Sustainable Technology Park at California Polytechnic State University San Luis Obispo

Handbook of Guidelines : Ecology meets Technology

Sam Vigil
Professor of Environmental Engineering,
Civil and Environmental Engineering Department
Cal Poly - SLO

Water Conservation and Wastewater Treatment

Water Conservation

Water conservation inside the building envelope is an important component of Green Design. This discussion will focus on potable and sanitary use by building occupants.

Typical water usage values are given in Table 1 below. These values can be reduced by the use of water conserving fixtures such as low flush toilets, dual flush toilets, waterless urinals, low water usage sinks and showers. Water conservation is essential if on-site wastewater treatment is used as discussed later in this report.

Table 1
Wastewater Generation Estimated by Water Usage For Various Activities

Water usage	Conventional gal/cap-day	Conservative gal/cap-day
Toilet flushing	17.5	8
Bathing/ showering	20	10
Bathroom sink	10	5
Dish washing - Manual	20	10
Dish washing - Machine	10	5
Clothes washing	15	7
TOTAL	**92.5**	**45**

After Leverenz, H., and G. Tchobanoglous, 2004.

The City of San Luis Obispo has adopted a water conservation law, The Retrofit Upon Sale Ordinance # 1224, which requires upgrading of residential and commercial building upon sale to the following standards:

Table 2
City of San Luis Obispo Water Conservation Standards

Fixture	Maximum water usage
Toilets	1.6 gallons per flush
Urinals	1.0 gallon per flush
Shower heads	2.5 gallon per minute
Faucet aerator	2.2 gallon per minute

After City of San Luis Obispo Ordinance # 1224

As a state agency, the university is not bound by City of San Luis Obispo building regulations, but the values given in Table 2 represent good engineering practice and should be regarded as the minimum water conservation standard for the Technology Park.

Low Flush Toilets

Low flow toilets, defined as 1.6 gallons/flush, have become the standard for the U.S. The National Energy Policy Act of 1992 took effect in 1994 for residential toilets and in 1997 for commercial toilets requiring all toilets made or sold in this country meet federal water conservation requirements. These

toilets are available from many manufacturers at competitive prices. They use significantly less water than the 5 to 7 gallons/flush which was formerly typical.

Ultra-low flow toilets are also available from several manufactures that achieve a flow of 1.0 gallons/flush. These toilets will reduce the average daily flow to 5.3 gallons/capita-day compared to 10.5 gallons/capita-day for a typical low flow toilet with 1.6 gallons/flush. These toilets use water pressure to compress air in a storage tank, which assists in toilet flushing. They require a minimum water pressure of 25 psi for proper functioning.

Dual Flush Toilets

Dual flush toilets incorporate a selector valve with two different flow rates. The standard flush is 1.6 gallons/flush, while the liquid only flush is 0.8 gallons/flush. Figure 1 shows the selector buttons on the Caroma dual-flush toilet.

Figure 1 – Dual Flush Toilet

Waterless Urinals

Waterless urinals use no water for flushing. Urine flows by gravity into the sewer line through a drain trap which contains a fluid that is lighter than water, allowing the urine to pass through. The trap blocks gases from the sewer line from entering the restroom in a similar manner to the water trap in a conventional urinal. The trap is a cartridge which is replaced on a routine maintenance schedule.

Figure 2 – Waterless Urinal

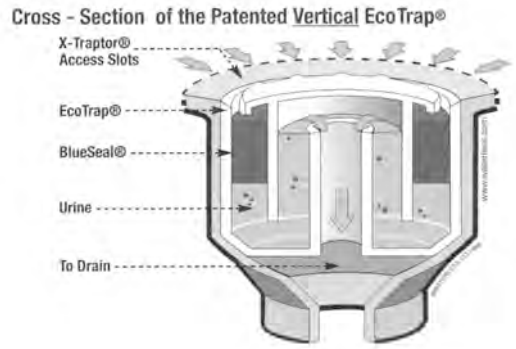

Figure 3 – Typical Drain Trap for Waterless Urinal

Water Conserving Fixtures and Appliances
The use of water conserving fixtures and appliances is a cost effective strategy. Examples include faucet aerators, low flow shower heads, automatic sinks (photocell controlled), and point of use water heaters. The latter also has significant energy savings compared to standard storage type water heaters. Figure 4 illustrates typical fixtures.

