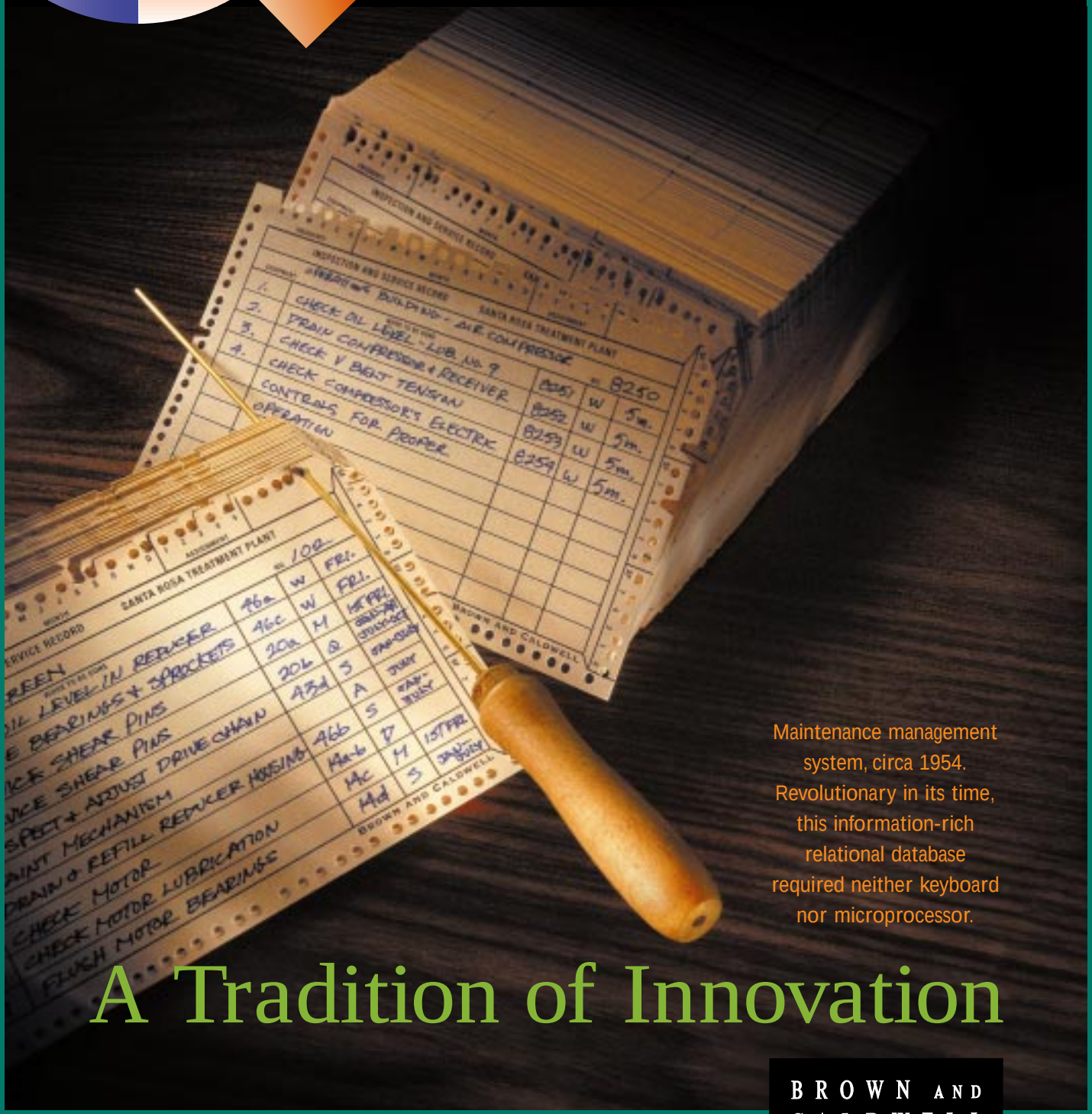
Fall 2000, Volume 29, Number 3

QUARTERLY



Maintenance management system, circa 1954. Revolutionary in its time, this information-rich relational database required neither keyboard nor microprocessor.

A Tradition of Innovation

BROWN AND CALDWELL

Photo by Jeff Alexander

In the early 1950s, Brown and Caldwell developed this maintenance management system, which employed a deck of cards with predrilled holes that were each assigned a specific meaning. Each piece of equipment was described on a card, and specific holes were notched to indicate various characteristics, such as service intervals, lubricant type, etc. To sort, a narrow rod was inserted into a hole and the entire deck was lifted upwards. The notches caused cards possessing that feature to fall from the deck for further sorting.

QUARTERLY

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Achieving a Return on Your Training Investment

Issues and Ideas

How to develop a training program that focuses on implementation and delivers measurable results.

"I hear and I forget. I see and I remember. I do and I understand." Confucius' wisdom highlights an important relationship between education and experience that is often missing in today's training. Schools, conferences, workshops, and college courses usually focus on show and tell but lack the transition to practical implementation.

In response to competitive pressures, many public and private organizations are considering training solutions. But if we don't apply the training in our day-to-day work, we don't achieve our goals or become any more competitive, and training is merely an expense, not an investment.

Think about all the training and educational activities in which your organization participates—conferences, workshops, college courses, correspondence courses, vendor training, and consultant training. The investment is often difficult to quantify because we do not fairly track the costs. Chances are it involves more than a single budget line-item of registration fees and travel. The training investment includes productivity, overtime, and administration costs.

What has been the return on your training investment? Okay, your staff members receive certificates of completion and continuing education units, and they get a day or two away from the rigors of the normal workday. These benefits can make people feel good, but they do very little for the organization or the customers who actually pay for the training.

Start defining your training objectives

If you can't measure a return on your training investment, your organization probably doesn't have clear objectives against which to measure. You can develop these objectives, and develop a training program around them too.

With most training, the trainer determines what he or she wants your staff to learn—not you, your staff, or your organization. But since your organization pays for the training, you should define the objectives you want to achieve.

