The Many Forms of Energy Conservation

James Clifton and Russell Kerrigan

There are many ways to conserve energy in water quality systems. This case study describes two that should be considered any time an existing facility is upgraded. They are: install the most energy efficient equipment that will achieve the treatment goals and, when possible, reuse existing structures.

The city of Dunnellon upgraded its Imhoff tank and trickling filter treatment process in 1993. The new 0.25 MGD process uses extended aeration activated sludge with predenitrification. An exceptional decision made during the design process was to reuse the concrete portion of the Imhoff tank for an aerobic digester. The tank was cleaned and the metal clarifier portion was removed. A 20-horsepower floating aerator was installed for mixing and aeration. Four steel cables supported and positioned the aerator.

The embodied energy in the concrete and steel making up the digester tank should not be ignored. By reusing the tank the embodied energy investment is still providing a payback. There are approximately 59 cubic yards of concrete and 10,000 lineal feet of various size rebar in the structure. This works out to a total embodied energy investment of 80,000 kWh.

To gain some perspective, during 1992 the average energy usage at the wastewater treatment plant was 7500 kWh/month. If the embodied energy in the digester could be recaptured, it could run the plant for 11 months. This provides some insight into why it's environmentally beneficial to reuse existing structures, if they can be conveniently modified to meet new needs. A complete accounting of energy savings would also include the energy that would have been required for demolition and disposal.

The Imhoff tank is very deep, 34.25 feet, for its 26-foot diameter. Therefore, the floating aerator needed to be sized to provide adequate mixing. This caused problems when the digester level exceeded 26.8 feet. The solids were thrown and splashed out of the tank. The tank was operated at less than 80 percent of its design volume to prevent splashing. Other concerns with this design were the lack of equipment redundancy, safety when performing maintenance on the aerator in the digester, and the need for a crane if the aerator or motor needed to be removed from the tank.

To maintain aerobic conditions, the surface aerator was operating 16 hours per day with a demand of 16.4 kW. As part of technical assistance being provided at the wastewater treatment facility, staff from the University of Florida/TREEO Center evaluated the use of diffused aeration as an alternative. Funds for the conversion project were made available through the Florida Energy Efficient Water Project (FEEWP), a grant to the Tri-County Community Council from the Florida Energy Office. The turnkey project provided two 20-HP premium efficiency motors and positive displacement blowers with all appurtenances. Twenty course bubble diffusers were installed on a stainless steel header. The total cost of the retrofit project was $39,025. A 30-minute ON/30-minute OFF cycle has been found to be adequate for maintaining aerobic conditions. The economics of the two systems are compared in the accompanying table.

Comparison of annual operating costs

Aeration Type	Demand kW	Daily Operation hours	Annual Operating Cost 0.05$/kWh
Surface	16.4	16	4789
Coarse Bubble	15.3	12	3351
		Annual savings	1438

Saving $1438 a year means that the payback provided from saved kWh will be a long time. However, there are other benefits. A big one is the ability to use the full capacity of the digester.

Before the installation of the course bubble diffusers it was difficult to fill the tank sufficiently to allow supernating. This is especially important since the utility contracts for lime stabilization and hauling to meet the requirements of 40 CFR 503. Hauling costs are based on gallonage with no consideration to the solids concentration, within normal gravity settling limits. Therefore, it is imperative that the digester is operated to provide the thickest sludge possible.

The new equipment has not been operating long enough to evaluate whether thickening capabilities have improved. Even without effective supernating, the digester was generating sludge with a total solids concentration of 1.8 percent.

Energy conservation takes many forms. Waste reduction efforts, almost invariably, conserve energy. When existing structures are demolished, all the energy used to create the

Continues Page 28

Program Management—the Miami-Dade Project

William M. Brant, Armando Rubio, Mark A. Biggers, and Ronald J. Ballard

An innovative approach to managing a major wastewater improvement program.

Program management is not a new technique. However, it has only been applied relatively recently to utility and environmental projects. Over the past ten years, there has been a significant increase in the number of owners who have utilized a "program management" approach to completing their work. The results of a survey conducted by Montgomery Watson of 16 major public works program management projects nationwide, indicated that owners have found program management to be an effective, efficient means for completing their project. They unanimously stated that utilizing a program management approach resulted in: • Savings in Time and Money • Elimination/Reduction of Peak Staffing Needs • Introduction Innovative Management Techniques.

Simply defined, program management is a focused approach led by a dedicated team for long-term inter-related projects to achieve specific objectives by a definite date within budget. It is a management approach that allows significant flexibility in approach to organization structure, function and level of effort by both the owner and consultant. The one main key is that the assigned staff, whether consultants or owner staff, be fully dedicated. This approach has been used successfully on comparatively small projects ($10-20 million) as well as very large projects (greater than $1 billion).

