## Wastewater and the Environment

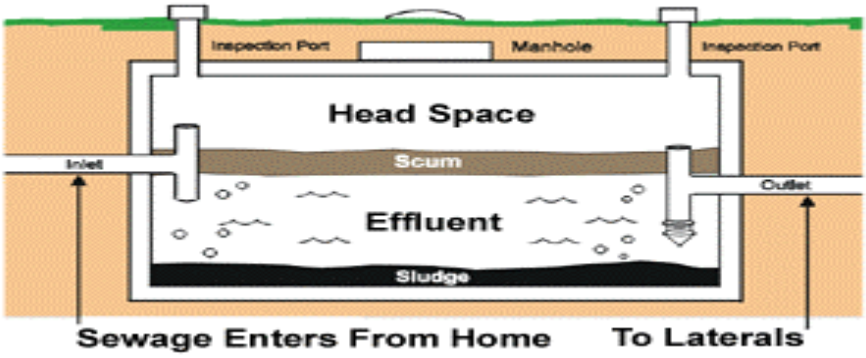
Human wastes require care in their disposal because they carry viruses, bacteria and nutrients. The bacteria contained within the waste are not suited to surviving outside the human body however the viruses and nutrients can persist for some time and travel for some distance from the source. If not carefully disposed, the wastes can contaminate drinking water and have caused serious and deadly disease outbreaks in the not too distant past in this country and continue to do so in Third World countries. Current wastewater disposal addresses the pathogens successfully. The nitrogen and phosphorus contained in the wastewater can affect drinking water quality and cause serious decline in coastal and freshwater pond habitat.

**Wastewater treatment:** Of the nearly 15000 dwellings on the Vineyard, well over 80 percent rely on the use of on-site wastewater disposal systems. On site sewage disposal systems are used throughout Aquinnah, Chilmark, West Tisbury and Chappaquiddick and in the areas outside the downtown sections of Edgartown, Oak Bluffs and Tisbury.

The basic requirements for the system are set by State standards (Title 5, State Environmental Code see www.state.ma.us/dep/matrix.htm then click on 310 CMR 15.00) although local Boards of Health can devise bylaws that are stricter than these minimums. The system includes a 1500-gallon tank, a cement or fiberglass container that discharges liquid wastewater by way of a tee outlet. The tank is connected to a soil absorption system (SAS) that infiltrates the liquid portion of the wastes into the ground and must be a minimum of 100 feet from a drinking water well.

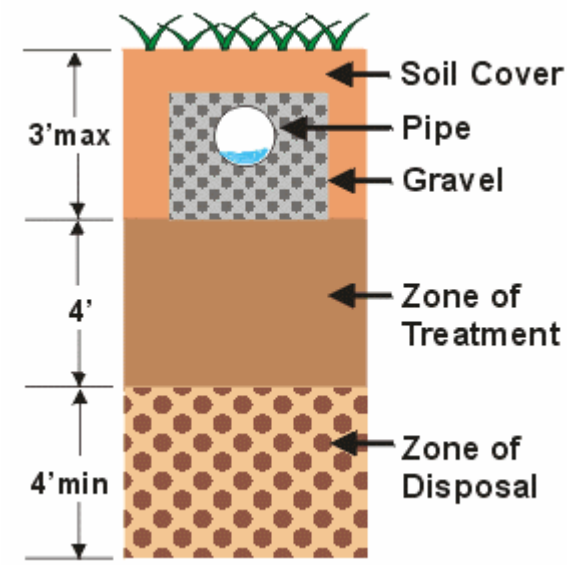
The on-site wastewater system separates the solids and grease that are stored in the tank from the liquids that are released to the SAS at a rate that will encourage long-term acceptance into the ground. The solids and grease must be retained so that they do not clog the soil at the SAS site. The size of the SAS is adjusted depending on the nature of the soil and the ability for liquid to percolate through it. The system is designed to infiltrate the liquid from the septic tank into the soil where bacteria and viruses are removed and to avoid having wastewater back up to the surface where people could be exposed to pathogens. The system is not designed to remove nutrients however there is a reduction in both nitrogen and phosphorus in the soil absorption system. For basic information on septic systems, see: http://epa.gov/seahome/septics/src/main.htm

### Septic Tank Cross Section



From: New Jersey Department of Environmental protection

A Soil Absorption System Leaching Pipe in Cross Section




From: New Jersey department of Environmental Protection

**Note: Distances shown may vary in Massachusetts**

**Wastewater effluent and its nutrient content:**

Human waste contains nitrogen as complex organic molecules such as urea and as simple molecules such as ammonium. The average person produces 4.8 to 13.6 pounds of nitrogen per year as measured in the wastewater effluent at the base of the soil absorption system (EPA, 1997). The average concentration of nitrogen in the effluent is around 35 to 40 parts per million but ranges from as low as 20 ppm to over 85 ppm.

Effluent from a septic system enters and flows with the groundwater with little mixing both in the vertical and the horizontal directions creating what is called a contaminant plume (Robertson, et al (1991). In well-aerated aquifers like ours, there is very little loss of nitrate once it enters the groundwater because for this to occur there must be no oxygen present for bacterial and chemical reactions to turn nitrate into nitrogen gas and remove it (Weiskel and Howes 1992). This condition is not common in a sand and gravel aquifer such as ours. As the groundwater carrying the wastewater effluent passes through a stream, fresh water pond or wetland, substantial nitrate removal from the effluent plume may occur (up to 30%). This may also occur as the effluent plume enters a coastal system where the presence of fringing marsh serves the same function. Where there are no marshes, the nitrogen seeping into the pond with the groundwater may produce areas of dense growth of green macro-algae coating the rocks and pilings. These include *Enteromorpha, Ulva, Gracillaria* and *Cladophora.*

Nitrogen loading may also stimulate the growth of phytoplankton to the point where they intercept the sunlight so completely that there isn't enough for the eelgrass growing on the bottom. Without sunlight, the eelgrass beds thin out and gradually disappear from a

pond impacting the marine species that are dependent on this habitat such as bay scallops, blue claw crabs, bait and sport fish.

