JOHN TODD ECOLOGICAL DESIGN, INC.

CASE STUDIES

Industrial Waste Treatment Restorer: Berlin, MD

Before consulting with the Ocean Arks International and John Todd Ecological Design team in 2001, the Maryland Environmental Protection Agency levied several fines against Tyson's poultry processing facility in Berlin, Maryland.

Effluent from the Tyson lagoon was frequently out of compliance with MD-EPA standards and was unfit to discharge into Chincoteague Bay, a local fishing and shell-fishing site.

With the help of John Todd's Lagoon Restorers, Tyson Foods Inc. turned their sludge filled lagoon into a thriving ecosystem and compliant wastewater treatment site. Lagoon Restorers were installed to work in collaboration with existing traditional treatment elements. The result was a 95% reduction of contaminants, 70% reduction in energy use, 20% reduction in sludge production, and a discharge that complied with Maryland's open water effluent parameters.

Restorers are floating structures that support an ecologically engineered aquatic ecosystem.

In this case, 25,000 native plants were chosen to create a balanced and complex aquatic ecosystem to provide habitat for a variety **o**f microbial communities, all of which perform a unique function in the waste treatment process. Flotation, aeration and water circulation are used to accelerate the ecosystem's natural ability to clean water.

Operation and maintenance of the Restorers is simple and low in cost. Their ecological diversity results in a highly resilient system—one that is able to handle sudden overloads better than traditional systems. More recently, several local plants and turtles have migrated to the lagoon, creating a unique self-organizing ecosystem.

Urban Municipal Canal Restorer: Fuzhou, China

Fuzhou, a city of 6 million people, empties their commercial wastewater and sewage into 80 kilometers of canals that run throughout the city before emptying into a large river. The polluted canals are a health risk for the city's inhabitants and threaten the livelihood of fishing communities downstream.

A 600-meter canal named Baima, considered one of the worst in the city, had extreme problems with odor and floating solids created by the influx of 750,000 gallons per day of untreated domestic sewage. Rather than re-piping the polluted water to a remote wastewater treatment facility, the city government sought an affordable and low-maintenance treatment system within the canal itself.

In 2002, John Todd Ecological Design collaborated with Ocean Arks International and Natural Systems, Inc. to design a restorer for their Chinese partners on the Baima canal using 12,000 plants composed of 20 native species. Built with a walkway down the center, the restorer has met water quality goals and created a desired recreational destination for the city's residents.

Solutions for Water Planning and Treatment

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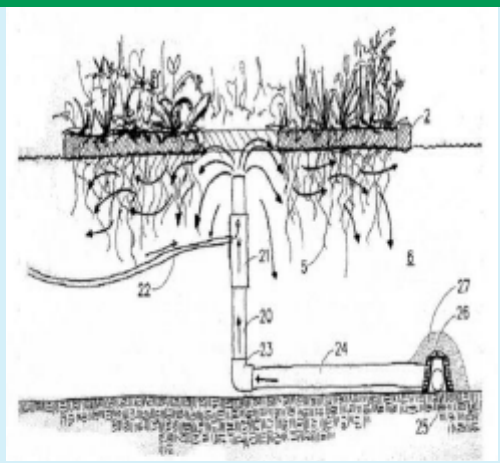
Rural Resort Lake Restorer: Kona, Hawaii

In 2003 John Todd Ecological Design Inc., Ocean Arks International and Hawaii's Natural Systems, Inc. were asked to collaborate on the restoration of a lake at the Four Seasons Resort at Hualalai on Kona. On Earth Day 2005, the Lake Restorer built at the Resort earned an award from the Environmental Protection Agency. The Restorer has turned a 3.5 million-gallon pond, adjacent to a golf course, into a thriving ecosystem that provides the Resort's restaurant with fish and shrimp, all at a very low cost.

The director of natural resources at Four Seasons estimates that a similar fishpond running on a conventional system would have cost $10,000 a month in power expenses. In contrast, the energy usage for the Restorer costs $400 per month. Since water conservation is especially valuable for this section of the island of Kona, where fresh water is limited, the conventional system of flushing the pond with fresh water was a non-optimal alternative.



Rather, the JTED system works by pumping pond water through a bottom layer of gravel up to the roots of two floating plant islands. The islands are equipped with 25 native plant species whose roots systems are home to aerobic bacteria that digest nitrates and out-compete algae for available nutrients. This keeps the pond clear and ecologically stable.

The Earth Day 2005 EPA Award was given for innovation, addressing environmental problems over the long term, and the ability to be replicated in other places. According to an April 22, 2005 edition of *West Hawaii Today* newspaper, Honolulu officials hope to install similar restorer technology in Ala Wai Canal, a heavily polluted urban waterway that borders Waikiki.

INNOVATION IN ACTION

Urban Wastewater Machine: South Burlington, Vermont

The South Burlington Eco-Machine was built in 1996 by Living Technologies, Inc., Dr. John Todd and Ocean Arks International undertook scientific oversight during its pilot phase.

