Florida Department of Health Assessment of Water Quality Protection by Advanced Onsite Sewage Treatment and Disposal Systems: Performance, Management, Monitoring

DRAFT Final Report

for

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Executive Summary

Onsite Sewage Treatment and Disposal Systems (OSTDS) serve approximately one-third of all households in Florida. While most OSTDS are conventional systems with septic tanks and drainfields, there are some other systems that provide additional, or advanced, treatment before disposal. Advanced OSTDS are utilized throughout Florida for various reasons and require more maintenance and management than a conventional OSTDS. There are two main categories of advanced systems in Florida: Aerobic Treatment Units (ATUs) which generally add air to improve the wastewater treatment process, and Performance-Based Treatment Systems (PBTS) which are designed by engineers to target specific performance levels for various wastewater components. Advanced systems in Florida require a maintenance entity (ME) which is a company that is certified by a system manufacturer to perform maintenance inspections on advanced systems and ensure proper functionality. Since 2001 there had been no systematic assessment of operation and effluent quality of advanced systems in Florida.

The purpose of this study was to assess the effectiveness of advanced OSTDS treatment before discharge to the drainfields and to develop best management practices to improve system performance. This project was funded through the Florida Department of Environmental Protection with a grant from the United States Environmental Protection Agency Nonpoint Source Pollution program (Section 319), with additional funding by the Florida Department of Health (FDOH). The study included: a pilot project in Monroe County assessing variability of samples, inventorying advanced systems, surveying user group perceptions, assessing the operational status of systems, sampling systems, and interviewing a target group of county FDOH staff and maintenance entities to assemble best management practices.

Based on a review of permit data there are about 12,000 advanced systems in Florida. Over 60% of the advanced systems are in five counties: Monroe, Charlotte, Brevard, Franklin, and Lee. ATUs are the predominant category of advanced systems; PBTS are only a tenth as frequent. The majority of installations are for new residential single-family homes with an estimated sewage flow of 300 gallons per day. Over 50 percent of the permitted drainfields associated with advanced systems were mounded drainfields, indicating they are on sites with high water tables. As of 2011 56 of 67 counties in Florida have one or more properties with advanced systems. Twenty-five of the 56 counties currently having an advanced system did not have one eleven years ago, which is an increase of 37%.

The detailed statewide sampling protocol was based on data gathered during a pilot study in Monroe County. The field assessment included evaluations to determine if the power was on, if there was a sanitary nuisance, if aeration was occurring, and if the alarms were working. Approximately 30% of all the visited sites were not operating properly based on at least one of these measures. Seventy percent of the operational issues found during field visits were due to the power being turned off or aeration issues. Many properties where the power was turned off were unoccupied. Field screening methods are a possible option to indicate system operational status without the expense of sample analysis.

A field evaluation procedure should assess whether the system has power, that no sanitary nuisance exists, that aeration results in bubbles and mixing of sewage, and that there are no alarms sounding. These data points provide an assessment of the operational status of a system and were found to correlate to sampling results. Having two ME visits in an annual

cycle also correlated positively to the operational status of an advanced system. There was also a correlation between systems that had a current operating permit and their operational status being satisfactory, indicating the importance of keeping the system paperwork up to date.

The study highlighted the need for regular inspections of these systems. The current requirement is one annual inspection by FDOH and two annual inspections by the ME. Having sufficient staff and a consistent and accurate record system are essential.

Surveys were sent to owners, regulators, installers, maintenance entities (ME), manufacturers, and engineers about the management of advanced onsite systems. The collected experiences and viewpoints from these groups outlined strengths as well as areas for further improvement in the management of these systems. Fifty-five percent of system owners reported that they have not had any problems with their system over the previous year. The major problems reported were pump failures, electrical malfunctions, faulty alarms, and bad motors. Almost eighty percent of owners indicated that they were very satisfied or satisfied with their system. Advanced systems appear to be fairly well accepted among the different user groups.

One problem encountered during the study was limited access to the system. Sampling locations may or may not be accessible depending on system installation. However, for nutrient monitoring the results suggest the sampling location is less important.

A comparison of median influent and effluent concentrations from systems found 95 percent removal for carbonaceous biochemical oxygen demand ($cBOD_5$), 75 percent removal for total suspended solids (TSS), 33 percent removal for total nitrogen (TN), and nearly no removal for total phosphorus (TP). These are generally consistent with the treatment steps employed, while the lower than expected TSS removal may be related to the sampling process. To assess the variability of performance of treatment systems and influent strength, samplers repeated visits to 25 sites. The results indicate that while there is considerably more variability for both influent and effluent concentrations among repeat sample results than previously seen for diurnal variations, results predominantly stay within a factor of two, with TSS being the most variable.

For PBTS, TN standards were exceeded in more than three quarters of the cases, and additional TP treatment steps did not meet their standard. There were significantly higher influent TN concentrations in PBTS as compared to ATUs. Estimates based on median concentrations indicated that PBTS reduced TN by about a third. These results indicate a need for review of design assumptions and technology.

There appeared to be good correlation between screening tests for nitrate and ammonia, and the lab results for Nitrate and Nitrite Nitrogen (NOx) and Total Kjeldahl Nitrogen (TKN), respectively. The analyses of the data indicate the need for additional data review and more thorough validation of screening methods for nutrient analysis.

Best Management Practices:

Five major categories of best management practices were identified. Each of the suggested best management practices should be considered individually based on the current needs of the county or maintenance entity.

1. Accurate and up-to-date records
2. Regular and comprehensive system maintenance
3. Consistent and fair enforcement
4. Sufficient staffing for FDOH and MEs
5. Effective training, education, and communication

Recommendations for Further Study

While the results of this study have answered many questions about the current performance and management of advanced OSTDS in Florida, there are areas that deserve further study.

1. Continuing the analysis of the data collected during this project.
2. Implementing the suggested enhancements to the Environmental Health Database (EHD) and website.
3. Developing a statewide standardized form for maintenance and inspections.
4. Evaluating low cost and effective nutrient reduction technologies. The FDOH Nitrogen Reduction Strategies Study is expected to be completed in 2015.
5. Developing a homeowner's awareness and education campaign.
6. Selecting a pilot county to implement the best management practices.
7. Developing an enforcement procedure.
8. Conducting workshops to further discuss best management practices.

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1 Introduction

1.1 Problem Definition/Background

Onsite Sewage Treatment and Disposal Systems (OSTDS) under the jurisdiction of the Florida Department of Health (FDOH) serve approximately one-third of all households in the state. OSTDS are one source of nutrients in nutrient impaired watersheds. Estimates of the extent of their contribution to nitrogen loadings for different watersheds in Florida have ranged from less than 5% to more than 20%, raising the question of what options are available to address their contribution. Conventional OSTDS (septic-tank-drainfields) have limited capacity to reduce nitrogen concentrations in water discharged to the drainfields. Because of this, residential density limitations have been used as one approach to meet the nitrate drinking water standard of 10 mg/L, which is not necessarily protective of ecological health. The phosphorus loading from OSTDS has been of most concern in the Florida Keys, where small lots, poor soils, and building practices increase the risks of impacts on surface water.

While most of Florida's OSTDS are conventional OSTDS, or septic systems, there are other advanced systems capable of providing additional or advanced treatment of wastewater prior to disposal in the drainfield. Advanced OSTDS can utilize various approaches to improve treatment before discharge to a drainfield, or the drainfield itself can be modified. On occasion, engineers have included the drainfield as part of the treatment process, usually as a means to achieve fecal coliform reduction. In such cases, the engineer is required to include shallow groundwater monitoring wells in the monitoring plan.

Interest in performance, management and monitoring of advanced systems comes from several perspectives:

- What options are available to reduce the risk of pollution from onsite systems? This question arises frequently in the context of water quality protection and restoration discussions.
- How effective are commonly used technologies in reducing this risk? The use of advanced systems or some subset of them could potentially be considered a "best management practice" for onsite systems in the context of water quality restoration efforts. Quantification of the effectiveness of such a practice would be useful.
- How is the day-to-day management and operation of such systems working and how can it be improved? Administratively, advanced systems in Florida are distinguished by several features from other onsite sewage programs.
- How are such systems perceived and accepted? Each group of people dealing with advanced onsite systems in some way manages a part of the life cycle of them, be it the

design, permitting, selling, installation, operation, maintenance, use, repair, control, and eventual abandonment. Their opinions can influence the implementation of such a program.

There are two large permitting categories in Florida onsite regulations that qualify as advanced treatment: Aerobic Treatment Units (ATUs) (Rule 64E-6.012, Florida Administrative Code (FAC)), which are generally permitted based on certification by the National Sanitation Foundation International (NSF); and performance-based treatment systems (PBTS) (Chapter 64E-6, part IV FAC), which are permitted based on design by a professional engineer experienced in wastewater treatment. Two additional permitting categories are rare: innovative systems and sand filters. Innovative systems serve to evaluate a technology, either treatment or disposal, for a limited time with a limited number of installations and have permitting procedures similar to performance-based treatment systems. Sand filters are engineer-designed alternative treatment systems that were used in some areas occasionally in the last century but are now rarely used and are mainly encountered in repair situations.

Advanced systems are required by Florida state law in the Florida Keys and the Aucilla and Suwannee River floodplains. They have also been required by local regulations, to protect sensitive areas (e.g., St. George Island in Franklin County and parts of Brevard, Charlotte, and Volusia Counties). In addition, Chapter 64E-6, FAC, allows advanced treatment, sometimes including nitrogen and fecal coliform reduction, for lots where the required setback or authorized lot flow restrictions cannot be met. A property owner may also want an advanced system that produces a higher level of wastewater treatment for protection of the environment.

Advanced systems differ in three aspects from conventional treatment systems that consist of a septic tank with drainfield. First, the design of advanced systems is more variable than the prescriptive approach for conventional systems. Second, these systems need more frequent evaluation and maintenance, which is the reason they require operating permits. Third, while the failure definition for advanced systems is vague, their performance expectations are more specific than simply the absence of sewage on the ground surface. The first two issues have been challenges for the permitting process. Site specific performance specifications are not captured completely in the databases that are used statewide for tracking permits. The specific performance expectations for advanced systems have made it hard to determine how well these systems are working in Florida.

Proper management of advanced onsite systems is a key to their success. Management of onsite systems has many facets. Each group of people dealing with onsite systems in some way manages a part of their life cycle, be it the design, permitting, selling, installation, operation, maintenance, use, repair, control, and eventual abandonment. Few are involved in all phases of a system's life, with the possible exceptions of regulators and installing maintenance entities. Anecdotally, there appears to be some variety of management approaches even within the uniform regulatory requirements (i.e., operating permit, maintenance contract, and FDOH inspection) in Florida. The approaches taken may depend on the work load, qualifications and interests of the people involved. With this variability two questions arise:

Is there a set of good or “best” management practices that deliver superior results in terms of treatment results and in terms of the satisfaction of the people involved?

How could people learn about such a set of practices?

Good data are needed in order to answer these questions. There has been no systematic assessment of effluent quality of advanced systems in Florida. A review of aerobic treatment unit sampling results gathered previously in one county, showed high variability of effluent quality that was at least in part related to differences in sample locations (Roeder and Brookman, 2006). The Water Quality Protection by Advanced OSTDS project aims to perform such a statewide assessment on a limited scale and, where needed, develop improvements in the management of advanced systems.

The emphasis of this study was to assess the effectiveness of treatment in advanced OSTDS before discharge to the drainfields. The objectives of the overall project were to:

1. Quantify the reduced loading of contaminants from advanced Onsite Sewage Treatment and Disposal Systems (OSTDS) to the environment;
2. Assess the operational status of systems under the current management framework, including a comparison of system functioning to the expected permit levels of performance;
3. Survey perceptions of user groups regarding the management of such systems;
4. Validate elements of a monitoring protocol for consistent assessment of systems; and
5. Document best management practices.

There were six major tasks associated with this project. These are described below with references to sections in this report that discuss these tasks:

Task 1. Monroe County detailed study of variability of performance of advanced systems (Keys Study) (Section 1.4)

Task 2. Statewide database inventory of advanced systems based on permit records (Section 1.3 and Appendix B)

Task 3. Survey of the perceived strengths and weaknesses of the current management of advanced onsite systems (Section 2.4, Section 3.4, and Appendix A)

Task 4. Statewide assessment of operating condition and performance of a random sample of approximately 550 advanced systems (Section 2.3, Section 3.3)

Task 5. Periodic influent and effluent sampling for a sample of approximately 25 systems (Section 3.3.6.2)

Task 6. Booklet with case studies outlining both strengths and weaknesses of the current program and best practices in advanced onsite management (Section 2.5, Section 3.5)

1.2 Glossary of Terms

Term	**Meaning**
ATU	Aerobic Treatment Unit. Type of advanced system that introduces oxygen to the wastewater. Generally permitted based on certification by the National Sanitation Foundation.
BMP	Best management practice. Effective and practical actions that can be taken to protect a resource. For the purposes of this paper, this would include actions that would improve the performance of advanced OSTDS.
EHD	Environmental Health Database. Statewide permitting database that FDOH uses to keep track of permits issued.
FAC	Florida Administrative Code. The part of the code that references OSTDS is Chapter 64E-6.
FDEP	Florida Department of Environmental Protection.
FDOH	Florida Department of Health. The Florida Department of Health has a central office and 67 local offices that administer health programs.
ME	Maintenance Entity. Company that does the maintenance inspections on advanced system, to ensure proper functionality.
NSF	National Sanitation Foundation International.
OP	Operating permit. Required for advanced systems.
OSTDS	Onsite sewage treatment and disposal systems. Includes both conventional septic systems and advanced systems.
PBTS	Performance-Based Treatment System. Type of advanced system that is designed to meet a specific performance level. Permitted based on design by a Florida licensed professional engineer experienced in wastewater treatment.
QAPP	Quality Assurance Project Plan. Document created to outline the methodologies, procedures, and other requirements necessary for collecting field data. Located online: http://www.doh.state.fl.us/environment/ostds/research/ResearchReports/final319qapp.pdf

1.3 Statewide Statistics on Advanced Systems

Developing a database of advanced systems was a key part of this project. This database contains a total of 16,595 systems from four main data sources: the FDOH Environmental Health Database (EHD), the Carmody system, various FDOH county office databases, and innovative permit files. The information came from two aspects of the permitting process: construction permitting for the initial construction or the repair of a system and operating permitting for the continued operation and maintenance of a system. The final report for the database portion of this project (Ursin and Roeder, 2011) contains detailed information about the database and its contents. The results are summarized in the following subsections.

1.3.1 Data Sources

The environmental health database is the centralized, web based successor to a previous central permitting data system of the FDOH, known as Centrax. Construction permits for system installation or repairs are captured separately from operating permits. EHD contains both data on permits issued since EHD has been implemented and legacy data from permits issued through Centrax since the mid- to late 1990s. Depending on the county, EHD was implemented between 2007 and 2008. The legacy data tend to contain fewer data fields. EHD contains information on all systems, not just advanced systems. The bulk of the data in the database was collected in September 2009. As an illustration, Figure 1 shows the total number of operating permits for ATU and PBTS in Florida as of April 2012 by county as generated from EHD.

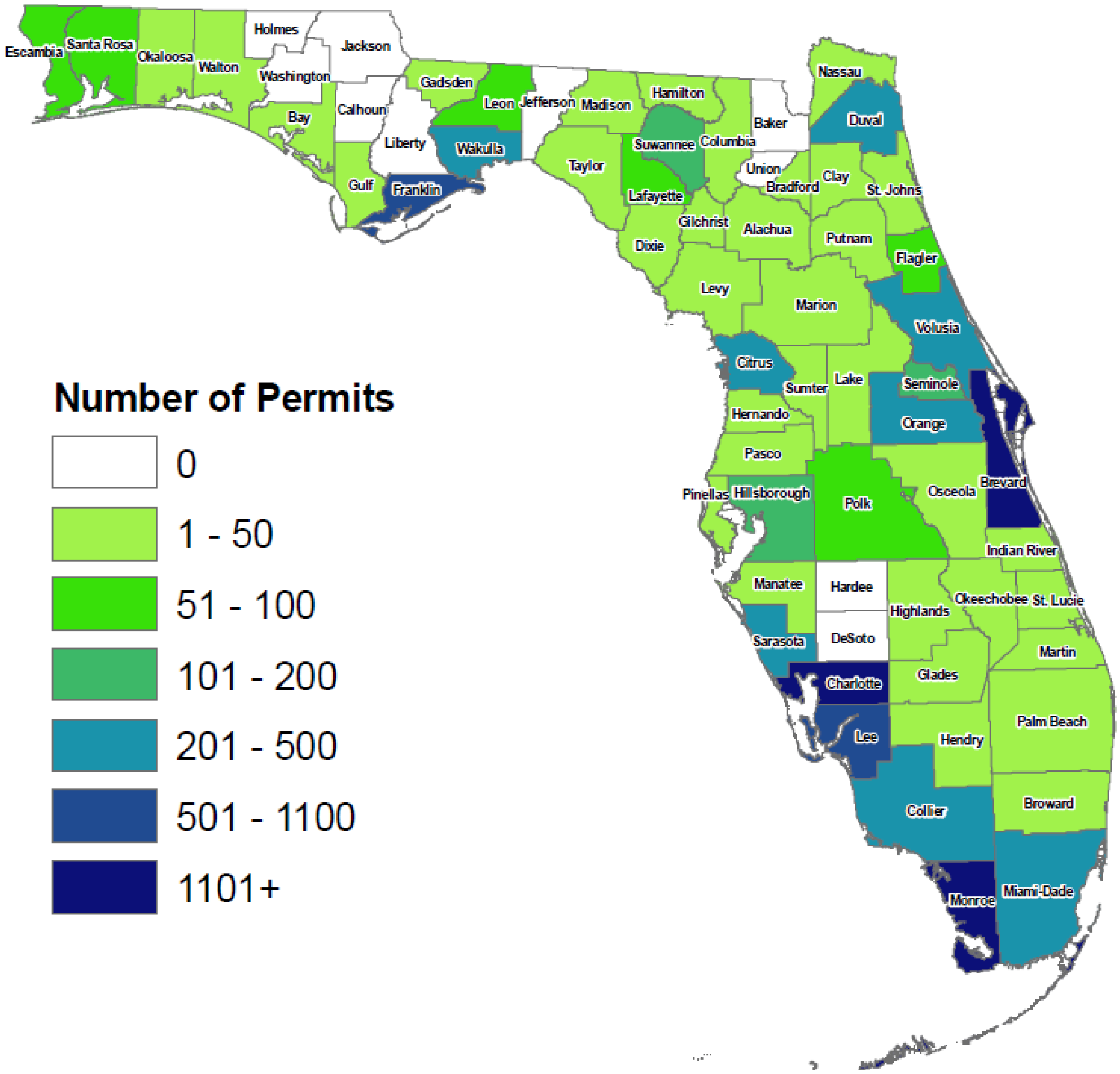


Figure 1. Total ATU/PBTS Operating Permits in Florida as of April 2012 per the FDOH Environmental Health Database

Carmody is a privately owned web-based maintenance and inspection tracking system. Carmody Data Systems, Inc. is under contract with the Florida Department of Environmental Protection (FDEP) to offer this service to ATU and PBTS maintenance entities and FDOH local offices, as a tool to electronically report maintenance and inspection events. Carmody administers access to this tracking system. A related, publicly accessible, tool is "Septic Search ™" (http://septicsearch.com), which allows viewing of documents that Carmody Data Systems makes available for each system. In addition to maintenance and inspection reports, this tracing system may include other permit files, usually available for counties in which Carmody Data Systems, Inc. has performed a project to scan and electronically organize such files.