Figure 4 – Typical Water Conserving Fixtures
(In-line flow control valve, faucet aerator, faucet aerator with valve, low flow shower head)

Water Conservation References

City of San Luis Obispo, California, Retrofit Upon Sale Ordinance # 1224 (available from the City website)
http://www.ci.sanluisobispo.ca.us/utilities/download/certguidelines.pdf

Leverenz , H. , G. Tchobanoglous, and J.L. Darby, *Review of Technologies for the Onsite Treatment of Wastewater in California*, California State Water Resources Control Board
Center for Environmental and Water Resources Engineering, Report No. 02-2 August, 2002.

Water Conservation Suppliers
(This list of suppliers is not an endorsement of a particular manufacturer or dealer)

Caroma USA Inc. , 2650 NE Aurora Drive , Hillsboro, Oregon 97124
Phone: (503) 681-2720 Fax: (503) 681-2150
www.caromausa.com
Manufacturer of dual flush toilets.

Sloan Valve Company, 10500 Seymour Ave, Franklin park, Illinois 60131
1-800-9-VALVE-9 Fax 1-800-501-3989
www.sloanvalve.com
Manufacturer of water conserving toilets, waterless urinals, and other water conservation devices.

Waterless Co. LLC, Vista, California
1-888-NOFLUSH
www.waterless.com
Manufacturer of waterless urinals.

Wastewater Treatment

Wastewater from the Cal Poly Sustainable Technology Park can be treated and recycled onto landscaping with on-site wastewater treatment systems. Alternatively, the buildings can be connected to the on-campus wastewater collection system for treatment by the City of San Luis Obispo Water Reclamation Facility (WRF).

On-Site Wastewater Treatment Options

Wastewater generated by the Technology Park can be treated on site and the water reclaimed for on site landscape irrigation. Several options for treatment are possible including:

1. Gray Water Recycling – Black Water Discharge System - Gray water, drain water from bathroom sinks and showers, can be treated on site and used for landscape irrigation. Black water, wastewater from urinals, toilets, and laboratory sinks, can be discharged to the Cal Poly on-campus wastewater collection system. The black water will be treated in the city WRF.

This option will require a dual plumbing system for black and gray water. A typical on-site gray water treatment system includes gray water storage, filtration, and gray water recycling using subsurface drip irrigation (discussed in Option 3 below) or a gravel lined leach field.

2. Gray Water Recycling – Black Water On-Site Treatment – Gray water will be treated as in Option 1 above. Black water will be treated in an on-site system as discussed in detail in Option 3.

3. Mixed Gray Water/Black Water On-Site Treatment – A single collection system can be used inside the Technology Park buildings. All wastewater will be treated and recycled onto landscaping. A typical system consists of primary treatment (septic tank), packed bed treatment (textile media filtration), and a subsurface recycling system (subsurface drip irrigation). Many other configurations are possible, but this system is the most advanced on-site system currently available.

Primary Treatment – Consists of a concrete or fiberglass septic tank. The tank removes large particles and organics. Septic tanks require periodic pumping and disposal of solids, typically on a two or three year schedule. Figure 5 is a cross-section of a typical tank.

