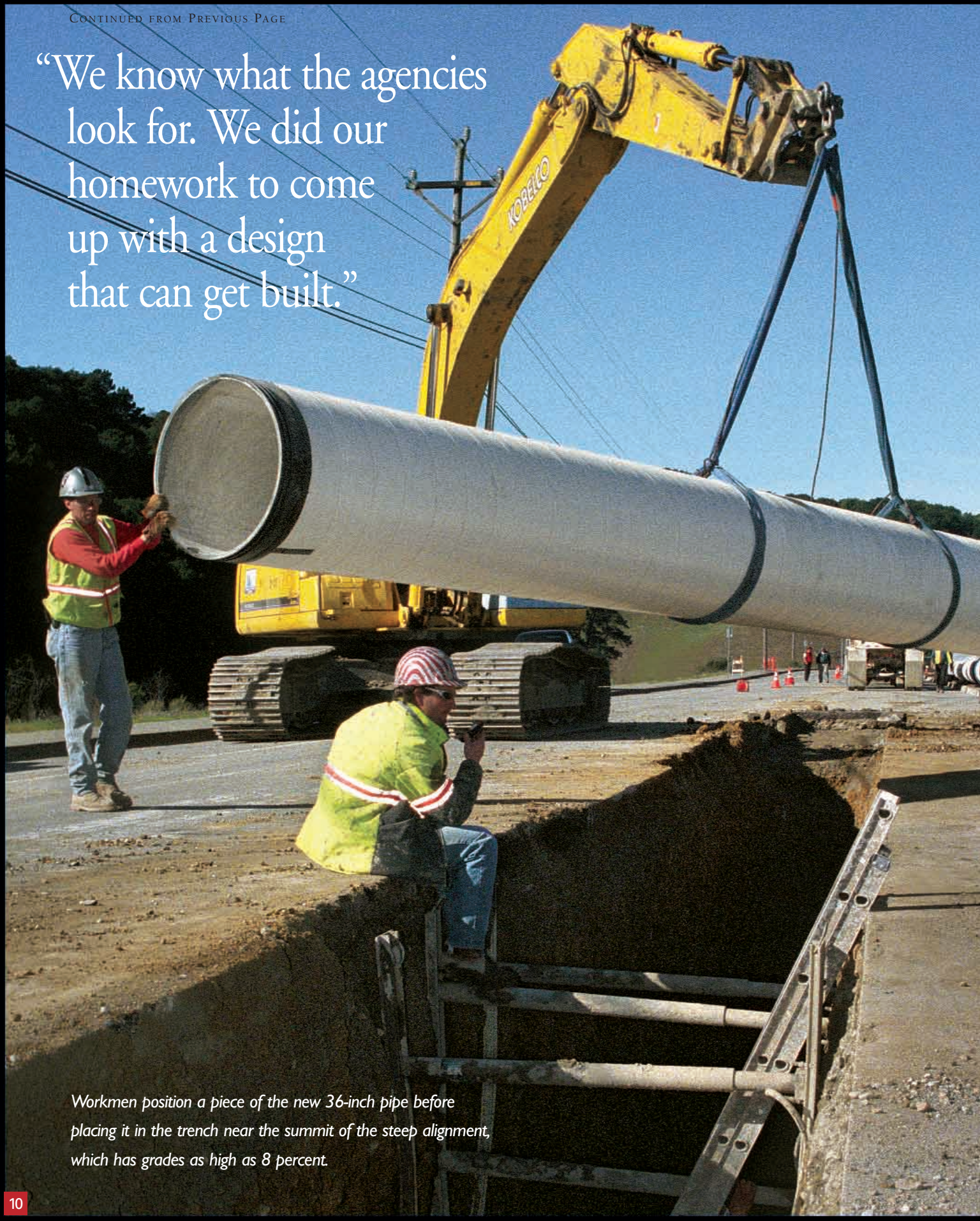
"We know what the agencies look for. We did our homework to come up with a design that can get built."



