BROWN AND CALDWELL

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INSIDE:

Innovative wells improve water quality

New software to manage environmental data

Advance in industrial wastewater reclamation

Featured this issue—Atlanta assesses its water and wastewater options

BROWN AND CALDWELL
Quarterly

Atlanta skyline.

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Quarternotes

Grace Chow

Grace Chow Named VP

Grace Chow, P.E., has been promoted to vice president at Brown and Caldwell and will manage the company's infrastructure group projects throughout California and Hawaii. Previously, she managed the wastewater department of the company's Pleasant Hill, Calif., office. With 20 years of experience in civil and sanitary engineering, Chow has worked for Brown and Caldwell since 1987, managing projects in wastewater collection, water distribution, and master planning, evaluation, and design of reclaimed water systems. Chow is vice president of the San Francisco Bay Section of the California Water Environment Association (CWEA). A registered professional engineer in California, she holds a bachelor's degree in engineering from the University of California, Irvine.

Atlanta-based illustrator Cheryl Henry's award-winning workshop cover.

Professional Developments

Camille Waters Sowells of Brown and Caldwell's Orlando, Fla., office is the National Alumni Chairperson for the National Society of Black Engineers, to serve through March 1999…Jim Hawkins of the Charlotte, N.C., office has been inducted as board member at large for the state's section of the American Water Works Association/Water Environment Association…Pleasant Hill, Calif., based vice president Tracy Stigers joined the Engineering Advisory Council for Clarkson University in Potsdam, N.Y., where she earned her bachelor's in civil and environmental engineering some years ago…John Bratby, Phoenix process engineer, is reviewing papers submitted to the Environmental Division of the American Society of Civil Engineers, as well as serving as external examiner for a doctoral dissertation submitted to the Rand Afrikaans University in South Africa and examined at the University of Massachusetts at Amherst…Also in Phoenix, Hugh Pace recently received his master's degree in project management and is hosting local Instrument Society of America board meetings at Brown and Caldwell's offices… The Denver office was registered by the state of Colorado as a consultant qualified to perform characterizations and remediation related to underground storage tanks, and Steve Haverl and Deb Gomez were registered as individual employees qualified to do the same…An unprecedented 16 papers were presented by Brown and Caldwell employees at last fall's Pacific Northwest Pollution Control Association conference. Topics included constructed wetlands; odor control; advanced secondary wastewater treatment; combined sewer overflow, infiltration/ inflow, and stormwater management; and public involvement in wastewater facilities planning… Cheryl Henry, lead illustrator in the company's Atlanta office, won an American Graphic Design Award for her excellent graphic presentations to General Electric and for a watershed management workshop co-sponsored by Limno-Tech, Inc., and Brown and Caldwell.

Continued on page 6

Managing Industrial Wastewater Treatment in A Competitive Context

Industrial wastewater treatment expert Paul Klopping discusses balancing the need for increased productivity with the need for environmental management.

Core business. Outsourcing. Asset transfers. Off-balance-sheet financing. These concepts are being bandied about from board rooms to cubicles. Companies across America are looking critically at themselves. Announcements of corporate restructuring, deverticalization, divestiture, and downsizing follow. Companies are making strategic moves to do what they do best, rid themselves of things they don't do well, and ultimately improve profitability and shareholder value. To meet the challenge of becoming more competitive, they are looking for ways to produce more products from fewer assets with less capital investment.

Yet while industry moves to invest in its core business, it does so in a climate of increasing environmental pressure from government and citizens alike. The competing agendas of capital investment in production and capital expenditure for environmental management weigh heavily on managers.

Wastewater treatment, for example, is not the core business of most companies. Paper mills make paper, canneries can, breweries brew, and metal platers plate. The fact remains, however, that these industries, and many others, are water-dependent—and it's increasingly difficult to tell where the manufacturing process ends and wastewater treatment begins. Reclaiming the water used in running the core business is both complicated and expensive, particularly as new regulations demand higher levels of treatment. Further, managers know that a sure way to destroy shareholder value is to experience an environmental catastrophe.

Environmental management, in other words, is integrally linked with core operations.

Corporations are exploring various mechanisms to increase competitiveness while managing the environmental aspects of their businesses. One mechanism companies have used for quite some time is contract operations. For example, a company simply hires a contractor to operate its wastewater treatment plant. This helps the company focus on its core business.

Corporations wanting to free up capital for investment in production have been looking at another mechanism: third-party ownership and operations. With this arrangement, a single-purpose, third-party company purchases existing assets—such as the wastewater treatment facility—and agrees to operate them as well as to provide the necessary capital to finance the engineering and construction of new facilities. Third-party ownership/operation allows the industrial company to redirect capital that would have been used for environmental improvements to areas of its business that yield much better return on invested capital. Also, the transfer of depreciating assets improves the balance sheet, enhancing shareholder value. The monthly fee a company pays for this service is an operating expense charged against the cost of goods sold.

For example, selling assets is working well for a large paper mill in Alabama, whose energy assets were bought by a third party in 1994. While the energy assets are critical to mill operation, the mill's core business is the production of pulp and tissue. The arrangement has stimulated creative thinking across the paper industry about other "utility islands," such as water and wastewater assets, that can be transferred to a third party.

Many of us whose core business is environmental management make a point of understanding the economic forces that motivate our clients. Businesses have multiple goals and objectives, and we well know that in today's market, there are many different ways to achieve those goals. Whether we're serving traditional owner/operators, contract operators, or third-party owner/operators, we tailor the expertise we've gained over the past 50 years about optimizing wastewater operations and minimizing compliance costs.