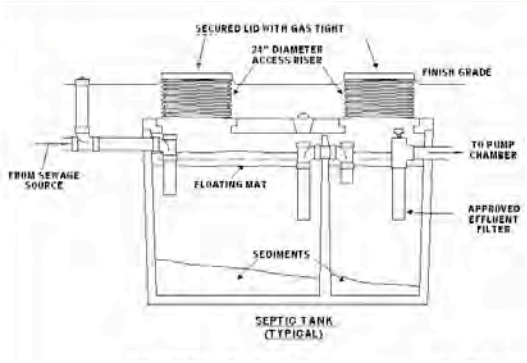

Figure 5 – Cross-Section View of Typical Septic Tank

Textile Media Filtration – Primary treated effluent is pumped into a textile media filtration unit (see Figure 6 below). An aerobic bacterial biofilm develops on the surface of the textile fibers which converts organic materials in the wastewater to carbon dioxide and water. The system is highly efficient and produces an effluent equivalent to traditional secondary treatment as used in large municipal plants. The units are modular and can be connected in parallel to provide needed capacity. There are no moving parts and electricity is not required.

Figure 6 – Cut away View of Textile Media Filtration Module

Subsurface Drip Irrigation – In a traditional on-site wastewater treatment system, wastewater is discharged to gravel lined leachfield trenches, typically 36 inches deep. The wastewater is allowed to infiltrate through the soil, eventually reaching the

groundwater table. In contrast a subsurface drip irrigation system is placed at a shallow depth of 12 inches . Small diameter drip tubing, with emitters at 1 to 2 foot intervals, disperses the treated wastewater in the active root zone of turf or other plants. The water is taken up by the plants with minimal infiltration into groundwater.

The wastewater must be filtered after primary (septic tank) and biological (textile media filtration) treatment to avoid clogging the emitters. Figure 7 is a typical drip irrigation system (primary and biological treatment not shown.

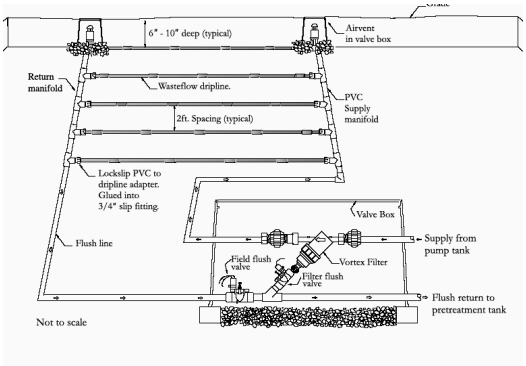

Figure 7 – Typical Subsurface Drip Irrigation System

Wastewater Export to the City of San Luis Obispo Water Reclamation Facility

All campus generated wastewater is collected in a gravity sewer system and conveyed to the City of San Luis Obispo Water Reclamation Facility (WRF). The plant is currently treating 4.5 million gallons/day (MGD) of sewage. All of the wastewater receives advanced biological treatment including denitrification and filtration. 1.1 MGD of the reclaimed water is piped through a dedicated pipeline for irrigation at public parks throughout the City (see Figure 8). The remainder of the reclaimed wastewater is discharged to San Luis Creek to maintain minimum stream flows as required by the Regional Water Quality Control Board. There are no plans to deliver reclaimed wastewater to the Cal Poly campus at this time.

Discussion and Analysis

There are two basic approaches to treating wastewater generated by the Technology Park, some variation of on-site treatment (the three Options previously discussed), and export of wastewater to the City of San Luis Obispo Water Recovery Facility. The design of the wastewater treatment system for the Technology Park should account for the capital costs of each approach, operating costs including