Workmen position a piece of the new 36-inch pipe before placing it in the trench near the summit of the steep alignment, which has grades as high as 8 percent.

Contractors (left) *weld and* (middle) *test a steel joint to prevent leaks and withstand thrusts and seismic jolts before* (right) *wrapping it with a coating of heat-shrink plastic.*

environments and enable televised inspection of the entire pipe.

Navigating the Permit Maze

Complicating the pipeline project was the maze of agencies the team had to work with to win construction approvals. Obtaining permits from the Regional Water Quality Control Board, U.S. Army Corps of Engineers, California State Lands Commission, California Occupational Safety and Health Administration, San Francisco Bay Conservation and Development Commission, Caltrans, BART and various city and county agencies took more than two years—but it could have taken twice that long, Joyce notes. "We know what the agencies look for. We did our homework to come up with a design that can get built."

Proactive communication was a key part of the strategy. Instead of just submitting paperwork, the team re- quested and arranged face-to-face meetings with agencies to go over every detail of the plans—an approach that significantly sped the permit process. Creative thinking also helped avoid long permitting delays. By rerouting the pipeline to bypass a wetland area, for example, the team was able to avert a lengthy permit negotiation with the U.S. Fish and Wildlife Service.

Community Outreach

Equally important was communication with community residents and businesses whose day-to-day activities are going to be disrupted by the project. Since the beginning of the design phase, the team has been holding monthly stakeholder meetings in affected neighborhoods to discuss construction impacts, traffic plans and other issues. Although some residents have been unhappy about the plans, the team has looked for ways to benefit the community and reduce and mitigate disruption—by paying close attention to construction scheduling, for example, so as to minimize the impact on schools.

"Community outreach has been a huge issue," Housen says. "But the communication we've had throughout the design phase helped us get through those issues so they didn't create unusual delays."

"It all came down," Joyce says, "to being a good neighbor. We're creating a disruption in a heavily traveled, densely populated area, so we need to minimize it as much as possible. We have to be conscientious about what's going on in the neighborhoods that we're going through and, if possible," he says, "find ways to leave them better than we found them."

QUARTERNOTES

BROWN AND CALDWELL ACQUIRES CGK ENVIRONMENTAL INC.

Brown and Caldwell recently acquired CGK Environmental Inc., an environmental engineering and consulting company based in Middleborough, Mass., that specializes in solid waste management.

The December 2001 acquisition strengthens Brown and Caldwell's solid waste management presence across the country. CGK, with its staff of 20, has developed a reputation for integrity in the industry, providing quality service and cutting-edge solutions. The firm is the engineer-of-record at two of Massachusett's five largest landfills, consults regularly at two others and provides engineering and consulting services at several landfills and transfer/recycling facilities across the state.

Integrity and expertise

"CGK has an excellent reputation with long-term industrial and municipal clients," Brown and Caldwell CEO Craig Goehring said. "We first teamed with CGK in 1999 and soon found that, from values to business focus to people, we fit and worked well together. I am delighted that CGK is now part of Brown and Caldwell."

The merger was also a plus for CGK, according to its Principals Alan Kirschner and Gerry Cushing. The company was well positioned for future growth in its other service areas—environmental services, wastewater and residuals management and environmental systems operations/maintenance. Brown and Caldwell's nationwide network of experts was all CGK needed to promote a much broader range of services and possibly grow its customer base.

"We saw a chance to expand service to our clients," Kirschner says. "We recognized," Cushing adds, "that joining forces with BC was the next strategic step for our team."

Though CGK officially is now Brown and Caldwell, the office location remains the same at 48 Leona Drive, Suite C, Middleborough, MA 02346.