What is important is that the objectives be quantifiable. But they don't have to be defined strictly in terms of financial return. Solving an operational problem or simply learning more about one's facility can be measurable objectives with measurable returns.

Identify opportunities to measure your training investment

Once you have defined training objectives, identify opportunities where what's learned can be implemented in your organization. This is how you can measure the return on your training investment. Link all classroom training to specific implementation actions that staff can take.

For example, if your organization has the objective of reducing operations and maintenance (O&M) costs, where are the opportunities to do it? These are the areas on which training should focus. Electrical usage in the secondary process of a wastewater treatment plant—usually high because of aeration and return-activated sludge pumping—is one likely opportunity to cut O&M costs; therefore, facilities with that objective should consider focusing training and its implementation on that topic.

Quantify the returns

Brown and Caldwell has helped many clients achieve returns on their training investments. One example is the Unified Sewerage Agency of Washington County, Ore. The agency defined the objective of improving its competitive position by reducing O&M costs. Then they identified the opportunity of implementing biological phosphorus removal at their Durham facility; the facility had the process flexibility for biological phosphorus removal, but so far results had been inconsistent. So Brown and Caldwell developed a workshop for the agency on biological nutrient removal. Staff at the Durham facility applied the knowledge gained from the workshop to identify what was limiting performance. Then the staff resolved these limiting factors with some minor plant modifications. The result: A $300,000 investment (including the modifications) produced far greater system-wide cost savings within 14 months, measurably improving USA's competitive position.

In another instance, Kitsap County, Wash., defined the objective of maximizing the capacity of the existing wastewater treatment plant as a means of deferring capital costs. Brown and Caldwell assisted Kitsap County staff with training and optimization recommendations on a range of opportunities associated with the secondary treatment process, including helping to control incidental nitrification. The result: a 16 percent capacity increase, achieved at no additional capital cost. Even more gratifying was the Kitsap County staff's measurable increase in confidence and sense of ownership during implementation of the necessary changes.

Directly link your organization's training to clear objectives, and to practical opportunities to apply and measure the results. I guarantee that you'll realize many returns, including improved work processes and employees motivated to keep learning more.

– WOODIE MUIRHEAD, VICE PRESIDENT

Woodie Muirhead is a member of Brown and Caldwell's operations services team. For more information on training, contact him in Portland, Ore., at (503) 244-7005.

Advances in Research

Brown and Caldwell's Projects for WERF

From infrastructure to effluent, Brown and Caldwell's projects in association with the Water Environment Research Foundation are forging new and needed methods for doing things better.

The mission of WERF—advancing the science and technology of water quality—is supported by a broad spectrum of the water-research community. Consulting firms, public utilities, sanitation districts, municipalities, and other government entities, including the USEPA, contribute to its $40 million research program.

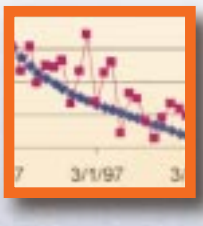
The award of a contract from WERF, therefore, is a vote of peer confidence in the grantee's ability to push forward the forefront of water research. Brown and Caldwell's record of WERF contracts is particularly noteworthy for its breadth, spanning sewerage infrastructure, wastewater and solids treatment and applications, and the protection of aquatic habitat. Here are snapshots of Brown and Caldwell's WERF projects in progress.

INFRASTRUCTURE

Developing a predictive tool to measure and rank sewer degradation. Given limited budgets, many agencies need a systematic way to identify sewers most in need of inspection; smaller agencies in particular lack the resources to inspect entire systems quickly. Directed by Principal Investigator (PI) Steve Merrill (Seattle), a Brown and Caldwell team is developing a tool to help agencies prioritize sewer lines for inspection.

Using whatever knowledge of the system is available—electronic or anecdotal—the tool estimates the risk and consequence of failure for specified pipelines and segments. It then ranks sewers for inspection on the basis of structural deterioration; operational defects such as blockages; potential impact on the local economy, the environment, and human health; and replacement cost. The tool is based on an "expert system" approach: its rules flow from a knowledge base derived from national experts.

Ranking methodologies to predict peak flows after sanitary sewer rehabilitation. Another Steve Merrill-led team is asking how to best predict the effectiveness of sewer repairs. The results will be a ranking of methods to predict how



extensively rehabilitation will reduce infiltration and inflow (I/I) of groundwater and storm drainage into sewer lines.

The team searched for methods to predict I/I reduction, then defined a short list for testing. Next, the team identified agencies with sufficient before-and-after data on rehabilitation. The data sets had to meet criteria for collection, reliability, and other issues. Now, the team is testing each prediction method on all sets of "before" and "after" data and evaluating how well the method forecasts actual reduction of I/I after pipeline rehabilitation. The work is accounting for regional and climatic differences.

TREATMENT

Determining the effects of wastewater characteristics and variances on primary clarifier performance. According to PI Eric Wahlberg (Walnut Creek, Calif.), "Primary sedimentation tanks are often overlooked by the bioreactor-centric wastewater profession, but they are the real workhorses of wastewater treatment, removing more influent biochemical oxygen demand (BOD) and total suspended solids (TSS) for less operating money than any other treatment process."

Wahlberg will be working with Dawn Lesley (Eugene, Ore.) and Dave Kinnear (Salt Lake City) to collect a year's worth of data from 10 or more treatment plants. Their goal is to quantify the characteristics of raw wastewater that affect performance of primary sedimentation tanks. Eight plants have already volunteered considerable support for sample collection and analysis. In return, the plants will receive reports evaluating the performance and capacities of their primary clarifiers.

Measuring the essential parameters of activated sludge models. At the heart of

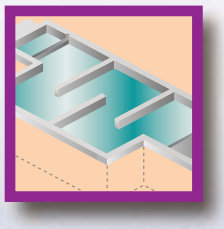
advances in computer-based modeling techniques which simulate the activated sludge process is the characterization of the wastewater to be treated; the profession has progressed far beyond BOD and TSS. Indeed, the accuracy of these simulation techniques depends on successful model calibration, which, in turn, depends on accurate characterization. Now, various methods are used to measure critical parameters in a wastewater characterization study, with no conformance among their protocols.