FDOH county offices have to various extents developed their own methods for recording operating permit data. Project staff made preliminary surveys and telephone inquiries to determine these. Several counties (i.e., Miami-Dade, Duval, Escambia, Flagler, Madison, and Palm Beach) provided the Excel-spreadsheets that they use to track operating permits.

Additional innovative system records stemmed from files in the FDOH Onsite Sewage Section of the Bureau of Environmental Health that pertained to the permitting of innovative systems. Generally, these provided some information on the location, and sometimes permitting information of systems that were installed under an experimental or innovative program.

Sand filter systems were not identified. Installations appear to have predated the current permitting databases and even if one were to be installed or repaired current permitting forms do not provide easily identifiable fields to locate them. Project staff undertook a site visit to Columbia County where FDOH staff had identified several sand filter systems. The visits suggested that including sand filter systems in the project would be labor intensive and would not result in sufficient effluent sample data. Data from the database sources overlapped. Matching records about a system from different sources based on permit number and address required extensive efforts. A description of these efforts is contained in the report on the project database (Ursin and Roeder, 2011).

1.3.2 Distribution of Systems

Based on the project database, Table 1 shows the frequency of advanced systems by county and is sorted alphabetically. Table 2 shows the frequency of advanced systems by county and is sorted by highest frequency to lowest frequency. Over 60% of the advanced systems in Florida are contained in these five counties: Monroe, Charlotte, Brevard, Franklin, and Lee.

Table 1. Frequency of Advanced Systems by County (Alphabetical)

	Frequency	Percent
Alachua	19	0.11
Baker	3	0.02
Bay	17	0.10
Bradford	7	0.04
Brevard	2,446	14.74
Broward	179	1.08
Calhoun	15	0.09
Charlotte	2,454	14.79
Citrus	246	1.48
Clay	52	0.31
Collier	430	2.59
Columbia	23	0.14
Desoto	22	0.13
Dixie	18	0.11
Duval	464	2.80
Escambia	150	0.90
Flagler	80	0.48
Franklin	1,104	6.65
Gadsden	12	0.07
Gilchrist	22	0.13
Glades	10	0.06
Gulf	60	0.36
Hamilton	16	0.10
Hardee	9	0.05
Hendry	86	0.52
Hernando	35	0.21
Highlands	28	0.17
Hillsborough	159	0.96
Holmes	8	0.05
Indian River	38	0.23
Jackson	29	0.17
Jefferson	15	0.09
Lafayette	21	0.13
Lake	125	0.75
Lee	706	4.25
Leon	111	0.67
Levy	42	0.25
Liberty	5	0.03
Madison	23	0.14
Manatee	20	0.12
Marion	331	1.99
Martin	88	0.53
Miami-Dade	299	1.80
Monroe	3,436	20.71
Nassau	54	0.33
Okaloosa	25	0.15
Okeechobee	12	0.07
Orange	561	3.38
Osceola	121	0.73
Palm Beach	286	1.72
Pasco	30	0.18
Pinellas	33	0.20
Polk	228	1.37
Putnam	77	0.46
Santa Rosa	110	0.66
Sarasota	404	2.43
Seminole	142	0.86
St. Johns	100	0.60
St. Lucie	125	0.75
Sumter	40	0.24
Suwannee	77	0.46
Taylor	46	0.28
Union	1	0.01
Volusia	413	2.49
Wakulla	164	0.99
Walton	78	0.47
Washington	5	0.03
Total	**16,595**	**100.00**

Table 2. Frequency of Advanced Systems by County (Highest to Lowest)

	Frequency	Percent
Monroe	3436	20.71
Charlotte	2454	14.79
Brevard	2446	14.74
Franklin	1104	6.65
Lee	706	4.25
Orange	561	3.38
Duval	464	2.80
Collier	430	2.59
Volusia	413	2.49
Sarasota	404	2.43
Marion	331	1.99
Miami-Dade	299	1.80
Palm Beach	286	1.72
Citrus	246	1.48
Polk	228	1.37
Broward	179	1.08
Wakulla	164	0.99
Hillsborough	159	0.96
Escambia	150	0.90
Seminole	142	0.86
Lake	125	0.75
St. Lucie	125	0.75
Osceola	121	0.73
Leon	111	0.67
Santa Rosa	110	0.66
St. Johns	100	0.60
Martin	88	0.53
Hendry	86	0.52
Flagler	80	0.48
Walton	78	0.47
Putnam	77	0.46
Suwannee	77	0.46
Gulf	60	0.36
Nassau	54	0.33
Clay	52	0.31
Taylor	46	0.28
Levy	42	0.25
Sumter	40	0.24
Indian River	38	0.23
Hernando	35	0.21
Pinellas	33	0.20
Pasco	30	0.18
Jackson	29	0.17
Highlands	28	0.17
Okaloosa	25	0.15
Columbia	23	0.14
Madison	23	0.14
Desoto	22	0.13
Gilchrist	22	0.13
Lafayette	21	0.13
Manatee	20	0.12
Alachua	19	0.11
Dixie	18	0.11
Bay	17	0.10
Hamilton	16	0.10
Calhoun	15	0.09
Jefferson	15	0.09
Gadsden	12	0.07
Okeechobee	12	0.07
Glades	10	0.06
Hardee	9	0.05
Holmes	8	0.05
Bradford	7	0.04
Liberty	5	0.03
Washington	5	0.03
Baker	3	0.02
Union	1	0.01
Total	**16595**	**100.00**

1.3.3 System Information

Table 3 illustrates the frequency of advanced systems by type in the database. Seventy-six percent of the systems are for ATUs and eight percent are for PBTS. Relatively few systems, about 15%, were recorded as unknown, indicating a limited potential of having included conventional systems.

Table 3. Frequency of Type of Advanced System (ATU, PBTS, Innovative, Unknown)

	Frequency	Percent
ATU	12660	76.3
Innovative	183	1.1
PBTS Non Innovative	1189	7.2
Unknown	2563	15.4
Total	**16,595**	**100.0**

Table 4 illustrates the advanced system age, in years, at January 1, 2010 for those systems in the database. The system installation date is entered on the construction permit and the operating permit application and was part of some FDOH and innovative records. The high occurrence of unknown ages could be a result of there being fewer EHD permits in the database. Of the systems with no final system approval date 8,248 (88%) did not have construction permit information. A total of 7,173 systems in the database had a final system approval date. Of these systems, 75% were installed 2-5 years before January 1, 2010.

Table 4. Age of Florida Advanced Systems at January 1, 2010 (years)

	Frequency	Percent
Unknown	9422	56.8
<2	431	2.6
2 – 5	5372	32.4
6 – 10	1313	7.9
11-15	47	.3
16-20	5	.0
>20	5	.0
Total	**16,595**	**100.0**

Out of a total of 16,595 systems, 9,206 (56%) had information on the different treatment technology approaches, manufacturers, products, and aeration subtypes (Table 6). The data reflect systems installed under a variety of approval conditions. There were three main types of treatment technology approaches considered: extended aeration, fixed media, and combined (aeration and fixed media) (Figure 2). Sand and gravel filters fit into the fixed media category, and several experimental or innovative treatment and disposal systems that involve effluent passage through a drainfield were also included in this category. Interim aggregate filters are fixed film systems that are required in the Florida Keys prior to discharge into an injection well. The interim aggregate filters were not reviewed in this project because they are generally placed after an aerobic treatment step. The "other" category mostly captures systems with injection wells that were not otherwise identified as including advanced onsite system components, along with a few systems installed under special circumstances.

One of the limitations of the data that became apparent at this stage is the designation of a treatment technology based on the tank approval number. For example, the distributors of one innovative treatment technology, Bionest, had obtained approval to fit their technology into several treatment tanks that can also be used as conventional septic tanks or other types of tanks. Finding the tank approval numbers in the construction records of advanced systems lead to 35 systems designated as Bionest systems, even though the distributor confirmed that no Bionest system had been installed.

The main treatment technology approach used in Florida is extended aeration, with 88% of the systems for which there was product information and over half of the systems in the database overall having this treatment technology approach. Extended aeration was introduced using diffusers in 42% of the systems while 10% use aspirators to aerate (Table 5). A combined technology approach was used in 7% of systems and 3% use fixed media.

Table 5. Use of Aeration in the Treatment Process

	Frequency	Percent
Aspirator	1724	10.4
Diffuser	7028	42.4
Unknown	7843	47.3
Total	16595	100.0

Figure 3 illustrates the different manufacturers for the systems that had information. Fourteen manufacturers had less than 100 systems each and these were totaled together and combined under the "Other" category. The top five manufacturers used in Florida are Consolidated, Aqua-Klear, Hoot, Norweco, and Clearstream.

Figure 4 illustrates the different products for the systems that had information. In many but not all cases the product carries the same name as the manufacturer. Nineteen products had less than 100 systems each and these were totaled together and combined under the "Other" category. The top five products used in Florida are Nayadic, Aqua-Klear, Hoot, Singulair, and Clearstream, which corresponds to the distribution of the respective manufacturers.

Table 6. Technology of Components with Sample Selection Information (see Section 2.1)

Technology Approach	Manufacturer	Product	Aeration Subtype	Number of Systems	Product Sample	Subtype Sample	Approach Sample
Combined	Bio-Microbics	FAST	Diffuser	394	35	35	70
	Bionest	Bionest	Diffuser	35[1]	0		
	Jet	Jet	Aspirator	188	35	35	
Extended Aeration	Acquired Wastewater Technologies	Alliance	Diffuser	76	2	35	70
	Ecological Tanks, Inc.	Aqua Aire	Diffuser	73	2		
	Ecological Tanks, Inc.	Aqua Safe	Diffuser	56	2		
	Aqua-Klear	Aqua-Klear	Diffuser	1353	4		
	American Wastewater	B.E.S.T. 1	Diffuser	130	3		
	Acquired Wastewater Technologies	Cajun Aire	Diffuser	132	3		
	Clearstream	Clearstream	Diffuser	861	3		
	Delta	DF or UC	Diffuser	257	3		
	Delta	N/D	Diffuser	507	0		
	Hoot	Hoot	Diffuser	975	4		
	Hydro-Action	Hydro-Action	Diffuser	89	2		
	H.E. McGrew	Mighty Mac	Diffuser	357	3		
	Consolidated	Nayadic	Diffuser	1733	4		
	Consolidated	Multi-Flo	Aspirator	583	15	35	
	Consolidated	Enviro-Guard	Aspirator	3	3		
	Norweco	Singulair	Aspirator	949	17		
Fixed Media	Orenco	AdvanTex		8	6		70
	Quanics	Aerocell		5	4		
	Quanics	Biocoir		5	4		

[1] Result of non-unique tank use, no systems actually installed. See text.

Technology Approach	Manufacturer	Product	Aeration Subtype	Number of Systems	Product Sample	Subtype Sample	Approach Sample
Fixed Media (cont.)	Carroll Environmental Technologies	Carroll Filter		1			
	Premier Tech	EcoFlo		30	9		
	EcoPure	EcoPure		19	8		
	Earthtek	EnviroFilter		149	14		
	Klargester	Klargester		2	2		
	Rotodisk	Rotodisk		3	3		
	Ruck	Ruck		11	7		
	NoMound	NoMound		21	8		
	Sand filter	Sand filter		6	5		
Other	Injection Well	Interim filter		173	0		0
		Cromaglass		1	0		
		P-removal		19	0		
	Evapotranspiration			2	0		
			Total	**9206**			**210**

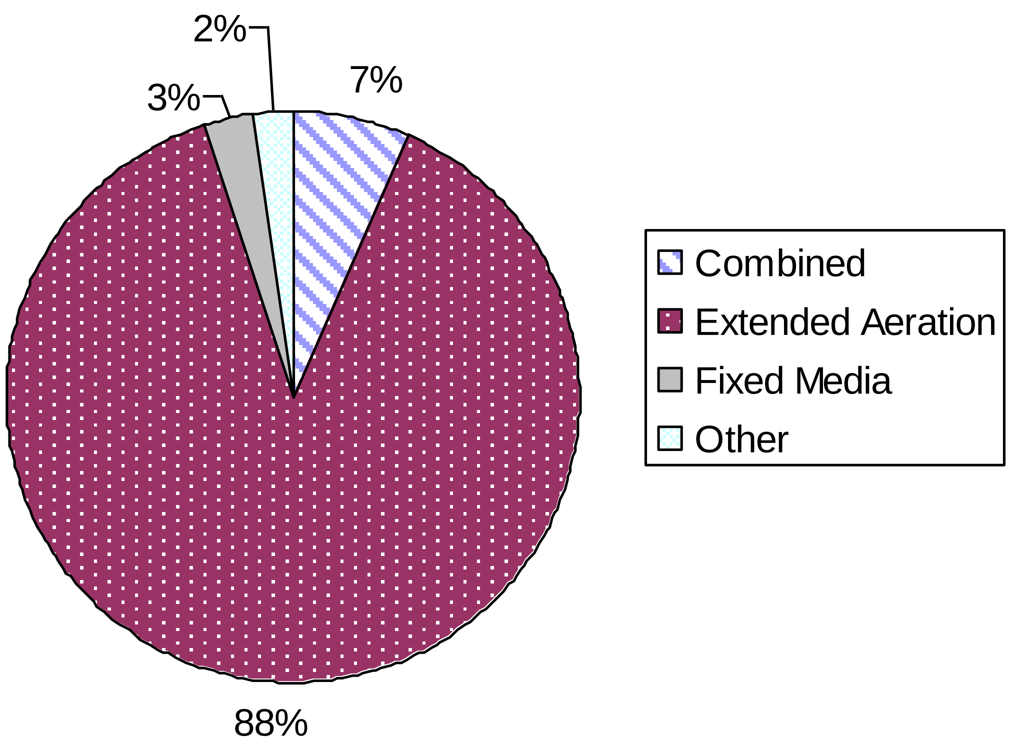


Figure 2. Treatment Technology Approaches for Systems with Information (n=9,206)

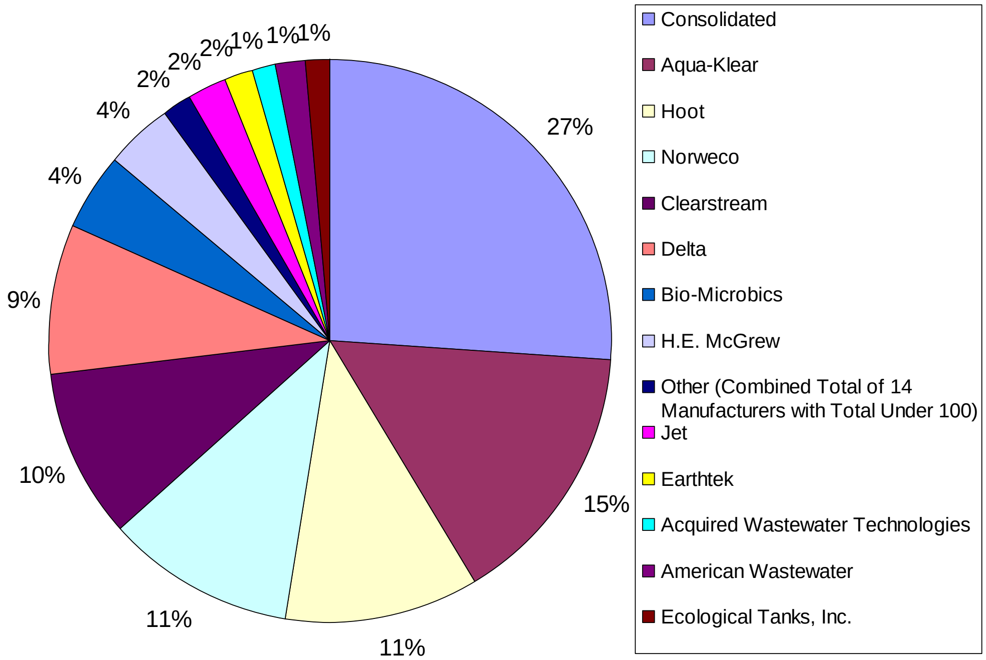


Figure 3. Manufacturer for Systems with Information (n=8,848)

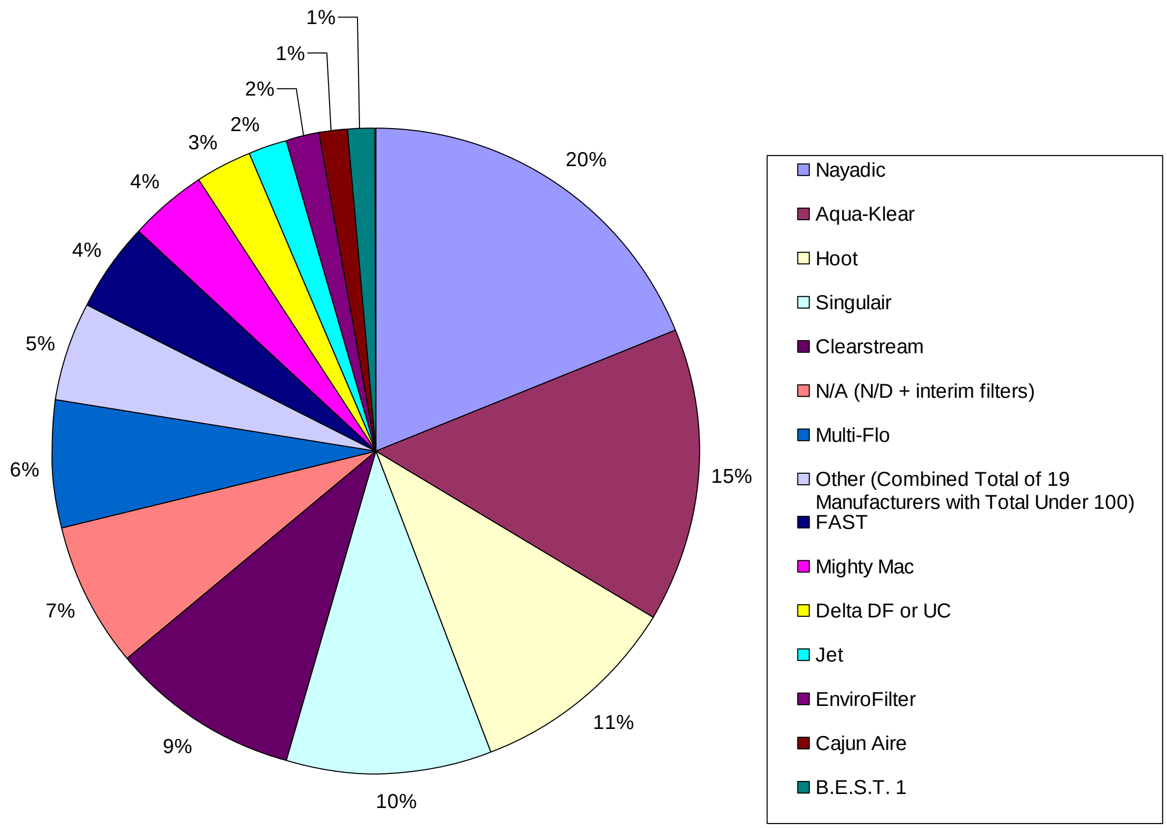


Figure 4. Product Technology for Systems with that Information (n=9,204)

1.4 Validation of Sampling Protocol

One goal of the project was to validate elements of a monitoring protocol for consistent assessment of systems. Two issues were of particular concern here: one was the suggestion that effluent quality might vary so much over the course of a day that one sample is not representative. The other was to work toward an assessment method or check list that could be used uniformly to minimize differences due to the way different people assess different systems. To address these issues, project staff, in cooperation with FDOH in Monroe County, implemented a pilot project. The project report (Roeder 2011) contains detailed results. Conclusions and lessons learned are summarized in this section.

