ONSITE WASTEWATER TREATMENT & DISPOSAL

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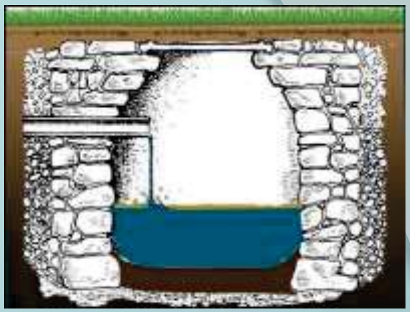
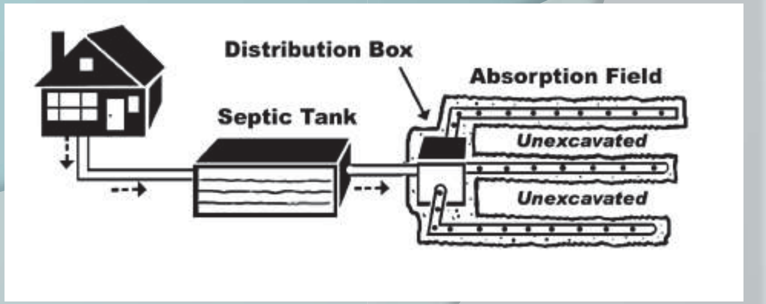
Topics



- Background
- Previous efforts
  - OSDS Innovative systems survey (2005)
  - OSDS Survey and Assessment (2008)
  - OSDS Management Program Development (2010)
  - OSDS Inspection & Sampling Study (2012)
  - OSDS Selection tool (2013)
  - ATU testing/certification (1998-99, 2004-05, 2013-14, 2015-16)
  - Gray water recycling (2009)
  - Urine diverting toilets, water recycling, fate & transport in local soils
- Current efforts
  - Upcountry Maui study
- Future plans
  - Pilot-test/permanent installation monitoring
  - Development/testing of innovative systems



Background:
On site disposal systems (OSDS)

- Hawaii has plenty of OSDSs
  - Approximately 30%
  - 130,000 systems (cesspool [88k], septic tanks, ATUs)
  - Connection to centralized sewers and WWTPs generally very costly
  - Disposal into the ground
- Risks:
  - Hawaii drinking water = mostly groundwater from unconfined aquifers
  - Surface waters
  - Nearshore waters
- Cesspool ban/replacement by 2050 (Act 125, 2017)
  - Cesspools provide only solids removal, possibly absorption
  - 43,000 pose risk to water resources (priority 1 [8140], 2 [15800], 3 [18790], 4)
- Septic tanks (ST) provide solids removal, anaerobic treatment plus soil absorption system
- Aerobic Treatment Units (ATU) meet secondary trt in tank and can include DN and disinfection, rely less/not-at-all on soil
- Projects: develop tools and systems to allow safe treatment and disposal on-site

Innovative Onsite Systems Survey (2005)

- National Conference on Affordable Housing in High Cost Areas (Honolulu)
- Conventional systems
- Many types of ATUs available at that time
- Recirculating & single pass sand filters (post ST)
- Peat filters (post ST)
- Denitrifying trenches (post ST)
- Mound and ET systems (post ST)
  - Tafgard, Waialua Pioneer Seed Corn, monitoring 2000-2001
- Constructed wetlands (Lauren Roth)
  - UH West Hawaii
  - Kaiser Med Bldg - Kona
- Disinfection, recycling/reuse, drip irrigation, gray water

Onsite Treatment Survey & Assessment (2008)

- No guidance document existed
- Needed to show if/when ATU or DN in high-risk areas
- To assist homeowners, developers, engineers/architects to:
  - Identify feasible alternatives
  - Describe constraints, including costs
  - Help to select
- With: DBEDT/DOH, June Nakamura, Kyle Okino, Russ Brain
- DOH website: hawaii.gov/health/environmental/water/wastewater/forms.html

Guidance Document

- Introduces wastewater treatment and regulatory framework
- Describe factors affecting OSDS performance
- Systematic method to select treatment and disposal technologies
  - Quantity and quality
  - Show which viable for each site condition; get options
  - Show costs & advantages/disadvantages; selection
  - Give design criteria
  - Examples
- Fact sheets
  - Treatment, disposal, O&M guides
- Vendor lists

ONSITE WASTEWATER TREATMENT SURVEY AND ASSESSMENT

March 2008

Prepared For:

State of Hawaii
Department of Business, Economic Development and Tourism
Office of Planning, Hawaii Coastal Zone Management Program

Department of Health

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Suitability of Disposal methods to various site conditions

Onsite Disposal Method	High Water Table	Impermeable Soil	Steep Terrain	Flood Zone	Inland Surface Water	Coastal Water	High Cesspool Density	Protection of Groundwater	Protection of Drinking Water (CWDA)	Hydrogeology
Holding Tank	P	P	P	NR	P	R	P	R	R	P
Injection Well	P	P	P	NR	P	P	P	P	P	P
Seepage Pit	NR	P	R	NR	NR	P	NR	P	NR	P
Adsorption Trenches	NR	NR	NR	NR	P	P	P	P	NR	P
Adsorption Beds	NR	NR	NR	NR	P	P	P	P	NR	P
Elevated Mounds	P	P	P	NR	P	P	P	P	P	P
Evapotranspiration	P	R	NR	NR	P	P	P	R	R	P
Water Reuse	R	R	R	NR	R	R	R	R	R	R

Legend:
R – Recommended
P – Possible
NR – Not Recommended

Suitability of onsite Treatment systems to varying site conditions

Onsite Treatment Method	High Water Table	Impermeable Soil	Steep Terrain	Flood Zone	Inland Surface Water	Coastal Water	High Cesspool Density	Protection of Groundwater	Protection of Drinking Water (CWDA)	Hydrogeology
Septic Tank	P	P	P	NR	NR	P	P	P	P	P
Low water/Waterless Toilets	R	R	R	NR	R	R	R	R	R	R
Continuous Flow, Suspended Growth	R	R	R	NR	R	R	R	R	R	R
Continuous Flow w/ Fixed Integral Packing	R	R	R	NR	R	R	R	R	R	R
Sequencing Batch Reactor ATU	R	R	R	NR	R	R	R	R	R	R
Single Pass Sand Filter	R	R	R	NR	R	R	R	R	R	R
Recirculating Sand Filter	R	R	R	NR	R	R	R	R	R	R
Enhanced Phosphorus Removal	R	P	P	NR	R	R	P	P	P	P
Enhanced Nitrogen Removal	R	P	P	NR	R	R	P	P	P	P
Emerging Trace Contaminant Removal	P	P	P	NR	P	P	P	P	P	P
Chlorine Disinfection	P	P	P	NR	NR	NR	P	R	R	R
UV Disinfection	P	P	P	NR	R	R	P	R	R	R

Legend:
R – Recommended
P – Possible
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Fact Sheets

Elevated Mounds — *Fact Sheet D-6*

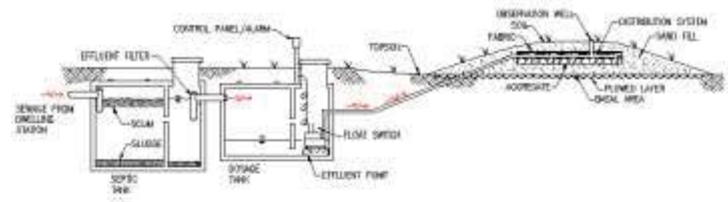

Figure 4-4 Elevated Mound System

Elevated mound systems are engineered mounds of sand/soil used to create acceptable soil conditions for effluent disposal and/or to create vertical separation from groundwater. The land on which the mound will sit is tilled, and a layer of sand and distribution system is placed over the tilled surface. The top of the mound is covered with surrounding soil and aesthetically landscaped.

Considerations and Restrictions
Mounds are commonly used in areas where absorption trenches and beds cannot be used, such as when the terrain is excessively steep, when there is a high groundwater table, or when the soil is not conducive for a SWIS. Landscaping is required as the mounds could reach a height of three feet. As shown in the figure above, the disposal point is higher than the septic tank, therefore a pump system will be required.

Effluent Quality
Effluent quality for an elevated mound system is similar to that of an absorption trench or bed (see D-4).