Henryk Melcer (Seattle) is heading up a Brown and Caldwell team to 1) identify the key parameters of International Association of Water Quality-based computer models; 2) determine the most appropriate methods for measuring these parameters; 3) evaluate the accuracy and cost of these methods; and 4) create a manual of protocols. Melcer's team has identified the most critical parameters influencing the outcome of biological-process models as a) the fraction of influent chemical oxygen demand (COD) that is readily biodegradable and b) nitrifier maximum specific growth rate.

Updating American Society of Civil Engineers protocol for evaluating secondary clarifier performance.

PI Eric Wahlberg's involvement in this project goes back to the early '90s, when he was the PI for the ASCE's Clarifier Research Technical Committee's field study to assess protocol for evaluating the performance of activated-sludge secondary clarifiers. Now WERF has contracted with Brown and Caldwell to revise and publish the protocol. A pre-conference workshop at this fall's WEFTEC conference will present the revised protocol and solicit input from design, academic, and operating professionals. WERF will publish the protocol early next year.

Studying oxidation reduction potential vs. residual control of chlorination.



Because of the delicate balance between the benefits of chlorine in controlling pathogens and its toxicity to aquatic wildlife, control of the chlorination

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Research

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process is one of the most sensitive aspects of wastewater treatment. Chlorine residual is the historical indicator for chlorination process control. But available methods of chlorine analysis, which include automated wet chemistry and electronic sensors, have drawbacks, including compliance difficulties, frequent maintenance requirements, and high operation costs.

David Murray (Portland, Ore.) is serving on the WERF Project Subcommittee to study the use of oxidation-reduction potential (ORP) as an alternative to chlorine residual analysis. ORP is a measure of chemical reactivity, directly related to chlorine concentration. It can be electronically quantified, but until now, no side-by-side, plant-scale studies have assessed the two methods' relative reliability. Studies at plants in California, Ohio, and Texas will account for variations in water chemistry, climate, and plant design.

BIOSOLIDS

Making Class A biosolids production more affordable. Perry Schafer is the PI of a study that aims to provide wastewater agencies with a more-affordable means of producing Class A (pathogen-free) biosolids.

"Our approach is low-tech, low-cost," says Schafer.

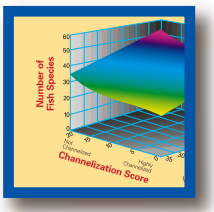
The team has evaluated various long-term storage and air-drying options that may be able to generate Class A material. Now, research is focusing on laboratory and field testing of long-term storage in biosolids lagoons. At a Sacramento, Calif., wastewater plant and at Tulane University in New Orleans, the method will be simulated on a small scale. Biosolids will be spiked with a non-contractible strain of poliovirus and *Ascaris* ova (worm eggs), and pathogen dieoff will be assessed. "These pathogens are particularly tough organisms to eliminate; therefore, they're the crucial ones to prove system performance," says Schafer.

Recommending nitrogen-management protocols for beneficial use of biosolids. Biosolids are a valuable source of plant nutrients, particularly nitrogen (N), which is slowly released from organic complexes through mineralization. Calculations of field-application rates for biosolids must consider such factors as mineralization rate, crop N requirements, soil type, and climate; otherwise, excessively applied N might leach to groundwater.

In this project, several academic institutions collaborated in field research under a variety of soil and climatic conditions. Steve Wilson (Portland) helped conceive the project, enlist academic researchers, and involve regulators from a dozen states to review findings and discussion. The result, a report completed in June 2000, recommends a refined methodology for calculating agronomic application rates.

AQUATIC HABITAT

Adding stream habitat to the water-quality equation. Cindy Paulson and Sarah Reeves (Denver) are creating a method to account for the physical characteristics, along with the chemistry, of a receiving stream, to enable water-quality managers and regulators to consider stream habitat when setting discharge limits. The method will help users identify the most limiting stressors on a stream system, whether chemical or physical; predict how changes in effluent will affect stream biology; assess the value of physical habitat improvements; and develop total maximum daily loads. The method incorporates the early use of high-powered statistical analyses to identify important variables, along with the user's knowledge of the stream system.



Go to www.werf.org for more detailed information on WERF's projects and activities.

Honolulu and Atlanta Face CMOM Issues Now

Two major metropolitan agencies improve management of their sewer collection systems, illustrating what others can expect from the EPA's new regulations on sanitary sewer overflows.

Within a couple of years, the USEPA's new regulations to minimize sanitary sewer overflows (SSOs) will take effect. The most dramatically impacted agencies will be municipal satellite collection systems, which will be required for the first time to get, or be included in, National Pollution Discharge Elimination System (NPDES) permits.

In addition, all sewer collection, or collection and treatment, agencies will need to launch rigorous programs to address capacity, management, operation, and maintenance (CMOM).

Many in the industry believe that CMOM requirements will revolutionize the way sewer agencies function—or at least enable their managers to do the jobs they had always hoped to do.

Two cities recently faced CMOM issues, both of them in response to negotiated USEPA consent decrees that closely mirror aspects of the forthcoming regulations. Honolulu's and Atlanta's approaches contain lessons for agencies across the country as they gear up to meet the new SSO requirements.

Prioritizing maintenance, hydraulic, and structural improvements

"In our work for Honolulu, we had to integrate maintenance, hydraulics, and structural needs into a prioritized improvement program. This is what CMOM requires," says Project Manager Pete Bellows, P.E.

The City and County of Honolulu covers the entire island of Oahu. Over 1,300 miles of pipeline convey wastewater to eight treatment plants, which together treat more than 120 million gallons each day.

Since 1992, Brown and Caldwell, as subcontractor to Hawaii-based consultant Fukunaga and Associates, Inc., has been helping Honolulu develop a long-range plan to minimize SSOs in response to a suit brought by the EPA. The

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Fukunaga/Brown and Caldwell team assessed the condition of the collection system, analyzed hydraulic capacity, and developed alternatives to reduce inflow and infiltration. Brown and Caldwell provided key technical services for the project and was an important part of the regulatory negotiating team.