Pilot study samples were taken from aerated OSTDS in the Florida Keys between February 2007 and June 2009. Both grab and composite samples were taken from 40 treatment systems at different frequencies and were analyzed for carbonaceous biochemical oxygen demand ($cBOD_5$), total suspended solids (TSS), total nitrogen (TN), and total phosphorus (TP); less frequently for total alkalinity; and occasionally for fecal coliforms and some screening tests. The objectives of this task were to validate the sampling protocol for statewide sampling of advanced systems by characterizing the variability of grab samples over the course of a day, to compare grab sample results to time-composite sample results, and to assess longer term or seasonal variability. A sampling protocol was written (Roeder et. al. 2009) documenting protocols to provide consistent and representative wastewater samples. Results from this sampling effort provided the basis for the sampling process for the statewide sample plan. Some of the findings from the final task report (Roeder 2011) were:

- Occasional spurious high concentrations were reported, in many cases for one analyte but not for others in the same sample. While this may influence means, median concentration results are less impacted by this and appear generally reliable. Review of sample results with typical results and communication with the laboratory appear to be a way to resolve some of these outlier data points. The conditions for such interaction were much improved for the statewide sampling portion of this project that is subject of this report.

- Relative to target concentrations, results from analysis of blanks indicated that the approach to sampling using peristaltic pumps was successful. For the statewide sampling portion of this project, flushing volumes were increased in an attempt to further reduce TN in equipment blanks, which had been detected most frequently.

- TSS appeared to be the most variable parameter in replicate samples from an intermediate container with a median relative standard deviation of 12%, but for $cBOD_5$, TN, and TP this measure was 3% or less. Concerns about samples obtained from intermediate containers are thus less warranted for nutrient analyses than for TSS analyses.

- Detailed characterization of the treatment systems and sampling locations is very important. Treatment systems with multiple treatment steps, “influent” and “effluent”, in particular, need further qualification, and may be ambiguous to a sampler encountering the treatment system or to a data analyst. In the pilot study this required some reclassification during data analysis from “influent” to “intermediate”. For the statewide sampling portion of this project, data fields for sample location description were more extensive, and a screen for the validity of “influent” samples was developed.

- The operational and maintenance conditions of a treatment system need to be better characterized if one wants to distinguish between technical limitations of treatment and shortcomings due to operator error or lack of maintenance. The assessment protocol for the statewide sampling portion of this project included a more detailed assessment, including characterization if the power was on, observation of problems and the dissolved oxygen concentration as a measure of aeration.

- Assessments of variability between grab samples during each event showed that TSS had the highest variability, while TP and total alkalinity had the least, followed by TN. The first grab sample of a sampling event tended to be about 20% higher in TSS and 10% in $cBOD_5$ than subsequent grab samples. This difference did not exist for nutrient species. Given that the emphasis of the project is on nutrient treatment effectiveness, grab sampling appeared appropriate for the statewide sampling portion of this project.

- There was no overall bias found between the effluent composite and average of grab samples during the same event, even though for any event there could be differences. These differences were the least for total alkalinity, TP, TN and nitrate, with more than 50% of events showing a relative difference of less that 10%.

- The between-event variability, as expressed by relative standard deviations, is at least twice as large as the within event-variability for all parameters, except for TSS.

- Analysis for differences by weekday showed no consistent results. Flow measurements for a subset of systems, but not for all measurements, appeared to decrease from Monday through Thursday. Grab but not composite effluent sample results for TSS and $cBOD_5$ indicated a decrease from Sunday through Thursday, but this was at least partly due to differences in the occurrence of first grab samples on each day.

- Differences in concentrations between the wet/hot and dry/cold seasons were not significant.

- Visual/olfactory assessments appeared to be able to discriminate a threshold-value of TSS (visual) and possibly TSS, ammonia, and TKN (olfactory). During the statewide sampling portion of this project, the assessment protocol was refined to use more standardized terminology.

- The Hach DR/890 colorimeter showed good agreement with laboratory nitrate and ammonia measurements and less so for ortho-phosphate compared to total phosphorus. In all cases there was an indication of between study-phase variability. To address these issues the recording forms for the statewide sampling portion of this project were revised to better capture dilution and conversion factors.

- Taylor kits provided good agreement with laboratory measurements for total alkalinity. The statewide sampling portion of this project relied largely on Taylor kits for this measurement, with some additional laboratory measurements for confirmation. Chlorine measurements by Taylor kit could not be independently assessed. They were utilized occasionally during the implementation of the statewide sampling portion of this project to assess the effectiveness of chlorination devices.

2 Methods

This section is based largely on the quality assurance project plan (QAPP) for the project, with supplemental information about non-field data (FDOH, 2011 http://www.doh.state.fl.us/environment/ostds/research/ResearchReports/final319qapp.pdf).

2.1 System Selection

2.1.1 Sampling Process Design (Experimental Design)

2.1.1.1 Site Selection

The database of advanced systems described in Section 1.3 provides an inventory of onsite sewage treatment and disposal systems for selection for further permit documentation review, site assessment, and sampling. Each system was assigned a random number. The sample selection process is illustrated in Figure 5.

Sample selection was based on two main objectives. One objective was to get a representative sample of all systems in Florida. The project target of about 600 effluent samples allowed for 95% confidence that the median of the overall data set is between the 46th and 54th percentile of measured effluent concentrations. About 600 samples allows for an estimation of the 10th and 90th percentile within ±2.5% (Moore and McGabe, 1989). To allow for missed samples because of an anticipated lack of access to some systems, the size of the initial sample was increased by 100 to 700.

The second objective was to gather samples from additional OSTDS technologies not represented in the random sample. Approximately 100 additional systems were targeted. For technologies where sufficient information existed, the system was categorized as described below and the information was linked to the system record (Table 6). The treatment technologies were grouped as either: fixed media, combined media, and extended aeration. Additionally, aeration technology for combined media and extended aeration was subcategorized into diffuser and aspirator approaches. Records were selected to represent each of the different technology approaches. Numbers of samples for each manufacturer were proportional to the logarithm of the number of identified systems in the same category. The record selection used for both the random and additional sample was done in the same way by selecting the records with the lowest random numbers that fulfilled the representative sample criteria.

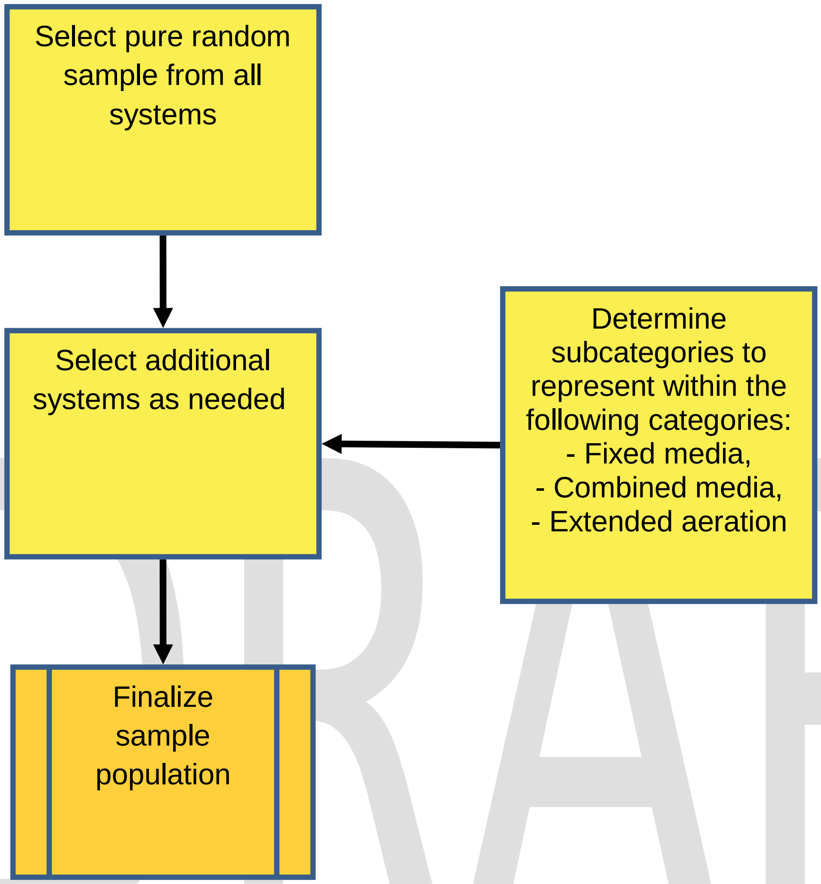


Figure 5. Site Selection Flowchart

Subsequently, in the early stages of requesting permit information from FDOH county offices, it was discovered that a larger than anticipated number of systems were no active advanced systems (i.e., they were either abandoned, a conventional system, connected to sewer, etc.). To address this, additional systems were drawn at random from the inventory.

2.1.1.2 Selection of Sites for Assessment of Variability of Performance

Variability of effluent and influent quality was assessed by a selection of systems for which access to the system was available for both influent and effluent sampling. These systems were solicited from the general sample population (Section 1.3). During the start of the general sampling efforts, homeowners were given a survey to complete and return regarding their use of the system (Appendix A). One of the survey questions asked if the owner would like to volunteer the system to be sampled periodically throughout the year. Those that answered yes to this question and met the requirements for providing access to the influent and effluent were considered. In addition, systems were targeted that had already been sampled and influent samples obtained under the general sampling effort described in Section 2.3.

2.2 File Review and System Description

2.2.1 Obtaining Permit Files

System information was gathered for each of the selected site locations. This information came mainly from FDOH permit files, the EHD, and Carmody's online SepticSearch website. Project staff collected the following documents, regarding the sample system's construction and operating permitting history, and the information was entered into the project's database:

1. Construction Permit Application (FDOH Form #DH 4015 p1)
2. Site Evaluation (FDOH Form #DH 4015 p3)
3. Construction Permit (FDOH Form #DH 4016 p1)
4. Final Inspection (FDOH Form #DH 4016 p2)
5. Site Plan
6. Engineer Design Drawing (if applicable)
7. As-Built Drawing
8. Operating Permit
9. Operating Permit Application (FDOH Form #DH 4081)
10. Maintenance Entity Contract
11. Checklist used while conducting FDOH inspections (if applicable)
12. Checklist of all activities associated with file (if applicable)
13. FDOH Inspection Reports
14. ME Inspection Reports
15. Enforcement Action (if applicable)

For PBTS and Innovative Systems Only:

1. System Design Calculations
2. System Design Criteria
3. Whether soil was used as part of the treatment system
4. Contingency Plan
5. Certification of Design
6. Operation and Maintenance Manual
7. A cover letter addressed to FDOH stating the applicant's intent to apply for a performance-based treatment system

Emails were sent to the environmental health director at FDOH county offices, requesting the information for the systems initially selected. Follow-up emails were sent if some of the documents were omitted or if no initial response to the initial data request had been received. This information was documented in the database. Some counties (i.e., Brevard, Charlotte, and Monroe) had scanned permit information available online. This allowed for easy access to the files, but at times the data available became limited to the information that was scanned (i.e., current maintenance contracts, operating permits, etc., were missing from the online system). Project staff repeated the process of contacting FDOH county offices after expanding the sample population.

2.2.2 Data Organization

Once the files were received, they were scanned electronically and organized alphabetically by county and then numerically by the unique system ID number assigned to each system. Similarly, electronically accessible information was transferred into the naming conventions of the project files.

2.2.3 Data Entry and System Description

Initially, an assessment was done to see if all requested permit files were received. Files that were sent as incomplete were noted in the database and were evaluated as a part of the assessment of the management practices of FDOH in the county office.

The database forms (Appendix B) were constructed to show basic identifying information about each property at the top of the forms (i.e., address, permit number, system ID). For more details, there are six tabs that can be clicked on to go to different data entry screens: record inquiry status, construction permit review, operating permit review, PBTS review, treatment train, and file review status. The tables that contain the data shown in the forms were originally populated with information gathered from EHD and Carmody, when available.

The instructions for data entry are included in Appendix C.

2.2.4 Feedback to Other Parts of the Project

If a permit file review revealed that the system should not be included in this project, e.g., because it was not an advanced system or because it had been abandoned, then this was noted in the project database. Similarly, it was noted in the database if the permit file could not be located. Systems were excluded from the list of systems to be visited if this determination was made before the field visit took place. Data review occurred in parallel with and continued after field visits were completed. This resulted in some site visits of systems that would have otherwise been excluded and thus provided an element of field validation. Occasionally, the field samplers determined that the condition of the systems were different from the way in which the permit files described them. In these cases, the system description was updated.

2.2.5 Data Quality Control

Each record underwent a quality control review. This review was completed by someone other than the data enterer, and was someone with extensive knowledge of the project database and project goals. Comments could be made by the quality control reviewers on each of the sub forms if necessary. An assessment of the results of the quality control was completed indicating whether the data entry agreed with records, missed some fields, contained data entry errors, or both missed fields and contained errors.

2.3 Field Assessment and Sampling

2.3.1 Quality Assurance Project Plan (QAPP)

Project staff developed a QAPP for this project that was approved by the granting agency (Florida Department of Health 2011, http://www.doh.state.fl.us/environment/ostds/research/ResearchReports/final319qapp.pdf). The QAPP lays out the methodologies, procedures, and other requirements necessary for collecting field data adequate to support the assessments of operational status and reduction of contaminant loads. Project staff developed this QAPP based on the experiences in the pilot study in the Florida Keys (Section 1.4 (Task 1)) and with cooperation from staff at the FDEP. This QAPP provided clear methods to obtain data to help quantify the reduction of wastewater parameters from different types of advanced onsite systems and to assess the operational status of systems under the current management system.

2.3.2 Preparatory Work

2.3.2.1 Selection of Samplers

Samplers were solicited from FDOH county offices based on interest and density of advanced systems. Samplers were selected from Monroe, Charlotte, Lee, Volusia, and Wakulla counties. The Volusia County samplers sampled both Volusia and Brevard counties. The Wakulla County sampler handled sampling all the systems that were not within the county boundaries of Monroe, Charlotte, Lee, Volusia, and Brevard. All samplers were trained by the Quality Control (QC) Officer or by someone trained by the QC Officer. Funding was provided to the FDOH counties involved to conduct inspections and samplings of onsite sewage treatment and disposal systems in accordance with the QAPP. This was a cost reimbursement agreement based on actual salaries, fringe benefits, supplies, and other costs. It was anticipated that it would take a sampler approximately 2-3 hours per system, which was reassessed as needed based on actual numbers. Samplers forwarded monitoring results to project staff on an ongoing basis.

2.3.2.2 Selection of Labs

2.3.2.2.1 Chemical Analysis: Xenco / Florida Testing Services LLC

The process for selecting a lab to conduct the main sample analysis portion of this project involved advertisement of an Invitation to Bid (ITB). The ITB, FDOH 09-054, was publicly advertised in the State of Florida Vendor Bid System.

The ITB required the successful lab to provide National Environmental Laboratory Accreditation Program (NELAP) certified analytical laboratory services to the FDOH for $cBOD_5$, TSS, TN, TP, and occasionally at the option of the FDOH, fecal coliform and total alkalinity. It was anticipated that the number of TP analyzes would be approximately half of the number of $cBOD_5$, TSS, and TN analyses; and that fecal coliform and total alkalinity analyses would rarely be requested.

Fifteen responses were received to the advertised ITB, and the lab that matched all of the criteria, which also provided the lowest price, was selected (Xenco / Florida Testing Services LLC). A blanket purchase order was created outlining the required services.

The laboratory provided results electronically, both as a report and in tabular spreadsheet format. Over the course of the project, the laboratory reorganized its workflow, resulting in a change of physical locations at which analyses occurred.

2.3.2.2.2 Fecal Laboratories

The process for selecting labs to conduct the fecal sample analysis involved contacting various labs within "hotspot" areas (i.e., Charlotte, Lee, Volusia, Tallahassee, and three regions in Monroe) and selecting the most affordable one within the area. The department issued a purchase order to each selected laboratory outlining that the laboratory must comply with all NELAP accreditation requirements, analyze samples for fecal coliform per Standard Methods # 9222 D, and provide sample bags. Samplers delivered samples to the lab based on the feasibility of sampling and delivery within the maximum six-hour holding time.