Owners typically consider the "Program Management Approach" when they faced with one or more of the following conditions or needs: • Insufficient in-house resources • Tight schedule and budget • Single point of responsibility • Improve skills of in-house staff • Uniform approach on multiple projects.

Typical services most frequently performed by the program manager are as follows: • Program Controls, Scheduling and Document Control • Planning and Project Definition • Permitting, Easements and Rights-of-Way • Predesign, Design Coordination, Design Review, and Management • Construction Management, including Inspection Services • Operator Training • Public Relations • Technology Transfer.

In many instances, program management services also include: financial management, institutional issues, negotiations/coordination with regulatory agencies, enhanced minority participation, subcontract management (design consultants), and standards development. The actual scope and level of service is largely dependent upon the size and type of project, the needs and capabilities of the owner and the stage at which the Program Manager is involved.

Structurally, there are several ways to organize the program management team depending upon the desired level of control and involvement by the owner. At one extreme, the owner staffs the entire team, such as is detailed in Figure 1. This includes not only typical program management duties, but also design and all other related activities. If the owner has the capability and resources, this organization can be efficient and effective. A second approach is for the owner to serve just as the program manager with consultants providing planning, permitting, design, construction and other related services.

Figure 1

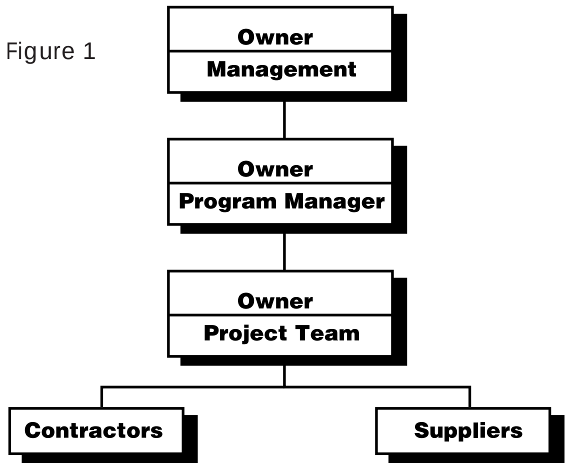


Figure 2

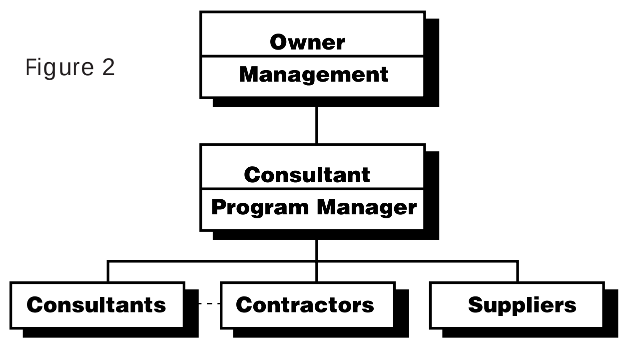
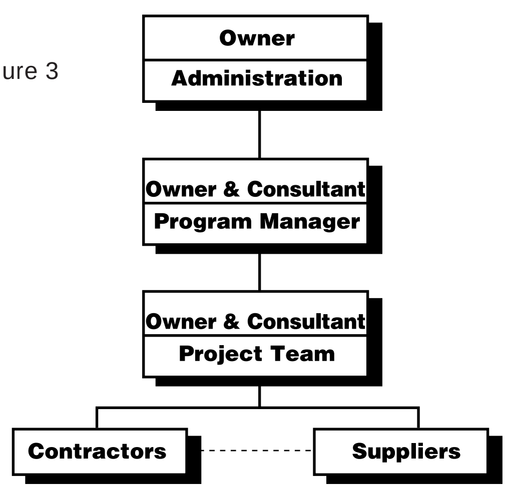


Figure 3



Turbidity barriers averted potential environmental impacts during construction by containing construction-related sediments. The barrier significantly enhanced the owner's efforts to minimize impact on seagrass and aquatic life.

It is more common for owners to either hire an outside program manager to be fully responsible for completion of the work (Figure 2), or to develop an integrated approach that includes significant numbers of the owner's staff working side-by-side with the consultant (Figure 3). Both of these alternatives have been demonstrated to work effectively. In some instances, particularly for very long term projects, an owner may choose to start the project utilizing the organization detailed in Figure 3 and eventually, over time, phase out the consultant and move toward the organization detailed in Figure 1. In doing this, the owner relies heavily on the consultant to help educate and train the owner's staff so the staff can capably take over all of the program management roles and responsibilities.

Case Study

The Miami-Dade Water and Sewer Department, the largest water and wastewater utility in the southeastern United States, provides water and wastewater services for over two million people. The department has an excellent in-house staff of engineers, construction managers, technicians, inspectors, and administrators that has typically allowed it to do design and provide construction management services for all of its required improvements.