"The team came in with a holistic approach, something we hadn't considered before," comments Tim Steinberger, Honolulu's Wastewater Planning Branch head. "The team focused not only on wet-weather conditions, but also on structural conditions and dry-weather problems within the system. That approach helped us develop a comprehensive rehabilitation program and financial strategy."

"We didn't just do spot sampling or give Honolulu a one-year snapshot," says Ray Matasci, P.E., Brown and Caldwell's Hawaii operations manager. "We took a comprehensive look at the entire collection system, including full monitoring over a number of years and then thorough data analysis."

"Adequate capacity" for Honolulu's huge system

One of CMOM's primary mandates is to prevent overflows during wet weather by guaranteeing adequate capacity to convey base and peak flows. If an overflow is caused by severe natural conditions, such as widespread flooding, hurricanes, or earthquakes, then it may not be subject to fines.

But what level of storm should a municipal sewer system reasonably be prepared to accommodate? CMOM guidelines don't designate appropriate wet-weather design flows from storms smaller than a hurricane.

To determine the answer for Honolulu, Fukunaga/Brown and Caldwell performed customized cost-performance and hydraulic analyses.

Bellows simulated flows from 28 years of historic rainfall. Then the team performed computer modeling of the collection system and identified hydraulic problems such as capacity difficulties and overflows.

Modeling showed that if the system were upgraded to accommodate flows resulting from a 2-year, 6-hour storm event for this tropical island, then wet-weather overflows would be reduced by 78 percent. Increasing the system capacity to accommodate storms with more severe flows would reduce overflows only marginally but would be prohibitively expensive. By convincing the EPA that this storm criterion was appropriate, Honolulu saved several hundred million dollars.

In response to the identified hydraulic problems and using the newly established criterion, the team analyzed alternatives—rehabilitation, storage, capacity expansion, and flow diversion—to recommend the optimum mix of remedies for the collection system.

Assessing pipeline condition and overall critical needs

While adequate system capacity is important, pipeline condition is also essential to overflow prevention. In Honolulu, the team assessed pipeline condition by identifying critical sewers and then performing manhole and closed-circuit-TV inspections, which revealed many corroded and structurally damaged pipes and manholes.

"The hydraulic and structural problems we uncovered ultimately totaled $885 million in capital improvements," says Bellows. "Clearly, we needed a practical way to prioritize projects. So we used a methodology based on risk and consequence of failure, in this case focusing on pipe collapses and overflows."

"We had five years to look at the whole system. It seemed like a monstrous undertaking," says Steinberger. "When I look at the completed project, I see that it allowed us to really know our system. The team

pinpointed all the problem pipes and a reasonable method for prediction, and we can go in *before* failure happens."

Steinberger adds, "We went from a city identified as having severe failure of our collection system to a city which, the EPA believes, is a model for the region."

Optimizing collection system operations

The City of Atlanta employs more than 285 workers to operate and maintain its 2,200 miles of sewage collection pipes and appurtenances. As part of its comprehensive business management services for the City, Brown and Caldwell has been working to reengineer operations of Atlanta's collection system, streamlining procedures and reducing expenses.

Preventing and responding to overflows is a key focus of the reengineering plan. A new management and organizational structure emphasizes one-stop customer service for such problems as pipeline blockages that could cause overflows.

The reengineered division also will feature improved and centralized support services to quicken response time; efficient materials procurement; increased computer training for an improved work-order tracking system; a grease-management information system; and expanded field capabilities to handle maintenance demands.

The grease-management information system will track progress toward eliminating sewer blockages due to grease discharges into Atlanta's collection system. "Proactive information-technology solutions such as this one will play an important role in the success of CMOM programs," explains Dan Skalsky, Brown and Caldwell's project manager.

In the spring of this year, the Atlanta City Council approved Phase I of the sewer department's reengineering plan, paving the way for a significant change in the operations.

"More than a year of collaboration and creative thinking went into the reengineering plan," says Skalsky. "Now the hard work begins. It takes lots of effort to change any organization that has been built over several decades."

Contact Pete Bellows at (925) 210-2386 for more information on CMOM and on the Honolulu collection system project. Contact Dan Skalsky at (770) 394-2997 for more information on Brown and Caldwell's services for Atlanta's sewer collection system.

"The team came in with a holistic approach, something we hadn't considered before," comments Tim Steinberger, Honolulu's Wastewater Planning Branch head. "That approach helped us develop a comprehensive rehabilitation program and financial strategy."

CMOM

What, When, and How

In the long continuum of the Clean Water Act, the USEPA has now set its sights on overflows from sewer collection systems. This year, the agency's Office of Wastewater Management is expected to issue proposed sanitary sewer overflow (SSO) regulations. At the core of them are the Capacity, Management, Operation, and Maintenance (CMOM) requirements.

The final regulations will not be promulgated until at least mid-2001.

For the first time, satellite collection systems will need to get NPDES permits. They will have two to three years to do so, except if they have an overflow, when they will need to get permits within 180 days. To get permits, satellite collection systems will have two options: apply for their own or become included in the regional sewerage agencies' existing NPDES permits.

To get permits or, in the case of collection and treatment agencies, to renew existing permits, agencies will need to prepare a written CMOM program. It should contain assessments and plans addressing these main elements:

- Preventive maintenance
- Structural conditions
- Information management
- Overflow emergency response
- Audits

For the draft regulations, proposed changes, and related information, visit www.epa.gov.

QUARTERNOTES

Toronto's Aggressive Transition to Biosolids Beneficial Use

Faced with an unexpected grass-roots campaign, the Toronto City Council ruled in January 1998 that within three years, all the biosolids produced by its main wastewater treatment plant had to be put to beneficial use instead of being incinerated.

The deadline was exceedingly tight. The normal timeline for a design-build project of this magnitude—which involves investigating alternatives, selecting a contractor, and designing and erecting new infrastructure worth $90 million Canadian in construction costs—is five to ten years.

Brown and Caldwell, along with R.V. Anderson Associates, Ltd., of Toronto, was selected as the city's biosolids consultant to help meet the deadline in the most technically sound way.