Typical Installed Costs (2007)
Construction costs range from $10,000 to $15,000, but can go as high as $25,000 per 1,000 gpd of treated wastewater in Hawaii.

Operation and Maintenance Costs
Since the elevated mound system requires a pump to lift the effluent to the specific elevation, the pump's power costs need to be budgeted. The estimated power consumption is approximately 100 – 300 kW-h per year. The same care must be provided to the mound as would be provided to trenches or beds. See Appendix A for tips on maintenance.

Elevated Mounds Summary	
Use in Steep Terrain	Yes
Use in High Ground Water Areas	Yes
Percolation Rate	All
Relative Footprint When Compared To Conventional Drainfield	Large
Maintenance Level:	Medium
Power Required:	Yes
Typical Installed Cost:	up to $25,000 /1,000 gallons

OSDS Management Program Development (2010)

- Currently little management after building permit (no inspections, permits, etc)
- Establish minimum maintenance, performance, and inspection standards for OSDSs
- Issue, monitor and enforce OSDS operating permits (2-yr cycle)
- Certify and license OSDS Service Providers and OSDS Inspectors
- With: Sean Ogata, MS

Documents Created

- Model law, framework, roles
- Homeowner education fact sheets
  - Cesspools, septic tanks, ATUs, Absorption fields, seepage pits, ET beds, Inspection expectations, self inspection
- Minimum maintenance requirements
  - Pumping frequency – septic
  - O&M for ATUs
- Inspection checksheets & protocols
  - Cesspools/Septic tanks
  - ATUs
  - Disposal units
- Application/renewal forms

Hawaii State Department of Health

OSDS Inspection Checksheet: Form #1

Inspection Number:

1. Owner Information

Owner: ____________________ Phone: __________

Representative: ____________________ Phone: __________

Site Address: ____________________

Mail Address: ____________________

Island: ☐ Hawaii ☐ Kauai ☐ Lanai ☐ Maui ☐ Molokai ☐ Oahu

2. Records

Inspection Application: ☐ Yes ☐ No

Water Bill: ☐ Yes ☐ No

Pumping Records: ☐ Yes ☐ No

System Drawings: ☐ Yes ☐ No

Certificate of Contruction: ☐ Yes ☐ No

Maintenance Records: ☐ Yes ☐ No

Operating Permit: ☐ Yes ☐ No

Operating Permit #: __________

Effective From: __________ To: __________

Date Issued: __________

3. Facility Description

Land Use: ☐ Single Family ☐ Seasonal occupation ☐ Commercial ☐ Multi-family residence ☐ Vacant ☐ Other: __________

Number of: ☐ Occupants ☐ Bedrooms ☐ Bathrooms ☐ Pool/Hot Tub

OSDS Type: ☐ Cesspool ☐ Holding Tank ☐ Septic Tank ☐ ATU

Tank Material: ☐ Concrete ☐ Steel ☐ Fiberglass ☐ Other: __________

Manufacturer: __________

Model: __________

Date Installed: __________

Volume: __________ gallons

Capacity: __________ gpd

Last Pumped: __________

4. Cesspool/Tank Inspection

Water Usage: ☐ Satisfactory ☐ Excessive Notes: __________

Pumping Rqd. for Inpt: ☐ Yes ☐ No Notes: __________

Tank Cover: ☐ Satisfactory ☐ Unsatisfactory Notes: __________

Risers: ☐ Satisfactory ☐ Unsatisfactory Notes: __________

Tank Integrity: ☐ Satisfactory ☐ Unsatisfactory Notes: __________

Signs of Leakage: ☐ Yes ☐ No Notes: __________

Decanter: ☐ Satisfactory ☐ Unsatisfactory Notes: __________

Baffles: ☐ Satisfactory ☐ Unsatisfactory Notes: __________

Inlet Tee: ☐ Satisfactory ☐ Unsatisfactory Notes: __________

Outlet Tee: ☐ Satisfactory ☐ Unsatisfactory Notes: __________

Distribution Box: ☐ Satisfactory ☐ Unsatisfactory Notes: __________

4. System Inspection (cont.)

Inspection Ports: ☐ Satisfactory ☐ Unsatisfactory Notes: __________

Disinfection Unit: ☐ Satisfactory ☐ Unsatisfactory Notes: __________

Lift Pump: ☐ Satisfactory ☐ Unsatisfactory Notes: __________

Sludge Depth (in): __________ Inches from Baffle: __________ in.

Scum Height (in): __________ Inches from Baffle: __________ in. Odor: ☐ Normal ☐ Excessive

Evidence of Backup/Excessive Flow: __________

Additional Notes: __________

5. Disposal System *(Check all that apply)*

Type: ☐ Absorption Trench ☐ Sand Mounds ☐ Absorption Bed ☐ Other: __________ ☐ Evapotranspiration Bed ☐ Seepage Pit/Dry Well

Observations:

☐ Yes ☐ No Impermeable surface over soil absorption system.

☐ Yes ☐ No Septic odors present, ponding, lush vegetation, or lush patches present.

☐ Yes ☐ No Large plants or trees over or near soil absorption system.

☐ Yes ☐ No Storm drains, sump pumps, or other runoff diverted over soil absorption system.

☐ Yes ☐ No Heavy objects or evidence of over soil absorption system.

☐ Yes ☐ No Cave-in or components exposed over soil absorption system.

For Seepage Pit/Dry Well

☐ Signs of overflow

☐ Solids/Signs of solids present

☐ Excessive odors

☐ Effluent is black

Additional Notes: __________

6. Additional Inspection Notes (Observations, Findings, Reccomendations)

7. Results

☐ **Pass**

☐ **Conditional Pass** Reason: __________

☐ **Fail** Reason: __________

8. Inspector Information

Inspector #: __________ Company: __________ Inspection Date: __________

Inspector Name (Print) __________ Inspector Signature __________ Date __________

9. Homeowner Signature

Owner Name (Print) __________ Owner Signature __________ Date __________

Hawaii State Department of Health

OSDS Inspection Checksheet: Form #2

10. Aerobic Treatment Unit

Manufacturer: ____________ **Service Contract:** ☐ Yes ☐ No

Model: ____________ **Contractor:** ____________

Date Installed: ____________ **Phone:** ____________

Volume: ____________ gallons **Exp. Date:** ____________

Capacity: ____________ gpd **Service Intervals:** ____________

Last Pumped: ____________

Tank Material: ☐ Concrete ☐ Fiberglass ☐ Steel ☐ Other: ____________

ATU Type: ☐ Suspended Growth ☐ Attached Growth

Tank Cover:	☐ Satisfactory	☐ Unsatisfactory	Notes:
Tank Integrity:	☐ Satisfactory	☐ Unsatisfactory	Notes:
Baffles/Wiers:	☐ Satisfactory	☐ Unsatisfactory	Notes:
Decanter:	☐ Satisfactory	☐ Unsatisfactory	Notes:
Compressor:	☐ Satisfactory	☐ Unsatisfactory	Notes:
Diffusers:	☐ Satisfactory	☐ Unsatisfactory	Notes:
Effluent Screen:	☐ Satisfactory	☐ Unsatisfactory	Notes:
Disinfection:	☐ Satisfactory	☐ Unsatisfactory	Notes:
Control Panel:	☐ Satisfactory	☐ Unsatisfactory	Notes:
Alarms:	☐ Satisfactory	☐ Unsatisfactory	Notes:
Timer:	☐ Satisfactory	☐ Unsatisfactory	Notes:

Mixed Liquor:

Dissolved Oxygen: ______ mg/L	**Aeration:**	☐ Uneven	☐ Uniform	Notes:
pH: ______	**Odor:**	☐ Anoxic	☐ Aerobic	Notes:
Settability (30 min): ______ % volume	**Color:**	☐ Black	☐ Brown	Notes:
Temperature: ______ F	**Surface:**	☐ Scum	☐ Foam	Notes:

Notes: ____________

11. Effluent Analysis *(if necessary or required)*

Sampling Date: ____________ **Time:** ______ **Sample Taken By:** ____________

Analysis Date: ____________ **Time:** ______ **Sample Analyzed By:** ____________

Effluent:

BOD5 (mg/L):	TKN (mg/L):	FOG (mg/L):
TSS (mg/L):	Nitrate (mg/L):	Total P (mg/L):
Fecal Coliforms (#/100mL):	Ammonia (mg/L):	Phosphate P (mg/L):
Dissolved Oxygen (mg/L):	Settability Test (% volume):	MLSS (mg/L):
pH:		

Notes: ____________

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Honolulu, HI 96813
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AEROBIC TREATMENT UNITS

Homeowners Guide: Fact Sheet #3

How Does Your Aerobic Treatment Unit Work?

