Horizons
Engineering Excellence in Meeting Environmental Challenges

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Catching the Green Wave

Green Building Begins to Reshape Environmental Infrastructure

By Michael Stallone, AIA, LEED AP and Tommaso Nardone, AIA, LEED AP

In the United States, moves to encourage green building are coalescing into a powerful wave that will reshape how we design homes, schools, offices, and environmental infrastructure. The good news is that developers, utilities, and decision-makers can ride this green wave to increased performance and, in some cases, higher profits as well.

Inside

Hazen and Sawyer architects collaborated with HVAC engineers to focus on Manayunk CSO facility's natural ventilation.

Fifteen states, over 45 cities, and the federal government now require that new public buildings meet some kind of sustainability standard - in most cases, the U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) standard. Over a dozen other cities are offering incentives for LEED-rated private buildings, including, in a handful of places, fast-track permitting.

For utility managers and decision-makers focusing on public infrastructure, the debate has begun to shift - weighing environmental sustainability against to facility performance, while keeping costs reasonable and meeting regulatory requirements.

Our experience designing sustainable environmental infrastructure has demonstrated that green building can create a "win-win" situation that simultaneously saves money while improving facility performance and protecting the environment.

"Green" Building From the Ground Up

According to the USEPA, "Green or sustainable building is the practice of creating healthier and more resource-efficient models of construction, renovation, operation, maintenance, and demolition." But what does this mean for environmental infrastructure projects, which face unique demands in terms of reliability, longevity, and performance? *Continued on Page 7*

HAZEN AND SAWYER
Environmental Engineers & Scientists

Hazen and Sawyer Happenings

Connor Creek CSO Wins Top Honors with New Treatment Approach

The Conner Creek CSO Control Facility was awarded the Honorable Conceptor Award for Engineering by the American Council of Engineering Companies (ACEC) of Michigan and the Michigan Society of Professional Engineers.

"The success of this project is evidence of the great spirit of cooperation between the Hazen and Sawyer team, the client (Detroit Water and Sewerage Department) and the contractor (Walsh Construction Company)," said Khamis Al-Omari, a Senior Associate with Hazen and Sawyer and Project Manager. "Our thanks to the ACEC, the Society of Professional Engineers, and everyone who worked to plan, design and build this project."

In service since July 2005, this facility improves water quality in the Detroit River by ending the discharge of untreated overflows into Conner Creek, a tributary of the river. The facility has 30 million gallons of storage capacity and includes screening, disinfection, settling, skimming, flushing, and dewatering systems. Existing outfalls were rehabilitated and reused, which added another 32 million gallons upstream of the facility.

Based on this project's successful demonstration, the Michigan Department of Environmental Quality may accept five minutes, in lieu of 10 minutes, as the required minimum disinfection contact time for disinfection, reducing the need for a costly future expansion of the facility.

Gilboa Dam Fast-Track Improvements Project Wins Award

The Gilboa Dam Fast-Track Improvements project was awarded the Grand Conceptor award by the American Council of Engineering Companies.

The project was commissioned by the New York City Department of Environmental Protection (NYCDEP) and carried out by the joint venture of Gannett Fleming/Hazen and Sawyer (GF/H&S), with assistance from Lakhani & Jordan Engineers, P.C., for support on various design and construction tasks.

After almost 80 years of service, Gilboa Dam required immediate improvements to ensure stability and bring it into compliance with current safety guidelines. To meet time constraints, GF/H&S completed improvements concurrently, mostly during the winter and compressed the design and construction schedules. As a result, the entire project took less than half the time normally required for such work.

In addition to scheduling challenges, the project involved diverse operational, engineering, environmental, and construction issues, and use of cutting-edge dam technology. Most notably, half of the 79 post-tensioned anchors will experience loads of over 1,000 tons - the practical limit of today's technology.

All work was successfully completed before the end of 2006, allowing the NYCDEP to keep its commitment to local communities downstream to improve dam stability as quickly as possible.

Hillsborough County, Florida Engages Hazen and Sawyer for Utility Assessment

As water and sewer systems age, breakdowns can cause major headaches for the community, businesses, and utility managers. Hillsborough County, Florida, in an effort to stay ahead of the curve, recently hired Hazen and Sawyer to assist with an inventory and condition assessment of all pressure/force mains within the County.