As a result of significant sewer system overflows in the late 1980s and early 1990s, enforcement action was initiated DEP and EPA to require the department to take corrective action. This corrective action includes comprehensive sewer system rehabilitation, major force main and pump station improvements, and upgrading and expansion of the department's three wastewater treatment plants and effluent disposal facilities. The estimated cost of these improvements is over $1.0 billion (see Table 1). Essentially, all of these improvements must be completed within seven years.

Since the volume of work required was significantly greater than the department could handle in-house and since the time frames were extremely tight, the department decided to hire a program manager to help it monitor and direct the work. In April 1994 Montgomery Watson's team (which included major subcontractors Post, Buckley, Schuh & Jernigan; Bermello, Ajamil and Partners; Williams-Russell and Johnson; and The Gothard Group) was authorized to serve as the department's program manager for the over $1.0 billion worth of work covered under the various enforcement actions.

Additionally, the Montgomery Watson team was retained to provide construction management services for a $178 million pump station improvement program.

The organization structure of the program management team is essentially as detailed in Figure 2, although there is significant involvement by the department's staff at the program management, design and construction management level. Additional consultants have been brought on board to provide specific assistance on particular components of the program.

To date, Miami-Dade has completed or has underway over $400 million worth of improvements. It has successfully met or beat the scheduled delivery date for all work activities and. as a result, has not had to pay any penalties associated with missed deadlines.

One of the key components of the enforcement action, installation of a new $60 million 84- to 102-inch force main crossing Biscayne Bay was completed almost one year ahead of schedule and over 20 percent below budget.

Through the efforts of the department's staff, the program manager and the numerous other consultants involved in this challenging project, the department's goal of finishing all projects ahead of schedule and below budget is being realized.

William M. Brant, P.E., and Armando Rubio, P.E., are with Miami-Dade Water and Sewer Department. Brant is deputy director and Rubio is a program manager.

Mark A. Biggers, P.E., and Ronald J. Ballard, P.E., are with Montgomery Watson. Biggers is a program director and Ballard is a program manager.

TABLE 1. SUMMARY OF ENFORCEMENT ACTIONS

Agency	Enforcement Action	Approximate Compliance Dates	Description of Activities
DEP	Settlement Agreement Bay Crossing	Feb 1993 to Dec 1996	• Construct New Cross Bay Line. • Develop contingency plan for failure of Existing Cross Bay Line (ECBL). • Construct O_2 injection system. • Final disposition of ECBL.
DEP	Settlement Agreement Systemwide	Jul 1993 to Dec 2000	• Odor control improvements at CDWWTP. • Expand and upgrade WWTP. • Construct major new FM/PS. • Comprehensive I/E/I and SSES. • PS inspection/evaluation program. • Evaluate transmission system capacity. • Enact I/I Ordinance.
EPA	First Partial Consent Decree	Sep 1993 to Dec 1998	• Construct New Cross Bay Line. • Final disposition of ECBL. • Develop various contingency plans. • Construct 4th St. to 9th St. force main. • Construct sulfide/corrosion control system. • Upgrade over 400 pump stations and construct 60 miles of force mains to improve transmission capacity. • Enact Grease Trap Ordinance.
EPA	Second and Final Partial Consent Decree	Apr 1995 to Dec 2002	• Comprehensive I/I and sewer rehabilitation. • Elimination of illegal stormwater connections. • Pump station inspection/repair. • Pump station remote monitoring (SCADA). • Collection system oper. plans. • Collection/transmission system model. • Peak flow management study. • Maintenance/Spare parts program. • Treatment Plant optimization program. • Volume Sewer Ordinance. • SEPs (water reuse and conservation).

Energy from Page 25

structure is lost, in addition to the energy required for demolition and disposal of the waste. When possible, any water quality upgrade should incorporate existing tankage and buildings.

There are many considerations that must be taken into account when designing new facilities, but two are of paramount inportance. The first should be to ensure that each unit process will achieve its treatment goals in the most operationally friendly way possible. If operating staff personnel have difficulty getting processes to achieve "paper" goals, performance will suffer. Any treatment plant design needs to be thoroughly evaluated by seasoned operating staff before construction.

The second consideration is to use the most energy conservative equipment and materials available. Although the difference in cost is difficult to justify, improved service for the life of the equipment usually provides a payback. An example is the use of stainless steel rather than carbon steel pipe for the diffuser header. Anyone who has worked with a carbon steel header after five or ten years can tell you which is more economical. In our activities with the FEEWP it is amazing how frequently the energy conservative equipment and operating strategies are also the most operationally friendly.

James Clifton, CET, is assistant director for technical training at the UF/TREEO Center. Russell Kerrigan is chief operator of the Dunnellon, Florida, wastewater treatment facility.