Massachusetts Landfill Wins National Award

In Dartmouth, Mass., the Greater New Bedford Regional Refuse Management District has been honored by the Solid Waste Association of North America (SWANA) for its commitment to the highest engineering, environmental and community standards. In 2001, the district's Crapo Hill Sanitary Landfill (CHSL) won SWANA's Landfill Management Excellence Award for achievements in design and operations, health and safety programs, aesthetics, public education and regulatory compliance.

"Crapo Hill is a pristine, state-of-the-art lined landfill facility that respects the environment," says landfill manager Hank Van Laarhoven. "We carefully monitor all daily activities and have worked hard to develop strong, positive relationships with our neighbors."

Opened in 1995, the 150-acre Crapo Hill site accepts an average of 425 tons of solid waste each day. Located within half a mile of some 70 residences and a dozen businesses, the facility is now undergoing a Phase 2 expansion that will enhance efficiency and environmental protections. Since 1996, CGK, recently acquired by Brown and Caldwell, has provided design and engineering services to Crapo Hill, and Brown and Caldwell is designing and supervising construction of the Phase 2 project.

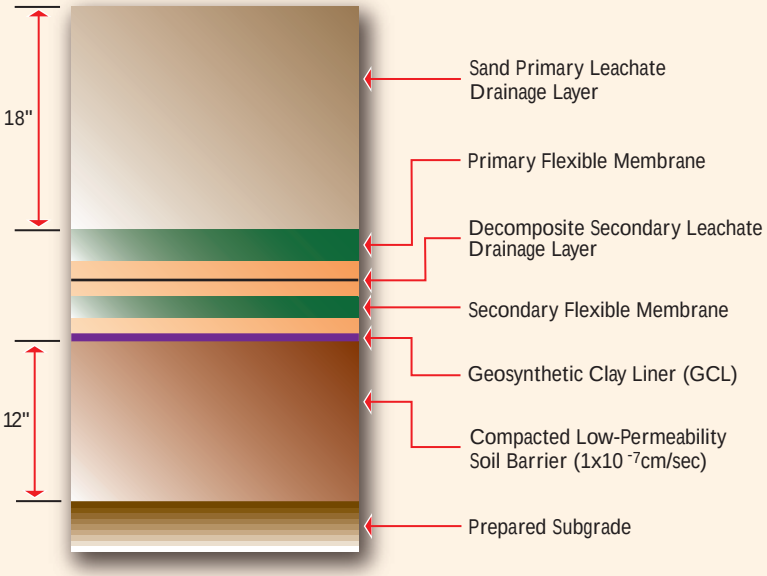
Leachate pumps and storage

The facility features an advanced leachate management system that provides unusual flexibility and on-site storage capacity, as well as the potential for recirculating leachate back into the landfill. Until this year, all leachate produced by Crapo Hill was conveyed to four underground storage tanks, with a combined capacity of 60,000 gallons. Leachate was removed by pumper truck and transported to wastewater treatment plants in the region. In 2000, however, the district received approval to pump leachate directly to the municipal sewerage system in a neighboring industrial park.

The landfill now has a pump and tank system that enables the district to store peak leachate flows and schedule discharges of leachate to the sewer during off-peak periods. All leachate is drained by gravity to a central pump station, where submersible pumps, powered by 15-horsepower motors, can each discharge 180 gallons per minute to the city sewerage system. The above-ground steel storage

The Crapo Hill landfill manages leachate with 100,000 gallons of on-site storage capacity.

Double Liner System



tank can hold 100,000 gallons of leachate and has a fused glass surface finish that resists leachate corrosion. A 75-kilowatt stand-by generator allows the system to continue operating during power outages, and the system is designed for connection to a future leachate evaporation or recirculation system.