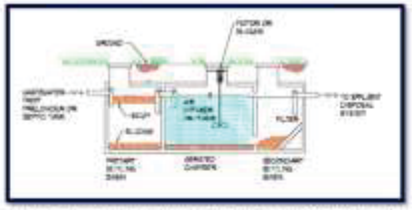

Figure 1. Three compartment suspended growth aerobic treatment unit.

Aerobic treatment units (ATUs) utilize aeration to enhance microbial degradation of sewage. In the presence of oxygen, microorganisms are able to break down organics and clarify wastewater more efficiently and effectively than in oxygen deficient systems such as septic tanks and cesspools. In the ATU, air is bubbled through the wastewater in the aeration chamber by a blower or mixer. This provides oxygen as well as thoroughly mixes the microbes and sewage. Here the microorganisms uptake oxygen and degrade organics to clarify the wastewater.

Preceding the aeration chamber, the wastewater may be pre-treated by a septic tank or a settling chamber. This separates and retains the larger solids, which take longer to be degraded by microorganisms. After the aeration chamber, another settling chamber often exists to allow remaining solids and microbes to settle out and be returned to the aeration chamber. This is extremely important as it maintains the microbe population in the aeration chamber and further clarifies the wastewater before it enters the disposal system.

There are different types of aerobic treatment units, however all ATUs function on the same basic principle, to provide an oxygenated environment for microbes to consume organic matter. Two common systems are the suspended growth aeration system, as described above, and the fixed-film growth system. The latter uses plastic, styrofoam, or gravel in the aeration chamber, which provide a medium for microorganism to grow on. In addition to the different types of systems, additional features such as disinfection units (such as chlorination) commonly accompany an ATU.

ATU's in Hawaii

ATU's are an alternative and advanced form of onsite wastewater treatment and are used moderately in Hawaii. Compared to the conventional septic tank or cesspool, it is a much more complex operating system that produces a much higher degree of wastewater treatment. ATUs are generally implemented in environmentally sensitive areas where conventional septic systems cannot meet the required treatment criteria. This can occur where soil conditions are not suitable for conventional systems, underground water tables are high, or land slopes are too steep. As a result, ATU usage is continually increasing as septic tanks and cesspools fail to meet treatment standards in Hawaii.

Because of its complex mechanical and electrical design, ATUs are maintenance intensive systems and cost more money to operate than a conventional system. However, when properly maintained, an ATU will outperform most onsite sewage disposal systems in terms of effluent quality and are designed to function for a long time. In addition, ATUs are subject to ANSI/NSF Standard 40 certification, which verifies the functionality of the ATU. New ATUs are also typically required to include two years of maintenance by the manufacturer. Therefore, despite the higher costs and maintenance required by an ATU, they provide a much safer and effective form of onsite wastewater treatment to protect Hawaii's environment.

Figure 2. ATU in septic system.

Typical Signs of a Failing System

1. Alarm triggered. The alarm signals any malfunction in the system. Know where to call before the event of a triggered alarm. The faster a problem is fixed, the cheaper it will be.

2. Sewage back-up. If sewage is not draining properly or odors are present inside the home, a clog in the system is likely. Report immediately since contact with sewage is hazardous.

3. Unusual changes in ATU operation. Changes in sound, smell, or sewage characteristics are telltale signs of a failing system. Notify a service provider immediately.

Produced by: The Hawaii State Department of Health & the University of Hawaii, Manoa Water Resources Research Center

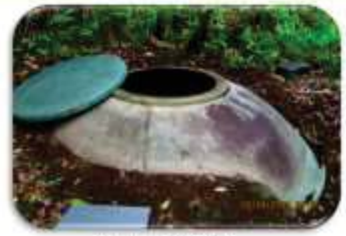

Figure 3. Installed ATU.

Do's & Don'ts

Aerobic treatment units utilize biological processes and as an owner, there are things you need to do to ensure the health of your system. An important characteristic of ATUs is that improper care for the system will reveal itself faster then conventional systems. Follow these simple Do's and Don'ts to protect your ATU from harm and abuse.

Do this:

- **Do keep a service contract provided by the system manufacturer or a licensed service provider.** ATUs are maintenance intensive and its operation is highly dependent on proper maintenance.
- **Do become familiar with your ATU and how it works.** Know how your ATU sounds, smells like, and looks like when it is properly functioning; so that you may be able to recognize when it is not working properly.
- **Do conserve water in your household and divert other water sources such as roof drainage and sump pumps away from your ATU.** Overloading your unit with larger flows will hurt your ATU.
- **Do constantly be aware of your alarm system.** Alarm systems are put in place to notify you of any malfunctions. Know where your alarm system is located and what to do when it is activated.
- **Do keep all general information and detailed records of your ATU on hand.** Service contracts, system manuals, installation information, and past maintenance are just a few things you should always have readily available if called upon.
- **Do check before using chemical additives in your ATU.** Typically chemical additives are not proven to work and may actually harm your system. Check with the DOH or a certified service provider before using a chemical additive.

Don't do this:

- **Do not drive or park over any part of your ATU and its drainfield.** This can cause damage to piping, the ATU tank, and the drainfield.
- **Do not attempt self-repairs or allow unauthorized repairs or maintenance on your ATU.** Aerobic treatment units have many mechanical parts and should only be maintained by a professional.
- **Do not allow chemicals or poisons to enter your ATU.** Avoid flushing down household chemicals or pesticides/herbicides because they can kill the bacteria used in the ATU.
- **Do not overuse your garbage disposal.** Waste from garbage disposals can overload your ATU and increase clogging and require more frequent pumping.
- **Do not allow non-biodegradable items such as cigarette butts, disposable diapers, or coffee grounds to enter your system.**

Maintenance and Inspections

Aerobic treatment units have many mechanical parts and therefore require diligent inspections and maintenance. In an ATU, even the smallest of malfunctions can significantly inhibit the wastewater treatment. However, if properly maintained ATUs will produce a very high level of wastewater treatment and are designed to last for a long time.

There are many types and brands of ATUs on the market and each contains specific demands for its maintenance and upkeep, therefore it is not always possible for the owner to provide the required inspections, repairs, and maintenance. Newly installed ATUs are required to have a service contract provided by the manufacturer. Operating permits issued by the DOH are also required and will stipulate the frequency of inspections and maintenance. Professional inspections consist of inspecting wastewater quality, the mechanical parts, and overall system functions. If any maintenance is required, always hire a certified service provider. An up-to-date list of certified service providers may be obtained from the DOH.

Figure 4. Aeration in an ATU.

More Information

For more information see "*Decentralized Systems Technology Fact Sheet: Aerobic Treatment*" by the US EPA. Available at:
www.epa.gov/npdes/pubs/aerobic_treatment.pdf

Additional information may also be found at:
http://[illegible]/pdf/ww/publications/[illegible]

More Fact Sheets and resources may be found on the Hawaii State Department of Health OSDS website: www.doh.com/TBD

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ABSORPTION FIELDS

Homeowners Guide: Fact Sheet #4

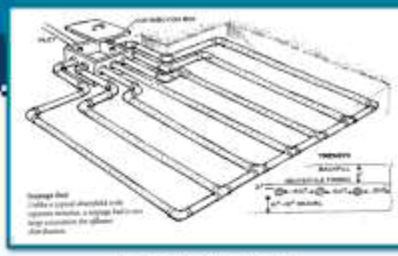


Figure 1. Soil absorption bed.

Soil Absorption Fields

Soil absorption fields are onsite wastewater disposal systems commonly found at the backend of many septic systems. They typically consist of a distribution box and a subsurface, perforated piping system. The absorption field may also be referred to as the drainfield or soil absorption field, and two common types of absorption fields are the absorption bed and the absorption trench. Nevertheless, all absorption fields function on the same basic principle as they utilize the soil to treat and effectively dispose of wastewater effluent.

