CASE STUDY

DISTRICT WASTEWATER MANAGEMENT

District wastewater management systems provide collection, treatment and dispersal or reuse of wastewater from individual buildings or clusters of buildings near the location where the waste is generated. These systems may treat sewage onsite through natural and/or mechanical processes, or may utilize more distributed management systems to collect and treat waste at a neighborhood, district or small community scale. Examples of decentralized approaches range from passive systems such as composting toilets, gravity fed grey water wetland treatment systems and living machines to more energy-intensive recalculating bio filters and membrane bioreactors.

Studies indicate that more distributed methods of collection that rely mostly on gravity-fed pipes, will have fewer negative environmental impacts than systems that expend large amounts of energy for conveyance. Current practices for managing wastewater nationwide involve conveying waste to large-scale, centralized treatment systems, some of which need expansion or are outdated, often resulting in the introduction of polluted water into the region's waterways. On-site or neighborhood scale systems present an interesting alternative to capturing and treating waste from the built environment.

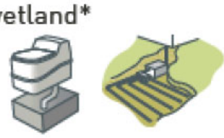
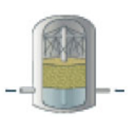
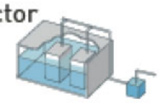
BENEFITS

ENVIRONMENT

- Less energy intensive than conventional, centralized systems
- Fewer environmentally harmful chemicals used to disinfect effluent from wastewater stream
- Less toxic sludge as a byproduct
- Less greenhouse gas emissions from construction and operation of centralized systems
- Uses non-potable instead of potable water whenever possible

EQUITY AND COMMUNITY

- Development and installation of appropriately scaled systems that can meet fluctuating community needs while still providing the expected convenience of tidy, odorless waste elimination
- Allows for dual use of land

	FOOTPRINT	OPERATING ENERGY	TECHNOLOGY
Composting toilets + Constructed wetland* 	Small – Large**	Zero – Low	Non-water discharging containment system Nutrient recovery Attached growth aerobic treatment
Constructed wetland 	Small – Large	Zero – Low	Attached growth aerobic treatment
Recirculating biofilter 	Medium	Low – Medium	Attached growth aerobic treatment
Membrane bioreactor 	Small – Medium	High	Suspended growth aerobic treatment with synthetic membrane ultra-filtration

* Constructed wetland for treatment of greywater from sinks, baths/showers and laundry.
** Wetland and soil dispersal area for greywater can have large space requirements depending on generated flow.

TABLE 1: Various distributed technologies used to treat water and wastes (Source: Cascadia Green Building Council) issues. On-site systems are perceived to be a step backward in time and technology to a less-developed age. Education and awareness among regulators, designers, engineers, and building occupants is necessary to fully highlight the environmental risks associated with wasteful practices.

ECONOMIC

- Less capital intensive than conventional, centralized wastewater treatment systems (reduced need for long-distance piping, pump stations, and associated infrastructure)
- Reduces capital costs for utilities of developing connection systems
- Reduces long-term operating costs for utilities of water use and discharge

BARRIERS TO IMPLEMENTATION

INSTITUTIONAL

In areas where development codes and public health regulations require connections to public utilities, small-scale decentralized systems frequently lack a clearly defined regulatory pathway for approvals and instead rely on developers with the will or financial means to navigate the regulatory system.

FINANCIAL

A project owner's upfront investments in on-site treatment systems may pose a financial barrier. These barriers may be directly related to the regulatory barriers. For example, backup or redundant connections to municipal wastewater utilities may be required by codes even when a system is designed and operated not to use them. Some municipalities have instituted innovative fee structures, such as in Portland, Oregon, whose Bureau of Environmental Services allows for emergency-only connections to its wastewater treatment facilities but charges large usage fees in the event the connection is needed.

CULTURAL

Public fears about the safety of on-site wastewater management present significant obstacles. Such fears are rooted in historical management of water and waste and the associated public-health District Wastewater Management

CASE STUDY: OREGON HEALTH & SCIENCE UNIVERSITY

Completed in October 2006, the Center for Health & Healing at the Oregon Health & Science University (OHSU) is a 396,000-squarefoot development. The building employs various green strategies, including an on-site wastewater treatment plant membrane bioreactor (MBR), which recycles 100 percent of wastewater resulting in a 60 percent reduction in the use of potable water.

STRATEGIC PARTNERS

RIMCO LLC is owned jointly by OHSU Medical Group and OHSU to develop, own and operate real property. Gerding Edlen Development developed the project.

FINANCING

The project's total construction cost was $145 million, with the mechanical, electrical and plumbing (MEP) systems costing $27 million (almost 10 percent less than the $30 million for conventional designs). The projected savings per year for water and utility use is 5.5 million gallons and $40,000. Greening costs came to $1.8 million, but tax credits and incentives for green initiatives decreased the development costs by $1.2 million. The project earned LEED Platinum certification, which earned it another $600,000 in tax credits.