2.3.2.2.3 Other Laboratories

FDOH in Volusia County's Environmental Health laboratory also provided an opportunity to compare analytical results with the Xenco / Florida Testing Services laboratory. A limited number of samples were sent to both laboratories and were sampled utilizing the same methods to quantify consistency.

2.3.3 Sampling Process

2.3.3.1 General Field Work Procedures

The general procedures for field work are outlined in the QAPP associated with this project (Florida Department of Health 2011) and are based on FDEP's standard operating procedures (SOPs). Standardization for each sampler was performed during joint site visits with the quality assurance officer or a previously trained staff.

2.3.3.2 Activities Prior to Site Visit

Charlotte and Volusia Counties sent out notification letters at the beginning of their sampling efforts to all of the selected sites to help facilitate the sampling. These notification letters outlined that the system was randomly selected for assessment and sampling along with some background information about the onsite sewage program. The system owner or user was asked to contact FDOH if they did not wish to participate in the sampling project. Generally, there were very few system owners that did not want to be a part of the sampling effort. Monroe County contacted maintenance entities to inform them of the project. One maintenance entity accompanied samplers to the first few sampling events, and provided extensive information and support to samplers; the other MEs did not get involved.

Prior to the site visit, the sampler made necessary preparations regarding planning trip routes, determining the appropriate receiving lab(s), obtaining sample containers and chain-of-custody forms, etc. Specifically, the QAPP outlined activities and procedures such as printing and assembling the proper assessment forms and site specific paperwork, coordinating with FDOH county office and maintenance entity if applicable, cleaning the sampling equipment, and ensuring field measuring devices are calibrated as specified in the QAPP (http://www.doh.state.fl.us/environment/ostds/research/ResearchReports/final319qapp.pdf).

2.3.3.3 Site Visit and Initial System Assessment

The core element of this project was the assessment of systems by visiting the sites and evaluating operation both qualitatively and quantitatively. Upon arrival at a site location, the sampler performed an assessment of the system using the initial system evaluation form (0). The information on this form was gathered based on observation, without accessing the sewage or opening of tanks. In this way the information was comparable to what is obtainable using the procedures of many FDOH county offices. The initial system evaluation form incorporates elements of checklists developed by the Consortium of Institutes of Decentralized Wastewater Treatment (CIDWT) (http://www.onsiteconsortium.org/omspchecklists.html), and guidance given by FDOH.

The locations of the tanks were determined by referencing site plans obtained during the permit review. A visual assessment was done to locate all system components shown on the site plans. If the system did not appear to exist then the sampler documented this and proceeded to the next site. If the system appeared to be temporarily inaccessible, the sampler may have returned at a later time if this was feasible based on work in the area.

During this assessment, the sampler determined whether there was access to the system components for sampling. This determination depended on the construction of the system, available tools, and on the presence of a maintenance entity that could assist with opening locked access covers.

2.3.3.4 System Use Survey

Project staff developed a system-use survey (Appendix A) designed to give FDOH a better understanding of the use of the system and how that use may affect the quality/quantity of the effluent leaving the system. The survey was distributed as samplers visited sites. The survey was to be handed to the system owner/user at the time of sampling, or left on the door. A cover letter provided the system owner/user with some basic information about the project, a copy of the survey, and an envelope for them to mail the survey back to the project staff. A total of thirty-eight questions were included in the survey.

2.3.3.5 Operational Assessment

Where access to sewage flow and/or the interior of tanks was available, the sampler performed a more detailed assessment and took samples. The assessment was done using the system operation evaluation form (0). This operational assessment form incorporated elements of checklists developed by the CIDWT and experiences gained during the sampling in the Florida Keys performed during the validation phase of this project (Section 1.4).

The general order for sampling sewage or measuring equipment was from the effluent to the influent to minimize potential for cross contamination. Exceptions to this may have occurred when a sampling port was empty and water addition to the influent was needed to establish flow to the sampling port. Such an addition introduced the potential for diluting the influent. Under these circumstances, the influent, if accessible, was characterized first, the equipment rinsed and the effluent characterized subsequently.

The operational assessment elements are described in the following subsections.

2.3.3.5.1 Visual Assessment of the Interior of the Tank or Compartment

After the access was opened, the sampler visually observed the interior of the tank, primarily to see if there was evidence of operational problems, the tank being damaged, and signs of leaking or of non-sewage water being added. The results were recorded on the operational assessment form (0).

2.3.3.5.2 In-situ Measurements

All in-situ data measurements of temperature, pH, dissolved oxygen (DO), specific conductance (SC), and redox potential (ORP) were achieved with an YSI model multi-parameter device. This instrument (one for each sampling team) included probes for dissolved oxygen, pH, specific conductance, and oxygen reduction potential, and provided related measures for salinity and dissolved oxygen saturation. To obtain measurements, the sampler slowly lowered the probe into the water so that the top of the instrument was between two and eight inches below the water level, which resulted in measurements taken between approximately six and twelve inches below the surface. However, if there was a scum and/or sludge layer thicker than about an inch, the sampler targeted the instrument to take measurements in the clear zone. The order of measurement points was generally from effluent to influent. Additional details on these in-situ measurements, including equipment calibration procedures, are described in the QAPP. Results were recorded on the operational assessment form in Appendix D.

2.3.3.5.3 Sampling

Systems that were accessible, had an adequate volume of wastewater, and were powered on, were sampled in accordance with FDEP SOP's (FS 1000 and 2400). Samples were analyzed for $cBOD_5$, TSS, TKN, NOx, TN, TP, and sometimes fecal coliform. Wastewater sample collection is described in Section 2.3.3. Where sewage flow was accessible, the sampler took samples for on-site and/or laboratory analysis. The samples were for:

- Effluent analysis
- Influent analysis
- Aeration chamber assessment
- Tap water analysis

Effluent sampling was generally performed before any sludge judging to avoid stirring up of sludge. Systems that were powered off were also sampled to establish effluent concentrations from non-operating systems.

Influent sampling was generally performed after sludge judging (next section) established the clear zone depth.

The aeration chamber assessment consisted of taking a sample, assessing the color of the biomass, and observing the settled sludge volume of the mixed liquor.

Tap water samples were taken to characterize specific conductance, alkalinity and nutrient content in the water that is carrying the wastewater for several sites at which influent samples were obtained.

2.3.3.5.4 Sludge Judge

Depending on access, the sampler measured the thickness of scum, clear zone, and sludge layers in the water column using a device commonly known as a sludge judge. This measurement was performed in all accessible compartments, unless visual inspections indicated that there are no scum and sludge layers, or the sampler was concerned that the measurement might interfere with treatment components.

2.3.3.6 Wastewater Sample Collection

The FDEP SOPs FS 1000 “General Sampling” and FS 2400 “Wastewater Sampling” guided the sampling efforts. About two liters of sample were needed for all analyses. All samples collected during this project consisted of only grab samples. A grab sample reflects performance only at the point in time that the sample was collected. The QAPP outlines the specific requirements for sample container preparation, determination of the sampling point, collection of the sample, preparation of the sample for shipment to the lab, and sample handling and custody.

2.3.3.7 Data Entry of Field and Lab Results

Field results were recorded by the samplers on paper forms during the field visit (0). These forms were scanned and placed in a shared electronic folder for data entry by project staff at the FDOH program office.

Lab results were sent electronically to staff at the FDOH program office from the lab. An Excel file format was established at the beginning of the work to ensure a smooth import into the project database.

2.3.4 Analytical Methods

2.3.4.1 Laboratory Analytical Methods

Table 7 provides a listing of the water quality parameters sampled for laboratory analysis along with the analytical methods, preservation requirements, and sample holding times. Fecal coliform samples were analyzed either by the same lab or by another NELAC-certified lab, depending on the feasibility of getting samples there within the holding time. The fecal coliform samples were hand delivered to NELAC certified laboratories throughout the state.

Table 7. Laboratory Sample Analysis Parameters

Parameter	Method	Method Detection Limit	Laboratory	Holding time	Preservative
$CBOD_5$	SM 5210B	2.0 mg/L	FTS	48 hrs	Cool, 4^oC
TSS	SM 2540D	3.5 mg/L	FTS	7 days	Cool, 4^oC
TKN	EPA 351.2† or SM4500-NH_3C (TKN)	0.0867 mg/L	FTS	28 days	H_2SO_4
NOx-N	EPA 353.2† or EPA300	0.05 mg/L	FTS	28 days	H_2SO_4
TP	EPA365.1 or EPA365.3	0.055 mg/L	FTS	28 days	H_2SO_4
Fecal Coliform	SM 9222D	1cfu/100 mL	Various	6 hrs	$Na_2S_2O_3$
Total Alkalinity	SM2320B	2.2 mg/L	FTS	14 days	Cool, 4^oC
cBOD5	SM 5210B	2.0 mg/L	FTS	48 hours	Cool, 4^oC
TSS	SM 2540D	3.5 mg/L	FTS	7 days	Cool, 4^oC
TKN	EPA 351.2† or SM4500-NH_3C (TKN)	0.0867 mg/L			
	FTS	28 days	H_2SO_4		
NOx-N	EPA 353.2† or EPA300	0.05 mg/L	FTS	28 days	H_2SO_4
TP	EPA365.1 or EPA365.3	0.055 mg/L	FTS	28 days	H_2SO_4
Fecal Coliform	SM 9222D	1cfu/100 mL	Various	6 hours	$Na_2S_2O_3$

FTS = Florida Testing Services, LLC
†Revision 2.0, 1993, will be used.

2.3.4.2 Field Screening Analytical Procedures

The QAPP outlined various procedures associated with conducting field screening activities such as the settled sludge volume test, protocols for obtaining visual/olfactory information, collection of titration measurements, colorimetric methods using the Hach DR/890 unit, test strip use, and any other evaluations that were used. These field screening methods were compared with the lab sample results to determine if there were any correlations.

2.3.5 Quality Control

2.3.5.1 Laboratory Quality Control

Table 8 presents the data quality objectives of the laboratory chemical analysis. The laboratory quality control resulted in assessments if data needed to be qualified. The laboratories provided the results both in electronic report and electronic tabular form.

The electronic tabular data facilitated data processing. Imported results were checked for accuracy and completeness. Occasionally fields did not align and were manually adjusted. On occasion reports included a result of 0 for samples that were below the detection limit (“U”). These results were manually changed to the provided detection limit (reporting limit for $cBOD_5$). The qualifiers reported by the lab (Appendix E) allowed an assessment of how many samples did not meet quality control standards of the lab.

For $cBOD_5$, the project operating procedures did not call for the analysis of blanks, and so only a small number of blanks were analyzed. A distinction was made between samples that did not have any problems, “J” codes that indicated that the laboratory had encountered problems that led to a qualification of results, a few samples with “Q” codes indicating exceedance of holding times, and “MDL_increases” where under-depletions compared to the expectations of the laboratory based on chemical oxygen demand analyses resulted in an increased detection and reporting limit.

Table 8. Data Quality Objectives for Laboratory Analyses

Parameter	**$cBOD_5$**	**TSS**	**TKN**	**NOx-N**	**TP**	**Total Alkalinity**
Method	SM 5210B	SM 2540D	EPA 351.2 † or SM4500-NH3C (TKN)	EPA 353.2 † or EPA 300	EPA 365.1 or EPA 365.3	SM2320B
Number of Calibration Standards	N/A	N/A	6 (n/a for SM4500)	6	6	N/A
Calibration Acceptance Criteria (correlation)	N/A	N/A	Corr >0.995 (n/a for SM4500)	Corr >0.995	Corr >0.995	N/A
Calibration Blank Criteria	N/A	N/A	<0.3	<0.2	<0.03	N/A
QC Check Sample Recovery Criteria (%)	70-120	80-120	90-110 (77-161 for SM4500)	90-110 (80-120 for EPA300)	90-110 (80-120 for EPA365.3)	80-120
Matrix Spike Recovery Criteria (%)	N/A	N/A	90-110 (77-161 for SM4500)	90-110 (80-120 for EPA300)	90-110 (80-120 for EPA365.3)	N/A
Laboratory and Field Duplicate Samples Acceptance Criteria (%RPD)	25 (20 starting Jul. '11)	20	20	25 (20 for EPA300)	20	20
Practical Quantitation Limit (mg/L)	2.0	4.0	0.30 (0.5 for SM4500)	0.20 (0.05 for EPA300)	0.03	4.0
Method Detection Limit (mg/L)	2.0	3.5	0.09 (0.28 for SM4500)	0.1 (0.008 for EPA300)	0.055 (0.007 for EPA 365.3)	2.2

†Revision 2.0, 1993, will be used.

2.3.5.2 Field Quality Assurance / Quality Control (QA/QC) Samples

QA/QC for laboratory chemical analyses consisted of two parts: assessments of the quality of the lab and assessments of the quality of the field work (see Sections 1.7.3 and 1.7.4 of the QAPP http://www.doh.state.fl.us/environment/ostds/research/ResearchReports/final319qapp.pdf). Blank samples (i.e., field blanks, field equipment blanks, and pre-cleaned equipment blanks) provided controls for cross contamination in the field and lab. For an overall assessment, two approaches were followed.

The first approach attempted to bracket each sample with a valid blank sample. The different types of blanks were determined as well as how frequently the detection limits were exceeded. If the detection limit was exceeded, further analysis revealed if the exceedance was large relative to typical values of concentrations. As a substitute for a comparison with 10% of individual sample results, fixed values were used for each parameter (0.5 mg/L for TP, 1 mg/L for nitrogen species, and 5 mg/L for TSS), and if the result did not exceed that value, it was qualified as “H”.

While more than 5% of chemical analyses consisted of various blanks, not every sampling event included a blank. Building on the analysis of blanks, each sample was assessed if it was bracketed by acceptable blank results. For this purpose, all samples were grouped into teams, based on groups of samplers and sampling equipment. For each sample result in a sampling team, a quality was assigned based on surrounding blanks: “pass” if the current event or both surrounding blank quality control samples did not exceed the method detection limit, “H” if at least one of the blanks exceeded the MDL but was within acceptance limits, and “fail” when at least one of the surrounding blanks exceeded acceptance limits. A secondary qualifier introduced was the result qualifier, such as “J” for the particular analytical result itself, and if the sample result showed lower concentrations than the MDL or the acceptance limit. When blank results were high, the possibility of patterns in the data was investigated. In many cases the occurrence of high blank results appeared to be sporadic and not associated with elevated concentrations in samples taken around the same time. For these analytes the second approach was used for further review.

The second approach looked at the qualification of samples individually. Few $cBOD_5$ blanks were analyzed because the QAPP did not require it. Results indicating non-detection at elevated detection limits were frequent, and other data qualifiers (Appendix E) occurred as well. For this parameter, the results of evaluations of individual sample results were reported.

In addition to blanks, samplers took field duplicate samples for analytes other than total alkalinity. The objective was that at least 75% of duplicates for each analyte would have a relative deviation of less than 20%.

2.3.5.3 Field Procedures Quality Control

All field work by samplers was performed in accordance with the procedures outlined in the QAPP or referenced as FDEP SOPs. The original plan had been to assess between-analyst precision for field screening methods during training, by comparing concurrent results by two different samplers on the same samples for at least five samples and five sites. This element of the project was abandoned as it became clear during the training of samplers that the number of sites visited were insufficient to accomplish both training and comparison.

2.3.5.4 Field and Lab Results Data Entry Quality Control

Each entered field evaluation form entry was quality control reviewed by someone with extensive knowledge of the project database and project goals that was different from the original person doing data entry. The name of the person performing the quality control check was recorded in the database. The majority of records were thoroughly reviewed with the exception of certain people doing data entry that consistently required few to no changes. These records were spot checked, looking at several fields on each form to see if the values matched. If there were any discrepancies, the record would be quality control reviewed in its entirety.

Lab results were quality control reviewed by looking at several factors. The quality control and data entry processes are outlined in Appendix C for both the main project laboratory (Xenco / Florida Testing Services LLC) as well as the individual fecal coliform testing laboratories. This process was successful in catching most erroneous or questionable data points. During subsequent analysis and cross checking, some errors in the format of the results spreadsheet were detected and corrected.

2.4 User Group Surveys

A series of surveys were created by FDOH personnel and distributed and analyzed by Florida State University's Survey Research Lab (FSU-SRL). The survey was sent to various user groups as one of the tasks in the overall project (Appendix F). The objective of the user group surveys was to allow a representative sample of several user groups to voice their views and opinions as well as to measure the practices and perceptions of these user groups about the management of advanced onsite systems. These user groups consisted of system owners and users, system manufacturers, maintenance entities, system engineers, septic tank contractors, and department of health regulators. Survey questions included both some that were targeted to specific user groups as well as some overlapping questions, where appropriate, to gauge differences between the groups on specific issues.

FSU-SRL sent a total of 3,793 surveys to a stratified random sample of system owners/users and 660 completed surveys (17.4%) were returned. The sample was based on the type of system (i.e., ATU, PBTS, or Innovative) and the use of the system (i.e., Residential, Commercial, or Unknown). The addresses were derived from the inventory database stratified according to if the system was an ATU or a PBTS, and if the facility served was residential or commercial. Systems that were selected for sampling included a notation in the database on whether the system owner was sent a survey and whether a completed survey was sent back. About 1,000 of these surveys were returned as undeliverable. This was mainly because the survey was addressed and sent to the property that had the advanced system. Many systems are not on owner-occupied residences, are located at vacant residences, or are on properties which do not have a mail receptacle at the physical address. The survey letters were re-addressed to the actual property owner after querying various county property appraiser databases.

FSU-SRL sent surveys to all FDOH county offices, and all installers (septic tank contractors), maintenance entities, and engineers for which the department had contact information from licensing or permitting files. Results of this survey were largely reported by FSU-SRL (FSU-Survey Research Laboratory, 2011). A summary of the results is provided in Section 3.4.

2.5 Evaluation of Management Practices

One objective of this project was to assess management practices that might serve as best practices. The following data were collected as part of this project: past FDOH program evaluations; the permitting, inspection, and maintenance records from systems selected for sampling; results from a survey that was sent as a part of this overall project to gather information from different stakeholder groups; and any other information regarding the procedures that the FDOH county offices use.

2.5.1 FDOH Onsite Sewage Program Evaluations

Past FDOH onsite sewage program evaluations and permit records were electronically stored to facilitate a quantitative means of assessing management practices.