Absorption fields are designed and chosen based on the characteristics of the soil and groundwater, surrounding terrain, and climate conditions. High groundwater tables, steep slopes, and wet climates are typical factors that limit the use and effectiveness of absorption fields. Maintaining the field is very important and greatly affects the performance of the system. Maintenance begins with maintaining the preceding treatment unit and includes being able to identify obvious warning signs and following a few simple rules. The absorption field is a simply maintained yet extremely important component of your onsite sewage disposal system.

How Does It Work?

Absorption systems are a type of subsurface wastewater infiltration systems (SWIS). The main function of the absorption field is to receive treated wastewater effluent from the septic tank (or any preceding treatment unit) and distribute the effluent into the subsurface soil. As the effluent seeps through the soil, microbial actions and filtration further breaks down pollutant organics and removes infectious bacteria from the effluent. If properly designed and maintained, this allows the wastewater effluent to be safely disposed of onsite without contamination or pollution of the receiving groundwater table.

This first component of an absorption system is the distribution box (D-box). The D-box receives wastewater effluent from a wastewater treatment unit and evenly distributes the effluent into the piping system. The piping system is typically a network of subsurface, perforated pipes overlain by gravel and soil. The main job of the piping system is to evenly distribute the effluent into the surrounding soil where it can be further purified and finally incorporated into the groundwater. Commonly a biological mat of microorganisms may grow under the absorption field and this is beneficial to the continued treatment of the wastewater effluent as it leaches through the soil.

More Information

Absorption Field Maintenance

The absorption field is the last component of your onsite sewage disposal system. It is essential to maintain your absorption field to ensure the proper disposal of your treated wastewater. A failing absorption field can lead to surfacing of wastewater or contamination of groundwater and pose health hazards to both your family and the public. The following are a few maintenance tips to keep your field running properly and safely.

1. **Have your absorption field inspected the same time your treatment unit is inspected.** This will ensure the proper functioning of your absorption field.
2. **Maintain your wastewater treatment unit.** The quality of effluent an absorption field receives is a direct factor to the health of the field. Maintaining a healthy treatment unit, whether it is a septic tank, aerobic treatment unit, or any other type of onsite wastewater treatment, will ensure the highest quality effluent possible and in turn protect your disposal field.
3. **Know where your absorption field is located.** By knowing where you septic system and absorption field is located, it will help you protect it from harmful activities and identify important warning signs.
4. **Avoid driving, digging, or construction over the field.** These activities may compact the soil or cave-in piping which will lead to system failures and safety hazards.
5. **Do not allow trees or large shrubs to grow on or near the field.** Roots can penetrate pipes causing leaks or clogs and prevent the proper distribution of effluent.
6. **Cover your disposal field with small vegetation.** Ground cover such as grass will protect your absorption field from erosion. However, do not plant trees or plants with invasive root systems.
7. **Divert surface water away from the disposal field.** Roof drains, sump pumps, or runoff should be kept away from the field as much as possible. Excessive water flowing over or into the absorption field may over saturate the soil and reduce the ability of the absorption field to properly dispose of the effluent.
8. **Use water efficiently.** Using less water will increase the treatment efficiency of your septic system and consequently prolong the health of your absorption field.

Common Failures and their Causes

Sewage ponding or evidence of ponding in yard. See top pictures.	Obnoxious odors inside or outside the house.	Fixtures backed-up or draining slowly.	Surface or groundwater contaminated with bacteria.
• Too much water is entering the septic system. • Surrounding soil is over saturated due to rising groundwater tables or excessive rain. • Solids are flowing into the absorption field. • Lift-station pumps failed or float switches incorrectly set. • Pipes are clogged.	• If inside, fixtures are likely backing up due to failure in the septic system. • If outside, sewage may be surfacing and ponding.	• Clogging is occurring somewhere in the septic system. • Piping system improperly designed or constructed if new. • Broken piping system. • Too much water is entering the septic system. • Lift-station pump failed.	• Septic system failing and improperly discharging wastewater into environment. • Septic system improperly constructed or placed. • Source is other than homeowner's system.

OSDS Inspection Project (2012)

- Statewide effort
  - Asked for voluntary inspections statewide
  - Provided free inspection using protocols and sheets developed previously – updated
  - Also collected data (sludge judge) and samples
  - Provided Homeowner Education Fact Sheets
  - Provided Maintenance requirements
- Goals
  - Find distribution of OSDS condition
  - Get better transport model inputs
  - Feed into Risk Analysis
  - Help to develop management program
- With: Mike Cummings, Bob Whittier, Aly El-Kadi
- On DOH website

Inspection Results

Participation Rates for Five Hawaiian Islands

Island	OSDS category			Island total[μ]	Accessed
	Visited	Contacted	Inspected		
Kauai	45	31	63	139 (31)	58
Oahu	21	44	59	124 (28)	56
Molokai	15	5	7	27 (6)	6
Maui	34	13	29	76 (17)	17
Big Island	11	11	55	77 (18)	44
Category total[μ]	126 (28)	104 (24)	213 (48)	443 (100)	181 (41)

Numbers shown represent the number of sites and numbers in parenthesis are percent of total

Inspection Results

OSDS Condition Assessment Scores

Island (location)	Assessment score and color coding (inspected)					Couldn't access	Total
	1	2	3	4	Total Accessed		
	Pass	Sludge/Scum	Potential failure	Fail			
Kauai	37 (64%)	3 (5%)	7 (12%)	11 (19%)	58	5	63
Oahu	33 (59%)	3 (5%)	12 (21%)	8 (14%)	56	3	59
Molokai	4 (67%)	1 (17%)	0 (0%)	1 (17%)	6	1	7
Maui	12 (71%)	1 (6%)	1 (6%)	3 (18%)	17	12	29
Big Island	37 (84%)	1 (2%)	0 (0%)	6 (14%)	44	11	55
Total	123 (68%)	9 (5%)	20 (11%)	29 (16%)	181	32[Ω]	213

[Ω] Breakdown of 32 sites that could not be accessed (sites that had portable toilets but were previously served by OSDS - 4, an attempt was made but the location could not be determined -12, OSDS that were located but the covers for access could not be removed because of obstructions - 8, sites were presumed to be OSDS but further investigation revealed that it was served by a sewer - 8)

Inspection Results

Self-reported pumping frequencies for septic tanks in the State of Hawaii

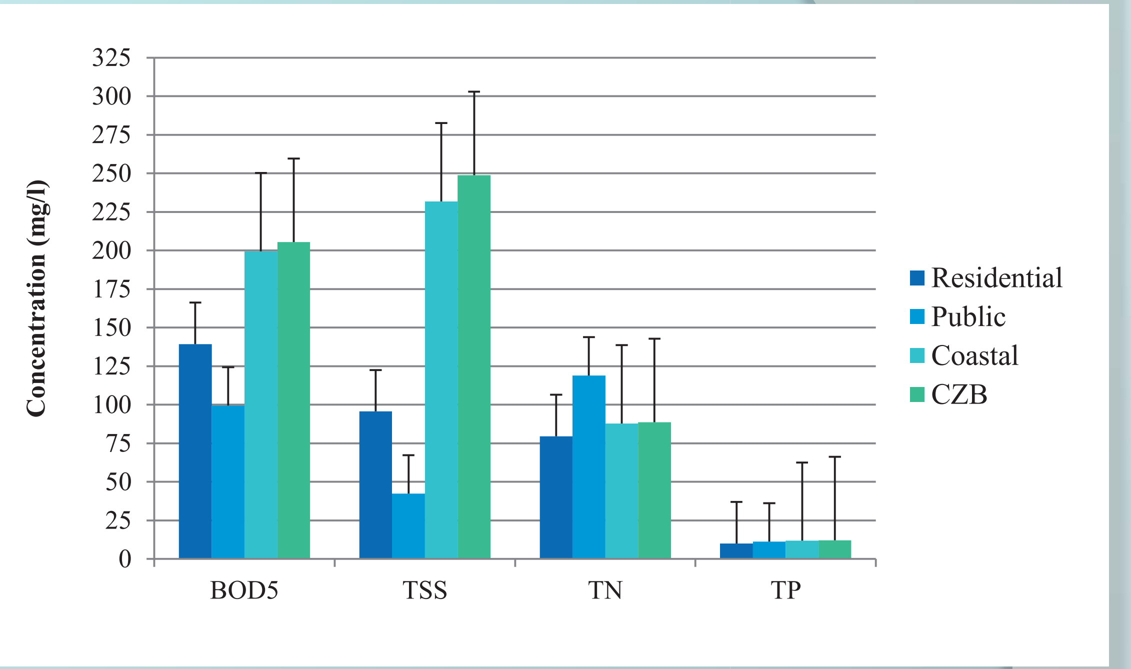
Pumping interval	Count	Percentage
Never	81	28.1
Unknown	150	52.1
Once or twice	11	3.8
Once or more per year	16	5.6
Contracted	30	10.4
Total	288	100