From RFP to construction, with public input all the way

"I don't know of many projects like this one," says Toronto's Project Manager **Kiyoshi Oka, P.Eng**. "It's been extremely challenging in terms of its size, its aggressive schedule, and the high degree of public and political input throughout the development of the beneficial use program. The consultant team had to deal with it all."

With city staff, the team wrote the request for design-build proposals, developed selection criteria, and evaluated bids and technologies. It then specified a combination of 50 percent drying and pelletization—which involves heating biosolids to approximately 220 degrees Fahrenheit—and 50 percent direct land application.

Accompanied by public stakeholders, Brown and Caldwell and the rest of the owner's team embarked on an unusual field evaluation of the specific processes used by its prequalified applicants. Finally, the team created 20 percent design-level drawings and specifications so that the selected prime would carry out exactly what Toronto needs.

State-of-the-art drying and pelletization

"Drying and pelletization is an up-and-coming technology that has recently advanced enough to cost-effectively produce Class A biosolids," says Project Manager **Steve Wilson**, Brown and Caldwell's specialist in biosolids reuse. "With the dried pellets, you have much lower transportation costs, so you can afford to ship the product further. As a Class A product, pellets also have a wider variety of uses, including fertilizer for golf courses and landscaping."

The partial choice of drying/pelletization also cuts the storage costs associated with land application, an important consideration in the cold climate of Canada, where dewatered biosolids must be stored for up to six months during winter.

To be prudent, the team recommended a combination of the two methods, because it not only proved to be cost-effective, it also safeguarded against changes in regulations and public opinion about biosolids reuse.

"After we settled on the drying/pelletizing and recommended the preferred contractors, we had the rare opportunity to evaluate their methods firsthand," adds Wilson. "We traveled with the client's team to Baltimore, Md., New York, Montreal, Belgium, and Spain to examine the different methods, all of which varied in design, emissions, and product quality."

Drying/pelletization plant being placed on existing incinerator foundation

Among North America's largest biosolids conversion projects

Toronto's main treatment plant produces 50,000 dry tons of dewatered biosolids per year. The entire output was incinerated prior to 1996, when a third of it was allocated to agricultural land application.

When the facilities are completed, Toronto will have one of the largest biosolids reuse programs in North America. The new structures include a drying/pelletization plant, storage units, and biosolids loading facilities. They also include a new plant heating system, designed by the team because the old incineration units previously supplied the heat for digesters and other elements.

To minimize owner risk, the consultant team defined the basic criteria for capacity, odor control, and other issues in the 20 percent design documents. Currently, the team is reviewing final design and inspecting the new facilities. Construction is within budget and on schedule.

BC People

Gene St. Godard, R.G., C.H.G., is leading Brown and Caldwell's new Spokane, Wash., office. With more than 14 years of experience as a geologist/hydrogeologist, St. Godard has conducted environmental assessments and remediations for hazardous waste sites, natural resource evaluations of watersheds, and hydrogeologic evaluations throughout the West...Joining the Denver office as vice president and regional water resources program manager, Peter Binney, P.E., has more than a quarter century of experience planning and managing water resources in the West and internationally...Vice President Jeff Sharon, P.E., joins the Cleveland and Columbus offices as Midwest operations manager, with more than 25 years of experience in planning and designing wet-weather collection systems, including CSO and SSO studies...Stationed in Tucson, Ariz., Mike Fleury, P.E., DEE, comes to the company as a vice president with more than 28 years of experience in facility planning, wastewater plant expansion, transmission main, and many other projects throughout the Southwest, along with leading national value engineering campaigns...Vice President Tom Marrou, P.E., comes to the Houston office with a 26-year history of consulting to commercial and industrial clients in process engineering, permitting, environmental management, and closure of facilities...Leading the company's Eastern industrial water quality practice from Mahwah, N.J., is Joseph Cleary, P.E., with 27 years of experience in characterization, treatability, pilot studies, design, construction oversight, design/build, and operations and maintenance for industrial wastewater and site remediation projects...Michael Macaulay, P.E., has joined the Twin Cities office as managing engineer, with 25 years of experience in industrial wastewater treatment, secondary fiber processes in the pulp and paper industry, and solid waste management for industry as well as municipalities... Joining the Miami office as managing engineer, Joseph Paterniti, P.E., brings with him more than 20 years of experience in water and wastewater master planning, design, and evaluation, along with contract administration and construction engineering...Susy Pepper, named vice president and director of human resources, is leading innovative employee programs focusing on communication, employee retention, and improving benefits...Linda Henry, Ph.D., vice president, has been appointed to Brown and Caldwell's Board of Directors. With 21 years of experience in assessing human health and environmental risk, Henry is Brown and Caldwell's chief toxicologist...Jeff Garvey, P.E., comes to the San Diego office as a managing engineer with more than 30 years worth of know-how in water and wastewater master planning, pipeline, and pump station projects, including three award-winning designs...With more than 17 years of experience in the water industry, Supervising Engineer Gary Silverman, P.E., also joins the San Diego staff. Silverman previously spent six years with the company before leaving to become director of engineering with the American Water Works Service Company...Tom Mingee, P.E., has joined the Sacramento, Calif., office as a managing engineer, contributing 25 years of engineering and management experience in planning, design, and construction management for water, recycled water, and wastewater projects...Also augmenting the Sacramento staff is Information Technology Professional Services Manager Allan Scott, with 12 years of experience developing software, geographical information, and data management systems for many municipal, state, and federal environmental agencies as well as private clients...Jeff Nelson, P.E., is a new senior project manager in the Walnut Creek, Calif., office, with 19 years of experience in remedial investigations and feasibility studies, risk-based cleanup, environmental due diligence, and site closures...Greg Stevens is leading services in environmental management systems from Atlanta...John Salo has been appointed director of the company's new Business Consulting Practice, which focuses on helping water and wastewater utilities to integrate private-sector practices in a context that preserves and promotes public service.