A system of program evaluations was developed by the FDOH to ensure consistency between FDOH county offices in implementing the onsite sewage program and to identify additional staff training opportunities. The evaluation is performed generally every three years by Onsite Sewage Program Office staff. Program evaluation tools are recorded in an Excel spreadsheet and generate an overall score and component scores based on findings. This project looked at the overall score and at the scores for ATU operating permits, PBTS operating permits, and maintenance entity service permits.

The program evaluation tool is periodically revised to incorporate rule or other program changes. For advanced systems, the tool currently focuses on documentation of permitting processes. Since the dropping of an ATU sampling requirement in 2001, the criteria have remained fairly consistent, with only a recent addition to assess PBTS operating permits separately.

A summary of evaluations completed during 2000 to 2010 provided historical data which was used as a baseline to identify common trends within a particular county and determine if there was a systematic trend. Capturing this information played a critical role in determining the strengths and weakness within FDOH's management practices. These data allow for an evaluation of which counties manage this program "best" in regard to consistency and completeness of documentation requirements. This later becomes an input to identify best management practice recommendations in Section 3.5.

2.5.2 Permit File Review Relative to Program Evaluation Criteria

The review of system files collected as described in Section 1.3 included a collection of certain data fields that were also included in the program evaluation tools to evaluate documented management practices. The particular components of the 2009-2011 program evaluation tools used with this project are those relating to ATU operating permits and PBTS operating permits. This allowed the scoring of project records to be standardized for comparison with historical records. Questions that were answered with this data review were:

- Is the current operating permit on file?
- Is the original operating permit application on file?
- Is there an inspection report completed by FDOH for a completed permit year?
- Is there an initial inspection report completed by the ME for a completed permit year?
- Is there a second inspection report completed by the ME for a completed permit year?
- Is the current ME contract on file?
- Are there monitoring requirements? [Only applicable to PBTS permits]

2.5.3 Procedures of FDOH

More qualitative observations on the inspection protocols used by counties and on enforcement steps taken, if applicable, were obtained. The permit file review allowed gathering of information on the forms used during FDOH inspections and on documented enforcement. Additionally, during the site visits, project staff had the opportunity to gather data to allow comparison of FDOH county office-staff protocols relative to the procedures used during this project.

3 Results and Analysis

3.1 System Selection

The final system population targeted for sampling consisted of a total of 1,014 systems (Section 2.1). The different criteria were designated by five sample group codes (Table 9). Five hundred and eighty seven systems were selected based only on a random sample taken from an inventory of all of the systems. A total of 210 systems (70 from each of three technology approaches: fixed media, combined media, and extended aeration), were selected based on the technology. Of these, 112 systems were included in the initially selected random sample (Y2), and 98 additional systems were selected based on the technology type (Y1).

There were 204 additional systems selected during the second round of random sampling (Y3). A few additional systems were assessed to gather data on monitoring points next to drainfields (Y6). Group Y4 included miscellaneous resampled systems from the pilot study, misidentifications, and assessments of a few systems of interest such as innovative systems located conveniently near other sampled systems.

The distribution of the total group of selected sites generally aligned with the distribution of advanced systems in the state, with counties that have the most advanced systems having the highest representation in the random sample.

Table 9. Systems Selected for Sampling

	Frequency
N	**15,581**
Systems targeted for sampling	**1,014**
Y-initial random sample	587
Y1-additional technology sample	98
Y2-sample for initial random sample and technology	112
Y3-second round of random samples	204
Y4-additional systems	8
Y6-drainfield monitoring samples	5
Total	**16,595**

3.2 Summary Statistics for Permit File Review

3.2.1 Summary of System Status

The permit file review outlined in Section 2.2 was conducted on 1,014 permit records. Table 10 breaks out the status determined for each of the systems evaluated based on the information obtained from the FDOH county offices. These results allowed for an assessment of the accuracy of the initial inventory of advanced onsite systems in Florida.

Table 10. System Status from Permit File Review

System Status	**Frequency**	**Percent**
Abandoned conventional system	1	0.1
Abandoned after file request	30	3.0
Abandoned before file request	74	7.3
Active	679	66.9
Active but conventional system	66	6.5
Active but vacant	36	3.6
Duplicate	1	0.1
Not existent	32	3.2
Not on file	9	0.9
Permit for maintenance entity, industrial/manufacturing facility, or other permitted facility type	81	8.0
System not final approved	4	0.4
Transferred to FDEP	1	0.1
Total	**1,014**	**100.0**

Further validation of the permit file data was done by after completion of the site visits. For example, comments of the sampler that the establishment was “unoccupied”, “vacant” or "shuttered" indicated that the system was active but vacant, i.e., not in use at the time of the site visit. Comparison of permit file data and information from the status assessment of the 535 systems that were visited showed largely good agreement.

Many additional systems (65) were found during site visits to be active but vacant or unoccupied, and three active systems were found without house or other sewage source on it. Twelve systems that had been considered "active but vacant" appeared to be in use during the site visits. There appeared to be considerably variability on whether a property is vacant or not. This was also indicated by the observation that 6 of 43 systems that were visited repeatedly had different vacancy-related comments on each occasion, all changing from active to active but vacant.

Among the identified systems, a substantial percentage were vacant or not currently in use. This percentage increased from initial assessments based on the field observations. Overall, the percentage of all advanced systems that were vacant or not used was 13%. This is likely an underestimate because determining vacancy was not an objective of the study, and for those systems that were not visited, no observations indicating vacancy were obtained. For the five counties with most systems, the estimated vacancy rate, calculated by comparing the number of identified vacant systems to all evaluated systems, ranged from 5% (Monroe), to 11% (Brevard), 17% (Franklin), 19% (Charlotte), and 22% (Lee). The vacancy rate is a combination of the effects of seasonal or vacation use (snow-birds) and empty properties for other reasons, such as eviction due to foreclosure, change in tenants, and renovations.

Smaller discrepancies were also noted. One system was abandoned after file request but also after the site visit, at which time it was active but vacant. Two systems, or all visited from that category, that had been not on file were found active. One system that was indicated as missing the final approval was found active.

There were four (0.4%) systems that had not received final approved. It appears most of these had not been installed as there was no maintenance information for any of these systems. One of the 4 was visited and was determined to be an active innovative system installed around 2000.

3.2.2 Revised Estimate of Number of Advanced Systems

Table 11 shows the number of advanced systems determined after the permit file review was completed. Based on the overall numbers, 29.5% of the reviewed files were found to not be an advanced system. This percent reduction can be applied to the statewide numbers for the overall estimate of advanced systems in Florida. If applied this would change the number of advanced systems from 16,595 to 11,700.

Table 11. Number of Advanced Systems from the Permit File Review

	Frequency	**Percent**
Advanced System On Site	715	70.5
Not an Advanced System	299	29.5
Total	**1,014**	**100**

Consideration of the observations during site visits changes the system inventory numbers slightly (Table 12). Among the systems selected as part of the random sample, 70% were confirmed as actual active systems. The systems selected only for representation of technology were found to be existent 80% of the time, while systems selected both as part of the random sample and part of the technology evaluation were confirmed in 93% of the systems reviewed. This indicates that those systems about which more specific information was known were less likely to be misidentified. For the random sample overall, the largest fraction, about 10% of systems, were abandoned by the end of the study, similar fractions were misidentified from other operating permits (9%) and conventional systems (7%), and a few systems did not exist or were not found in the files. Applying the 30% exclusion rate to the number of systems in the database results in an estimate of 11,600 advanced system active in mid- 2011.

Table 12. Summary of System Existence after File Review and Site Visits

	Random Sample	Technology Sample	Other	Total
active	629	78	12	719
abandoned	92	11	0	103
other OP	79	2	0	81
conventional	62	5	0	67
Not existent/ no files/ duplicate	41	2	1	44
Total	903	98	13	1,014

For counties that had over 10 permit files reviewed, the following counties had a significant number of non-advanced systems: Monroe (almost 50% were converted to sewer), Marion (mostly due to the permit file not being existent), Orange (mostly due to the permit files being other types of non-advanced system operating permits), and Palm Beach (mostly due to the permit files being other types of non-advanced system operating permits).

Forty-two counties had less than 10 files reviewed. Of those, twenty-two had none of the selected files be an advanced system, and for thirty-two counties over 50% of the files were not an advanced system.

3.2.3 Summary of Randomly Selected Advanced Systems

A review of data in the permit files was completed. The criteria for the summary statistics were that the site had to be randomly selected, and not one of the sites selected specifically for the type of technology on site, and had to have a system status of either active, active but vacant, or installed but did not receive final approval from FDOH. The final dataset included 629 systems. The summary statistics listed in this section include an evaluation of those 629 systems unless otherwise noted. The analysis was performed in four main parts: system age, system location and use information, system construction details, and a permitting evaluation. Focusing on the randomly selected files allowed for the results to better illustrate similar trends statewide.

3.2.3.1 Summary of System Age

Permit files were requested from the FDOH county offices from early 2010 to early 2011. The oldest system from those evaluated received final system approval on March 30, 1983 for a single-family residence in Franklin County. The most recent system in the random selection of permits that received final system approval was for a single-family residence in Orange County on November 4, 2010. An analysis was done of active systems that had a final approval date. Among these, the average advanced system final approval date was May of 2004 and the median final approval date was January, 2006 (Figure 6). Figure 7 shows the distribution by year of permit application.

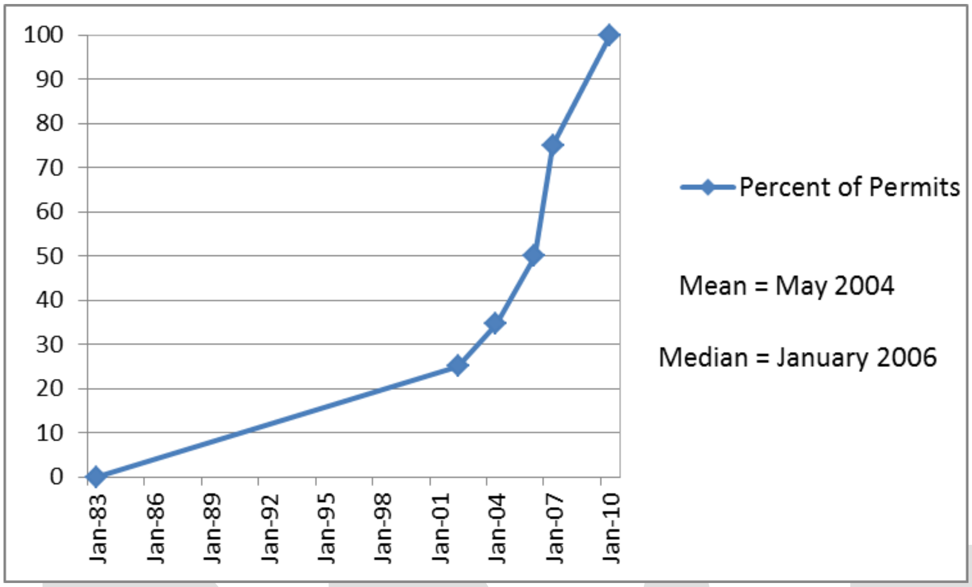


Figure 6. Distribution of Permits by Final Approval Date

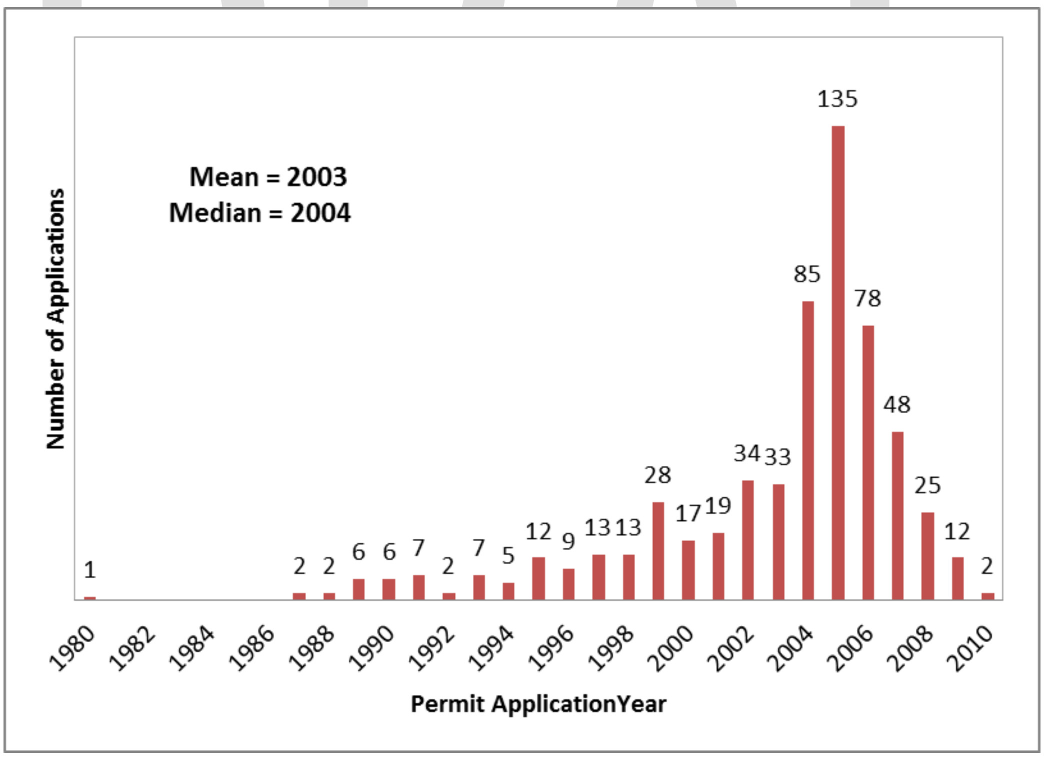


Figure 7. Distribution of Number of Applications by Permit Application Year

3.2.3.2 Summary of System Location and Use

The property information and proposed use of the system were evaluated among the randomly selected systems that had a permit file review and also had construction permit file information available. Table 13 shows the details on the type of application that was applied for. This clearly shows that the majority of permits for advanced systems are for new systems.

Table 13. Frequency of Advanced Septic Treatment Application Type

	Frequency	Percent
New	547	89.4
Repair	36	5.9
Existing	10	1.6
Multiple	3	0.5
PBTS	3	0.5
Modification	2	0.3
Innovative	1	0.2
Other	1	0.2
Total	612	100.0

Out of the permits reviewed, 95% were for residential applications, 4% were for commercial establishments, and 1% were for either properties that had both commercial and residential establishments or data as to the type of establishment were missing. By far, residential single-family residences were the majority of the establishments (90%), followed by duplexes (2%). The remaining establishment types included churches, office buildings, doctors' offices, and other such common establishments.

The distribution of estimated sewage flow from the permits that had a documented site evaluation showed that the vast majority of permits were for establishments with an estimated sewage flow of 300 gallons per day (Figure 8). There were a few establishments with very large flows going up to a maximum of 4,300 gallons per day.

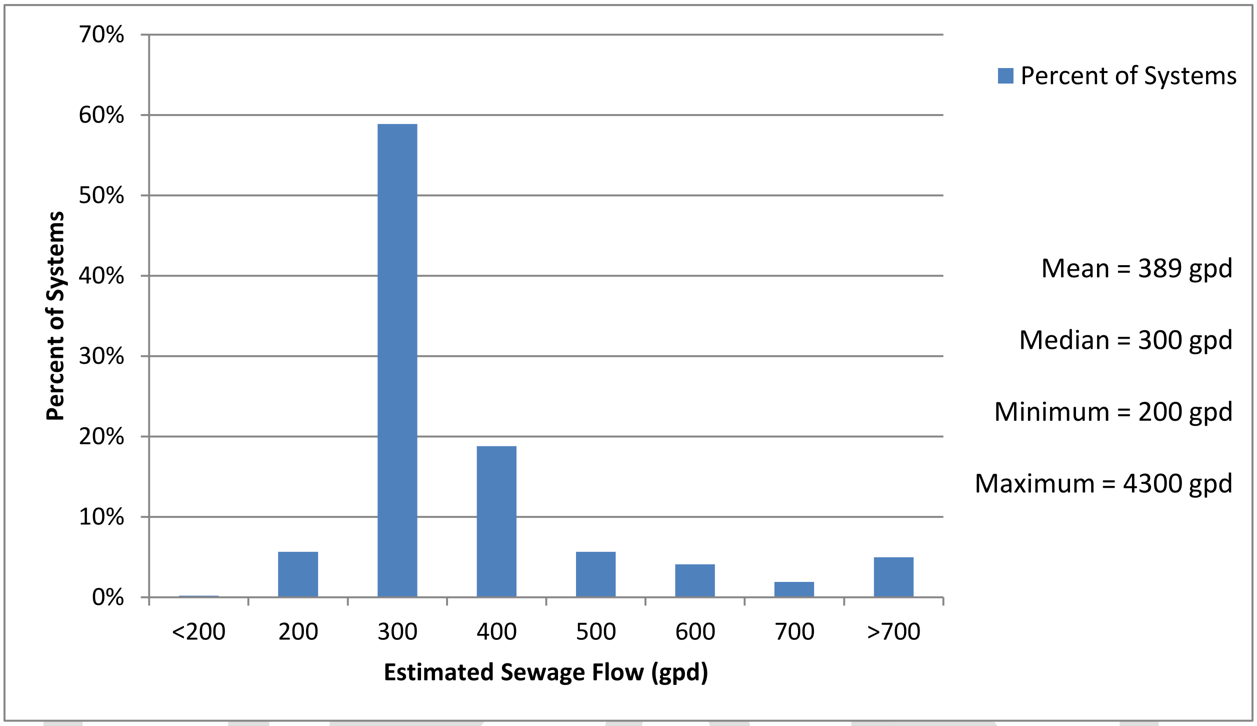


Figure 8. Distribution of Estimated Sewage Flow in Gallons per Day among Systems with a Documented Site Evaluation (n=586)

There were twenty-nine systems where the amount of sewage flow allowed on the lot, was less than the estimated sewage flow. Eight of these were permitted as a result of a variance. Five were for systems meeting secondary treatment standards and six were for advanced secondary systems where the % difference fell within the parameters allowed by code. One system did not receive final approval from FDOH. The remaining ten systems were for ATUs. A quick check on a few of the permits showed that the engineer that filled out the paperwork had indicated that the property was served by a private well when in fact the property was on public water. Other possible errors might come from the permit file review done at the FDOH county office or incomplete permit files submitted.