Double-liner technology

The Phase 2 expansion, notes Brown and Caldwell Project Manager Alan Kirschner, will incorporate new double-liner technology that exceeds current regulatory requirements. A sub-grade of engineered fill will provide a stable base for the liner system and the contour for leachate collection. The system will have a compacted, low-permeability soil layer, 12 inches thick and comprised of native glacial tills or clay, with a maximum hydraulic conductivity of $1x10^{-7}$ centimeters per second. A geosynthetic clay liner (GCL) will be laid in direct contact with this low-permeability soil layer, and a 60-mil-thick high-density polyethylene (HDPE) geomembrane will be placed on the surface of the GCL. Secondary leachate collection will be accomplished using a geocomposite drainage system. The primary liner will be an 80-mil-thick HDPE geomembrane.

The landfill's appearance, aesthetic appeal and environmental quality has also been a high priority. The district constructed 4,000 square feet of replacement wetland—designed and engineered by CGK and approved by the Department of Environmental Protection and the Army Corps of Engineers—to replace wetland lost during the construction of the Phase 2 landfill project.

In addition, the facility's new methane gas and odor management system, developed with CGK in response to community concerns, features vertical gas extraction wells, horizontal collection trenches and a 2,000-scfm open flare system. Various reuse options for the landfill gas are currently being considered. The system earned the district an environmental award from the Hands Across the River Coalition in 2001.

"CGK came up with the right strategy and brought a great team together," says Van Laarhoven. "We were able to keep our promises to the community, and we have a great relationship with our neighbors as a result."

Cutting Sediment Remediation Costs, Protecting River Water Quality in New York State

After an extensive brownfields remediation project, a 60-acre site in New York State has been restored at lower-than-expected cost. The two-year cleanup of a former riverside pigment and dye manufacturing facility, dating to the turn of the century, involved the removal of approximately 27,000 cubic yards of sediment contaminated with heavy metals, including cadmium, lead, chromium and mercury.

Reducing excavation volume

Brown and Caldwell's Sediments Remediation Group was able to reduce by about 50 percent the volume of sediments requiring remediation. "We showed that biological impacts associated with the contaminated sediments were limited to areas where those sediments included significant amounts of entrained waste materials," explains Project Manager Bob O'Neill. The team also demonstrated that the sediments posed no risk to surface water quality.

The sediment removal was conducted using long-reach backhoes, both below and above the water line. The contaminated material was disposed of in an on-site containment facility. In addition, to protect the river and contain resuspended sediments within the area, the team used turbidity curtains, equipped with floats and weights made of PVC-coated fabric. Dual curtains were used in key project areas.

The team achieved further cost savings, O'Neill says, by coordinating sediment removal with a local hydroelectric utility that operates a dam on the river. "We scheduled sediment removal activities," he explains, "to occur as much as possible during periods of controlled low water on the river"— a move, he says, that significantly reduced the cost of sediment removal.

The project team *(above left)* removes sediments at the river's edge, *(right)* monitors the emplacement of a silt curtain to protect the water quality and *(bottom)* restores the riverbank after remediation.

Progress and Preservation

Updating Utah's first water treatment plant while protecting its sensitive environment

Located in a pristine, scenic canyon in the Wasatch range, outside of Salt Lake City, the City Creek Water Treatment Plant was the first water treatment facility constructed in the state of Utah. Originally built in 1954, the plant was upgraded once in the 1960s—but now, after nearly half a century of service, the facility is being completely renovated to meet 2002 seismic standards and replace aged equipment and control systems. The $10-million upgrade will enable the treatment plant to incorporate, at a later date, a UV disinfection system—a relatively new technology for potable water—to eliminate cryptosporidium and giardia microbes generated by wildlife in the watershed.

Because the plant is situated in an environmentally sensitive area, the renovation has been designed to minimize disruption and maintain the facility's original footprint. Brown and Caldwell is working with CH2M-Hill to complete the upgrade, which will be on line by summer 2004.

"City Creek Canyon is a protected wildlife area that's closed to cars and very popular with bikers and joggers," says Tom Peters, project manager for Brown and Caldwell. "Our goal has been to keep the public happy and keep the canyon open throughout the upgrade."