In an area where there are private drinking water wells and on lot wastewater disposal, as the housing density increases, there are more and more plumes from septic systems and the likelihood of a well intercepting a plume increases. It has been shown by sampling in the field, that nitrate content in an effluent plume may well exceed the drinking water standard (10 ppm of nitrate) at a distance of about 100 feet from the source and up to 200 feet of travel may be necessary for the plume to be diluted to the point where it meets the drinking water standard (Walker, 1973). For long-term planning for high quality drinking water, we suggest that the minimum lot size should be one acre for areas where long-term private well water and on site wastewater disposal are desirable. This reduces the number of plumes and lowers the risk of well contamination. It also provides more space to site the well in a location where it is least likely to intercept the plumes from all disposal sites in the immediate neighborhood.

A septic system should last for decades if it is maintained and properly treated.

**Innovative and Alternative On-site Treatment Systems: These systems fall into two categories- units that do not produce any wastewater to dispose into the ground and units that treat the wastewater to remove a significant amount of the nitrogen before in-ground disposal.**
Nitrogen removal from wastewater is crucial to the long-term health of our coastal systems.

There are systems that produce no toilet wastewater flow such as composting toilets. These systems release almost no nitrogen to the environment. Other systems can remove up to 60 percent of the nitrogen from the wastewater and then discharge the effluent through a conventional soil absorption system. These types of systems often rely on encouraging the growth of bacteria on plastic surfaces on which the effluent is sprayed. These organisms take up the nitrogen and convert a substantial portion into nitrogen gas that returns to the atmosphere in a process called denitrification. These units can be added on to an existing system. They work best where the wastewater flow is even throughout the year. Package wastewater treatment units can serve a cluster of houses situated in a sensitive area and obtain relatively constant flows by serving both year-round and seasonal homes. For more information on alternative systems go to:
Department of Environmental Protection www.state.ma.us/dep/brp/wwm/t5itprog.htm
Alternative Septic System test Center www.buzzardsbay.org/etimain.htm
National Small Flows Clearinghouse www.nesc.wvu.edu/nsfc/nsfc_index.htm

**What is the Martha's Vineyard Commission's Concern with Wastewater Disposal?**
Under Chapter 831 the Commission is mandated to specify broad guidelines to assure that development within Critical Districts will not result in undue "…water, air, land or noise pollution..". The Commission is also mandated to review Developments of Regional Impact and to consider the "extent to which a type of development would create or alleviate environmental problems, including but not limited to, air, water and noise

pollution;". In both the review of DRIs and the formulation of guidelines for Critical Districts it is clear that our legislation requires the Commission to consider sources of potential water pollution. Wastewater is the most concentrated source of nitrogen found in Vineyard environment. Our concern is focused on assuring that the future added wastewater flow will not degrade the quality of our coastal resources or cause groundwater contamination either within the project under review or for the neighbors.

At the present time, the basis for Commission review of the wastewater component of DRI projects includes:

1. We believe that the evidence is clear that on-site wastewater disposal affects the water quality in the aquifer and the coastal ponds into which the effluent plumes flow.
2. Each coastal pond has a tolerance level for nitrogen and when that is exceeded there is a decline in water quality including increased turbidity, loss of eelgrass, increase in organic sediment, increase in wrack algae and decline in important resources such as bay scallop.
3. Title 5 is primarily focused on the hydraulic disposal of wastewater and the prevention of wastewater borne diseases. At this time, Title 5 regulations alone do not provide protection to coastal ponds from wastewater disposal within their watersheds. Until it does, there is a need to take proactive action to protect these resources. In our opinion, Title 5 also does not assure long term protection of private wells from nitrate contamination at housing density exceeding one dwelling per acre.
4. We need to move as quickly as possible to a clear scientific basis for limiting the nitrogen loading to each coastal pond to a rate that will maintain water quality for the foreseeable future.
5. The Commission supports the Estuaries Project as the means to reach this goal but because that process will take at least another 5 years for many of our ponds, we will apply our interim nitrogen loading limits in the review of Development of Regional Impact projects.
6. On site wastewater nitrogen content can be reduced by about 45 percent with current wastewater denitrifying treatment technology. We strongly urge Boards of Health to consider the use of individual or community nitrogen removing wastewater systems to address both existing and future densely developed areas that will not be sewered and either use private wells or are in the watershed of a nitrogen-sensitive pond. Sewering to collect and treat wastewater from dispersed residences at a central facility is very expensive and should be confined to the present day service areas and nearby areas.

**REFERENCES:**

EPA (1997) The Potential for Nutrient Loadings from Septic Systems to Ground and Surface Water Resources and the Chesapeake Bay. EPA Chesapeake Bay Program EPA #903-R-97-006 Report #CBP/TRS 166/97

Robertson, W., J. Cherry & E. Sudicky (1991) Ground-water Contamination from Two Small Septic Systems on Sand Aquifers. Ground Water Vol. 29, #1, pp. 82-92.

W. Walker, J. Bouma, D. Keeney & P. Olcott (1973) Nitrogen Transformations During Subsurface Disposal of Septic Tank Effluent in Sands: II Ground Water Quality. J. Env. Quality, Vol. 2, #4, pp. 521- 525

Weiskel, P. and B. Howes (1992) Differential Transport of Sewage-Derived Nitrogen and Phosphorus through a Coastal Watershed. Environmental Science and Technology, Vol. 26, #2, pp. 352-360.