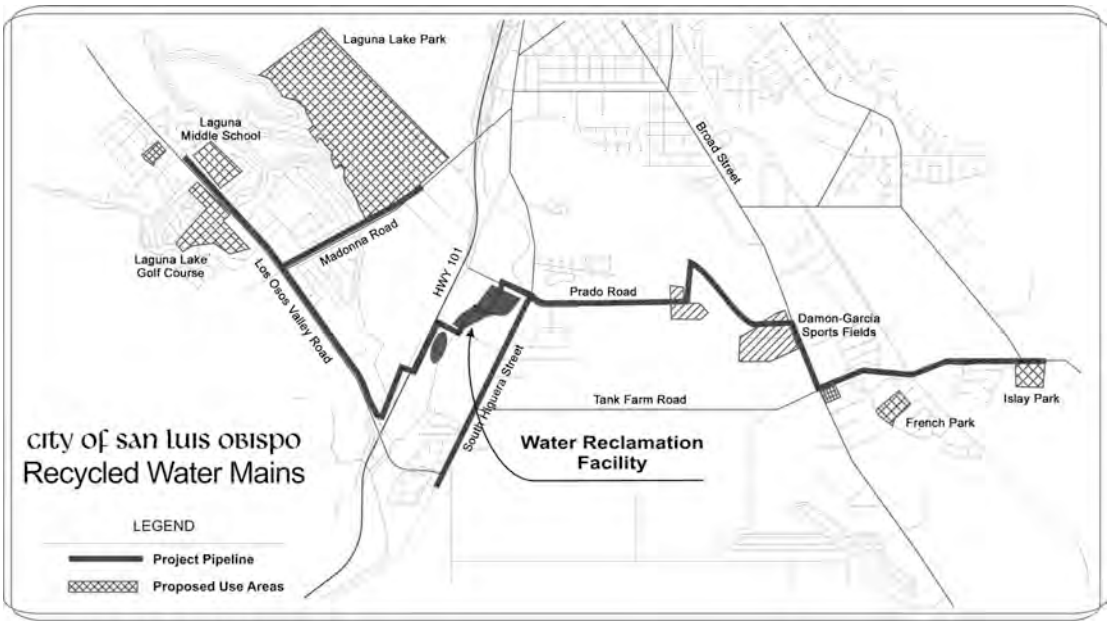

Figure 8 – City of San Luis Obispo Reclaimed Wastewater Pipeline M

maintenance, and the potential for wastewater recycling as irrigation water. It should be noted that about 25% of the treated effluent from the City of San Luis Obispo WRF is recycled throughout the city. The remaining effluent is discharged to the ocean through San Luis Creek to maintain habitat requirements for migrating fish.

All on-site Options will require permits from the Regional Water Quality Control Board. Discharge to the City of San Luis Obispo WRF will require a permit from the city. There will also be a small incremental increase to the university sewage fees that are paid to the city.

Wastewater Treatment References

Crites, R.W. and G. Tchobanoglous, *Small and Decentralized Wastewater Management Systems*, McGraw-Hill Book Co., New York, 1998.

Leverenz , H. , G. Tchobanoglous, and J.L. Darby, *Review of Technologies for the Onsite Treatment of Wastewater in California*, California State Water Resources Control Board
Center for Environmental and Water Resources Engineering, Report No. 02-2 August, 2002.

Metcalf & Eddy, Inc. , Revised by Tchobanoglous, G., F.L. Burton, and H.D. Stensel, *Wastewater Engineering Treatment and Reuse, Fourth Edition*, McGraw-Hill Book Co., New York, 2003.

Proceedings of the Tenth National Symposium on Individual and Small Community Sewage Systems, American Society of Agricultural Engineers, March 21-24, 2004, Sacramento, California.

Title 24, Part 5, California Administrative Code , Appendix G, *Graywater Standards*, March 18, 1997.

Wastewater Treatment Typical Suppliers

(This list of suppliers is not an endorsement of a particular manufacturer or dealer)

Orenco Systems, Inc, 814 Airway Ave., Sutherlin, CA 97479
Phone (541) 459-4449 , Fax (541) 459-2884
www.orenco.com
Manufacturer of aerobic treatment systems (Advantex), fiberglass septic tanks, and appurtenances.

Jensen Precast, 5400 Raley Blvd, Sacramento, CA 95838
Phone (916) 991-8800, (800) 843-9569 Fax (916) 991-8810
www.jensenprecast.com
Manufacturer of precast septic tanks

Geoflow, Inc., 200 Gate 5 Road #103, Sausalito CA 94966
Phone (415) 331-0166 Fax (415) 331-0167
www.geoflow.com
Manufacturer of subsurface drip irrigation systems.