Brown and Caldwell is responsible for seismic improvements, site and civil design, washwater and sludge handling, electrical system improvements, instrumentation and controls. As part of the project, the team is also upgrading the rapid mix, flocculation basins, sedimentation basins, filtration building and disinfection systems.

In addition to other improvements, the renovation will boost the plant's rated capacity from 15 to 20 mgd, enabling it to capture a greater flow volume during high runoff periods, at nominal cost. "The project is going well and right on schedule to begin construction in the fall of 2002," Peters says. It will be completed in phases, according to funding available from the Salt Lake City Department of Public Utilities.

Utah's City Creek Canyon watershed is a protected area for mountain lions and other wildlife.

Knowing the Flow

Inaccurate flow meters can lead to a flood of unexpected costs

For water and wastewater facilities, flow measurements are a key basis for decisions ranging from engineering design and operations to mass loading calculations, rate allocations and dispute resolution. Because flow data are so central to a host of crucial and potentially costly judgments, their accuracy is essential. Errors in flow measurements can at best lead to embarrassment and at worst to tens of millions of dollars in unforeseen expense.

Unfortunately, inaccurate flow data are more common than many site managers believe, due to the faulty functioning or calibration of flow meters. Incorrect installation, errors in setup parameters, inappropriate applications, incorrect signal processing, shifts in sensor position, maintenance problems and less-than-ideal hydraulic conditions can all lead to instrument trouble and poor data.

"Are you charging or being charged too much based on flow? Are your system upgrade plans both needed and realistic? Are you in compliance with permiting requirements? The only way to know for sure is to check your flow measurements," says Rhys McDonald, supervising scientist at Brown and Caldwell. If flow testing is warranted, he adds, it should be done correctly. "If not," he says, "you'll spend money for inconclusive results or raise more questions than you'll answer."

The best test

Dye dilution or similar conservative tracer techniques provide the most accurate primary methods of measuring flows and calibrating flow meters, regardless of hydraulic conditions. For example, a nontoxic fluorescent tracer dye (Rhodamine WT) can be injected at a known, constant rate into the flow stream being measured. After the dye is mixed completely with the flow stream, its concentration can then be measured downstream using a fluorometer. When conducted properly, dye dilution testing can determine flow with an accuracy of a few percent.

In practice, though, it can be tricky to achieve the proper test conditions to produce definitive results. Many factors—including incomplete mixing, background fluorescence, dye absorption and temperature—can affect testing results, especially when the flow stream is raw sewage.

"Successful flow measurement by dye dilution is an art and a science that few understand," says McDonald, who has conducted more than 90 tests of flow metering devices at wastewater collection, effluent discharge and natural stream sites. He has solved the practical problems of the technique by refining each step of the dye dilution procedure, developing specialized instrumentation and constructing a dedicated system for conducting the tests.

With its custom-outfitted, self-contained dye injection van, Brown and Caldwell performs accurate dye-dilution flow meter validation tests at a large wastewater treatment plant.

McDonald has created a mobile laboratory to perform volumetric dilutions and precision dye measurements in the field. In addition, a sophisticated, computer-controlled dye metering and measurement system with radio telemetry provides real-time feedback and control over all aspects of the tests. McDonald has also developed a comprehensive test protocol that identifies and compensates for conditions affecting accuracy. "Our results," he says, "are definitive and precise, with excellent repeatability, and are presented with extensive documentation."

Confirming compliance

Thanks to his testing, the staff of a major wastewater treatment facility with strict discharge limits discovered that the plant's 80-inch-diameter magnetic flow meter reading was more than 20 percent low. This surprising finding—which was at first strongly disputed by the meter manufacturing representatives—meant that the plant's discharge flows were much closer than expected to regulatory limits, with potentially millions of dollars in compliance implications.

"For many facilities, definitive testing can be a smart investment," McDonald points out, given the enormous risks and consequences of faulty data.