Brown and Caldwell 1) seeks to understand our clients' varying business needs and contexts and 2) uses an operations-oriented approach. That means collaborating with companies to define the exact performance goals of their wastewater management system; optimizing existing resources; and delivering innovative solutions.

Brown and Caldwell's core business complements our clients' rediscovery of their own.

Paul Klopping

Groundbreaking Assessment of Atlanta's Water and Wastewater Operations

A Brown and Caldwell team identifies strategies—from re-engineering to privatization—to help the City of Atlanta cut costs and improve water and wastewater service.

Brown and Caldwell assessed the City of Atlanta's water and wastewater operations in a groundbreaking study of potential cost savings and technical improvements—groundbreaking because of the magnitude of the alternatives it considered and the immense size of the Atlanta system. The study was completed with unprecedented speed, in less than three months.

At the outset, the city demanded that the study provide an independent, unbiased assessment of a comprehensive range of alternatives. It did. "The operations assessment by the Brown and Caldwell team was very thorough," says Larry Wallace, chief operating officer for Atlanta Mayor Bill Campbell. "It gave the city an objective analysis of our options."

Neutrality in a challenging context

Over the next five years, the city must invest more than $850 million to replace and upgrade antiquated water, wastewater, and sewer facilities, provide more capacity, and meet stringent environmental requirements. The city decided not to assume it would pass related costs to users via increased rates. Instead, it charged the Brown and Caldwell team with analyzing how water and wastewater operations could become more "competitive" by achieving greater productivity and efficiency while maintaining or improving service.

The context for the work was challenging: pressure from state and federal regulators, media scrutiny, and worker concerns about job security. Timing was critical, since the city must issue a major bond in mid-1998 to keep constructing its regulatory-mandated phosphorus reduction program, and a plan for utility rates and savings must be in place before it can do so.

Investigation, benchmarking—and communication

With 1,450 employees and an operating budget of over $115 million, the city's extensive water and wastewater facilities serve more than 1.5 million people in metropolitan Atlanta. The Brown and Caldwell team—which included management consultants Price Waterhouse and Atlanta-based environmental engineering firm Harrington, George, and Dunn—began by investigating the cost-effectiveness of existing operations.

Team members analyzed approximately 40 functions and facilities, conducting many interviews and reviewing hundreds of documents. Next, the team made comparisons with similar systems and applied team members' expertise to identify operations that could be more efficient.

Information-sharing was crucial early in the process. A day-long competitive-issues presentation was held for more than 100 City of Atlanta staff by major contractors and public agency representatives that had tried various competitive strategies. Attendees included managers from Charlotte, N.C.; Orange County, Fla.; San Diego; Houston; and Indianapolis. "The forum achieved many things at once," says Brown and Caldwell Senior Vice President John Salo, who managed the team's efforts. "It allowed city managers and the consultants to gather current information about the marketplace; informed city employees about possible changes and gained their input; and united private and public sector workers and managers in pointed questioning and real discussion."

Down to dollars and sense

The team then identified eight detailed operations alternatives, from which the city could choose or combine features (see box). The alternatives included internal reengineering, outsourcing some non-core functions to specialists, managed competition, contract operations of specific facilities, and private system management.

Alternatives Identified for City of Atlanta Water and Wastewater Operations

1 *"Light" Re-Engineering/Outsourcing*
Straightforward changes within a single system/department and from implementation of the capital improvement program. Includes outsourcing non-core functions to the private sector.

2 *"Heavy" Re-Engineering/Outsourcing*
Changes comprising alternative 1, plus more difficult internal actions involving cooperation among departments and basic changes in how the city conducts business.

3, 4, and 5 *Contract Operations*
Competitive selection of private firms to operate one or more of the five treatment facilities, in addition to heavy re-engineering of non-contracted facilities and functions. The Brown and Caldwell team outlined three alternatives: contracting out the two water treatment plants; contracting out two co-located water and wastewater treatment plants; and contracting out all five water and wastewater treatment plants.

6, 7, and 8 *Private System Management*
Selection through competition of a private firm to manage the water system, the wastewater/sewer system, or both, in addition to heavy re-engineering of the remaining systems.

The team calculated the savings to be gained by each alternative for each of the next four years, estimating implementation time, investment costs, and timing of gains. And to evaluate the impact on customers, the team constructed financial models. The models reproduce the flows of revenues and costs throughout the systems, including operations, indirect costs, capital spending, debt service on bonds, and outside revenue sources, to show future rate scenarios.

One goal of the city was to see if enough could be saved to avoid rate increases other than for annual cost-of-living adjustments. The models demonstrated that rate increases given existing constraints could be halved or even further reduced by implementing any of the alternatives except "light" reengineering. Only the most dramatic alternative—placing all systems under private management—could keep rate increases below inflation, which is estimated as 3 percent annually. The study projected annual savings at full program implementation in the year 2000 ranging from $25 million with heavy re-engineering/outsourcing to over $35 million with private management of all water, wastewater, and sewer operations.

Weighing risks and commitments

Rate impact wasn't the only consideration in the study, although it was the most important. The team defined other financial, operational, legal, and policy criteria to help them characterize the alternatives and the ways they differed.

The team concluded that all the alternatives would mean some risk for the city—the greater the potential savings, the greater the risk. And it concluded that every alternative would demand a major commitment from the city to implement programs. More training, plans to increase employee empowerment and incentive, cooperation among departments, and citywide system changes would be needed. Also, the success of the public-private alternatives would depend on improved contract management techniques and skills; requirements, prohibitions, penalties, and incentives must be properly written into contracts with a private firm, and must be attentively managed.