Minority Scholarship Program Launches

Photo by Crystal Freeman

Atlanta-based engineer Craig Langworthy with Manouchka Jean

Manouchka Jean, a senior majoring in civil engineering at the New Jersey Institute of Technology, is the recipient of Brown and Caldwell's first Minority Scholarship award. The program, which is being piloted in the company's Atlanta office, includes a paid summer internship to provide on-the-job experience, a $3,000 tuition scholarship, and a dedicated mentor/career role model. The company will roll out the program to more offices next year.

"We're very excited to have Manouchka here," says Managing Engineer Doug Edwards, P.E., who is leading the program in Atlanta. "The selection process was rigorous, and she has demonstrated a real eagerness to learn."

Jean will work with project teams on a variety of assignments. "We're seeing to it that she gets broad exposure to the capabilities we provide our municipal and private sector clients," says Edwards. "It's our hope that this summer is just the beginning of her tenure with Brown and Caldwell."

Minority Scholarship PROGRAM

Fats, Oil, and Grease and Municipal Storm Water: New Best Practices Available Online

"Best Management Practices for Fats, Oil, and Grease (FOG)" and "Municipal Stormwater Toolbox for Maintenance Practices" were recently developed by Brown and Caldwell for the Oregon Association of Clean Water Agencies (ORACWA). The two new manuals are available at www.oracwa.org under the publications section. Reproduction with credit is encouraged.

An association of more than 70 municipal agencies in Oregon and Southern Washington, ORACWA saw the need for practical guidance on these two pressing issues. It funded development of the manuals in conjunction with the Oregon Department of Environmental Quality and the Lower Columbia National Estuary Program.

Fats, oil, and grease can cause serious problems in collection and treatment—sewage spills, manhole overflows, and sewage backups in homes and businesses. "Best Management Practices for FOG" gives municipal wastewater pretreatment staff, as well as managers and owners of restaurants and fast-food businesses, techniques to prevent FOG pollution.

For business owners, the manual outlines effective ways to reduce maintenance costs and prevent oil and grease discharges to the sewer system. It includes answers to frequently asked questions, prohibitions, and details on proper maintenance of grease traps and interceptors.

For municipal pretreatment inspectors, the manual includes inspection and installation checklists. It's also designed to help municipal pretreatment staff educate those in the food-service industry about how to prevent FOG problems.

Brown and Caldwell also developed ORACWA's "Municipal Stormwater Toolbox for Maintenance Practices" to offer tips to regulatory agencies, cities, industry, hospitals, and small businesses on how to affordably integrate water-quality-friendly practices into everyday maintenance activities. This glove-box size manual provides quick and easy guidance for maintenance staffs, with common-sense ideas that can be easily incorporated into daily routines. Detailed checklists are included for maintenance of storm-water systems, roadways, roadside areas, and maintenance yards, and for storage and disposal of waste materials.

Idaho Sets Example in Operator Training

The USEPA has mandated that every state submit a Drinking Water Operator Certification Program for the federal agency's review and approval by February 5, 2001. While 49 states already have such programs, many may not conform to the EPA's new guidelines—or help operators meet the agency's training requirements.

Idaho is the last state in the country to require certification of drinking-water-system operators, with new rules that took effect April 15, 2000. Yet since the early 1980s, the state has trained operators to support drinking-water and wastewater grant and loan programs. Brown and Caldwell Project Manager **Pat Brown**—herself a certified wastewater treatment operator and laboratory analyst—has led the training program for the last dozen-plus years under contract with the state's Department of Environmental Quality (DEQ). Three years ago, the program was expanded to encompass and promote the coming requirements.

Pat Brown

Ironically, although it was the last state to mandate operator certification, Idaho has discovered that its program is one of the best available. First of all, the longstanding volunteer certification effort established by water and wastewater operators in the late '60s, linked to the Association of Boards of Certification, was found to measure up well against other states' mandatory programs.

Second, "We're now in the forefront, because Idaho's current certification rules mirror the USEPA requirements," explains State Training and Certification Coordinator **Nancy Bowser**, senior water quality analyst with the DEQ. "Other states are now having to go back and amend their drinking-water rules to reflect the federal guidelines—and encountering some difficulties and delays." She also cites the state's knowledgeable Water/Wastewater Operators Certification Board, with which the state has contracted to run the certification program.

And third, the program is wildly successful with operators themselves, in no small part due to Pat Brown.

"Pat is unique because she's a hands-on trainer," says Bowser. "She understands the whole laboratory-testing-and-procedures side of plants, as well as the equipment side, the pumps, valves, and clarifiers. It's rare to find people with experience in both arenas. Because of that, she has a lot of respect from the operator community."

"Also, Pat changes her delivery and presentation according to each audience's technical understanding and background. Her intuitive understanding of her audience makes her a very effective teacher," Bowser explains.

Driven by eagerness as well as uncertainty about certification, operators responded to the offering of drinking-water training in such numbers that **Sandra Southern** joined Brown and Caldwell's project team two years ago to handle inquiries.

Classes and workshops are offered for wastewater as well as drinking-water operators. Topics include activated sludge, collection systems, very small water systems, pumps and motors, interpretation of mechanical drawings, ultraviolet disinfection, and more, for those with varying amounts of experience. Go to www.idahocertificationtraining.com for more detail and links.

Brown was awarded the Joe Koon Lifetime Achievement Award by the Idaho Water/Wastewater Operators Certification Board last spring for her leadership in the state. Call her or Southern at (208) 465-5725 to discuss Brown and Caldwell's training offerings elsewhere in the country.

Photo by Bordner Aerials

Bio-P Conversion of Twin Cities Treatment Plant Averts Need for More Tanks

Metropolitan Council Environmental Services (MCES) in St. Paul, Minn., is converting the entire secondary treatment system of its Metropolitan Wastewater Treatment Plant to a biological phosphorus (bio-p) removal process.

The recent conversion of one-quarter of the plant to the bio-p process proved that it could remove the desired level of phosphorus with existing tankage. This confirmed that construction of more tanks for this purpose wasn't needed—and saved MCES more than $100 million compared to initial planning estimates.