Membrane Bioreactors Expand Reclamation Facility

Pima County, Ariz., needed new supplies of reclaimed water to irrigate the City of Tucson's upgraded Del Urich Golf Course and other county-owned facilities. So officials in the Pima County Wastewater Management Department (PCWWM) turned to cutting-edge membrane bioreactor (MBR) technology to make the most of limited land resources and produce high-quality reclaimed water.

To meet the increased need, they opted to place efficient immersed membranes in the existing 1.5 million gallons per day (mgd) wastewater tankage of a small, 26-year-old site next to a residential neighborhood, busy intersection and golf course. As a result, the county was able to double the treatment capacity of the 1.5-acre Randolph Park Water Reclamation Facility and produce Class A+ reclaimed water that meets the most stringent reuse standards of the Arizona Department of Environmental Quality.

Pioneering treatment plant

The Randolph Park MBR facility will be the second and largest of its kind in Arizona and one of the largest MBR plants in the United States. Brown and Caldwell, led by Project Manager Mike Fleury, provided the preliminary design and evaluation for the upgrade and expansion. The team is now designing the new 3-mgd facility and will proceed into construction management services by summer 2002.

MBR technology, similar to reverse osmosis (water treatment), has been in use overseas for nearly 10 years, but it is just now starting to gain popularity in the United States. In the MBR process, membranes are suspended in the mixed liquor of the aeration basins. Water is drawn by vacuum through the membrane walls,

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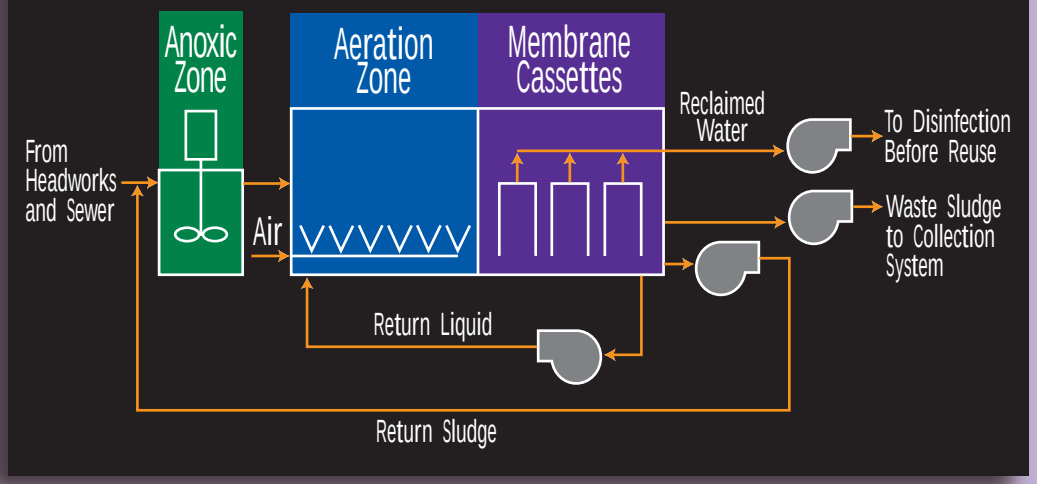
while the main constituents of mixed liquor suspended solids (MLSS) remain outside the membrane and are wasted to another treatment plant for processing. The reuse water drawn through the membrane walls is then further disinfected to ensure that it meets Class A+ requirements.

By installing membranes, wastewater plants can handle a much higher concentration of MLSS, since the systems require no secondary clarifiers or filters. Normal mixed liquor at a conventional activated sludge plant, depending on the facilities, is 2,000 to 4,000 milligrams per liter (mg/l). An MBR plant, however, can handle concentrations as high as 10,000 or even 15,000 mg/l. As a result, MBRs can reduce a facility's required tankage size by about 40 percent.

