State of Oregon
Department of Environmental Quality

OREGON DEPARTMENT OF ENVIRONMENTAL QUALITY

Design Notes

Design Notes for Non-Discharging Sewage Lagoons **October 1999**

GENERAL

For sites that do not have soils suitable for drainfields, one option for disposal in arid areas is a non-discharging (evaporation) lagoon. These lagoon systems generally consist of a septic tank, a pump tank, and a evaporation lagoon. The design criteria for the septic tank and pump tank are contained in OAR 340 Division 71 and 73. Also, general guidance can be found in "Information on Domestic Sewage Lagoons or Stabilization Ponds", DEQ, June 1985. The following are suggested design criteria for the evaporation lagoon.

DESIGN OF LAGOONS

The lagoon must have a primary cell and at least one secondary cell. The primary cell is designed to maintain a minimum water depth during the summer. The secondary cell(s) is/are designed to store all the sewage during the wet weather season.

Lagoons should be lined with a synthetic liner. The liner should be a minimum of 30 mil. If PVC is used, the liner must be covered with 12" of soil to prevent photodegradation and the inside dikes should not exceed a 3 to 1 slope to prevent slumping of the soil. If a photoresistant liner such as hypalon or polyethylene is used, a steeper slope of 2:1 is allowable. A 3 foot freeboard should also be maintained. To minimize potential damage to the liner, rocks, sticks and roots should be removed from the underlaying soils. The soils should then be compacted and a geotextile membrane should be placed over the compacted soils. Synthetic liners must also have a method to vent gases.

Liners must be leak-tested at the time of installation. The bottom of liners must be installed 3 feet above the highest seasonal ground water level. In wet areas, this may preclude excavation and require the construction of elevated berms to contain the lagoons. Lagoons bermed above surrounding ground level should be built with an overflow culvert or spillway at the top of the berm to ensure against washout.

The lagoons should be securely fenced to exclude pets, cattle, sheep, and children, with warning signs posted on all sides. Fencing around lagoons should be livestock rated. The lagoons should have a minimum 50-foot set back from the property line. The signs should contain words to the effect of:

SEWAGE POND
Keep away
Do Not Drink

A minimum depth of 12 inches must be maintained in the primary lagoon. To prevent the primary lagoon from dying out in the late summer, a source of makeup water is needed. A float switch in the cell and a solenoid valve should be used. Plumbing a potable water line directly to the primary lagoon for makeup water must provide an air gap or other backflow prevention per plumbing code.

A staff gage should be installed in each cell to track water depth and the final secondary cell must have an overflow alarm. This alarm should be both audible and flashing light. The alarm should be placed where it can be heard/seen at all times. The alarm may be battery operated, if desired. The audible alarm must be installed with a weatherproof silence button on the face of the panel.

SIZING OF PRIMARY CELL

The surface area of this cell should not be so small that the pond goes anaerobic, nor so great that excessive makeup water is needed. The minimum surface area is based on a BOD loading of 35 pounds per day per acre:

Surface Area (ft^2) = (BOD (mg/l) x Flow (gpd) x 0.00000834) / (35 lbs/day/acre / 43,560)
= BOD (mg/l) x Flow (gpd) x 0.01

For single family residences, septic tank effluent ranges from 140-200 mg/l (Metcalf & Eddy, 3rd ed.) and flows are generally in the range of 45 – 75 gallons per person per day (EPA Design Manual, *Onsite Wastewater Treatment and Disposal Systems*, October 1980). So, for a 3 bedroom home (estimate 200 gpd) the minimum surface area for the primary cell would be:

Surface Area (ft^2) = 200 (mg/l) x 200 (gpd) x 0.01 = 400 ft^2

SECONDARY CELL SIZING

The sizing of the secondary cell is based on storage of the septic tank effluent during the wet weather season. A water balance needs to be preformed to determine the required capacity. This water balance should be cumulative month to month starting with October. Monthly average precipitation and evaporation data can be obtained from the Oregon Climate Service on the Internet at http://www.ocs.oregonstate.edu/index.html.

The monthly volume change is calculated as follows:

Monthly volume change = total sewage flow + [(rainfall*MOS – evaporation) x lagoon surface area]

Also, it can be assumed that the primary cell is at the minimum 1-foot depth at the end of September.

An iterative calculation of water balance must be preformed to determine the required total surface area to evaporate the sewage plus the rainfall. The cumulative water balance for September should be slightly negative.

An example of this calculation for a residence (200 gpd) in the Medford area follows:

Month	Days in Month	Gallons of Sewage	Monthly mean Rainfall (in)	Monthly Mean Pan Evaporation (in)	Net (in)	Monthly increase (gal)	Cumulative Gallons
October	31	6200	1.49	1.85	-0.36	5,056	5,056
November	30	6000	3.23	0.77	2.46	13,820	18,876
December	31	6200	3.32	0.56	2.76	14,974	33,850
January	31	6200	2.69	0.57	2.12	12,939	46,789
February	28	5600	1.93	1.18	0.75	7,984	54,774
March	31	6200	1.82	2.49	-0.67	4,070	58,844
April	30	6000	1.16	3.6	-2.44	-1,757	57,087
May	31	6200	1	5.38	-4.38	-7,724	49,363
June	30	6000	0.58	6.74	-6.16	-13,583	35,780
July	31	6200	0.26	8.17	-7.91	-18,946	16,834
August	31	6200	0.52	6.71	-6.19	-13,478	3,356
September	30	6000	0.86	4.04	-3.18	-4,109	-753

By an iterative approach, the required total surface area is 5100 square feet. The maximum volume is about 60,000 gallons, the cells should be 60,000 (gal) / 7.481 (cf/gal)/ 5100 (sf) = 1.6 feet deep. Adding the 3 feet of freeboard makes them about 5 feet deep.

Therefore, for a residence with a flow of 200 gpd in the Medford area, the recommended design would be a primary cell with a surface area of 400 square feet and a secondary cell with a surface area of 4700 square feet and a depth of 5 feet.