"Preventive maintenance saves communities money, protects the environment, and ensures that vital services won't be interrupted," explained Sanjay Puranik, P.E., an Associate with Hazen and Sawyer. "Taking action before there is a major problem is the smart thing to do – and we are pleased to be the lead engineering firm on this project," he continued.

Hazen and Sawyer will execute this Pressure Main Inventory and Condition Assessment project in association with The Halcrow Group, KCI Technologies, and Faller, Davis & Associates. The team will conduct a detailed inventory of vital data on the County's pressure/force mains - conveyance systems that are pump-driven instead of gravity-driven – for the water, wastewater, and reclaimed water systems and update asset attributes in Hillsborough County's GIS and computerized asset management system. Hydraulic modeling, field location, data collection, and advanced condition assessment on selected assets will also be performed during this project.

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A Sustainable Approach to Stormwater Management

By Sandeep Mehrotra, PE, Senior Associate

With the United States population growing, water quality regulations being tightened, and the likelihood of climate change already increasing the intensity of peak wet-weather flows, efforts to control flooding and manage stormwater face a host of challenges.

However, by using sustainable, watershed-based approaches, stormwater management can be made both more effective and more environmentally friendly. In fact, this is one area where improving environmental performance can be highly beneficial to reducing flooding and improving water quality.

Benefits of Sustainable Stormwater Management

The traditional approach to stormwater management, sometimes dubbed "capture, convey, and discharge," can be very effective at reducing flooding, but often creates water quality problems at the end of the pipe.

Treating polluted stormwater, especially when flows peak during intense wet weather, can necessitate expensive, large-scale treatment facilities to ensure that runoff doesn't harm potable water supplies or natural habitat. Traditional systems must be built with significant "headroom" to ensure that peak flows don't overwhelm the finite capacity of pipes and stormwater treatment facilities.

Part of the challenge is that planners have long focused on the middle of a projected lifecycle, thus missing the upstream and downstream impacts of traditional ditch-and-drain approaches. These include impacts stemming from the materials and manufacturing of conveyance structures (pipes and outlets); the energy required to transport, assemble and install these structures; and the environmental impact of their eventual removal and disposal.

A more sustainable alternative applies a comprehensive, watershed-based approach that minimizes the conveyance of stormwater, maximizes upstream treatment, and uses natural features, such as creeks, streams, and swales, to move as much of the water as is possible. Natural features are supplemented with engineered structures to ensure drainage of developed areas, bypass roads and infrastructure, and interface with collection and treatment systems.

This approach has many benefits aside from the obvious ones of reducing the need for expensive, built infrastructure. By maintaining sub-watershed water budgets, groundwater aquifers can be recharged and wetlands can be restored. And, by limiting the extent of pipe and other conveyance structures, a municipality can save money and reduce environmental impacts.

However, these benefits are only part of the picture. Natural systems are more adaptable to changing conditions and, with proper planning, BMPs, and engineered structures are better able to withstand intense storm events. Natural systems can later be supplemented by conventional infrastructure down the road if development or climatic conditions require greater capacity.

The Staten Island Bluebelt

The Staten Island Bluebelt Project is an excellent example of a sustainable approach to stormwater management. By using natural creeks, streams, and wetlands in combination with culverts and engineered structures, flooding has been significantly reduced, wetlands are being restored, stormwater water quality has improved, and the City of New York has saved tens of millions of dollars in construction costs.

Ancillary benefits of the project are significant as well: restored wetlands are increasing property values by creating aesthetically pleasing natural areas. By beautifying neighborhoods while reducing flooding, the project has won over skeptical residents and helped create more demand for additional BMP sites, expanding from the current 10,000 acres to 18,000 acres at project completion.

BlueHeron Project: Bluebelt, Staten Island

For those municipalities that have the appropriate urban, suburban, or rural terrain, site surveying and site selection is key to the success of a stormwater management project. Other critical activities include:

- Early involvement and communication with the local community;
- Focus on the aesthetics of built infrastructure and restored wetlands;
- Careful attention to selection of BMPs and design of engineered structures; and
- Inclusion of sufficient funds in the project budget for the often-forgotten pieces of the project, such as community outreach, O&M, and wetland restoration.

In the near-term, a Bluebelt-style approach can be more maintenance intensive, since it requires attention to recently planted areas. However, over the long-term, the savings on construction costs far outweigh these minor maintenance costs.