This space efficiency is making it possible to double Randolph Park's capacity on its existing footprint. The plant was previously equipped with a primary clarifier, two secondary clarifiers and two aeration basins. "We are reusing every cubic inch of the existing basins," explains Melodee Loyer, supervising engineer and lead engineer on the project. "Since we don't need the existing clarifiers, we'll add a third aeration basin of the same size and turn the existing clarifiers into anoxic zones."

Membrane Bioreactor Flow Diagram for the Treatment Process



The right system at the right price

Because there is only one qualified MBR manufacturer in the United States, Brown and Caldwell and the client (PCWWM) traveled to the United Kingdom to visit wastewater treatment plants designed by another manufacturer. They opted to compare two membrane manufacturers, Zenon and Kubota, that are qualified in the United States and around the world. "This is the first U.S. project to involve competitive bidding from the two leading vendors," Loyer adds. "MBR is a hot technology in the industry and will be the future of water reclamation in areas with stringent water quality requirements and land scarcity, as well as in plant expansion projects that seek to minimize capital expenditures."

Each day, on a newly opened stretch of freeway, thousands of Phoenix-area commuters drive past approximately 200 acres of industrial brownfields located in the heart of Tempe, Ariz. A developer is currently working with the City of Tempe to transform this barren landscape of auto salvage yards, landfills and industrial operations into an attractive area of commercial businesses, multi-tenant housing and hotels.

To facilitate the planning and redevelopment process, Brown and Caldwell has created a multifunctional, interactive database that includes detailed environmental data and infrastructure information for every land parcel in the site. Linked to a high-resolution aerial photograph of the redevelopment area, it makes the data easily accessible to potential buyers and investors, the public and environmental regulators.

"It's a pretty slick tool," says database developer Mike Simms of Brown and Caldwell's Phoenix office. Users can navigate through the high-resolution aerial photo of the brownfields area and zoom in to examine details. Clicking on a particular parcel displays specific environmental and infrastructure data for that site, as well as additional photographic views.

"The project is still in the early stages," adds Project Manager Kevin Hebert, "but this database will speed efforts by the developer to turn this site into a visually pleasing, productive tax base for the City of Tempe."

Managing the Business of I.T.

Information technology systems should be planned, monitored and measured— just like any other business investment

If you decided to buy a $200 million pumping station for your facility—but you never planned for it, never used it, never trained people to run it, never updated or monitored it and never measured its performance, the results would be unpleasant, if not downright catastrophic.

Unfortunately, this is the way many managers approach major information technology investments. Too often, they decide to invest in a new IT system without looking closely at its overall costs and benefits to their business. They fail to consider the impact on organizational and business culture as well as costs for training, data input and maintaining and managing the system once it is in place. They rarely measure the system's success or return on investment, and they don't monitor performance. Then, when the system ultimately fails to meet the needs of users, they spend a huge chunk of unplanned money to replace it—possibly jeopardizing their goals and leading to unpleasant rate increases for customers.

What is the goal of each IT project? Does it help achieve overall business objectives?

This is, of course, no way to run a business, and it's certainly no way to manage an IT system. Whether you're considering the purchase of a customer information system, document management tool, financial accounting package, asset management, process control, work management or training and safety system, you should apply the same kind of disciplined planning and analysis that you would for any other major business investment.

Even though many managers may feel uncomfortable with IT and prefer to leave systems decisions to IT specialists, this approach may actually cause more problems than it solves. The fact is, IT experts may know their area thoroughly, but they are not responsible for the overall performance of the business and do not run the systems on a daily basis. Instead of viewing IT systems as "orphans" outside of their normal area of responsibility, facility managers need to inform themselves and approach IT investments with the same business rigor they routinely apply to brick-and-mortar systems and expansions. The following steps can help you ensure a positive return on your investment in IT systems:

Make an IT investment plan. If you don't have one, this is the time and place to start. Begin by stating your organization's business objectives and define the level of service that it provides. Align present and future IT investments with those objectives and list them, starting with the smallest projects first and working up to the bigger investments. Look at investments across the entire organization and determine the value of each individual IT project. Include realistic costs for software, hardware, data entry, maintenance, management, training, personnel and organizational changes.