Of 83 performance-based treatment systems in the files that were reviewed that had construction permit information, 32% indicated that the utilization of the treatment level was to assist with an increase in authorized sewage flow. Less commonly reported, at 5%, were horizontal setback reductions.

Figure 9 shows the percent of permits that required sampling as part of the permitting process. Innovative systems required the most sampling, followed by PBTS non-innovative systems. ATUs required the least sampling.

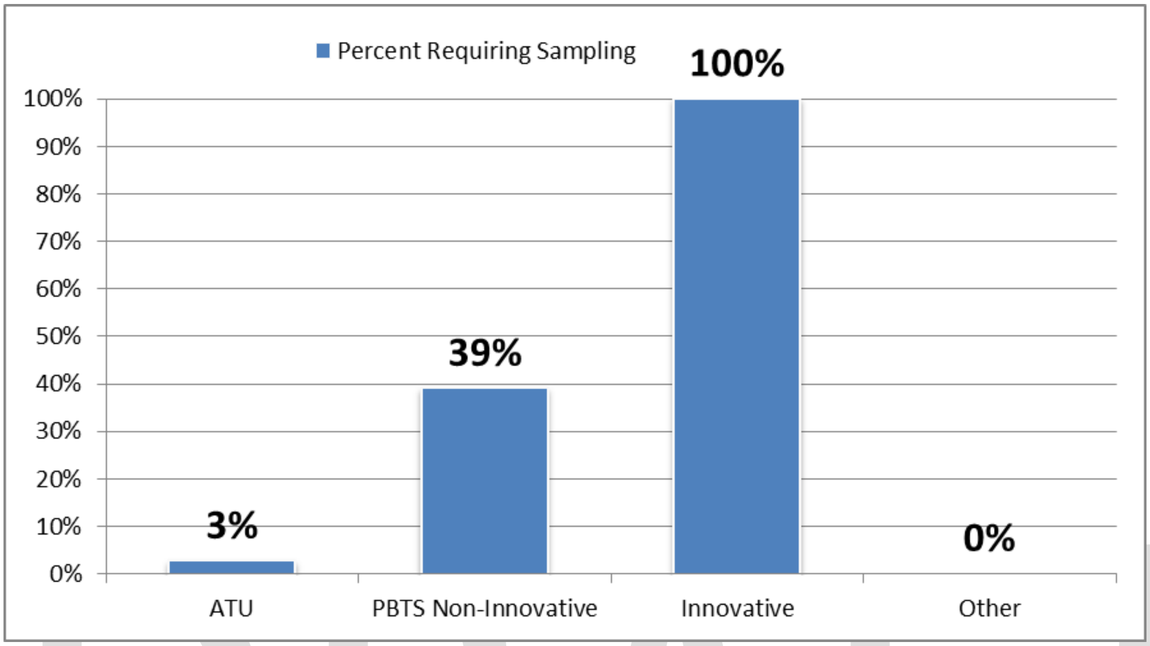


Figure 9. Percentage of Permits Requiring Sampling by System Type (n=612)

3.2.3.3 Summary of System Construction Details

A review of the system construction permit files was performed to document the physical properties of these systems.

Regarding the size of the drainfield, there is space for two drainfields on both the construction permit and the final inspection form. The sum of the square footage of the two drainfields was used to determine the distribution of permitted versus installed drainfields. Only those systems that had a final inspection form reviewed as part of the permit file review were analyzed. As indicated in Table 14, there is not much difference between the size of the permitted and installed drainfield. The installed drainfield tended to be slightly larger with a median 3 square foot difference and a mean 15 square foot difference.

Table 14. Mean and Median Square Footage (SqFt) of Drainfield

	Total Drainfield Permit (SqFt)	Total Drainfield Final (SqFt)	Difference Between Permitted and Installed Drainfield (SqFt)
Mean	398	414	15
Median	360	375	3

For those systems where a construction permit was available for review, an evaluation was done to show the most common drainfield type (i.e., mounded, standard, filled) and drainfield configuration (i.e., bed, trench). Table 15 shows that mounded drainfields were the most frequent type of drainfield with over 50 percent of the permitted drainfields requiring this, and is followed by standard in-ground drainfields (25%) and filled systems (15%). Only 26% of the systems with final approval had a pump. This would indicate that many of the sites requiring mounded drainfields have been built up so that the building plumbing is at a level to allow for gravity flow to the drainfield.

Table 15. Frequency of Drainfield Type

	Frequency	Percentage
Mound	298	51%
Standard	145	25%
Filled	90	15%
Unknown	52	9%
Sand Filter	3	1%
Total	**588**	**100%**

Table 16 shows that drainfields installed in bed configuration (63%) are more common than trenches (26%).

Table 16. Frequency of Drainfield Geometry

	Frequency	Percent
Bed	373	63%
Trench	152	26%
Unknown	60	10%
Injection Well	3	1%
Total	**588**	**100%**

Only four reviewed permits had grease interceptors present, indicating that commercial strength sewage waste is uncommon for advanced systems.

Figure 10 shows the percentage of products by product type/manufacturer for installed drainfields. The top four products were mineral aggregate (28%), infiltrator chambers (18%), drip irrigation (16%), and Plastic Tubing Industries, Inc. (P.T.I) multi-pipe systems (15%).

Table 17 outlines how the wastewater moves to the drainfield, showing that gravity systems are the most common, with 66% of the installed systems, followed by drip-irrigation, and then lift-dosing.

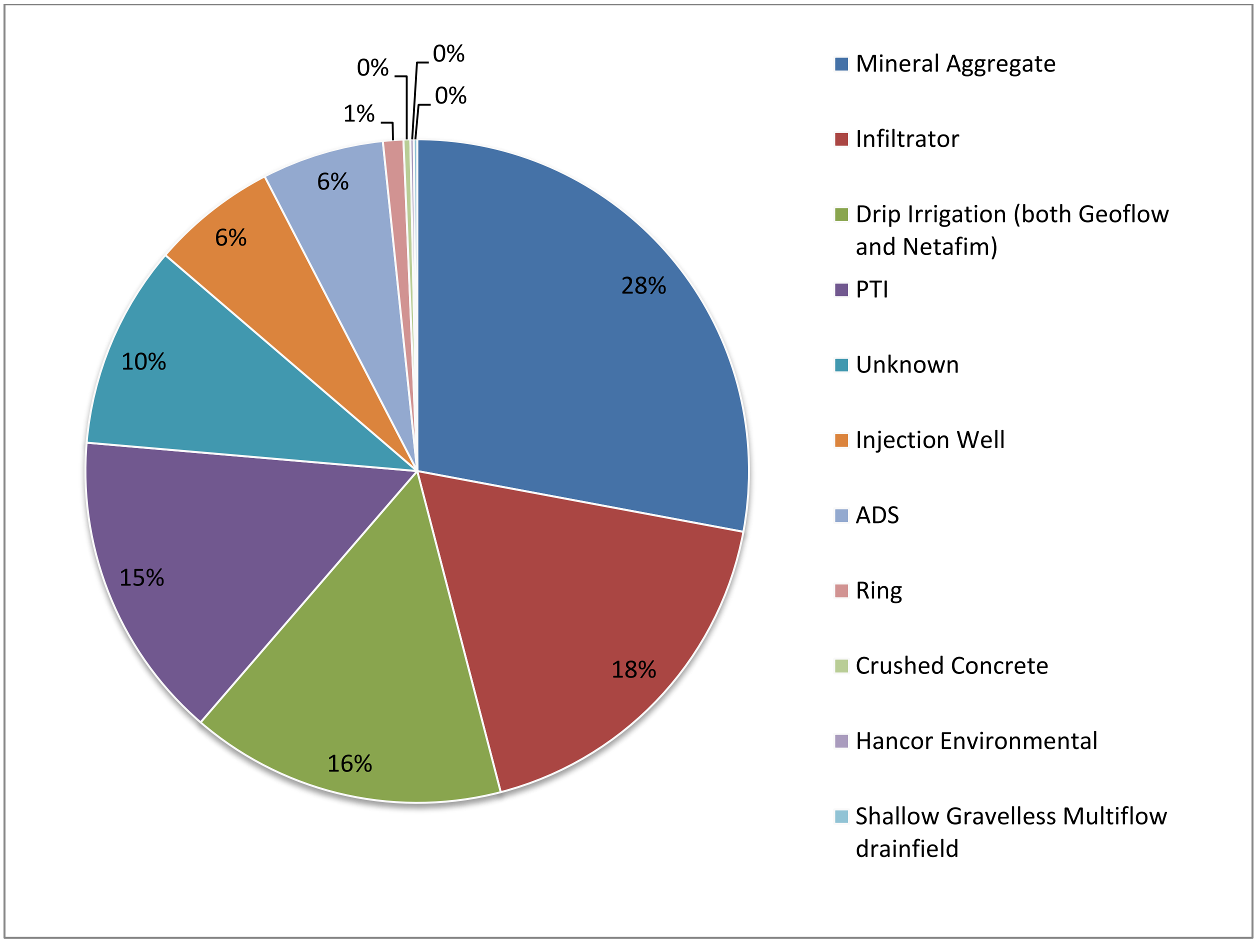


Figure 10. Distribution of Drainfield Product Type/Manufacturer (n=605)

Table 17. Summary of Final Distribution of Wastewater

	Frequency	**Percent**
Drip	100	17%
Gravity	402	66%
Injection	1	0%
Lift-dosed	54	9%
Low Pressure Distribution System	6	1%
Unknown	42	7%
Total	**605**	**100%**

Engineered systems were slightly more common (51%) than non-engineered systems (49%). Reasons for why an engineer would be asked to design the system include: requirement by code for PBTS and drip irrigation systems, requirement by some counties for all onsite systems, choice of the applicant.

Table 18 shows information on pretreatment for the advanced systems that were evaluated. Some sort of pretreatment, either as a compartment within the ATU or as a separate tank, was found in 59% of the systems evaluated.

Table 18. Frequency and Type of Pretreatment

	Frequency	**Percentage**
Absent	240	38%
Compartment in ATU	248	40%
Separate tank	120	19%
Unknown	21	3%
Total	**629**	**100%**

For those with pretreatment, 305 systems had information on the pretreatment volume. The distribution of pretreatment volumes for systems with this information is shown in Figure 11. Only two percent of systems that had pretreatment included dosing into the treatment unit.

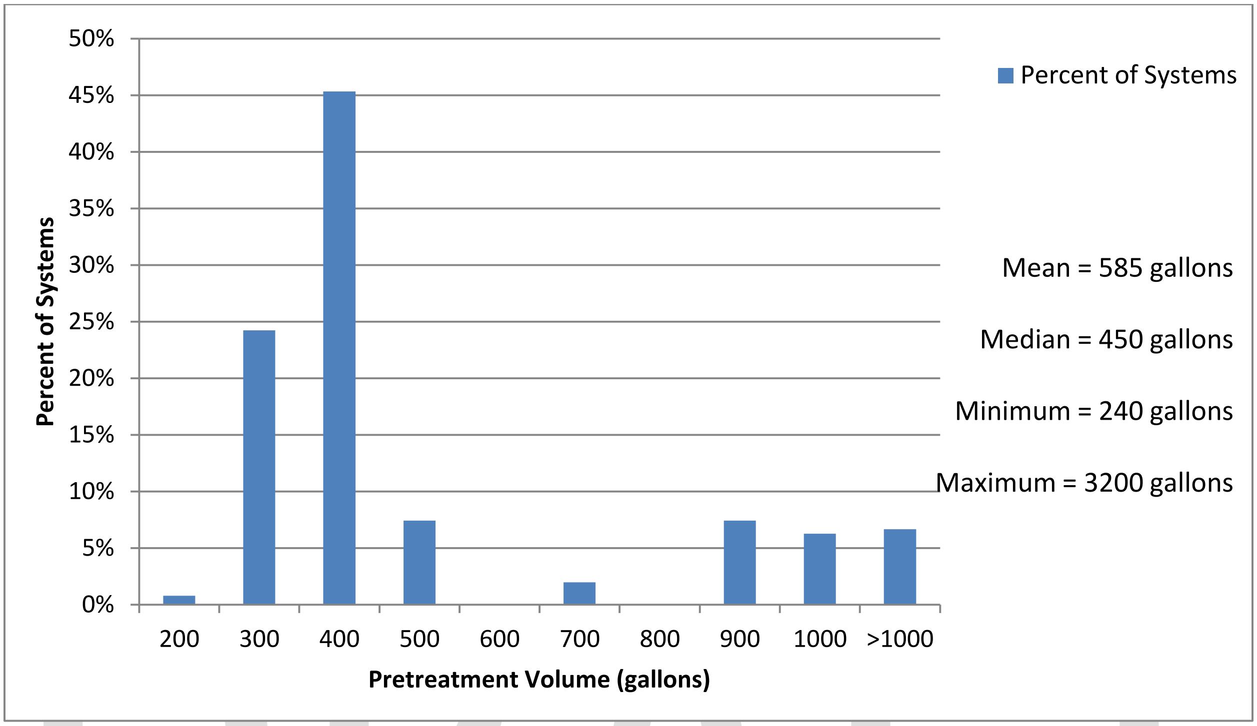


Figure 11. Distribution of Pretreatment Volumes in Gallons for Systems with This Information (n=256)

The permit review resulted in assignment of a manufacturer to nearly all advanced systems. Figure 12 shows the distribution of the manufacturers of advanced treatment systems in the reviewed permit files. The result over-represents manufacturers of infrequently used technologies to some extent, as 90 of the 715 systems were specifically selected based on the manufacturer. Still, the rank order of the first six manufacturers, which accounted for about three quarters of the random sample, did not change compared to the assessment based on initial project database.

Figure 13 shows the frequency of the various product lines and manufacturers found during the system evaluation of the random sample. The most common manufacturers were Consolidated, Hoot, Aqua-Klear, Norweco, Delta, and Clearstream.

Figure 14 shows the distribution of the treatment unit hydraulic treatment capacity. The median value of 500 gallons per day (gpd) appears to be in line with the current sizing requirement in the FAC for a three bedroom house, which matches the median estimated sewage flow value of 300 gpd found in Figure 8.

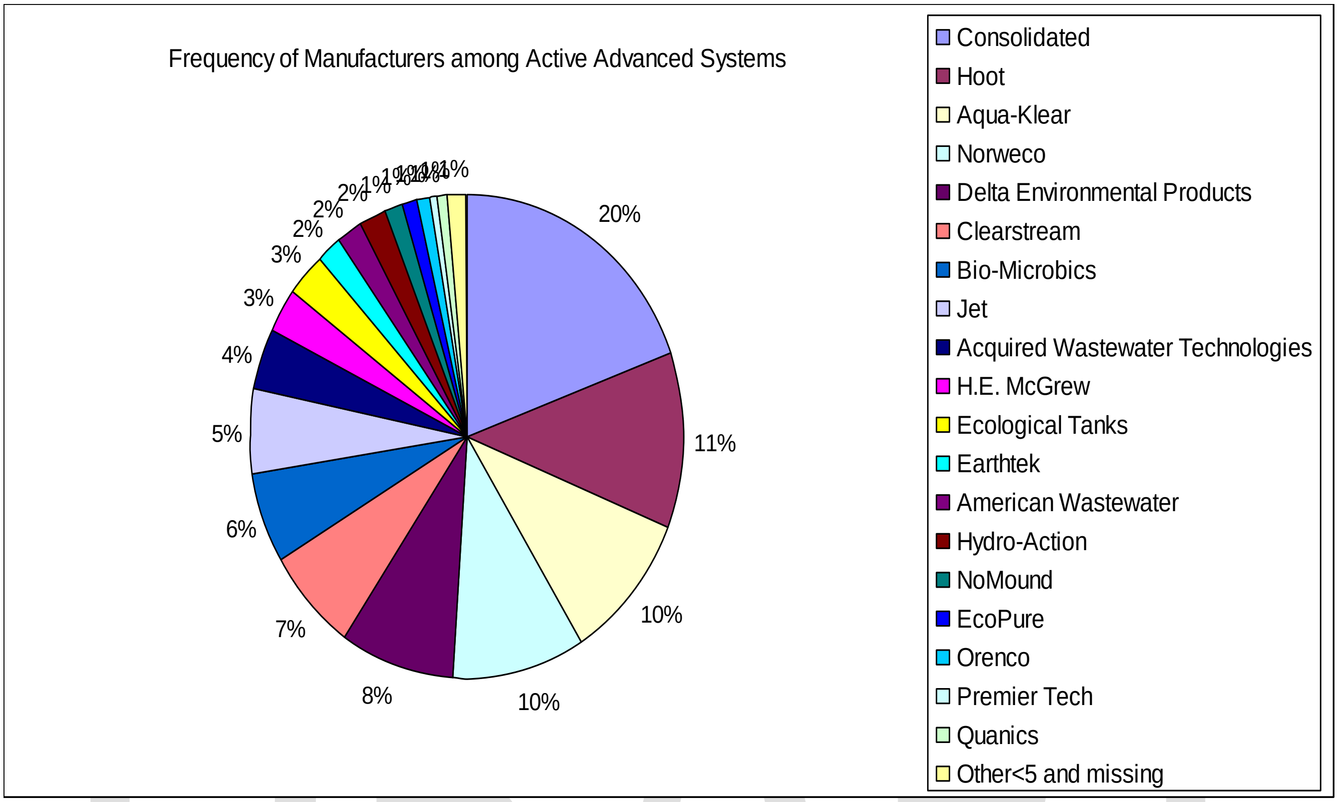


Figure 12. Distribution of the Manufacturers of Advanced Systems in the Reviewed Permit Files (Active or Active but Vacant, n=715)