The consultants also determined that every alternative could accommodate Atlanta's key nonfinancial concerns. The study showed that no city employee would be displaced by any of the alternatives for up to the first three years of implementation, and that important goals—about affirmative action, city control over systems, tax-exempt financing, etc.—could still be reached.

Providing options for a decision

Brown and Caldwell's report on the Phase 1 operations assessment was delivered in October 1997. As requested, it offered clear analysis, a broad range of options, and an objective framework within which the city could select its course of action. After Mayor Campbell and his staff reviewed the study, they concluded that private management of water and wastewater facilities should be a major part of Atlanta's cost-savings program (see sidebar).

In December 1997, city staff and the consultant team began implementing the mayor's plan. City staff committees are developing detailed blueprints on different program aspects, while the mayor and his staff are working with the City Council and other stakeholders to smooth the way for implementation. In concert with the city, the Brown and Caldwell team is developing requests for proposals for water and wastewater functions that will be outsourced and helping to coordinate re-engineering of wastewater, sewer, and support functions that will be retained by the city. The city's goal is to have private operator(s) in place and a plan for re-engineering of non-contracted functions developed by mid-1998.

"This has been one of the most challenging and interesting projects I've worked on during my 25 years with Brown and Caldwell," says Salo, "because of the pace of the work and the complex set of technical, financial, and political issues." Atlanta won't be alone in reaping the rewards of the work, Salo notes. "The comprehensive nature of our assessment—and the combination of actions that the city is embarking on—will make the Atlanta experience very valuable to other water and wastewater utilities who need to reduce operating costs."

Contact John Salo at (770) 394-2997 for more information about the Atlanta utilities operations assessment.

The Mayor's Decision

The operations assessment had a bold outcome. After considering the eight alternatives presented by the Brown and Caldwell team, Mayor Bill Campbell recommended private management of the city's drinking water system and one of its wastewater treatment plants. Privatization of such utilities on this scale has not been undertaken previously in the United States.


Mayor Bill Campbell

In making the decision, the mayor and his staff considered five broad policy goals, which the mayor outlined in a letter announcing his decision to city employees: "…being fair to City employees, making operations more efficient, keeping water and sewer rates competitive, delivering quality customer service and reducing the need for rate increases."

Specifically, Campbell recommended a hybrid of what the operations assessment had identified as alternatives 4 and 6. He advised that the city engage a private operator(s) to manage the entire drinking water system and the 100-million-gallon-per-day R. M. Clayton Water Reclamation Center under multi-year contracts.

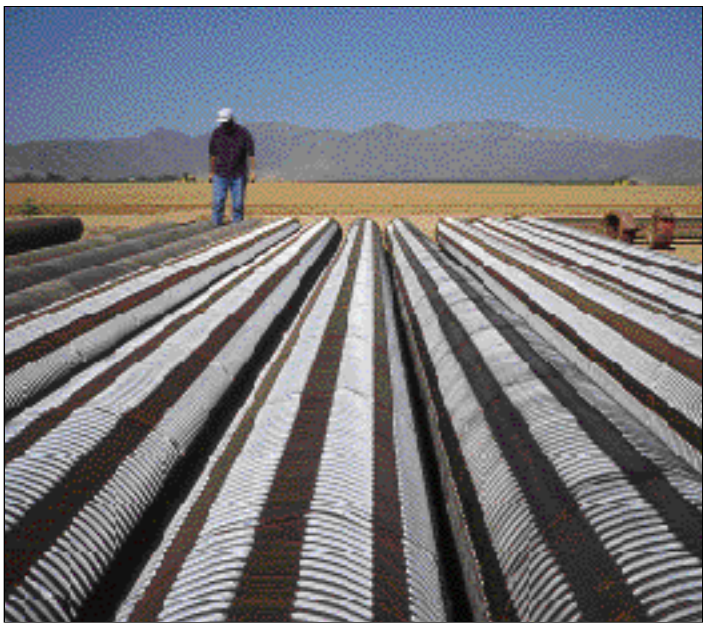
Six staff subcommittees are developing detailed plans for various parts of the program: legal and financial issues, employee-related issues, contract management and organization, facilities, re-engineering, and executive coordination.

Innovative Well Design Overcomes Water-Quality Problems

Brown and Caldwell designs wells that account for varying water quality—and gains drinkable water from "non-potable" sources.

Many cities and private water companies are faced with the difficult task of getting potable water from a subsurface site containing some poor-quality aquifers. Typically, they must resort to expensive and complicated treatment or blending methods to improve water quality once it's out of the ground. When these options are not available, the well may be rejected entirely as a potable water source, at a substantial loss of time and money.

Marvin Glotfelty and his associates in Brown and Caldwell's Phoenix-based groundwater resources group have found a simpler, more efficient, and less expensive solution—innovative well-design techniques that overcome water-quality problems at the source. Their approach takes advantage of something that is typically overlooked or considered a disadvantage: water-quality stratification.



A Brown and Caldwell hydrogeologist inspects well screens and casing before their installation in a public supply well.

Revealing the hidden world of aquifers

Glotfelty and his group pay unusually close attention to the water quality of aquifers penetrated by a well. Glotfelty has pioneered a method involving isolation and blending of water from different strata *within* an aquifer. Although this approach is straightforward, it has not been widely applied—perhaps, Glotfelty says, because "many people consider the hidden world of aquifers to be mysterious and uncontrollable."

