CONSTRUCTED WETLANDS

The Sustainable Alternative to Conventional Wastewater Treatment

AMERICAN SOCIETY OF LANDSCAPE ARCHITECTS
Annual Meeting, Washington, DC   September 10, 2010

Learning Objectives

- Learn how constructed wetlands work and how they compete against conventional water treatment systems.
- Learn about the full rural-to-urban transect of closed-loop biological and biomimicry water treatment solutions.
- Learn about wetland-based water treatment utilities that are searching for landscape and planning projects in which to provide service.

It has become apparent in recent years that a key aspect of sustainable design practice is the handling of water—not just stormwater, but wastewater, which conventional practice treats with extreme profligacy. Potable water—a limited resource—is wasted on non-potable uses like cooling, toilets, and irrigation. Meanwhile, liquid waste, rich with nutrients and potential energy sources, is purged of those elements (typically discarded) through conventional processes that are energy and chemical intensive, expensive and polluting. For every pound of carbon removed from wastewater, four pounds are introduced to the atmosphere. There is a solution to this crisis, and it lies in the landscape.
Constructed wetland technology is a well established, fully tested, broadly used, but still relatively unknown alternative to the conventional water treatment regime. Its primary characteristics include decentralization, small scale, closed loops, and a holistic approach that integrates potable, stormwater, and wastewater needs into a single self-reinforcing system. The typical naturally-based water treatment facility costs 50% as much to build and operate as conventional systems, while reducing water demand by 50% as well. These savings accrue directly to the communities, institutions, and companies that wish to apply the sustainability objective beyond individual buildings and landscapes, to their entire water equation.

While constructed wetlands in more suburban locations are the best known examples of closed-loop, decentralized systems, there actually exists a full range of naturally-based technologies that can be applied across the entire rural-to-urban transect. Some of these, such as biomimicry and roof-garden treatment, can occur in the most intensely urban locations. Because they are decentralized by nature, wetland-based water treatment systems have until recently lacked a national-scale utility company focused on their promulgation. With the founding of Natural Systems Utilities, that equation has changed. Panelist Dominic Kulik will describe the mission of his new firm, and how they are working to change the water treatment paradigm one wetland at a time.

What is our Technology? ....

Let’s start with what it is not: Conventional
Require strict alignments
Require complicated pumping systems
Generate odors and corrosive gases
Require costly repairs/replacements

CONVENTIONAL SEWER COLLECTION SYSTEMS

Infrastructure intensive: 70% of systems cost is in collection. Also prone to pharmaceutical contamination.

Mechanically intensive.

Operations and Maintenance intensive.
Chemically intensive.
Carbon intensive: Every ton of carbon removed from water results in 4 tons of carbon being pumped into the atmosphere.

Systems aging, prone to leakage, and in need of replacement.

A leading contaminant of our waterways, especially due to combined sewage overflows during storm events.

Nation's Water Systems in Dire Shape
Aging Pipelines In Need of Cost Utilities Billions, EPA

City's aging sewer lines expensive to replace:

Pharmaceuticals found in US drinking water
What is our Technology? ....

Inspired and informed by nature...

Plants and bacteria work for free... people and machines don’t.

Core Principals of Natural Systems Technology

• Natural Systems and Biomimicry
• Local and onsite
• Align Form and Source with Function
  • Separate water and solids
  • Potable and non-potable
• Close Loop
• Reuse, Integrate and Regenerate

Why Natural Systems?

• Mechanically simple, yet biologically complex
• Operate mainly on ambient solar energy
• Ultra water and energy efficient
• Highly capital and operating cost effective
• Can be built and operated locally with local materials
Natural vs. Mechanical Systems

- **Energy and O&M Needs**
  - **Natural Systems**: LEAST
  - **Engineered Wetlands**: MOST
  - **Mechanical Treatment Systems**: MOST

- **Area Requirements**
  - **Natural Systems**: MOST
  - **Engineered Wetlands**: LEAST

- **Effluent Strength**
  - **Lowest**: Natural Systems
  - **Highest**: Mechanical Treatment Systems

Low Density Solution:
- **Primary Treatment**
- **Secondary Treatment**
Technology & Market Diversification

- NatSys
- Engineered NatSys
- Biomimic/Adv Process NatSys

- Rural
- Sub-urban
- Urban

- Residential
- Municipal/NGO
- Industrial

- Local
- National
- Global

HIGH DENSITY SOLUTION.