Built with a grant from the US Environmental Protection Agency, the South Burlington Eco Machine has demonstrated high performance even in very cold temperatures. On a daily basis, the sewage typically generated by 1,600 residents, 80,000 gallons, was diverted from the City's conventional waste treatment plant to the Living Machine. The site served as an educational center for local schools and resembled a local garden center more than a waste treatment facility.

Inside the greenhouse, this cost competitive system used several stages to achieve stable nutrient removal. First, sewage flowed through aerobic reactors made of aerators and a variety of plants. In this environment lived a host of organisms that ate the waste out of the water. A clarifier then worked to settle out the solids. Afterward, Ecological Fluidized Beds™ (developed by Ocean Arks International) provided the final polishing of nitrification and suspended solid digestion.

The South Burlington facility is now temporarily closed.

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Vertical Flow Reed Bed: M&M/Mars Factory, Waco, Texas

"The reed bed provides dewatering and stabilizing of solids on site, with very low capital investment. Safe, on-site disposal gives us more control, reduces our legal exposure, plus we end up with a really nice soil amendment."

–Norm Burgess, M&M/Mars Facility Engineer

The M&M/Mars candy factory in Waco, Texas was faced with high sludge disposal fees and the risks associated with off-site disposal. M&M/Mars installed a Vertical Flow Reed Bed, designed by Living Technologies, Inc. of Burlington, Vermont, founded by Dr. John Todd, to dewater and compost the wastewater biosolids from an activated sludge process.

Vertical Flow Reed Beds are similar to vertical flow sand filters except they are planted with the common reed (*Phragmites communis*). Unlike sand drying beds, sludge is only removed once every 7 to 10 years. During this time the sludge is reduced by up to 98%, pathogens are killed and organics are broken down and mineralized. The result is stabilized compost suitable for storing in windrows for future applications.

The 4,000 ft² reed bed installed at M&M/Mars treats approximately 18,500 gallons of biosolids per month. The reed bed cost of $50,000 eliminated $31,500 annual disposal fees, and established a safe, effective, and odor free sludge reduction method on-site.

Mixed Use Community Development Eco-Machine: Sutton, England

This award-winning sustainable suburban development, known as The Beddington Zero Energy Development, or **BedZed**, was constructed in 2004 and uses John Todd's Eco-Machine Design for wastewater treatment. The Peabody Trust project converted a former sewage works brown field into a mixed-use community of properties, gardens, and childcare facility. BedZed's wastewater is treated on-site by a small scale greenhouse system that prepares water for re-use. Bedzed is the first of its size to be a "*carbon neutral* community".

High Altitude Constructed Wetland: Ouray, Colorado, USA

The system, installed in 1999, functions at an altitude of 7489 feet and endures winter temperatures of minus 40 degrees Fahrenheit. The wetland cells treat 36,000 gallons per day and reduce fecal coliform counts to permitted levels, making chlorine and other disinfection processes unnecessary.

The concept of using constructed wetlands for the treatment of wastewaters evolved over years of observing high water quality inherent in natural wetlands despite contaminated influent. By harnessing and encouraging the complex ecologies present in these natural systems, constructed wetlands reliably treat Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), and Suspended Solids (SS). Properly designed, constructed wetlands can also reduce metals, fecal coliforms and nutrients, such as nitrogen and phosphorus.

Constructed wetland technology is offered either as a complete system with pretreatment and disinfection as part of a zero-discharge system or as a producer of high quality effluent for re-use. In Ouray, treatment is provided by a partially mixed, two cell aerated, lagoon that is followed by sub-surface flow wetland cells.

There are now several Constructed Wetlands throughout the United States. Various sites are designed to treat municipal wastewater and sewage, agricultural runoff, landfill leachates, airport runoff, livestock and poultry wastes, urban storm water runoff and combined sewer overflows. JTED uses the principles of this system in its Bio Pool design and construction.

Fact Sheet for JTED Case Studies

Baima China: Estimated flow is 750,000 gallons per day

Design Treatment Standards and Preliminary Results for Restorer

	Influent	Effluent Design	Preliminary Results (Effluent Month 1)	Reduction
COD (mg/l)	480	<50	40	92%
BOD (mg/l)	240	<30	19	92%
NH3 (mg/l)	40	<15	No Data	N/A
TSS (mg/l)	-	-	20	-

Ouray, CO: Estimated flow 363,00 gallons per day

Design Treatment Standards and Results

	Influent	Effluent	Reduction
BOD (mg/l)	250	30	92%
TSS (mg/l)	250	30	92%

Tyson, MD: Estimated flow 1 million gallons per day

Design Treatment Standards and Preliminary Results for Restorer

	Influent	Effluent	Target Effluent	Reduction
COD	490	22	-	95%
BOD (summer)*	418	16	7.5	96%
BOD (winter)*	275	21	23.0	92%
BOD (actual)**	267	12	-	95%
Nitrate	1.3	9.8	10.0	35% (of total N)***
TSS	80	4.3	26.5	95%

*Based on estimated BOD-COD ratio at influent and effluent
** BOD actual represents mean data analyzed by BOD, N=13 over 4 months
***Percent nitrification of total nitrogen load to the system (including ammonia)

BOD =Biological Oxygen Demand
COD = Chemical Oxygen Demand
TSS = Total Suspended Solids

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