Calculate risks and rewards. What is the goal of each project? Does it help achieve overall business objectives? What are the rewards if it succeeds? What are the risks if it fails? If the IT project would not help the organization reach its goals, don't even think about making the investment.

Identify measures of success. State the specific goals of each IT investment, identify the measures of success and set up a system to monitor performance and results against the goals. Use a single measurement system for all IT investments to make them easy to compare, prioritize and manage.

Create a database to track all IT projects. Key elements to include are:

- project name
- type of technology
- line of accountability
- estimated time to complete
- estimated cost
- number of people required for the project
- scope
- risk
- value
- business justification.

Prioritize the projects. Put all your IT projects into one database so that they are easier to review, compare and prioritize. Look for ways in which they may be interrelated and anticipate potential efficiencies and conflicts.

Benchmark and measure results. For each project, develop benchmarks and measure its progress against them. By continually tracking the results, you will be able to make quick, midcourse corrections and avoid unpleasant and costly surprises down the road. The end result is that you will be better able to manage and control your organization's collection of IT investments, reduce risk, boost success and maximize their value to your business.

Information technology investments need management just like every other part of the business. These guidelines can help your organization improve its performance and control costs associated with investments in information systems. IT terms and systems can seem confusing, but, bottom line, they are about dollars and sense.

— Scott Bash, Vice President-Information Technology

Scott Bash is the National Practice Leader for Brown and Caldwell's Information Technology team. For more information, contact him in Atlanta, Ga., at (770) 673-3647.

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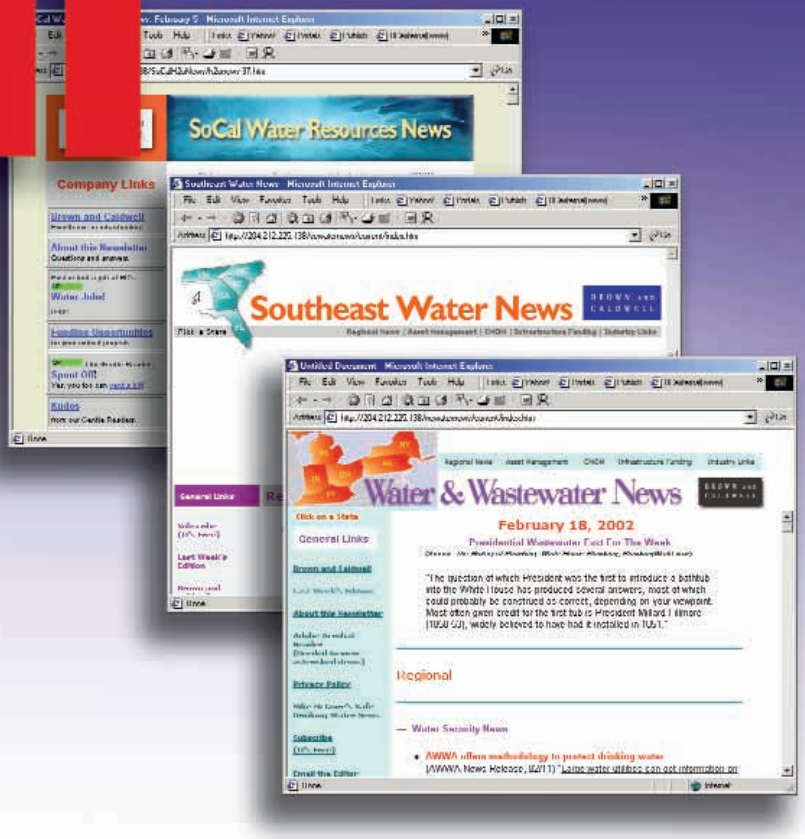

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