Effluent Samples

72 systems (40%):

58 Septic

14 ATU



Component	Septic tank effluent characteristics			
	Expected (EPA) values		Actual measured values	
	Concentration range	Typical concentration	Fraction that fall within range	Fraction exceeding typical concentration
TSS (mg/l)	36 - 85	60	40 %	43%
BOD5 (mg/l)	118 - 189	120	25 %	40%
Total N (mg/l)	29.5 - 63.4	60	19 %	74%
Total P (mg/l)	8.1 - 8.2	8.1	2 %	69%

Inspection Survey summary

- 80% of 181 systems not receiving basic maintenance
- 2/3 of systems rated as passing
- 1/6 are in need of service and could fail
- 1/6 are considered failing
- Unmaintained ATUs do not perform better than septic tanks, and do not meet 30/30
- 70% of effluent samples exceeded typical values of TN & TP
- 40% of samples exceeded typical values for TSS and BOD
- Honor system for ATU maintenance not effective
- A more managed program is needed

Selection Tool (2013)

- Four step process:
  1) Preliminary site analysis (location, topography, soil type, separation distances)
  2) Site conditions (high WT, soil perm, steepness, flood zone, proximity, density)
  3) Wastewater characterization
  4) Estimate costs
- Tables for applicability
- Cost tables
- Examples provided
- With: Terry Chan MS

	Minimum Horizontal Distance From (ft) HAR 11-62 ("Recommended Standards")			
	Cesspool	Treatment Unit	Seepage Pit	Soil Absorption System
Wall line of any structure	5	5 (10)	5	5
Property line	9	5 (10)	9	5
Stream, ocean (taken from the vegetation line), pond, lake or other surface water body	50	50 (50)	50	50
Large tree	10	5	10	10
Treatment unit	5	5	5	5
Seepage pit	18	5	12	5
Cesspool	18	5	18	5
Soil absorption system	5	5	5	5
Potable water source serving public water systems (potable wells)	1,000	500 (50)	1,000	1,000

Soil Texture	Percolation Rate (min/in)	Application Rate (gpd/ft^2)
Coarse sand or coarser	<1	Not suitable
Medium sand	1-5	1.2
Porous, well-developed structure in silt and silt loams	31-60	0.45
Other silt loams, silty loams, clay loams	61-120	0.2

Treatment selection

	High Water Table (<3' below point of discharge)	Low Permeable Soil (<1 or >10 min/in)	Steep Terrain (>8% slope)	Flood zone (100-yr flood)	Proximity to Inland Surface Water (<50' to streams, lakes)	Proximity to Coastal Waters (<50' to oceans)	High OSDS Density (>40 OSDS/acre)	Protection of Groundwater	Lateral Movemen t
Onsite Treatment Method									
Septic Tank	No[1]	No[1]	Yes	No[1]	No[1]	No[1]	No[1]	No[1]	No[1]
Continuous Flow ATU w/ Fixed Integral Packing	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No[1]
Sequencing Batch Reactor ATU	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No[1]
Sand Filter	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes[2]
Recirculating Sand Filter	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes[2]
Enhanced Phosphorus Removal	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]
Enhanced Nitrogen Removal	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]
Emerging Trace Contaminant Removal	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]
Chlorine Disinfection	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]
UV Disinfection	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]	Yes[2]

[1] Additional treatment required

[2] Treatment supplement

Disposal selection

	High Water Table (<3' below point of discharge)	Low Permeable Soil (<1 or >10 min/in)	Steep Terrain (>8% slope)	Flood zone (100-yr flood)	Proximity to Inland Surface Water (<50' to streams, lakes)	Proximity to Coastal Waters (<50' to oceans)	High OSDS Density (>40 OSDS/acre)	Protection of Groundwater	Lateral Movement
Onsite Disposal System									
Holding Tank	No	No	No	No	No	No	No	No	No
Cesspool	No	No	No	No	No	No	No	No	No
Seepage Pit	No	No	Yes	No	No	No	No	No	No
Adsorption Trenches	No	No	No	No	No	No	No	No	No
Adsorption Beds	No	No	No	No	No	No	No	No	No
Elevated Mounds	Yes	Yes	No	Yes	No	No	No	No	No
Evapotranspiration	Yes[3]	Yes[3]	Yes[3]	Yes[3]	Yes[3]	Yes[3]	Yes[3]	Yes[3]	Yes[3]
Water Reuse	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Stand Alone Facilities									
Waterless toilets	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

[3] Contained with no percolation into subsurface

Costs

	Typical Installation Costs ($/Unit)	Annual Maintenance Fees ($/yr) (Including pumping and labor)	Energy Consumption (kW-h/yr)	Energy Costs ($/yr) (Assuming 35 cents per kW-h)	Annual Replacement Parts ($/yr) (Including chemicals)	Annual Amortized Cost over 5 years ($/mon) (At nominal 6% annual interest rate, compounded monthly)
Treatment System						
Septic Tank	6,000-14,000	60-250	0	0	0	100-300
Sequenced Batch Reactor ATU	24,000-36,000	250-350	915-3,650	315-1280	0	500-800
Recirculating Sand Filter	18,000-36,000	200-250	110-300	35-105	350-750 (media replacement every 4-5 years)	350-750
Enhanced Phosphorus Removal	6,000-13,000	-	-	-	500-900 (media replacement every 4-5 years)	130-280
UV Disinfection	1,000-3,000	50-150	307	105-115	80-95	40-70
Disposal System						
Seepage Pit	>10,000	-	-	-	-	>230
Absorption Trenches	8,000-22,000	-	-	-	-	160-420
Elevated Mounds	12,000-30,000	-	110-365	35-130	-	230-590
Evapotranspiration	18,000-30,000	-	-	35-130	-	350-680
Water Reuse	Varies (assume 6,000-7,000)	-	-	-	-	Varies