Aquifers are layers of permeable, water-bearing rock, sand, and gravel. Each aquifer may contain one or more stratified zones, defined by their varying water quality. The quality of the water within the zones varies for two reasons: 1) groundwater interacts with the geologic environment through which it flows, and 2) human-made contaminants, such as nitrate from agricultural fertilizer, percolate down from the land surface to the water table, forming a zone of poor-quality water in the upper portion of the aquifer.

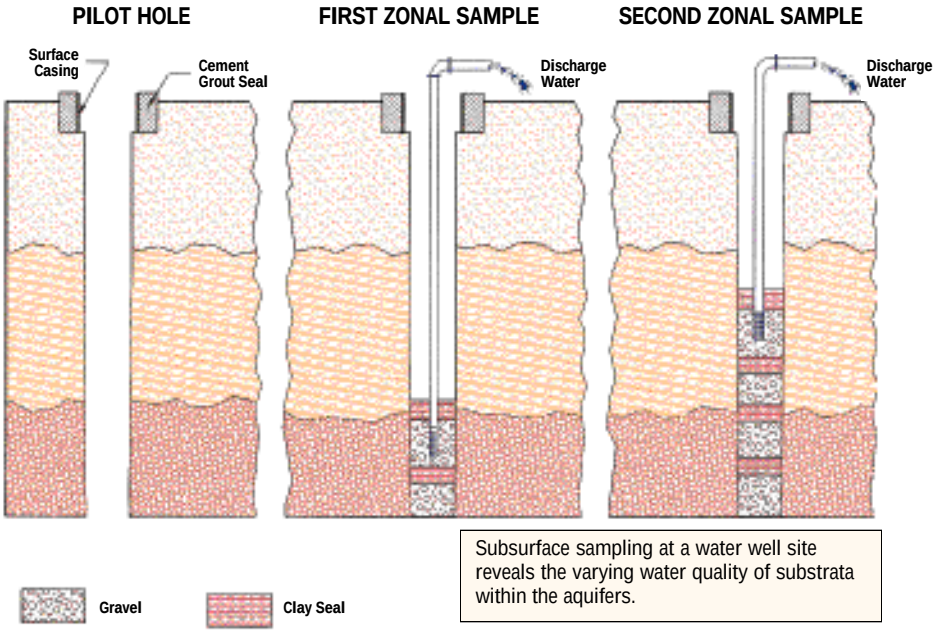
The conventional response to poor-quality zones within aquifers has been to pump water from throughout the well and remediate it at a later point, or reject the well altogether.

But according to Glotfelty, this approach ignores the "good" groundwater zones—the high-quality or uncontaminated strata within the aquifer that remain undisturbed by the non-turbulent flow of groundwater.

Sampling at different depths is the key

To meet drinking water standards, Glotfelty's group began designing supply wells that blend water from some water-quality zones while isolating other zones. The stratified water quality is revealed by a careful sampling program. Using the results, Glotfelty and his associates place screens at carefully selected depths within an aquifer to cause groundwater from certain zones to blend within the well. Zones with overall poor water quality are sealed off completely.

The accompanying figure illustrates the sampling sequence. Large water wells are typically drilled in two passes. The first pass creates a smaller-diameter pilot hole. Drill cuttings and geophysical logs from the pilot hole provide an understanding of the site geology, which enables the hydrogeologists to identify the most appropriate depths in the well for groundwater sampling. A perforated pipe is lowered to the lowest sampling depth, where it is isolated between two layers of bentonite clay, and surrounded by an envelope of pea gravel. Groundwater is air-lifted or pumped from this temporary mini-well, which is now isolated from the rest of the aquifer. After the sample has been collected, the drilling rig pulls up the pipe to the next sampling zone, and the process is repeated. The well penetrates a number of layered water-quality zones, and one or more zones within an aquifer are sampled. After



Subsurface sampling at a water well site reveals the varying water quality of substrata within the aquifers.

sampling is completed, the pilot hole is reamed out to its final diameter.

Well construction based on water-quality zones

Using the groundwater sampling results, Brown and Caldwell designs and constructs wells that make the most of the source water quality at different depths or zones.

For example, zonal groundwater samples for public supply well no. 108 in Scottsdale, Ariz., revealed concentrations of arsenic, fluoride, iron, and manganese that approached or exceeded state and federal drinking water standards (the shaded values in Table 1). All the sampled zones contained elevated concentrations of at least one of the naturally occurring constituents noted.

If all these zones were sealed off in the well, the city would not have been able to meet its water production goal of about 2,000 gallons per minute (gpm) for the well.

Instead, the design for well no. 108 incorporated blending water from some zones and isolating other zones. The portion of the aquifer below 1,450 feet was sealed off because of its poor overall water-quality, and the remaining two zones were screened to allow them to blend together. The intent was to allow the upper zone (with high iron) to blend with the middle zone (with low iron, but high arsenic, fluoride, and manganese). The resulting dilution would likely yield potable water. In case it didn't, a section of unperforated well casing was placed between the uppermost two water-quality zones, and the annulus behind this casing was sealed in place with a layer of cement. This blank casing between the two water-quality zones would allow for abandonment of the middle water-quality zone if drinking water standards for arsenic, fluoride, or manganese were exceeded in the completed well.

Brown and Caldwell's design for Scottsdale's well no. 108 resulted in excellent water production—over 3,000 gpm, with a specific capacity of over 50 gpm per foot of drawdown—and excellent water quality, as shown in Table 2.

Constituent	Completed Well	Drinking Water Standard
	(milligrams/liter)	
Arsenic	0.010	0.05
Fluoride	0.64	4.0
Iron	<0.050	0.3
Manganese	<0.010	0.05

Table 2 - Groundwater quality of completed Scottsdale well no. 108.