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Innovations in Nutrient Removal: Exploring Alternatives to Methanol

By Paul Pitt, PhD, PE, Vice President and Norman Bradley, PE, Principal Engineer

Enhanced Nutrient Removal reduces nutrients in wastewater by adding anaerobic, anoxic, and aerobic zones to the secondary treatment process. Nitrogen, phosphorus and other nutrients can be greatly reduced with this approach – however, in some cases, supplemental carbon must be added to the process to achieve optimum performance.

Not surprisingly, as more wastewater treatment plants add ENR technology, the use of carbon supplements is also growing. The challenge is that many of these supplements have their own drawbacks, including handling difficulties and rising costs. With this in mind, Hazen and Sawyer has been at the forefront of an effort to research alternative carbon sources and identify the most safe and cost-effective products.

A Brief History of Methanol

For the past decade, methanol has been the supplemental carbon source of choice for wastewater treatment plants. It is readily available, relatively inexpensive, and has a long shelf life. As the market leader, methanol has been studied in depth, and its impact on treatment kinetics and plant performance are well-understood.

Recently, however, prices for methanol have been rising, as the cost of methane (from which methanol is derived) have continued to increase, prompting many treatment facility owners to begin looking for alternatives. Methanol also has other drawbacks – it is a highly flammable liquid, poisonous, and reactive with oxidants. This necessitates using costly fire- and explosion-proof materials for methanol storage and feed systems, which, in some cases, can make the permitting and approval process more difficult. And although methanol is effective as a carbon source for ENR processes, its single carbon molecule configuration (CH_3OH) results in less favorable kinetics for carbon addition than certain other carbon sources.

Alternatives to Methanol Move Forward

Given the downsides of methanol, Hazen and Sawyer is evaluating a range of alternative supplements including:

- Primary sludge fermentation
- Byproducts from biodiesel generation
- Acetic acid
- Sodium acetate
- Aqueous sucrose solutions (i.e., "sugar water")
- A variety of proprietary chemicals

Typically, acetate and the products of primary sludge fermentation are added to the anaerobic zones in the secondary treatment process, to enhance phosphorus removal. For enhanced denitrification, all of the above-listed carbon sources, including methanol, could be applied to the anoxic zones.

Henrico County WRS

One facility for which Hazen and Sawyer is evaluating methanol alternatives is the Henrico Wastewater Reclamation Facility. This plant has to meet current discharge standards of 8 mg/L TN and 2 mg/L TP, with anticipated future values of 5 mg/L and 0.5 mg/L, respectively. Methanol is planned as a future addition; however, because of the previously identified issues, the plant is testing the use of a waste syrup product known as “sugar water.”

Preliminary results from the Henrico facility show that waste syrup has potential as an ENR carbon source. However, more detailed tests, currently underway, are needed to better understand how the syrup interacts with seasonal swings in influent characteristics. The tests will also help determine the extent to which the corn syrup product is actually available to drive the denitrification process. *Continued on Page 8*

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City of Raleigh Wins Public Information Award for Video Tour

The City of Raleigh won a 2007 National Environmental Achievement Award for the Neuse River Wastewater Treatment Plant tour video. Produced in conjunction with Hazen and Sawyer, the presentation was given an Award in the Public Information and Education category by the National Association of Clean Water Agencies.

"Educating the public about the importance of environmental infrastructure helps ensure continued support for its upkeep," noted Scott May, Communications Manager for Hazen and Sawyer's Raleigh office, who helped write, produce, and animate the video. "We thank the Association of Clean Water Agencies for the award and the City of Raleigh for the opportunity to contribute."

Asset Management and Sustainability:

Protecting Environment and Infrastructure

By George R. Freiberg, Director of Utility Management Services, and Henry R. (Kelly) Derr, PE, Senior Associate

A creative, forward-thinking approach to asset management can help water and wastewater system operators address the challenges of environmental sustainability while protecting their facilities, ensuring smooth operations, predicting and stabilizing user fees, and, in some cases, saving money.

This article explores the basics of both asset management and sustainability and describes how they can fit together in a fashion that's friendly to both plant operations and the environment.

Asset Management and Sustainability: Defining Our Terms

The term "asset management" (AM) can have different meanings depending on its application, but in the water and wastewater world, it generally entails…"the combination of management, financial, economic, engineering and other practices applied to physical assets, with the objective of providing the required level of service in the most cost effective manner."