Distributed Water Reuse System Schematic:

1. Wastewater collected for treatment
2. Stormwater collected for treatment where appropriate
3. Biological treatment
4. Final polishing and disinfection
5. Storage for nonpotable reuse

Project Examples

Examples of integrated, sustainable water management and distributed utility infrastructure
Market Segments

- Mixed Use Community
- Rural to Urban
- Industrial
- Municipal
- Institutional

Remote Area Infrastructure

- Wastewater Treatment
- Effluent Lift Station

Private Development

- Wastewater System Locations

Hamlets

- Recirculating Gravel Filter serving a City of 195 people.
-Constructed Wetland serving a City of 60 people.
**Urban: The Solaire**
- 293 Residential Units, Opened in 2003
- 25,000 GPD WW treatment plant
- LEED™ Gold Certification
- 48% reduction in water use
- 56% reduction in wastewater discharge

30 systems predate The Solaire beginning in 1987 –up to 95% reuse in commercial applications

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**Industrial Applications**
- Oil and Gas Refineries
- Mining
- Processing
- Landfill Leachate
- Transportation/Airport
- Contaminated Groundwater
- Farm waste

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**Industrial & Residential: Treatment & Reuse**

BP Remediation in Casper, WY

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**Mining**
- Phosphate
- Gold
Landfill

Kedlec & Wallace, 2008

Airport Deicing Effluent

Buffalo Niagara International Airport

Process Water Recycling

Min Aqua Fisheries, Renville, Minnesota

Agri-Food Production

Cheese Factory
Case Studies: Mixed-Use (Urban/Dense)

200+ Installations Worldwide
- The Solaire Apartments (NY)
- Earth Rangers Wildlife Centre (ON)
- Falling Water Conservancy (PA)
- Pittsburgh Convention Center (PA)
- Vancouver Convention Centre (BC)
- Skyland Baseball Park (NJ)
- Coral Reef Club (Barbados)
- Gillette Stadium, Foxboro (MA)
- Westbrook Outlet Mall (CT)
- Viejas Casino (CA)
- Oakwood Village Apartments (NJ)
- Salisbury School (CT)
- Thunder Valley Casino (CA)
- Heritage Pointe (AB)
- Westin Hotel (Virgin Islands)
- Fern Resort (ON)
- Hidden Meadows (NJ)

Case Studies: Municipal

City of Mandeville
New Orleans, LA
- Natural system treatment attached to conventional municipal sewer system.
- NSI designed and permitted 4 MGPD, operating at 2.0 MGPD.
- 6x less costly than a competing activated sludge system proposal.
- Surface flow design that teems with wildlife, including new species of migratory birds.
- Treated effluent is restoring an adjacent cypress forest.

Case Studies: Residential

Barrio de Tubac
Tucson, AZ
- NSI designed and permitted system to 100,000 GPD.
- Existing operation since 1987 servicing 1000-1200 people.
- 427 EDUs operating and 480 additional permitted.
- Reclaiming water for irrigation of development, leading to better use of precious local potable water and cost savings.

Case Studies: Industrial

Ethel M. Chocolate Factory
Henderson, NV
- City of Henderson was penalizing factory with additional utility surcharge for high BOD/COD levels.
- System has become an interesting site amenity for visitors to the factory.
- NSI designed wetlands for nitrate removal and reed beds for sludge dewatering.
- Now reclaiming water for irrigation of cactus gardens, resulting in lower fines.
NSI designed the wastewater and storm water treatment systems.

- Constructed wetland, recirculating sand filter and trickling filter onsite.
- Rainwater collection, rain gardens with biofiltration, and habitat pools for classroom study.
- LEED Platinum certified and winner of the “AIA top ten 2007.”

**Case Studies: Commercial/Civic**

Sidwell Friends School
Washington, DC

What Is The Goal

- **Improved Public Health Protection**
  - Greater Isolation and Potential for Treatment of Potable Water
- **Less Net Water Abstraction From Environment**
- **Significantly Reduced Environmental Discharges**
  - Volume (Stormwater, Wastewater & CSO)
  - Constituents (Organics, Nutrients, Compounds of Concern)
- **Reduced Resource Consumption (Energy, Chemicals)**
- **Easier System Upgrade and Expansion**
- **Increased System Resiliency**
- **Enhanced Urban Environment**

**Benefits of Decentralized Systems**

- “Just-In-Time, Just-The-Right-Size” service delivered without excess capital - built to exact customer needs and specifications
- **Maximum efficiency** in energy and resources
- Avoid undesirable secondary impacts, yet allow modern planned development concepts
- Conducive to “Smart Growth” and “Low Impact Development” concepts that incorporate stormwater reuse, groundwater recharge and integrated water resource management with CHP, cooling, solid waste
- Provide higher quality effluent that has nutrients removed – simply because it has to be acceptable for reuse
- **Eliminate infiltration and inflow** conditions that are readily addressed in small systems
- **Lower security risk** due to smaller size and greater dispersion

**QUESTIONS?:**

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