Floyd Marsh, Scottsdale's water resources director, lauds the company's skills and approach. "Hydrogeologic complexities often result in unexpected challenges," he says. "Brown and Caldwell responded with a thorough analysis of available water-quality data and an innovative design technique. These resulted in an important new water supply for the city. They also applied this technique to a second city well," Marsh continues, "that had similar unexpected problems. We're obviously pleased with the approach and the outcome."

Brown and Caldwell has successfully applied the new approach throughout the southwestern United States. Glotfelty is pleased to have helped pioneer it. "We really *can* understand complex groundwater systems," he says. "More and more clients now realize that we do have some control over the quality of water from a new water-supply well."

For more information on Brown and Caldwell's water-well design services, contact Marvin Glotfelty in Phoenix at (602) 222-4444.

Constituent	Sample from 960–1,000 feet	Sample from 1,310–1,350 feet	Sample from 1,450–1,490 feet	Drinking Water Standard
	(milligrams/liter)			
Arsenic	<0.005	0.033	0.027	0.05
Fluoride	1.4	3.1	3.8	4.0
Iron	0.26	0.09	0.72	0.3
Manganese	0.01	0.03	0.05	0.05

Table 1 - Sampling results indicating quality of groundwater zones at future site of City of Scottsdale well no. 108. Shaded values approach or exceed state or federal drinking water standards.

A driller installs a public water-supply well in Scottsdale, Ariz.

Continued from inside front cover

International Experts Author Book on Secondary Clarifers

The International Association on Water Quality (IAWQ) recently published its sixth in a series of scientific and technical reports. The new book, "Secondary Settling Tanks: Theory, Modelling, Design and Operation," is co-authored by seven international experts on secondary settling tanks, or secondary clarifiers. The authors are George Ekama, University of Cape Town, South Africa; Peter Krebs, Swiss Federal Institute for Environmental Science and Technology; James Barnard, Reid Crowther and Partners, Canada; Wolfgang Gunthert, Bundeswehr University, Munich, Germany; Alex McCorquodale, University of New Orleans; and Denny Parker and Eric Wahlberg, both of Brown and Caldwell.

The new publication compiles the significant developments over the past 20 years in secondary clarifier theory, modeling, design, and operation. In nine chapters, the authors unite disparate pieces in a considerably fragmented area of wastewater treatment. The central theme is simply that to achieve effluent suspended solids concentrations of less than 10 milligrams/liter, consideration must be given to optimizing the clarification (i.e., flocculation), thickening, and sludge storage functions of the secondary clarifier, in addition to the clarifier area, depth, and recycle flow. Many of the performance-enhancing elements referenced in the book were pioneered by Brown and Caldwell. Each chapter concludes with a section on additional research needs. For an order form, contact the IAWQ at 44 (0) 171-839-8390 (phone) or -8299 (fax).

Corps Strengthens Nationwide Permit Requirements

The U.S. Army Corps of Engineers (Corps) recently updated their Nationwide Permits, which are required under Section 404 of the Clean Water Act for any construction activity that will have a minimal impact on wetlands or "waters of the U.S." The new Nationwide Permits have more stringent requirements—the result of increasing concerns over wetlands losses across the U.S.

The goal of Section 404—administered by the Corps—is to ensure that wetlands remain protected, and that they are affected only minimally by new projects. The Nationwide Permits limit such construction impacts as the filling or dredging of wetlands. The permits are reviewed every five years; the new ones were issued February 11, 1997, but public awareness about the changes is still growing.

One of the newly tightened requirements is the need to include candidate species in assessments of threatened and endangered species. Another is the modification of the most frequently used Nationwide Permit, NP no. 26. Now, it

requires that the Corps be contacted before the start of any construction project that will impact more than 1/3 acre of wetlands; previously, up to 1 acre of wetlands could be affected without Corps notification. If less than 1/3 acre will be impacted, the Corps now must be notified after the project is completed. Also, the new NP no. 26 only allows for impact to up to 3 wetlands acres. An Individual Permit, which involves an alternatives analysis and public notice, is required for greater areas. Previously, up to 10 acres of impacted wetlands could be approved under the more general NP no. 26.

These regulatory changes could significantly affect your project design and construction schedule. But the permitting process can be successful if Section 404 requirements are addressed early on. The steps to success include conducting a site visit to determine the presence or absence of wetlands; completing a wetlands delineation, if necessary; developing a permitting strategy; and coordinating with the Corps early in the process. If you have questions about these modifications or other aspects of Section 404, contact Brown and Caldwell wetlands expert Elisabeth Benjamin at (303) 743-5405.

Glen Jacoby

BC Office News

Brown and Caldwell has opened an office in Baton Rouge, La., to strengthen its service to industrial clients in the Gulf Coast region. Managing engineer Glen Jacoby is leading the new office. Jacoby has more than 26 years of management and technical experience in facility siting, permitting, environmental assessment, hazardous waste management, and project engineering. He has lived in Baton Rouge for 20 years, supporting the petrochemical marketplace with environmental consulting services. Jacoby and the rest of the staff can be reached at 2900 Westfork Drive, Suite 200, Baton Rouge, La. 70827, (504) 298-1307, voice, and (504) 298-1308, fax…Brown and Caldwell's Carson City, Nev. office has moved to 3488 Goni Road, Suite 142, Carson City, Nev. 89706, (702) 883-4118. Contact office manager Chuck Zimmerman for more information or consulting assistance…The El Paso, Texas, office has relocated to 700 North Stanton Street, Suite 210, El Paso, Texas 79902. Telephone there at (915) 545-4400; send faxes to (915) 543-9400.