Few will argue that AM includes those practices which, when taken together, maximize the life and value of assets. And, in reality, AM is nothing new – although not always managed or formerly connected, these practices are known to many as financial management planning, capital improvement planning and maintenance management.

Similarly, the term "environmental sustainability" is a somewhat amorphous concept that has been used in many different contexts. For our industry's purposes, the USEPA's definition of sustainability is good, if a bit broad: "…the ability to achieve continuing economic prosperity while protecting the natural systems of the planet and providing a high quality of life for its people."

Creating a Successful Management Approach

Ensuring that environmental infrastructure lasts as long as possible, while operating efficiently, can actually improve environmental sustainability in several ways – by reducing plant effluent impacts on water quality, ensuring that money invested in facilities is well-spent, and minimizing periodic replacement of equipment and materials.

Thus, the key challenges of asset management are not in conflict with ecological goals. However, developing an effective AM program can often seem too complicated, especially for small to medium-sized utilities, to pursue in an organized fashion. While there is no "magic bullet" to create an effective AM program, there are plenty of practical steps utilities can take.

The first step on this seemingly daunting path is to avoid becoming mired in trying to achieve perfection. Quite often, the effective implementation of asset management programs is delayed, or in some situations scrapped, because too much time and emphasis are placed on the need to employ unnecessarily elaborate and complicated management software programs. Once managers realize that an effective program should be built piece-by-piece, drawn on procedures and information already available in the enterprise, they can create an effective AM program.

Implementing an Effective AM Program

- Conduct an Overview Assessment of current asset management practices (Hazen and Sawyer will be happy to provide a questionnaire to assist in this regard);
- Develop an Overall Asset Management Plan that draws on input from all levels of the organization and sets out specific goals, objectives, and expected outcomes. A good plan will exploit organizational strengths and identify solutions to remedy shortfalls;
- Create an Implementation Plan that includes specific tasks and assignments and attends to immediate AM needs as well as long-term goals;
- Ensure that Field Staff Participate in developing and implementing the AM program - support from field operation and maintenance staff is key to the accurate recording and updating of asset data; and
- Update the Plan to account for personnel turnover, and procurement of new systems, tools and assets.

Keeping it in the Black While Going Green

Ensuring that facilities and infrastructure meet or exceed their lifespan goals and operate effectively over time is not just good for business – in most cases, it's good for the environment as well. There are some specific approaches and concerns that will improve environmental performance. At the top of the list: pay attention to environmental performance, because poor performance often means that a process or system isn't working reliably.

A proactive approach to maintaining burried infrastructure facilities will reduce the risk of regulatory non-compliance penalties and user-fee sticker-shock while protecting the environment and the water or wastewater system.

In the longer term, an effective AM program will provide operators and decision-makers with the hard data needed to weigh different technologies and understand the impact of spending decisions on performance. Combined with prudent maintenance management, lifecycle analysis, and environmental reporting, this information helps ensure that infrastructure investments achieve maximum fiscal and environmental performance.

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Long Term Demand Forecasting: Meeting Water Challenges for the New Century

By Sanjay Puranik, PE, Associate

With the population of the United States expected to top 400 million in the next decade, existing water resources are being pushed to their limit. Utilities are now looking at alternative sources and strategies such as water conservation, reclaimed water, desalination, and aquifer storage and recovery (ASR), to enhance their current supply.

Water utilities with diverse supply sources (e.g., ground water, surface water, desalination) and rapidly growing service areas face a difficult task in forecasting potable water needs over a long-time horizon. Surface water sources dependent on weather conditions and the uncertainties in growth patterns and regions of growth make this task even harder.

Creating a long-term demand forecast can help utilities reduce this uncertainty and plan for the future.

Better Demand Forecasting and Supply Planning

Long-term potable water demand may be estimated from socioeconomic, meteorological, and policy conditions. Factors include the number of single-family and multi-family households, persons per household, employment, household income, housing density, temperature, rainfall, and reclaimed water availability.