In 1993, after the Minnesota Pollution Control Agency tightened National Pollution Discharge Elimination System permit limits, other consultants advised MCES that to gain compliance, it needed to either increase tankage or derate capacity by as much as 30 percent.

Brown and Caldwell showed otherwise, applying innovative approaches and successful experience with both the bio-p process and capacity optimization applications. The team employed a process model, calibrated from bench-scale test data, to accurately predict that modifications to existing tankage could achieve biological removal of phosphorus without capacity loss.

In addition to reducing capital outlay, the project cut annual energy costs by $2 million—with the collaboration of the MCES research and development department, the Metro plant's operations and maintenance staffs, and other consultants—by converting the coarse-bubble aeration system throughout the secondary treatment process to fine-bubble aeration.

"After we converted 25 percent of the secondary treatment system to bio-p, we conducted a one-year test program to compare the performance of the step-feed nitrifying activated sludge system remaining in the rest of the plant with the performance of the new system," says **Tim Block, P.E.,** Brown and Caldwell's project manager for the initial construction and now principal in charge of full-plant conversion. "We found that phosphorus removal and nitrification results satisfied permit requirements. And overall, the biomass generated by the new system was better flocculated, had better settling characteristics, and varied less in day-to-day settleability. Each of

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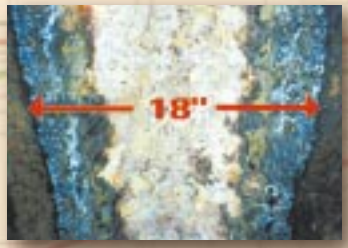
Pipeline Rehab Project Wins Top Honors



Phoenix's rehabilitation at the 91st Avenue Wastewater Treatment Plant—one of the most complicated and challenging pipeline rehabilitation projects ever attempted in the United States—recently won top honors in two national engineering competitions. The American Consulting Engineers Council named it a 2000 Honor Project, making it one of their Top 25 projects for the year. The American Public Works Association awarded it 2000 Project of the Year in the category of disaster or emergency construction/repair.

Crisis-level corrosion

In 1998, a potentially catastrophic situation was discovered at the plant, which treats an average sewage flow of 162 million gallons per day (mgd) from the cities of Phoenix, Glendale, Mesa, Scottsdale, and Tempe, Ariz. Fifteen large-diameter reinforced-concrete pipelines (RCPs) carrying primary clarifier influent and effluent flow inside the facility were found to have wasted away because of hydrogen sulfide corrosion. The compromised 54- and 60-inch-diameter pipes totaled 6,631 linear feet. In addition, large holes, several feet in diameter, were discovered in the parallel, 72-inch-diameter RCPs outside the plant, each carrying up to 85 mgd of raw sewage into the facility. In all, over 15,231 linear feet of pipeline was compromised.

Because segments of the pipeline are located beneath roadways carrying heavily-loaded truck traffic, the area was in imminent danger of a catastrophic pipeline failure.

Advanced infrastructure rehabilitation

In October 1998, the City of Phoenix asked Brown and Caldwell to evaluate the deterioration, prepare plans and specifications to correct the problem, and provide bid and engineering services during construction to complete all construction work on the fifteen 54- and 60-inch pipes by October 15, 1999. Only five months were available for construction. The deadline for completing rehabilitation of the 72-inch-diameter pipelines, located outside the plant, was December 15, 1999.

"The fact is, plant treatment capacity couldn't be reduced to accommodate pipe rehabilitation," says **Sam Edmondson, P.E.,** Brown and Caldwell's principal in charge. "Work on nine pipelines had to be completed within the first 60 days of construction. That's when the plant operates at peak treatment efficiency and when sewage flow is at a seasonal low."

Traditional pipeline replacement methods were not only too time-consuming and costly, but would have created a high risk of rupturing adjacent pipelines during excavation, which would have caused a major sewage spill. Instead, the team looked to cured-in-place pipe (CIPP)—a proven pipeline rehabilitation technology that involves inserting a resin-impregnated, polyester-felt tube into the deteriorated pipeline. The result is a continuous, form-fitting pipe within a pipe.

CIPP, however, had never before been used in such large-diameter pipelines with as many short-radius bends as contained in this project. A major issue to consider was the possible reduction in carrying capacity from insertion of the polyester-felt tube, due to reduction of the internal pipeline diameter and the liner's potential to wrinkle on the bends, thereby impeding flow. This dilemma was resolved by careful hydraulic calculations, specifications limiting the amount of permitted wrinkles, and assignment of staff with related experience. Another issue was the high temperatures in Phoenix, which could have caused the resin to harden prematurely. The problem was averted by the use of massive tents, a 200-ton chiller, and 1000 pounds of ice per day before the resin was impregnated into the liner.

Record-breaking success

"We had numerous technical intricacies and construction challenges to overcome. Our success rests heavily on the cooperative, trusting relationships that developed between the city, Brown and Caldwell, and the contractor," says Edmondson.

The team rehabilitated the 15,231 linear feet of deteriorated pipes in record time: 15 days ahead of an initial July 15, 1999 milestone and 2-1/2 months ahead of the October 15, 1999 deadline. In addition, the project was completed nearly $760,000 under budget, even with an additional 352 feet of pipeline rehabilitated, with no sewage spills or discharge violations.

Bio-P Conversion,

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these characteristics promoted a more stable process for MCES." After the one-year test program, the team did further bench-scale testing and calibration of the model to optimize the bio-p process.

The 250-million-gallon-per-day Metro is the largest wastewater treatment plant discharging to the Mississippi River. It treats approximately 80 percent of the wastewater generated by the seven counties surrounding the Twin Cities, providing primary and secondary treatment prior to disinfection and discharge.

Metro's secondary treatment facilities consist of 16 four-pass aeration tanks (ATs) and 24 rectangular final sedimentation tanks (FSTs). Like many large wastewater treatment plants, Metro has several solids-processing return streams. This made design much more challenging, because of the high loads coming back from the solids-processing system.