Testing ATUs

- Tested 4 HI-produced ATUs
- NSF Std-40 protocol, Class I

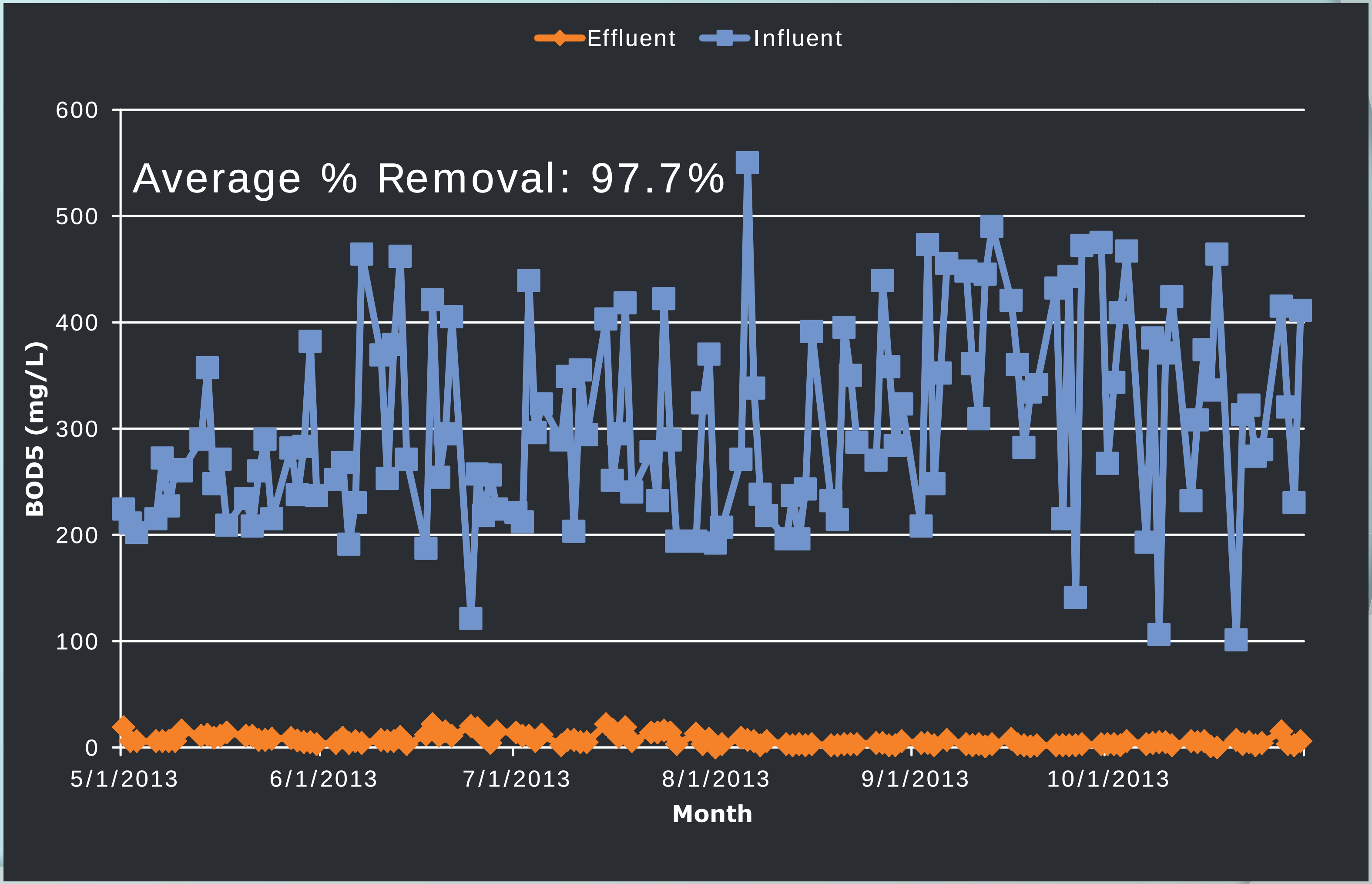
- NSF Std-245 protocol, N-removal
- Feasibility for recycling
  - R-3 = Class I
  - R-2 = disinfected (23 CFU/100mL)
  - R-1 = Title 22 (+ sand filter & UV)

Acknowledgements

- The work of several students over the past 20 years
  - Best OESIS 400 1998-99:
    Daniel McNair, Lance Edling, Beth Florendo, Keith Oshiro
  - IWT CBT 800 2004-05:
    Atiim Senthill, Tieshi Huang, Yingyot Chanthawornsawat, Sumon Kanpirom, Jing Hu
  - Envirocycle ECR 600 2013-14:
    Gloria Cheong, Branden Santiano, Yanling Li, Krishna Lamichhane
  - WaipomoPure 800 2015-16:
    Collin Nguyen, Stanley Taguchi, Jeremy DeGracia, Xavier Visaya

- The City and County of Honolulu, ENV T&D has given access/power and let us do this

Sample data



Effluent
Influent
Average % Removal: 97.7%
BOD5 (mg/L)
600
500
400
300
200
100
0
5/1/2013
6/1/2013
7/1/2013
8/1/2013
9/1/2013
10/1/2013
Month

Sample data

		Avg.	Std. Dev.	Min.	Max.	Med.	Data Points
Dosed Volume (Gallons/day)		600	NA	600	600	600	NA
Dissolved Oxygen (mg/L)	Aeration Chamber	6.84	1.64	0.2	8.70	7.45	125
Ambient Temperature (°C)	Aeration Chamber	29.05	1.18	25.00	31.60	29.10	130
pH (SU)	Aeration Chamber	6.52	0.39	5.40	7.61	6.57	128
BOD_5 (mg/L)	Influent	303	92	101	550	284	133
BOD_5 (mg/L)	Effluent	7	5	0	22	6	132
Total Suspended Solids (mg/L)	Influent	257	80	32	571	239	129
	Effluent	4	4	0	30	3	131
Settleable Solids (mL/L)	Effluent	0	0	0	0	0	0
Ammonia (mg/L)	Effluent	14.8	12	0.02	49.4	12.2	71
Nitrate (mg/L)	Effluent	50.8	27	4.58	126	51.4	117
Nitrite (mg/L)	Effluent	3.27	4	0.01	21.36	2.24	67
Total Nitrogen (mg/L)	Influent	38	11	8	96	37.50	66
	Effluent	18	13	1	76	18	66
Total Phosphorus (mg/L)	Influent	15	10	1.5	44.5	15.3	56
	Effluent	12	6	0.05	25.50	13.50	56

Approvals & Nitrogen Removal

- DOH Approvals
  - Best Industries OESIS-750 – APPROVED 1999
  - International WW Technologies CBT 0.8KF-210 – APPROVED 2005
  - Envirocycle ECR 600 – APPROVED 2014
  - WaiponoPure 800 – APPROVED 2016 (NSF 245 pending)

- BOD & TSS Average in Effluents

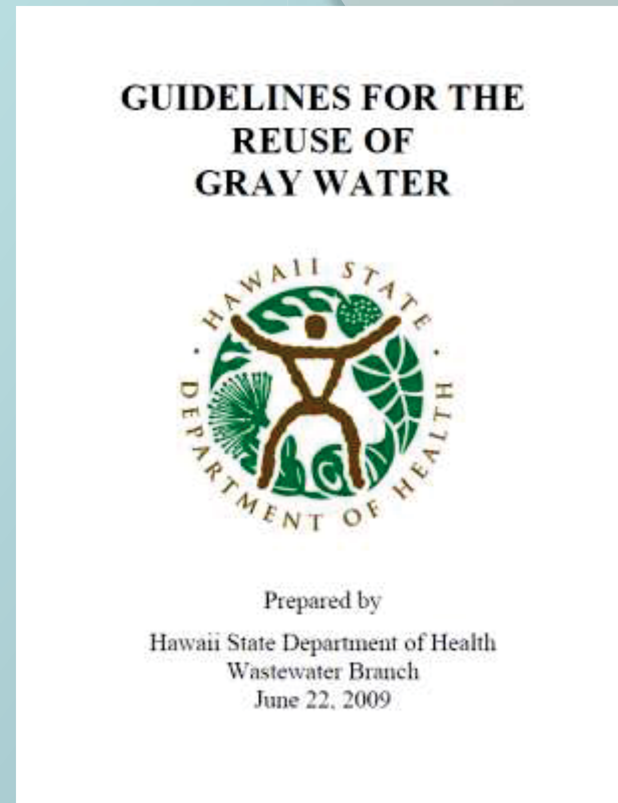
	CBOD	TSS
OESIS-750	13.9	13.1
CBT 0.8KF-210	4.6	2.7
Envirocycle ECR 600	7.0	4.0
WaiponoPure 800	14.4	9.1

- Nitrogen Removals

Nitrogen Removals	%	Meets CZARA/245
OESIS-750	19	No
IWT CBT 0.8KF-210	81	Yes
Envirocycle ECR 600	53	Yes
WaiponoPure 800	74	Yes

Gray Water Reuse

- Guidelines for the Reuse of Gray Water, DOH, June 2009 (on-line at: hawaii.gov)
- Blackwater: toilets, kitchen sinks
- Gray water: showers/tubs, lavatories, clotheswashing machines
  - 50-80% of generated residential wastewater
- Uses
  - Irrigation – subsurface only
  - Plant lists
- Treatment – none
- System requirements, design considerations, and maintenance
- Example calculations
  - Gray water volume
  - Sizing the Tank
  - Sizing the Irrigation area