Brown and Caldwell engineer Joe Wong and J. A. Kuo of Enprotech System Corp. used an innovative, membrane-based (ultrafiltration/reverse osmosis), 25-gallon-per-minute pilot treatment system to test industrial wastewater reclamation at a major petrochemical plant in Taiwan.

State-of-the-Art Industrial Wastewater Reclamation System To Be Built in Taiwan

Brown and Caldwell helped spearhead the development and implementation of an advanced system to reclaim industrial wastewater at a major petrochemical plant in Kaohsiung, Taiwan, Republic of China. The first of its kind in Taiwan, the system will serve as a model of how to help solve Taiwan's chronic water shortage problems.

During a water resources management study of the largest purified terephthalic acid (PTA) plant in the world, owned by the China American Petrochemical Company (CAPCO), Brown and Caldwell engineer Joe Wong identified the unique opportunity for wastewater reclamation. Droughts occur almost every year during the dry months at the plant's water-limited location, causing cutbacks in water supply and curtailing PTA production. The water resources study indicated that the reclamation project would not only solve the plant's problems with water shortage and inadequate deionization (DI) system capacity, it would also be economically attractive, paying for itself in less than five years.

The reclamation system will use advanced membrane processes to treat blended wastewater consisting of cooling tower blowdown and biologically treated process wastewater. The reclaimed pure water will be recycled to the DI system as makeup water. Major savings will include 80 percent lower DI regeneration costs and significantly lower water purchase costs and wastewater discharge fees.

Under Brown and Caldwell's direction, Enprotech System Corp. conducted a comprehensive pilot testing program, which demonstrated the technical feasibility and reliability of the proposed treatment process and provided data for design and cost estimation. The treatment process includes ultrafiltration (UF) and reverse osmosis (RO)—state-of-the-art wastewater reclamation technologies—as well as chemical oxidation, dual-media filtration, granular activated carbon (GAC) adsorption, ultraviolet (UV) disinfection, and degasification. The 25-gallon-per-minute on-site pilot system, with semiautomatic controls, resembled a small, full-scale treatment plant. Various flow and flux conditions, including an accelerated biofouling test for the UF membrane, were tested over approximately 20 months.

Design of the full-scale reclamation project began in August 1997. The initial system will treat an influent flow of approximately 9,000 cubic meters per day, or m^3/d (2.35 millions of gallons per day, or mgd) and produce 6,600 m^3/d (1.73 mgd) of pure water for supply to the PTA plant's existing DI system. The treatment system is designed to be expandable by 50 percent with minimal facility addition. Brown and Caldwell will assist in process design, equipment selection and specification, start-up, and training for the design/build project, administered by CTCI Corporation in Taiwan.

Linda Henry

Risk Assessment News and Tips

Health risk assessment is a tool to help our clients determine whether chemicals in the soil, air, and groundwater must be remediated to protect human health and the environment. Regulators and scientists at the federal and local levels are supporting changes to make risk assessments more flexible and realistic.

Relief Available for Stringent TPH Cleanup Levels

Until recently, calculating a health-based cleanup level for total petroleum hydrocarbons (TPH) has been problematic because TPH is a complex mixture that varies with the source and age of the release. Typically, TPH cleanup levels are based on single chemicals, such as benzene, toluene, ethyl benzene, and xylene. But sometimes these chemicals are not present, and the TPH is a mixture of undefined aliphatic and aromatic chemicals.

Two groups have recently developed methodologies for calculating health-based cleanup levels for TPH as a mixture. Both methods require laboratory analyses of TPH and calculation of a cleanup level based on the composition. The use of these methods can substantially reduce remediation costs. For example, Brown and Caldwell used one of these methods to increase the regulatory cleanup level for TPH by over a factor of 1000.

EPA Issues Policy on Probabilistic Risk Assessment

On May 15, 1997, the U.S. Environmental Protection Agency (USEPA) issued their "Policy for Use of Probabilistic Analysis in Risk Assessment," thus giving their blessing to this alternative way to predict health risks and calculate health-based cleanup levels.

Probabilistic analysis uses a range of exposure assumptions, instead of the single data point used in traditional deterministic risk calculations. For example, the deterministic method assumes that people drink over 8 glasses of water a day (2 liters). Probabilistic analysis selects from a statistical range of reasonable drinking water rates. Thus, probabilistic analyses result in more reasonable exposure scenarios and, generally, in lower predicted risks and higher cleanup levels.

We urge you to use probabilistic analysis whenever possible *after* determining that the cost of the probabilistic analysis is justified by the potential return. Probabilistic analysis can be costly when applied to complex exposure scenarios. Also, it's a developing area—new to the majority of regulators—and your path through it may not be smooth. In many cases, however, a probabilistic risk assessment will result in significant savings. An increase in a health-based cleanup level by a factor of 5 or 20 could eliminate the need for remediation. A copy of the policy is available on line at http://www.epa.gov/ncea/mcpolicy.htm.

Stay Tuned

USEPA has set up an expert panel to review the toxicology of arsenic, and a forthcoming issue of *Quarterly* will review developments. For additional information on any of these topics, please contact Linda Henry, Ph.D., at (510) 210-2362 or lhenry@brwncald.com.

LINDA HENRY

At this former site of a cement manufacturing facility in Port of Tampa, Fla., Brown and Caldwell excavated 12,000 tons of contaminated material from above-ground storage tanks. The use of risk-based cleanup levels—the first in the state—sped completion of the cleanup and meant that more than 24,000 tons of soil could be used as backfill or left in place.