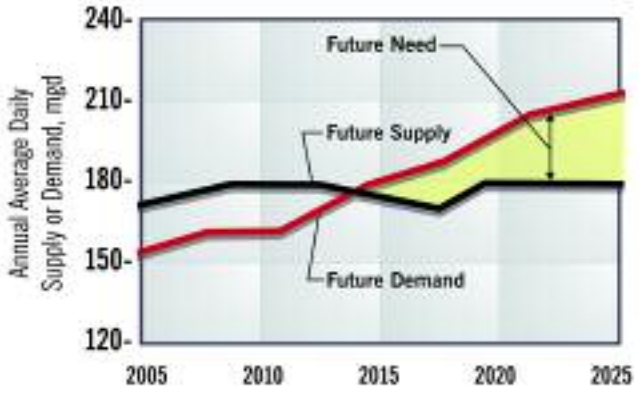
Projections of expected values and the variability of these drivers can be used to produce distributions of forecasted regional demand over time. These distribution-based forecasts can help decision makers assess the risk of future supply shortfalls and plan future supply projects to meet anticipated demand.

Probabilistic Future Water Need Forecasting in West-Central Florida

To help utilities make more accurate predictions about future needs, Hazen and Sawyer has developed an effective and user-friendly computerized long-term demand forecasting system (LTDFS).

Initially created for Tampa Bay Water, a wholesale water supplier in west-central Florida, the modeling approach and techniques are applicable to a wide range of circumstances. Historical water use and demographic data were entered into a relational database and a Geographic Information System(GIS), and then used to develop the statistical models used for forecasting.

Based on these forecasts, Tampa Bay Water was able to defer significant additional water supply projects from 2008 to 2012. This more accurate forecast data has also helped Tampa Bay Water optimize use of existing supplies, and has fed into other related demand management and Water Supply Mitigation projects



Forecasting Requires Good Record Keeping

The benefits of long term demand forecasting are many - from being able to better plan capital projects and take advantage of the associated savings from deferred investments, to coordinating a capital improvement program with conservation and efficiency initiatives. However, creating accurate models does take some planning, especially to ensure that required data is collected and organized properly.

Utilities and businesses interested in creating these kinds of models should consider the following issues:

- Water use data and demographic information should be collected regularly in a flexible electronic format;
- Key data sources, like customer billing records, should be retained for as long as possible in electronic format - relying on back-ups can create a huge amount of extra work if analog records or outdated formats need to be converted; and
- Ensuring that different utilities use consistent units and collect similar kinds of data. For Tampa Bay Water, we had to collect utility level account data from six different systems that utilized different formats, collection frequencies and data, complicating the initial research.

Planning water projects to ensure a safe, reliable, and sustainable supply over decades is never an easy task, but long-term demand forecasting can help increase our understanding of future conditions. Ensuring the inclusion of accurate, well-organized data will greatly contribute to the success of this important activity.

"Catching the Green Wave" Continued from Page 1

First and foremost, utilities and municipal clients must examine system-wide issues, such as trade-offs between building new or, rehabilitating existing infrastructure, and reducing demand through efficiency and conservation.

Once system-wide issues have been evaluated and facility planning commences, sustainability should be addressed from the "get-go". This may require greater effort during the design phase, but, over the life of a facility, savings in resource consumption and maintenance costs usually far outweigh any extra design costs.

Properly siting the facility is key to minimizing impacts on the surrounding community and maximizing the benefits of passive efficiency–the orientation of windows and walls can make a big difference in how much cooling or heating a process or office building requires.

Lighting and ventilation go hand-in-hand with siting. Certain easy-to-add features–such as operable windows, light shelves (a kind of fixed shade to block summer sun), and clerestory windows–can significantly reduce the money spent on heating, cooling, and lighting at little to no additional project cost.

These improvements can add up to big savings, but to reap maximum gains, it is critical that all professionals involved in design understand the project's environmental goals and communicate clearly with one another throughout the process. While designing the Manayunk CSO facility, for instance, Hazen and Sawyer architects and HVAC engineers collaborated closely resulting in HVAC equipment being resituated to take advantage of the building's natural ventilation. Since the change was made very early in the design, there was no impact on the final design cost.

The materials chosen for facility construction also play a key role in determining a building's performance. With recent improvements in materials technology, we no longer have to trade performance for environmental sustainability–in some cases, recycled materials and green technology actually improve building envelope performance. For example, concrete panels for Manayunk will be made using recycled post industrial slag, embedded waterproofing, and integrated insulation panels–all at a cost just slightly higher then standard concrete panels. With a very high insulation value and no need for internal or external paint, these pre-cast panels improve environmental performance, reduce heating costs, and eliminate the need for future repainting–saving many times their cost premium over the life of the project.

