Sustainable Design Saves Costs While Benefiting the Environment

The water and wastewater industry indirectly supports sustainability through activities that protect public health and restore the environment. Resource scarcity, increasing construction material costs, and evolving regulations are the challenges that are driving our industry to adopt sustainable design practices. Carollo’s sustainable design services help our clients realize a number of benefits including:

- Cost savings over the life of a facility by improving efficiencies in energy and other resource usage.
- Higher treatment quality and reliability by optimizing unit processes.
- Improved public perception and regulator relations.
- Reduced environmental impacts.

**Energy Efficiency**

Wastewater treatment plants (WWTPs) nationwide are responsible for approximately 1.5 percent of all energy used in this country (PG&E, 2006). Approximately 25 to 35 percent of the operations and maintenance budget for a typical WWTP goes to energy consumption costs. Therefore, energy use within this industry is not only a major cost concern, but also a reason to consider sustainable design practices. Energy use falls within three main areas at a typical treatment plant: aeration systems, pumping systems, and solids handling. Some sustainable design considerations include the following:

**Aeration Systems:**
- Consider the use of fine bubble diffusers to increase oxygen transfer efficiency.
- Consider single-stage blowers over multi-stage. Single-stage blowers are more efficient with higher turndown capabilities.
- Provide dissolved oxygen (DO) control in the aeration basins.

**Pumping Systems:**
- Consider using high-efficiency pumps and motors.
- Design the pump station to accommodate flow fluctuations. Variable frequency drives (VFDs) can help with this.

**Solids Handling:**
- Consider anaerobic digestion. Stabilizing solids in the absence of oxygen is a huge energy-use-reduction step.
- Use cogeneration to convert digester biogas to electric energy.
- Consider thickening sludge prior to digestion. This equates to less water in the digester, which allows for a higher solids concentration. This allows for more digestion to occur, resulting in more biogas and more energy potential.

**Water Efficiency and Conservation**

Water conservation is becoming an important planning objective for many communities because the available potable water supply does not adequately meet the needs of the community. Some sustainable design considerations include the following:

**Water Conservation in the Service Area:**
- **Water recycling.** Consider a recycled water program using treated wastewater to irrigate public parks, golf courses, or agricultural land.
- **Public outreach.** Consider promoting the use of water conservation and low-flow plumbing fixtures through the internet or via promotional materials.

**Water Conservation On-Site:**
- **Dual-plumbing.** Consider the use of treated wastewater for non-potable applications on-site, including: pump seal water, spray wash systems, chemical dilution, hose bibs, and toilets.
- **High-efficiency fixtures.** Provide high-efficiency plumbing fixtures in occupied buildings.

The addition of fats, oil, and grease to a digester can greatly increase biogas production.
Material Conservation and Resource Efficiency

Construction and demolition (C&D) materials consist of the debris generated during the construction, demolition, or renovation of structures. Reducing and/or reusing C&D materials conserves landfill space, reduces the environmental impact of producing new construction materials, and can reduce overall project construction costs through avoided material purchase costs. Some sustainable design considerations include the following:

- Consider specifying that construction waste be recycled, as there are many markets that exist for these materials.
- Consider specifying the use of local construction materials.
- Consider specifying use of materials with recycled content.

Incorporating Sustainable Design into Carollo Projects

Highlighted below are two of our key projects that integrated sustainability concepts as a core objective.

City of Petaluma, California, Ellis Creek Water Recycling Facility. The City of Petaluma, California, embarked on a project to replace its 1930's vintage wastewater treatment plant with a new water recycling facility. One of the primary goals of the project was to design and build an ecologically and economically sustainable facility that is widely regarded as a public amenity.

The challenge for the design team was to take sustainability principles and concepts and apply them to a wastewater treatment plant planning and design project. Several planning tools were used and several sustainable strategies were identified and incorporated into final design:

- Constructed wetlands for algae removal in place of the energy- and chemical-intensive Dissolved Air Flotation Thickening process.

City of Carnation, Washington, Carnation Treatment Plant. Lack of centralized sewage collection and treatment had limited growth and forestalled development within the City of Carnation, Washington. To enable Carnation to grow according to their Comprehensive Plan, the City partnered with King County Department of Natural Resources and Parks to provide local wastewater treatment. The City of Carnation is located in the Snoqualmie Valley, a pristine rural area on the eastern edge of King County.

Sustainability was an issue from the start of the project. With the new treatment plant located in such an environmentally sensitive area, it was important to design the plant’s Operations Building in a way that strived to minimize the building’s impact on the environment. One step in this process was to utilize the design and construction standards set forth under the Leadership in Energy and Environmental Design (LEED™) system. Numerous LEED™ methods were utilized to achieve this goal, including:

- Optimizing cement mix design (including fly ash) to reduce greenhouse gas emissions impact of cement production.
- Passive solar heating, ventilation, and day lighting techniques to reduce the energy load of the occupied buildings.
- Optimizing mechanical systems design to reduce energy loads.

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- Reduction of building energy consumption;
- Using building materials with low or no volatile organic compounds;
- Using a roofing system with high emissivity coatings;
- Recycling construction waste;
- Providing high windows for daylighting, and;
- Using high-efficiency water fixtures, and irrigation system heads.

Carollo Engineers integrated sustainable design into Petaluma’s Ellis Creek Water Recycling Facility including: recycled materials and natural treatment systems.