Risk-Based Remediation Yields Cost-Effective Closure

Brown and Caldwell saved Lafarge Corporation, the owner of a cement manufacturing facility at the Port of Tampa, Fla., more than $1 million in cleanup costs by using risk-based remediation. It was the first time in the state that this remediation approach was used. Led by chief contractor Brown and Caldwell, an integrated team of designers, contractors, and vendors from Denver, Houston, Tampa, and Orlando conducted the design-build project on a fast track.

Built in the early 1900s and supported on driven piles and platforms, the cement factory operated six cement kilns, fired by fuel oil that was stored in three 500,000-gallon above-ground tanks. Over time, the land surrounding the platforms was filled to 7 feet above grade with kiln dust, debris, and channel dredge spoil.

In the early 1980s, the facility was converted to a distribution plant, and the site was sequentially demolished. When a waterfront parcel on the site became attractive for sale, Lafarge hired Brown and Caldwell to plan, design, and complete site remediation.

As a single contact for all the project team members, Brown and Caldwell cut costs, compressed schedules, and streamlined coordination. The work was structured to meet the requirements of Florida's Brownfields Redevelopment Act. Crucial to achieving the closure was Brown and Caldwell's close work with Florida regulators to complete the first risk-based cleanup not only in Hillsborough County, but in the whole state. Brown and Caldwell conducted sampling and analysis to fill data gaps remaining from prior work, developed soil-cleanup target levels using risk assessment logic, and managed all excavation and disposal activities. Thousands of feet of process piping was exhumed, decontaminated, and sold as scrap to defray Lafarge's costs. Tank shells also were recovered and scrapped. The project was planned and executed rapidly, even though actual volumes of contaminated material were twice the original estimate.

William Voshell, environmental manager for the Lafarge Corporation, summarized the outcome: "Brown and Caldwell's strategic thinking produced a timely and cost-effective closure at this complicated site."

EPA Starts Chemical Risk Management Program

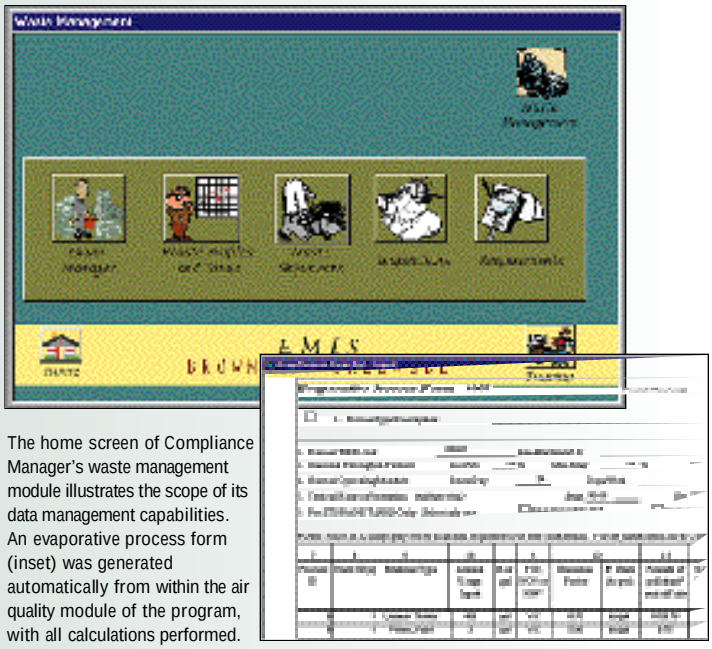
Facilities that store and/or handle specified chemicals—including chlorine, sulfur dioxide, ammonia, and propane—in quantities above specified thresholds will need to comply with the requirements and deadlines of the EPA Risk Management Program (RMP) by June 21, 1999. That means taking steps toward compliance now. The program, geared toward preventing accidental chemical releases, covers 77 toxic substances, 63 flammables, and certain explosives. Municipal and industrial wastewater and water treatment plants, pulp and paper mills, petroleum refineries, and chemical manufacturers are certain to be affected by the program. The final rule, which is part of the Clean Air Act Amendments of 1990, was established in June 1996; the requirements are in the 40 CFR, Part 68, regulations. Facilities should start preparing for compliance now by doing at least the following:

- Compiling a five-year history of accidental chemical releases
- Identifying and characterizing potential releases
- Performing air dispersion modeling based on the identified potential releases and the quantities of chemicals on site

To identify whether a facility is subject to the rule, the applicable program level and requirements, how prepared the facility is given its current risk management procedures and existing documentation, and how to efficiently execute the remaining work and prepare the submittal by the deadline, call Denis O'Malley or Wilma Dreessen in Pleasant Hill, Calif., at (510) 937-9010.

Joining Brown and Caldwell…

Now leading client services for the water resources group in Brown and Caldwell's Tampa, Fla., office is Roger Copp, P.E. With 19 years of experience in water resources management, Copp is focusing on restoration projects in the Florida Everglades. He has done watershed management studies in Egypt and in Michigan, Pennsylvania, New York, New Jersey, Delaware, Maryland, Virgina, and Florida, as well as dredged-material planning and design, lake and estuary restoration, and waste load allocation for wastewater dischargers. Copp holds a bachelor's degree in biology and a master's of science in water resources management. He can be reached at (813) 889-9515… Based in the Denver office, Elisabeth Benjamin, P.W.S. (professional wetlands scientist), amplifies Brown and Caldwell's wetlands capabilities company-wide. Benjamin contributes expertise in wetlands permitting, compliance, delineation, and design. She is working on wetlands projects across the country, as well as watershed projects and mining-related environmental assessments. She has 10 years of professional experience, a bachelor's degree in biology, and a forthcoming master's in environmental policy and management… New health and safety director Anne Baptiste, J.D., C.I.H., is consulting nationwide on training, health and safety compliance, and other industrial-hygiene issues. A practitioner of leading techniques in worker-exposure monitoring, ergonomics, indoor air quality, ventilation evaluation, and asbestos and lead services, she is an expert in environmental health and legal issues. Baptiste has designed and managed programs for construction contractors, manufacturers, aerospace companies, the U.S. Navy, and others. She holds a bachelor's degree in biology, a master's in public health, and a law degree. Call her at (619) 528-9090.