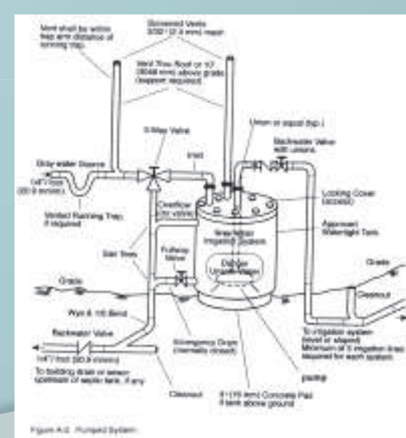


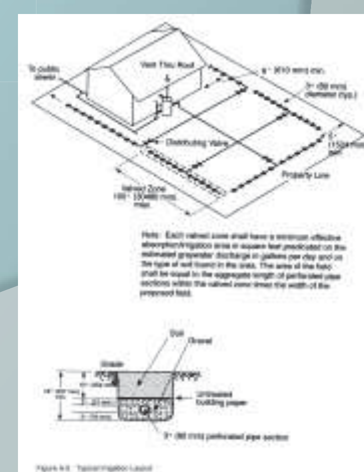
GUIDELINES FOR THE REUSE OF GRAY WATER

HAWAII STATE DEPARTMENT OF HEALTH

Prepared by

Hawaii State Department of Health
Wastewater Branch
June 22, 2009





CURRENT: Investigation of Cesspool Upgrade Alternatives for Upcountry Maui

DOH-SDWB: Babcock, Oleson, Barnes, (student: Adrienne Fung)

- Identify replacement alternatives
  - On-site treatment and disposal options, incl. new
  - Sewers and WWTPs
  - Site conditions, siting rules
  - Costs (capital, O&M)
  - Management program
- Analyze environmental benefits
  - Modeling transport of N
  - Goal: TN < 5 mg/L
- Cost/Benefit decision-making analysis
  - Replacement costs, O&M costs, Management costs
  - Benefits quantification
- Stakeholder engagement

Cesspool Upgrades

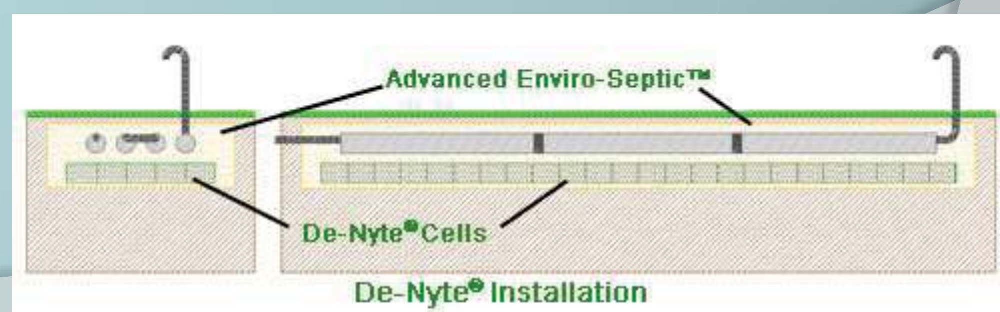
- Non-priority areas
  - Conventional septic tank with absorption trenches/bed
  - ATU with absorption trenches/bed
  - Advanced ATU with disinfection and seepage pit or drip irrigation
- Priority areas (risks to public health, drinking water, sensitive surface/ocean waters)
  - ATU w/DN with absorption trenches/bed
  - Advanced ATU w/DN with disinfection and seepage pit or drip irrigation
  - Septic tank with DN absorption bed

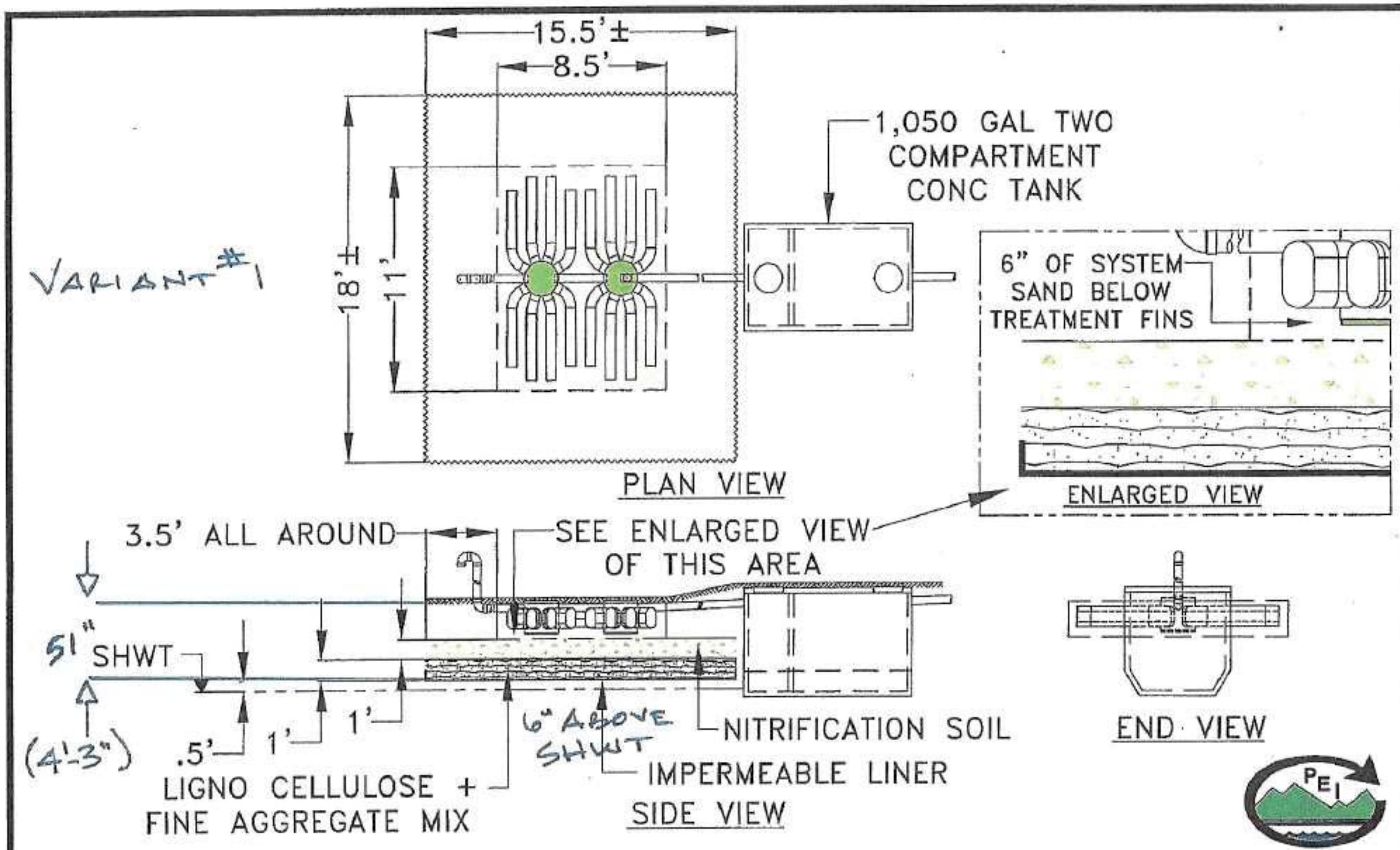
FUTURE:

- Pilot testing MBR ATUs
- Bench+field testing glass foam absorption beds
- Field test Presby system
- Bench+field test denitrifying absorption beds (wood chips/sawdust)
- Issues/Research:
  - Local conditions, locally sourced materials
  - Low vs high tech, operation cost vs reliability
  - Inspection/Maintenance needs and lifespan
  - Management program, permits, design stds/manual
  - “pressure” to innovate and reduce costs


Ridges
Increase surface area
Improve cooling
Provide more bacterial growth areas
Skimmers at Each Perforation
Prevent grease and suspended solids from leaving the pipe
Protect green fibers and geo-textiles from clogging
Black Geotextile
Surrounds the pipe and fibers
Provides protected bacterial treatment surface
Green Plastic Fiber Mat
Filters more suspended solids
Protects outer geotextile bacterial treatment surface
Creates a massive bacterial treatment area
Bio-Accelerator® Fabric
Quickly develops treatment biomat
Screens more solids from the wastewater
Ensures distribution of wastewater along the entire length of the pipes
Provides additional treatment surface
Enhances and accelerates treatment
Facilitates quick start-up
Further protects outer layers and the receiving surfaces


ENVIRO FIN™
Revolutionary Design ~ Proven Technology
Perforated Pipe (Air Duct)
• Allows air to flow lengthwise into the fibers & System Sand to promote bacterial growth
Fin Distribution Unit (FDU)
• Settles & breaks down suspended solids
• Equalizes flow between units
• Distributes effluent into the Treatment Fins
Skimmer Tabs
• Prevents grease and suspended solids from leaving the FDU
• Protects coarse Green Fibers and geo-textile from clogging
Treatment Fins
Air Ports
• Allows air to enter the Treatment Fins to promote aerobic bacterial growth
Coarse Green Fibers
• Filters and digests more suspended solids
• Protects outer geo-textile bacterial treatment surface
• Creates massive bacteria treatment area
Ships Easily!
1 EnviroFin™ System
Fits in 1 Box (~50 lbs)
NSF


Advanced Enviro-Septic™
De-Nyte® Cells
De-Nyte® Installation



SCALE: NONE

Presby Environmental, Inc.