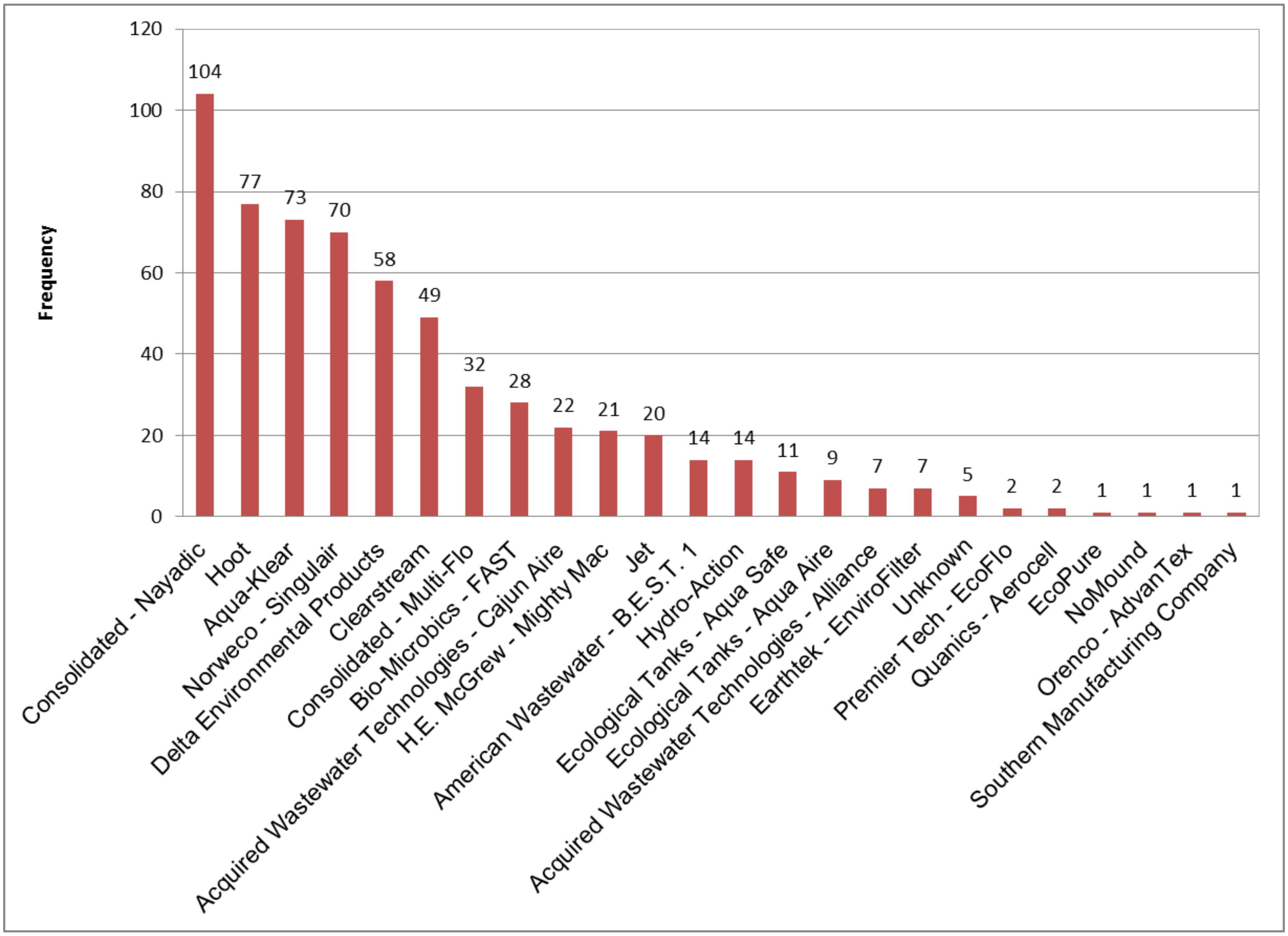


Figure 13. Frequency of Manufacturer Product Lines for Randomly Selected Advanced System Permits (n=629)

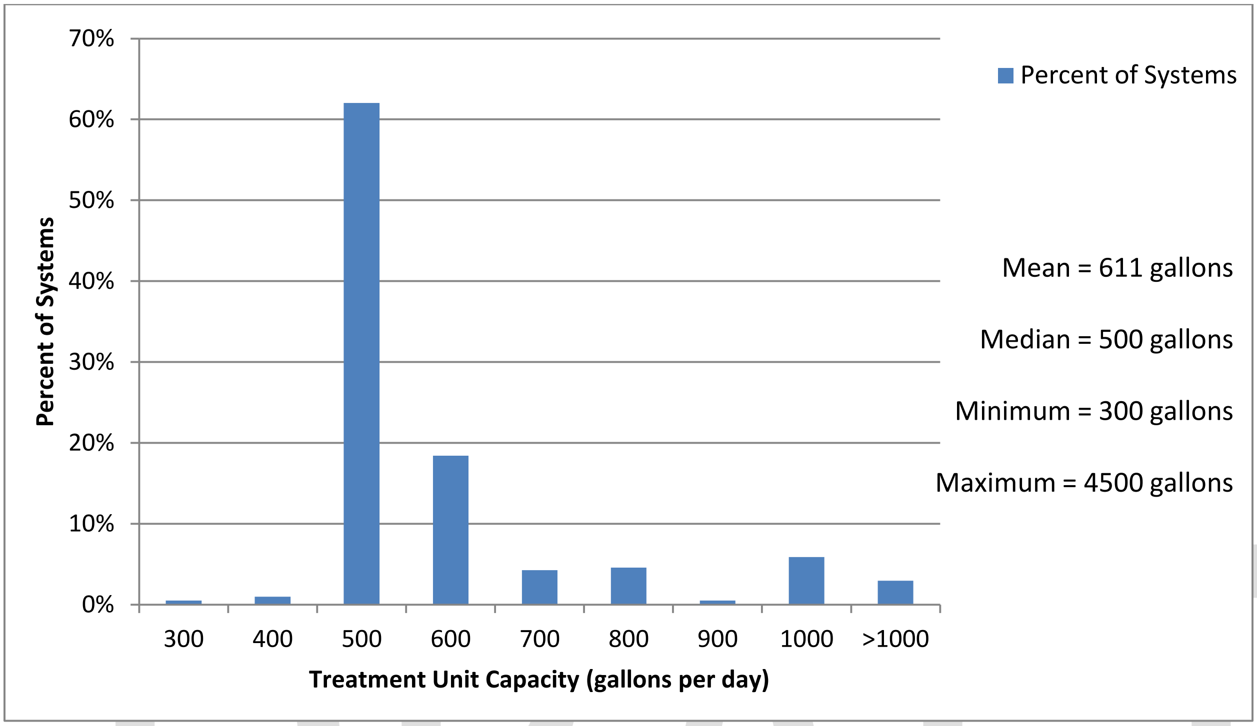


Figure 14. Distribution of the Hydraulic Capacity of the Treatment Unit in Gallons per Day (n=614)

Table 19 summarizes information regarding the dosing tank. The majority of systems did not have a dosing tank (65%). Most of the systems with a dosing tank, included that feature as a separate tank, while a smaller group, associated with a few product lines, included a dosing compartment in the treatment tank. The combination of a dosing compartment with a filter tank or a chlorination compartment occurs mainly in Monroe County.

Table 19. Frequency and Location of Dosing Tank

Dosing Tank	Frequency	Percent
Absent	407	65
Either part of ATU or a separate tank	21	3
In chlorination tank	1	0
Part of ATU-tank	62	10
Part of filter tank	18	3
Separate tank	92	15
Unknown	28	5
Total	**629**	**100.0**

3.2.3.4 Evaluation of Permitting

An evaluation was performed to document the permit file review process for the random selection of advanced systems. This evaluation will help illustrate some of the strengths and weaknesses with the file review process. An evaluation was done in Section 3.5.2 showing permit file completeness.

Data in the project permitting database were often brought over from the EHD when the information was available within the database. This database replaced an earlier permitting database and the transition occurred in the mid-2000s, increasing data availability and quality since then. The permit file reviewers for this project marked a check box when evaluating the final inspection form to note when changes to previously entered information were made. Out of the 629 system files analyzed under this task, almost 41% required some sort of change due to information being absent or entered incorrectly. This shows that the data within EHD are not always completed or accurate. A crosstab was done to see if any of the counties with a larger number of systems showed any trends toward having the final inspection data correct in EHD, and only Monroe County seemed to have fairly low accuracy, with 22% of permit files showing incorrect data. There did not seem to be any overall trend showing improvement on this over time.

Over 91% of the files reviewed had a signed and approved construction permit in the file. Of those permit files for which the construction permit was available, 93% also included a signed and approved final inspection form. This shows that for a fairly high number of systems review and approval by FDOH could be documented.

Approximately 54% of the submitted site plans show the monitoring locations on the site plan. Charlotte County was by far the most consistent with showing this, among the counties that had the most advanced systems, with 92% of the submitted site plans showing the monitoring locations.

Of those systems for which an operating permit application was provided for permit file review, two percent did not have record of an operating permit having been issued. Of those systems that had an operating permit in the reviewed permit file, 92% of them had documentation of a current operating permit.

Four percent of the files had documentation regarding a requirement for a variance. This is a process that involves review by the FDOH Variance Board and the State Health Office and takes additional time. Only one percent of the permit files listed any enforcement for the construction permit. This indicates that the construction of the systems is generally not problematic. There were considerably more systems that required enforcement for operating permit issues, though. A field in the database was available for data entry on the description of the violations for the permit files. Out of 629 permit files, 169 (27%) required some sort of enforcement action by FDOH with many of these showing several or repeated violations. The violations and their frequencies are shown in Figure 15. Paperwork issues appear to be the majority of the issues relating to enforcement, with 86% of all enforcement issues being either that the maintenance agreement and/or the operating permit are expired.

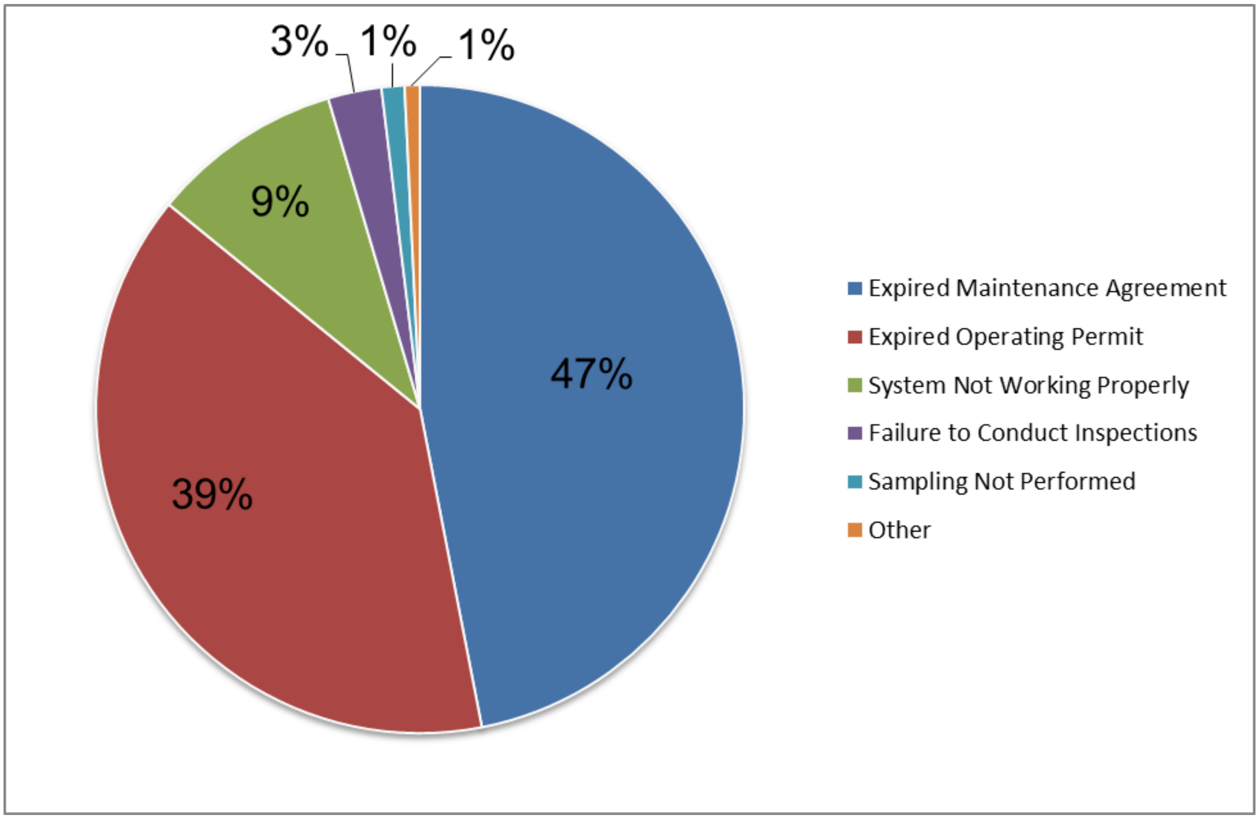


Figure 15. Distribution of Advanced OSTDS Permitting Violations Requiring Enforcement (n=262)

3.2.3.5 Duration of Permitting Steps

An evaluation was performed to look at how long it takes to complete several key steps along the permitting and installation timeline. Generally, the timeline shown in Figure 16 are the steps required and the general order of events. There are times when the dates in the database did not follow the general format. These tended to be for systems where there was an original system and another permit was applied for, or if the system was installed but did not obtain an operating permit and a new construction permit was applied for. For the purposes of evaluating the amount of time between steps in the permit process, these outliers were eliminated.

Figure 16. General Order of Events for Advanced OSTDS Permitting and Installation

Table 20 displays information on the amount of time in days between the various steps for all reviewed systems, and then split out by ATU and PBTS. Figure 17 shows a timeline visually summarizing the total combined data for the median values. As permits for advanced systems are generally more complicated than conventional systems, it is likely that more time is required for the permitting process from all involved parties (i.e., homeowner, contractor/installer, maintenance entity, engineer, FDOH). FDOH has a required amount of time to review applications, which differs as to whether the application is for an ATU or a PBTS. ATUs fall under normal permit review timeframe limits (no more than 30 days to request additional information and 90 days to issue or deny the permit once it is complete) while PBTS have a much more strict timeframe limitation (no more than 5 days to request additional information and 15 days to issue or deny the permit once it is complete). Counteracting these differences in timeframes is the higher complexity of PBTS-applications.

If the median values are totaled across all the permitting steps, an advanced system takes a median of 299 days before all steps from application to final approval are completed for all systems overall, 309 days for ATUs, and 236 days for PBTS. In looking at the median values in Table 20, it is apparent that the longest time period is after the permit has been issued and before construction approval is given, that is the construction phase of the system. After the construction approval is obtained, it then still takes a while before the applicant provides operating permit application (and maintenance contract) in order to receive final approval. It appears that PBTS systems tend to be constructed and inspected more quickly than ATUs, but that ATUs are generally permitted quicker and an approved operating permit is generally received more quickly.

Table 20. Analysis of Amount of Time between Permitting Steps for Total Advanced Systems, ATUs, and PBTS

			Days between application date and permit date	Days between permit date and construction approval date	Days between construction approval date and final approval date	Days between final approval date and operating permit application date	Days between operating permit application date and operating permit approval date
Total For All Advanced Systems	N	Valid	572	571	606	488	124
		Missing	57	58	23	141	505
	Mean		61	227	115	-106	164
	Median		28	211	52	-8	16
	Minimum		0	0	0	-1733	0
	Maximum		1947	1707	1536	954	1093
	Percentiles	25	8	76	12	-243	3
		50	28	211	52	-8	16
		75	60	330	128	0	153
ATU	N	Valid	496	492	523	417	91
		Missing	49	53	22	128	454
	Mean		59	235	122	-117	168
	Median		27	220	55	-8	15
	Minimum		0	0	0	-1733	0
	Maximum		1947	1707	1536	858	920
	Percentiles	25	8	92	14	-273	3
		50	27	220	55	-8	15
		75	58	338	136	0	163
PBTS	N	Valid	76	78	82	69	33
		Missing	7	5	1	14	50
	Mean		77	178	68	-47	155
	Median		34	136	34	-6	38
	Minimum		0	1	0	-1087	0
	Maximum		809	983	434	954	1093
	Percentiles	25	9	54	4	-126	3
		50	34	136	34	-6	38
		75	100	261	91	0	142

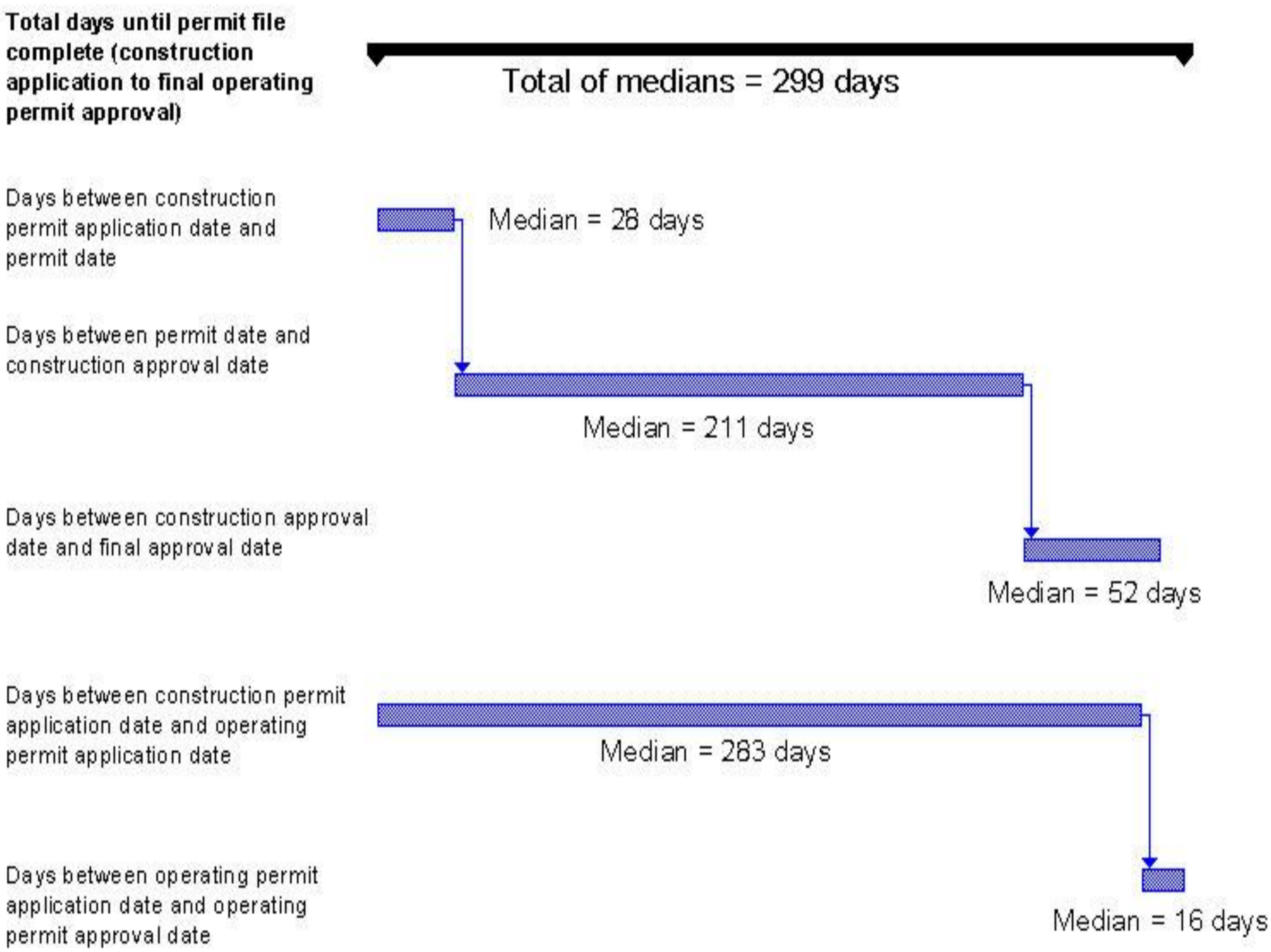


Figure 17. Median Time Spent on Various Permitting and Installation Steps for Advanced Systems

3.2.3.6 Specifications for Performance Based Treatment Systems

Review of PBTS permit files in particular indicated several difficulties in obtaining an accurate overview of permitting conditions. During the permitting process, applicants, engineers, and department employees may all have been aware of site and local requirements but this was not always recorded.