The home screen of Compliance Manager's waste management module illustrates the scope of its data management capabilities. An evaporative process form (inset) was generated automatically from within the air quality module of the program, with all calculations performed.

Tailored Software Available to Manage Environmental Data

Brown and Caldwell now offers clients a customized software application to manage environmental data. Compliance Manager is friendly to users—including production staff, facility managers, and environmental specialists—who need to track and perform compliance activities. With modules addressing waste management, hazardous materials management, air quality, stormwater management, and underground storage tanks, Compliance Manager covers the bases: outlining tasks needing to be done, providing easy-to-edit data input forms and spreadsheets, prompting actions at specific times, and informing the user of applicable regulations and available training.

Greg Cameron, Brown and Caldwell geologist and hydrogeologist—with assistance from compliance specialists in the company's Phoenix office—designed Compliance Manager after a number of clients asked for help. Existing software packages demanded steep learning curves, and clients complained that they had to force-feed their data into the software. So Cameron and the Phoenix team decided to construct a program that would adapt to each client's unique data set and management challenges, and that could be learned in about an hour.

Developed as a Microsoft Access database application, Compliance Manager can be made to interface with virtually any existing data set, database, and software, including CADD and geographical information systems. And while it offers a user-friendly front end, it's meant to be customized by Brown and Caldwell consultants according to each client's facilities, operations, corporate processes, and existing information management applications.

Depending on the client's needs, the home screen can show as many as five modules (described above) along with ways to access information on system maintenance and emergency response plans. For example, the screen for the waste-management module allows the user to access tasks, forms, previously input data, summary information, and calculations, on such subjects as waste drums, waste profiles and totals, waste shipments, RCRA inspections and corrective actions, and the company's other waste management program requirements. Some of the summary information from this module feeds into the air quality module, which calculates total air emissions generated by the facility.

Geared toward medium-sized and small companies and municipalities, Compliance Manager is already being used by a number of public and private organizations, including the Arizona Public Services utility, a nationwide rental company, a private transit operator, and industrial manufacturers. Call Greg Cameron at (602) 222-4490 for a free demonstration disk and more information.

Responsive, Reliable, and Ready for the Next 50 Years

1998 marks Brown and Caldwell's 51st year of serving clients throughout North America and in many locations abroad. Our success in this industry is firmly grounded in the many long-standing and trusting relationships we have with our clients, business partners, and colleagues. As we stand on the threshold of our next half-century of doing business, what better time to take a snapshot of who we are today and how far we have come?

Growth. Even as environmental spending in the U.S. remains flat, 1997 marked Brown and Caldwell's third straight year of steady growth—in revenues, clients, and offices. This past year alone we added four new offices, bringing the total to 30 locations, two of which are outside the U.S. (Buenos Aires and Vancouver, B.C.). We have also built on our established position in the petroleum, water, and wastewater markets and deepened our involvement with the mining, forest products, food, and steel industries.

Efficiency. Like many companies, we have restructured our operations and practices for greater efficiency and responsiveness. Most important, our one-firm structure enables us to assemble the right team of experts for every job, every time. Brown and Caldwell was an early adopter of intranet technology. Now we use it to link technical, scientific, and project management resources around the country, and to share best practices and lessons learned. Our strategic commitment to information technology has boosted internal productivity, enhanced employee and client collaboration, and spawned a new generation of information-related products for environmental directors, utility managers, and front-line operators.

Supporting competitiveness and renewing infrastructure. Brown and Caldwell is working with clients to rebuild aging and inefficient infrastructure. We're using risk-based and other corrective measure to minimize compliance-related costs while fully protecting human health. And as businesses and utilities have continued their push for re-engineering and improved competitiveness, we have anticipated their expanding needs, becoming an industry leader in process and system optimization, management consulting, and information technology services.

Trust. So who is Brown and Caldwell at 50? We're just now entering our prime. As much as our experience speaks volumes about our ability to perform, it is the confidence of our clients, the regulatory community, and industry colleagues, who know that we will perform, that gives me the greatest sense of achievement. Trust is the foundation upon which employees past and present have built the diversified, client-focused company we are today. The fact that we are exceeding so many industry benchmarks shows we're doing the right things, and we can be trusted to continue doing so throughout our next 50 years.

Craig Goehring

Craig Goehring

Technical Papers

The technical papers listed below are available to readers. For copies, please write, call, or e-mail Andrea Atkins, Brown and Caldwell, 3480 Buskirk Avenue, Pleasant Hill, Calif., 94523, (510) 210-2464, aatkins@brwncald.com, or access them via our web site at www.brownandcaldwell.com.

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"Implementing an Award-Winning Stormwater Management Program within a Watershed Framework" No. 642

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"Benchmark Evaluation of Three Recent Fixed Cover Anaerobic Digester Projects" No. 643

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"Improving Effluent" No. 665

GOODWIN, J., et al.
"Specifications That Ensure Slipping Success" No. 666

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