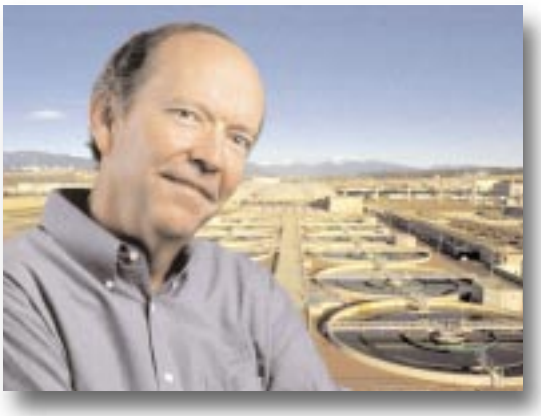
Now, Project Manager **Lori McIntyre, P.E.,** and her team are nearing completion of design for full-plant conversion. It entails:

- Incorporating partitioned and mixed unaerated zones near the front of each AT
- Improving the hydraulic distribution and sludge-withdrawal features in the corresponding FSTs
- Adding a common mixing point for all return-activated sludge from the FSTs before distribution to the ATs
- Implementing a mixed-liquor waste-activated sludge system
- Improving automatic dissolved oxygen (DO) control in each AT

With existing tanks and no capacity derating, the plant will achieve an annual average total phosphorus concentration of 1.0 milligram per liter for treated effluent, in addition to meeting a seasonal nitrification requirement. The new, more stringent, requirements must be met by 2005.

Denny Parker:

The Innovation of Process and the Process of Innovation



Denny Parker, Ph.D., P.E., celebrated his 30th anniversary of employment with Brown and Caldwell earlier this year. Parker, who has consulted on hundreds of wastewater-related investigation, design, and planning projects, may be best known for his career-long focus on process innovation. He has lectured at USEPA technology-transfer sessions across the U.S., on nitrogen removal and innovative technologies, and invented or co-invented several widely used wastewater treatment processes, including the trickling filter/solids contact process (TF/SC), the flocculator-clarifier, and the biofilm-controlled nitrifying trickling filter (BCNTF). CEO Craig Goehring, P.E., interviewed him in August on technology trends in wastewater treatment.

Craig Goehring: **Denny, considering your past innovations in treatment processes, do you see more in the future?**

Denny Parker: Yes, because the environment that allows it is part of our firm's culture. People who had the opportunity to work with Dr. Dave Caldwell were challenged to always make things better, to come up with creative solutions, and to make things easier for the operator. Dave had a disdain for the handbook, but a great appreciation for the use of basic science in the practice of engineering.

CG: **Some in our industry are risk-averse, sticking closely to the guidelines defined in the "Manuals of Practice" (MOPs).**

DP: Yes. The MOPs have contributed to the suppression of new technologies by not giving them even-handed treatment. On the other hand, MOPs also have played a positive role in gaining industry acceptance for certain technologies. Wetlands treatment is an example of an effective technology that is now seeing its proper use.

Being risk-averse isn't the same as being risk managers. And risk management doesn't mean avoiding innovation, but applying the scientific method—starting with a hypothesis, going on to testing at lab or pilot scale, proceeding to the full scale, and then learning from it. The only risky part of this technology development cycle is skipping a step.

CG: **How do you convince our clients to apply the whole development cycle?**

DP: Everyone has to understand the potential risks, rewards, and fall-back positions. For instance, several years back we convinced several of our clients to oversize the conduits leading to and from our flocculator-clarifiers on the basis that they could later be rerated at higher surface loading rates. Yes, there is some marginal cost for doing this, but the potential reward is cheap incremental capacity. So far, the risk-taking has paid off handsomely.

CG: **What do you see for the younger generation of Brown and Caldwell engineers?**

DP: Just in the course of our business, we have passed on this innovation ethic to the next generation. It has become so much a part of our practice it almost goes unnoticed. For instance, I was surprised to find that our competitors are largely not using classifying selectors for controlling foam-causing organisms. We seem to be the only major firm routinely recommending them to our clients. We now have seven activated sludge plants successfully operating with this technology, with others under design, in construction, or nearing startup.

CG: **What do you see in the future of wastewater-treatment technology development?**

DP: My crystal ball says that, at least for plants serving urban areas, space considerations will start to become critical as plants provide even more advanced levels of treatment. For instance, I'm working on technology that will allow the plant to perform both carbonaceous removal and nitrification in the same activated sludge volume, where the plant previously performed only carbonaceous removal.

Also, with higher and higher levels of treatment, reclamation and reuse should see a renaissance. I recently participated in two WERF workshops which separately projected that localized wastewater reuse facilities, built with robust technology, would decrease the pressure to expand centralized facilities by treating gray water near reuse points in the watershed, and by sending residuals-bearing streams to the central plants for resource recovery.

CG: **What about the influence of competitive pressures on treatment technology?**

DP: Certainly, one thing we have always brought to our clients is the ability to assess, with the best scientific methods available, how to get the most out of their plants. Competitive pressures reinforce the need to keep doing that, to keep applying these methods along with our skill at innovation. As we often tell our clients, the cheapest concrete to build is the concrete you already own.

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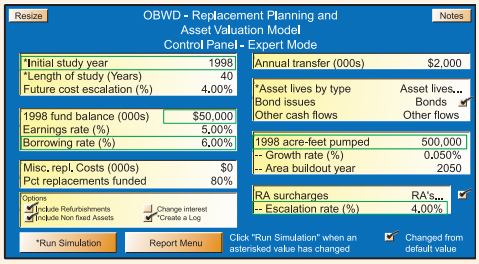

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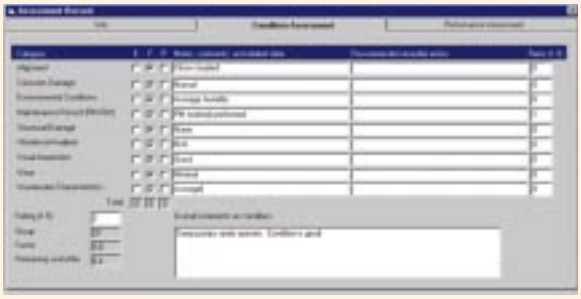

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