Retrofitting Facilities: Move Cautiously

Creating a new structure that's efficient is one thing - but what about retrofitting or restoring buildings or systems? Here, too, are many opportunities to improve sustainability and performance, while saving money.

Since demolition and materials disposal can generate significant costs, clients should evaluate the environmental and fiscal impacts of expanding to the site limits and using existing infrastructure, versus tearing down old facilities to build new ones.

New York City's Avenue V Pump Station Upgrade and Restoration project (*rendering below*) is an excellent example of the benefits of restoration. Although this historic building is suffering from cracks and a crumbling façade, we worked with the city to restore it, using careful analysis and reclaimed materials–improving the insulation value of the existing envelope and minimizing demolition impacts and costs.

Advancements in materials technology can benefit retrofitted structures as well as new construction - easy-to-use ceramic paint coatings, as one example, can achieve an insulation value of R-20 when applied to exteriors of metal structures, steam piping, and other metal surfaces. Despite all of these advances, however, retrofitting existing facilities (especially when adding more "active efficiency" technology such as photovoltaic panels), does have its challenges, particularly when the facility must remain operational during the retrofit.

One way to improve performance without disrupting core processes is to first switch non-critical operations (such as power for administrative offices) to sustainable energy sources, then addressing high-demand equipment like blowers. It's good idea to be savvy as to witch renewable technology is most appropriate for an application. For example, using DC power from photovoltaic panels for DC applications, instead of converting it from AC power, increases efficiency.

In some cases, new, active technology is needed to mitigate a hazard or capture waste. Here, too, facilities must proceed carefully, but apprehension over a new approach can be overblown. Methane capture, for instance, involves technology that wastewater utilities are very familiar with and can, in some cases, be added as an extension of odor control.

Going Green and Saving Green

As the green building wave continues to rise, facility owners and operators face a bevy of choices. Planning and siting, building efficient structures, and adding active technology like on-site renewable energy can do wonders for even relatively efficient facilities - and our capabilities in lifecycle analysis, efficiency modeling, Building Information Management, and integrated 3-D design can help you determine the optimum path.

For a project to be successful and truly green, issues of environmental performance and sustainability must be brought into the planning process from the outset and addressed at each stage in the project's development. The upside is that green building techniques and technology can create a powerful "win-win" by helping create high-performance facilities that save money and minimize impacts on the environment.

"Sustainable Stormwater Management"
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Climate change, population growth, and urbanization are making the already challenging task of stormwater management even tougher, but there are sustainable solutions that can reduce flooding, save money and improve water quality – all while ensuring flexibility to respond to future conditions and creating benefits for the environment and residents.

While using natural systems to convey and treat stormwater may not be appropriate in all areas, with the proper planning and design, features such as pocket parks and small green areas can be fully integrated into a traditional stormwater management system, even in densely-populated urban areas.

The South Richmond Bluebelt Project Gains International Recognition

The innovative Bluebelt Stormwater Management Program was presented in Lyon, France, at Novatech 2007, one of the main international conferences on sustainable techniques and strategies in urban water management. The conference had more than 500 participants representing over 30 countries and highlighted integrated strategies for wet weather management and urban planning.

"Innovations in Nutrient Removal"
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Hazen and Sawyer's paper entitled "Review of Primary Sludge Fermentation Performance in South Africa and the USA," discussing different methods of primary sludge fermentation for ENR performance, has been accepted for presentation at the upcoming San Diego WEFTEC conference. We look forward to sharing more detailed results later this year.

"Asset Managment" Continued from Page 5

In Conclusion: Start Small, Think Sustainably

Effective asset management programs provide an on-the-job education for utility staff. To build institutional support, you should ensure that all organizational facets are tied into the process, and update asset life cycle information as available. In some cases, proper asset management may require significant spending on technology and people-power, but the long-term economic, environmental, and performance benefits usually far outweigh this initial investment.

Although Asset Management and environmental sustainability aren't often thought of in the same sentence, they should be. While these concepts can seem daunting, once you sweep away the confusion, the benefits become clear. Proper planning and solid information can help an organization maximize current investments, plan for the future, stabilize costs and improve environmental performance – keeping operators, decision makers and the people, plants, and animals who depend on them, happy.