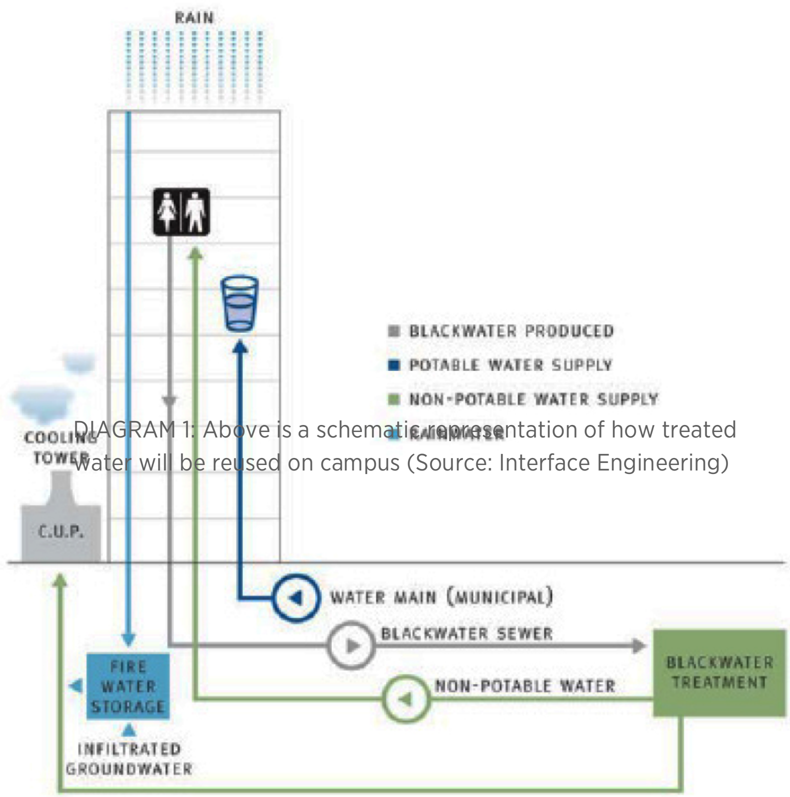


DIAGRAM 1: Above is a schematic representation of how treated water will be reused on campus (Source: Interface Engineering)

IMPLEMENTATION

The on-site sewage treatment plant recycles all the building's wastewater, including medical waste, sewage, and storm water, to a tertiary level. The treated water is reused for irrigating the green roofs, campus green, and landscaped areas; for flushing toilets and urinals; as cooling tower water and for landscape water features. Biological sludge generated in the treatment process is pumped to the city sewer system, contributing only a fraction of the sewage load that would otherwise have been discharged.

The membrane bioreactor was designed to be modular so that it can be expanded as the campus grows. A new discharge point to the Willamette River was required and permitted. Care is taken to make sure that the temperature of the discharged water does not adversely affect the river temperature. The plant is located in the below-grade parking levels and is essentially a scaled-down version of a typical municipal plant, processing 4,000 gallons per day. It employs waste-consuming bacteria in a bioreactor system, and produces water that is just less than potable. The plumbing system also collects all the rainwater falling on the site, as well as groundwater pumped from the underground parking garage, and adds them to the same supply.

LESSONS LEARNED

- Wastewater regulations established to protect risk to public health need to be assessed and updated to fully account for current environmental, social, and economic risks related to centralized wastewater treatment systems, creating new standards in support of more integrated waste treatment systems at the site and neighborhood scales.
- Removing regulatory barriers can help spur market innovations and new products available to designers and homeowners pursuing decentralized and distributed systems, thus bringing down upfront costs. Financial incentives for on-site renewable energy generation have been accelerating

market adoption, serving as examples for similar approaches for decentralized and on-site wastewater systems.

- Addressing cultural barriers around decentralized water systems requires a shift in the way we view human waste. Education will likely be the key tool to overcome the uncomfortable feeling of using decentralized systems such as composting toilets.
- As the environmental and economic costs of maintaining and operating centralized wastewater systems continue to grow, installation of appropriately scaled systems that can meet fluctuating community needs while still providing the expected convenience of tidy, odorless waste elimination is the solution for the future.
- While many wastewater treatment systems, such as living machines and bioreactors, are currently installed to serve one building, there is an opportunity for economies of scale to size these systems to serve multiple buildings and even an entire district.

OTHER EXAMPLES

- SAN FRANCISCO, CA Public Utilities Commission project
- RHINEBECK, NY Omega Center for Sustainable Living
- KANSAS CITY, MO Anita B. Gorman Conservation Discovery Center

REFERENCES

- Clean Water, Health Sound: A Life Cycle Analysis of Alternative Wastewater Treatment Strategies in the Puget Sound Area. http://living-future.org/sites/default/files/reports/clean%20water-%20healthy%20sound.pdf
- Oregon Health & Science University case study: http://www.ohsu.edu/xd/about/services/cpdre/planning/upload/Section-4.pdf
- NDRC Building Green OHSU: http://www.nrdc.org/buildinggreen/casestudies/ohsu.pdf