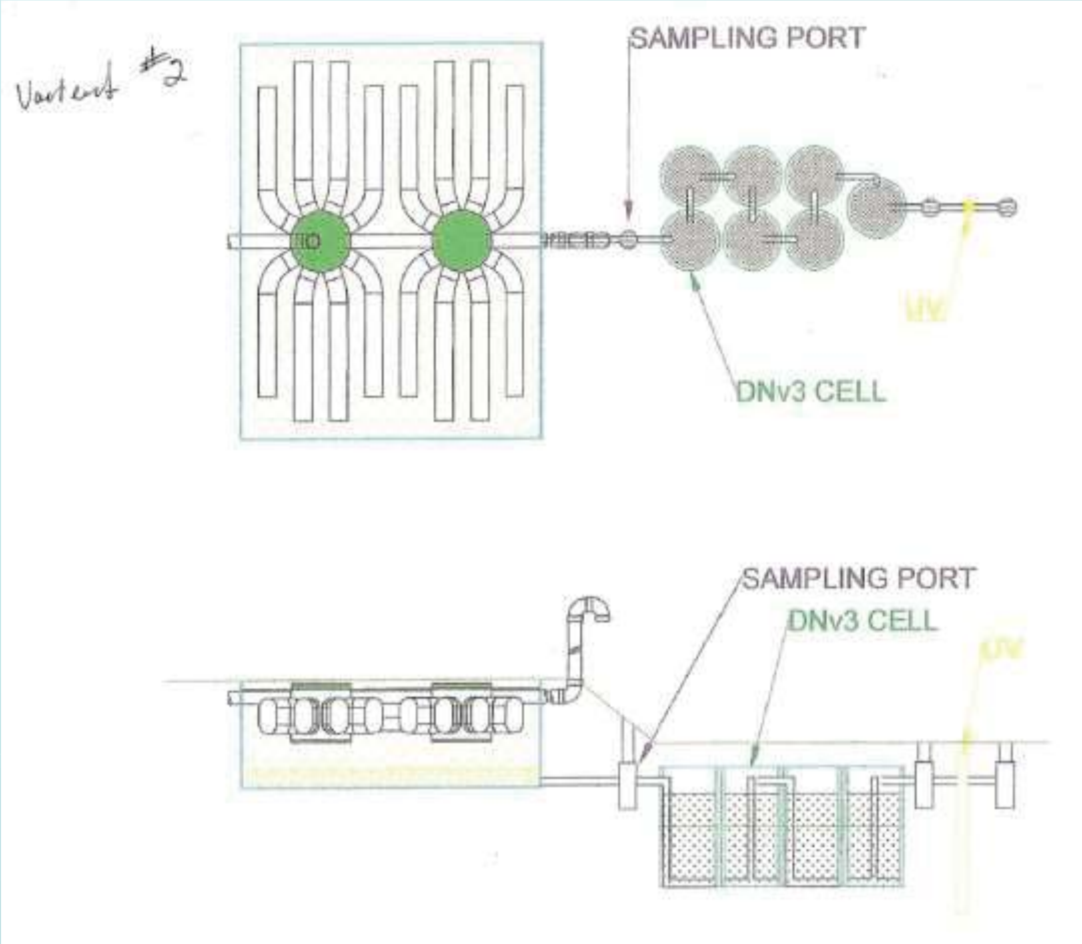
143 Airport Road
Whitefield, NH 03598

Phone: 800-473-5298 603-837-9864

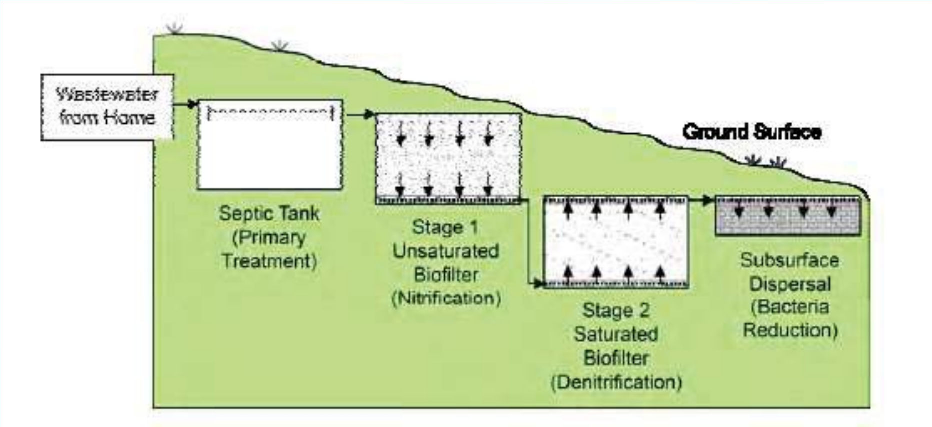
THE PRESBY WASTEWATER TREATEMENT SYSTEM

Florida De-Nyte® System

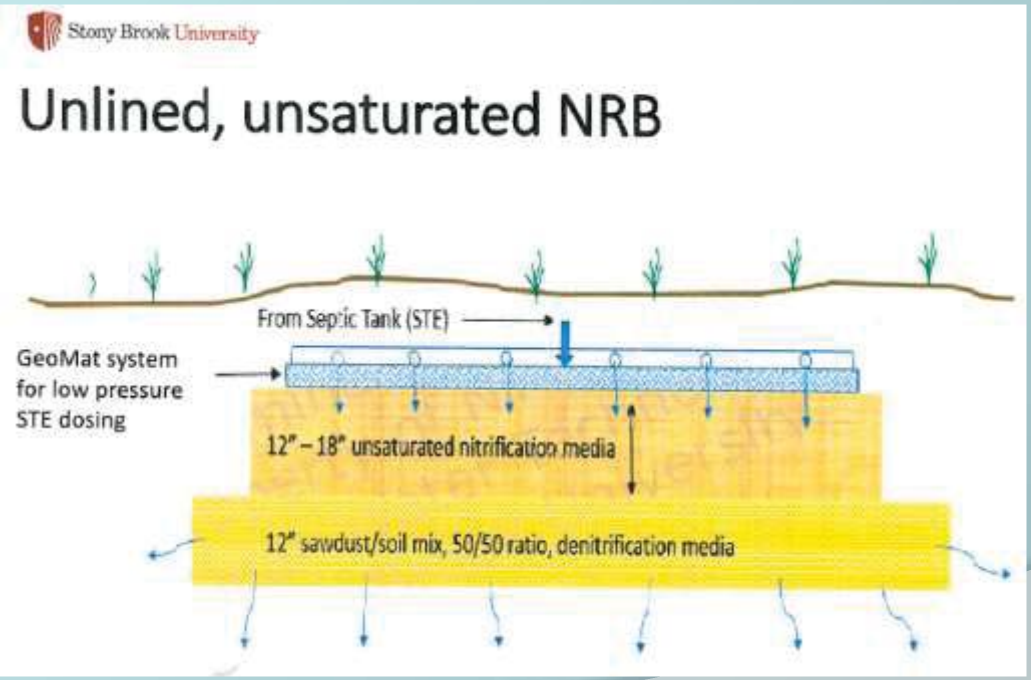
Drawn by	Checked	DWG #	Date	Job #
DF	KS		3-10-17	



SAMPLING PORT
UV
DNv3 CELL
SAMPLING PORT
DNv3 CELL
UV



Florida



New York

Questions