There was a vagueness of specified and required treatment standards. The FDOH permit application forms and the FDOH permitting database do not contain dedicated fields for the required treatment standards. Correspondingly, the design engineer and the FDOH staff had to decide where to record this information. For the engineer, a likely place is the required cover letter. In some cases, the permit file only stated that the application was for a PBTS. In reviewing cover letters it was apparent that the engineers, if they included specifications at all, frequently did not distinguish between performance data that they relied on in the design of the system, and treatment standards that a particular system would be required to meet, leading to incomplete or inconsistent specifications. Similarly, cover letters for drip irrigation systems with aerobic treatment units and performance-based treatment systems tended to use the same or nearly the same wording.

There was a lack of specificity regarding benefits obtained from using a PBTS such as reduced drainfield sizes, reduced setbacks and increases in authorized sewage flow. These benefits depend on the specified treatment levels and in turn influence the monitoring requirements.

There was also confusion about terminology and standards. Florida's regulations recognize several treatment levels (secondary, advanced secondary, advanced wastewater, Florida Keys) that address multiple parameters at the same time. On the other hand, drainfield size reductions, or the use of PBTS in lieu of an ATU, require treatment only of $cBOD_5$ and TSS to certain levels. For example, a system designed to obtain a drainfield size reduction may refer to advanced secondary treatment levels, without being clear that only $cBOD_5$ and TSS, but no nutrients and fecal coliforms treatment levels are part of the treatment specifications.

3.2.3.7 Quality Assurance Results

Each one of the reviewed permit files had a quality control review done. This review consisted of quality checking each of the entered fields and fixing all errors or omissions encountered. Table 21 shows the results of the quality control review. The reason for the large number of data entry errors was due to the complexity, the number of the data fields and the lack of experience some of the data entry staff members had with the project and with aerobic treatment unit technologies.

Table 21. Quality Control Status for the Permit File Review

Quality Control Status	Number of Permit Files
Agrees with records	297
Data Entry Errors	79
Missing Some and Errors	475
Missing Some Fields	162
Unknown	1

3.3 Field Assessment and Sampling

3.3.1 Completion Rate of Site Visits

Over the course of the statewide assessment, evaluation forms for 535 different advanced systems were filled out and 534 systems visited. Logistical challenges and time constraints prevented sampling in about ten southern Florida counties (with a total of 87 selected sites) and kept the completion rate in Monroe at about 34% of the 184 active systems. Sewer construction in Monroe County also complicated early identification of abandoned systems. Of the visited systems, 30 systems were visited twice and two were visited three times with the intention of obtaining more than one set of samples. In addition, ten systems were initially visited and assessed, but samples were obtained only during a later visit. In two cases, second attempts and site visits to take a sample were not successful, and in two cases site assessment records indicated that the owner let the samplers know in advance that they did not want their system inspected, only one of which was confirmed during a site visit.

For the random sample (Y, Y2 and Y3) 470 of 629 systems were visited, a completion rate of 75%. For the samples selected only based on the technology (Y1), 42 of 78 selected systems were visited, a completion rate of 54%. The technology-specific systems were overrepresented in the counties that did not get visited completely or not at all.

Among the visited sites, field observations indicated that about 17% of the visited advanced systems served vacant establishments or lots (18% for the random sample). For the largest counties, the rates ranged from 11% (Brevard) to 23% (Lee). This is higher than the previously discussed rate for the selected systems and reflects that vacancy information was to a large extent only obtained during site visits. It is likely still an underestimate of non-use because the field instruments did not specifically assess for vacancy, and some houses may have been vacant or not in use but did not look that way.

Figure 18 shows how many different site visits each sample team performed. Charlotte performed 120 visits, Lee 47 visits, Monroe 63 visits, Volusia in Brevard and Volusia counties 139 visits, and Wakulla Statewide 166 visits. These numbers include site visits performed by project staff in the respective counties. Some sites were visited multiple times and are not duplicated in these numbers.

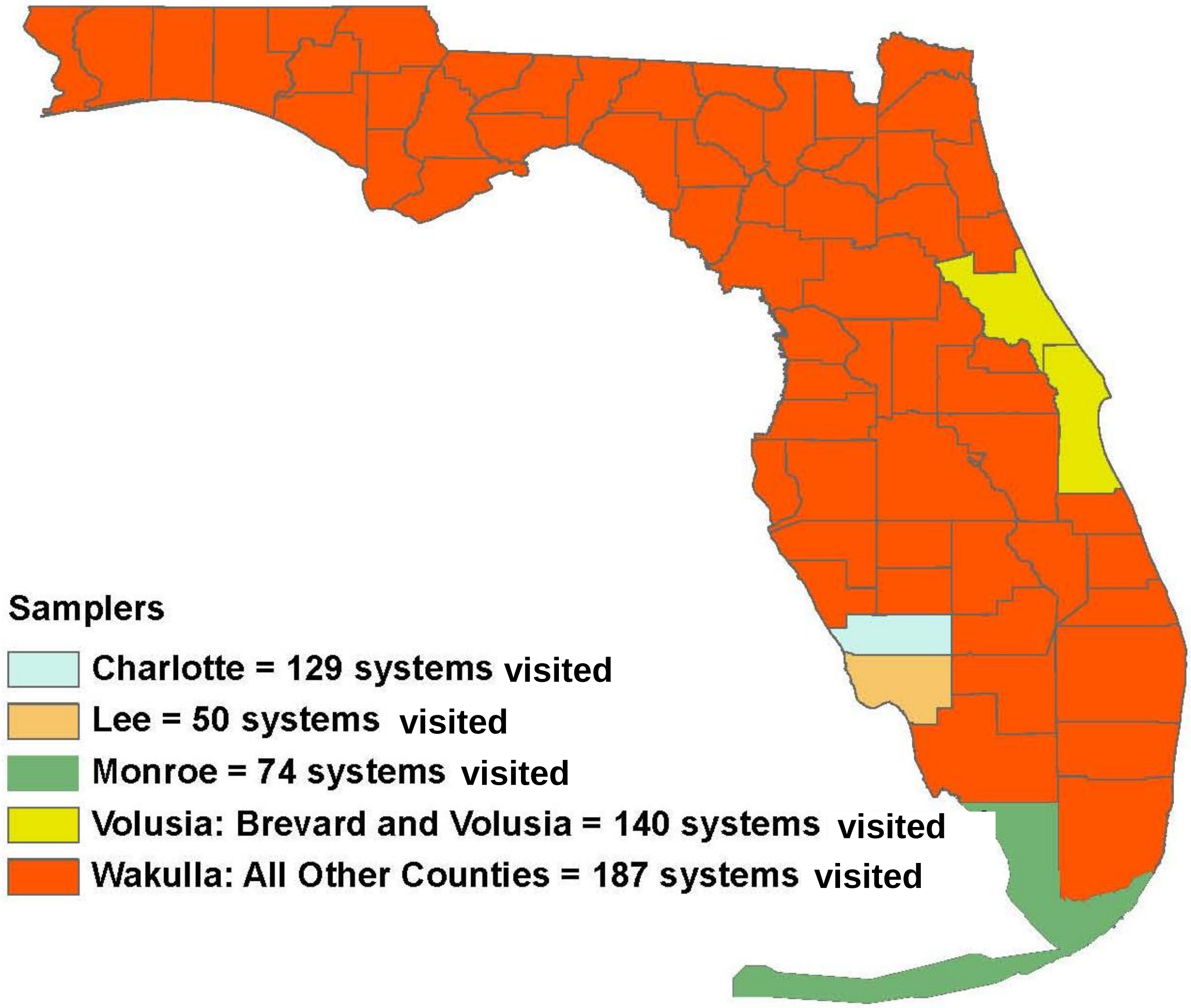


Figure 18. Map of Sampler Locations and Systems Visited

3.3.2 Results of the Initial System Evaluation (Step 3)

The following sections analyze the results of one site visit per system (534 systems) unless emphasized differently. The initial questions of the system evaluation form (0) provide information on the situation of the system evaluation, e.g., who was present, was the system accessible and what was the base for the subsequent evaluation. These were followed by questions about the operating conditions and components of the systems in increasing detail.

3.3.2.1 Background Information

The first few items of the initial site evaluation form describe who all was present during the site visit. For the 534 single system visits the results shown in Table 22 were recorded. Maintenance entities were rarely present. In Monroe one maintenance entity initially observed the sampling process and provided support in opening and explaining the treatment systems. Charlotte was the other county in which several systems were visited jointly with maintenance entities. Owner or users were present in about a quarter of the site visits.

Table 22. Who Was Present During the Site Visit to Each System?

Present	Maintenance Entity	Owner/ User	FDOH county office
Yes	20	130	342
No/not filled out	514	404	192

During the system visits, there were several possibilities that could preclude completing the initial system evaluation form: a denial of access from the system user or owner, locked/gated properties without access, and the lack of a system. Of the 534 system visits, only ten denials were recorded and 23 systems were denoted as obstructed. For eight systems the response to this question was omitted.

The next question, what information was used for the initial system evaluation, which allowed multiple responses, was apparently ambiguous. In at least three quarters of the system visits, permit records were used as part of the initial system evaluation, but one county's sampling group indicated them as nearly the only source of information even though they observed the functioning of the system, too. Corresponding to the importance of permit information, more than half of the system sketches referred to permit information, while a third of the sketches were indicated as drawn during the site visits. Lack of an indication that permit records were used may indicate lack of availability or lack of detail. These systems were concentrated in the statewide sampling, where access to complete permit records was not always feasible, and in Monroe County, where some permits provided very little detail on the installed system.

On about two thirds of forms the samplers indicated that they found one system. There was a non-response rate of about a third for this question. During four system visits, no system was found, and in one case more than one system was encountered.

In 85 cases the samplers indicated that they did not determine the components of the treatment systems and their order.

3.3.2.2 General Appearance and Functioning

The next few questions covered obviously visible issues that indicate problems and safety concerns. The samplers found surfacing/breakout of sewage in 12 and possibly in one additional system. Seven tank lids or covers were indicated as broken, nine systems exhibited signs of erosion or settling after installation, and ten systems were subject to vehicular traffic. In about 10% of the systems encroachment on the system observed. About half of the encroachment concerns stemmed from plants, landscaping and gardening, while the other half related to construction and driving concerns.

The number of non-responses was consistently between 35 and 38 for these questions, indicating that samplers were able to get close enough to nearly 500 systems for these initial evaluations. The fraction of non-responses was higher, nearly a quarter, for the systems that were targeted only for technology representation. Table 23 indicates the results of initial system observations separated by sample population.

Table 23. Frequency of Observations Indicating Problems or Likely Problems with the Advanced OSTDS.

Sample Group	Yes/No	Surfacing/ Breakout	Broken/Missing Cover	Settling/ Erosion	Traffic	Encroach-ment
Random	Yes	11 (+1possible)	7	5	7	43
	No	441	446 (includes N/A and unknown)	448	447	408
	No Response	25	25	25	24	27
Tech	Yes	0	0	2	2	4
	No	33	32 (includes N/A and unknown)	31	31	29
	No Response	11	12	11	11	11
Other	Yes	1	0	2	1	2
	No	11	12	10	11	10
	No Response	0	0	0	0	0

The conditions of the drainfield were evaluated based on the type and presence of vegetation in the drainfield area, along with signs of saturation or ponding. In about 5% of responses a tree was located in the drainfield area. The vegetation on the drainfield looked the same as the surrounding vegetation in 70% of the responses. In 14% of responses there was more vegetation on the drainfield than surrounding it, in 10% the vegetation was uneven, and in 4% of cases there was less vegetation on the drainfield than in the surrounding area. In 5, or 1% of systems, there were indications of ponding over the drainfield, with two systems showing standing water on the drainfield surface. Three of these were found by the Volusia/Brevard sampling team, and one each by the Wakulla Statewide and the Lee county sampler. The five ponded systems showed the same vegetation on top of the drainfield as elsewhere, and none had a tree in the drainfield. Four of the five systems with ponding had also been indicated as systems with surfacing/breakout issues.

The next set of questions aimed to determine if site conditions had changed since approval of the systems. The results are summarized in Table 24. About 4% of systems indicated landscape construction, utility work or changes in drainage patterns, just below 2% found obstructions of the system, no recent additions to systems were found, and about 2% of systems had missing or modified components. There were apparent differences between sampling teams: Most of the less definite "not determined" observations stemmed from the Wakulla Statewide sampler who would have been least familiar with previous conditions. About half of the alterations stemmed from Monroe County (13 landscaping drainage changes, four obstructions, five components missing or modified).

Table 24. Observed Alterations since Approval

	Landscaping/ Drainage	Obstructed	Additions	Components Missing/Modified
Yes	22	9	-	11
No	376	487	361	339
N/D	102	Not an option	138	144
No response	34	38	35	40
Total	534	534	534	534

3.3.2.3 Sound and Odor

Two characteristics of treatment systems operation that tend to be of concern to the owners and users of the system are sound and odor. Samplers characterized sound and odor before trying to open any access covers. Table 25 summarizes the results. For 87% of records and 95% of responses there was no perceivable odor. The distribution of perceived odors by sampling teams was fairly even. For those systems that exhibited at least faint odor, 16 odors were identified as septic, eight as earthy/musty/moldy, one as “chemical” and one as unspecified “other”. The sources of the odor tended to be attributed to the treatment tank. Interestingly, of the three identified sources for clearly perceivable odors, one was an aeration tank covered by grates, one was a blowout in the corner of the drainfield, and one did not appear to be coming from the system but from the back of the yard.

About 40% of systems each had “non-perceivable” or “quiet” sound intensity. For sounds, there appeared to be a difference between sampling teams or samplers, in that the fraction of systems indicated as “clearly perceivable” or “loud” of all records varied quite a bit around the average of 17%, from less than 2% in Charlotte over 6% in Lee, 16% in Monroe, 19% in Volusia/Brevard, to 29% in Wakulla Statewide. Differences in sensitivity of the samplers, operational status of the systems or manufacturers could be reasons for this difference. The fractions of the systems with “none perceivable” sounds agreed more between sample teams. The sources of the sounds were overwhelmingly the aeration equipment, with only five mentions of a pump as the source.

Table 25. Odor Intensity and Sound Intensity during the Initial System Evaluation (n=534)

Odor Intensity		Sound Intensity	
No response	41	No response	38
None perceivable	466	None perceivable	206
Barely perceivable	16	Quiet	201
Faint but identifiable	6	Clearly perceivable	88
Clearly perceivable	5	Loud	1

Watertightness was recorded based on initial observations. For 13 system visits, or 2.4%, the samplers indicated that there was a problem with watertightness of the tank(s). The identified openings were: access cover (5), riser attachment to tank (2), lid (1), inlet/outlet (1), grates (1), cut in top of the tank (1), tank (1), and bottom of pump tank (1). Slightly more than half of the observations (7) indicated that water was expected to enter the system, with only one observation which recorded an expectation that water was leaving the system, through the riser attachment. The finding that there was a leak through the bottom of pump tank is one that would have required closer inspection of the system than anticipated at this stage of the system evaluation.

3.3.2.4 Power Observations

Observing the system from up close, the next set of questions asked about visibility and accessibility of the control panel, and several indications of power to the system.

Table 26 summarizes the results separately for the sample populations. The questions were structured to see how feasible it was to determine the conditions of the systems.

Among the observed variables, the question if the system appeared to be switched off was answered most frequently with a definitive yes or no. For about one eighth of the systems with responses there was no control panel visible or accessible. Nearly half of the systems with responses did not have an identifiable power indicator. For the technology based systems this fraction was two thirds. For active aeration systems, there was one additional power indicator, if the aerator was on. For those systems that have intermittent aeration this may result in erroneous determinations of lack of power, but there are only a limited number of treatment systems with such a system.

These observations of power and aeration status allow the independent estimation of the fraction of systems that have been determined to not operate properly relative to systems determined to operate properly. For the random sample of systems, the estimates of the fraction of not properly operating systems were 15% switched off, 22% aeration not working, and 24% power indicators off. For the much smaller number of systems selected only for technology, these fractions appeared to be somewhat lower with 6% switched off, 16% aeration not working, and 9% power indicators off. Given the small number of technology-based selections and other systems, the overall fractions were similar to the results for the random samples.

The different indications of power to a system were generally consistent with each other. In two cases the aerator was indicated as working but the system was switched off. In one case this appeared to have been a data entry error due to column alignment in the form, in the other case the system was switched off when the sampler arrived, but the aeration was working once the system was switched on.

Table 26. Results of Control Panel and Power Observations

Sample	Result	Control Panel Visible	Control Panel Accessible	On per Indicator	On per Aerator	Switched Off
Random Sample	no response (+unknown)	26	26	26	28	28(+3)
	N/A	57	64	216	61	6
	no	49	57	57	86	376
	Yes	346	331	179	303	66
	no/(yes+no)	0.12	0.15	0.24	0.22	0.85
Tech Sample	no response	11	11	11	12	11
	N/A	2	2	22	13	1
	no	4	5	1	3	30
	Yes	27	26	10	16	2
	no/(yes+no)	0.13	0.16	0.09	0.16	0.94
Other	no response	0	0	0	0	0
	N/A	0	0	1	0	0
	No	1	1	2	2	10
	Yes	11	11	9	10	2
	no/(yes+no)	0.08	0.08	0.18	0.17	0.83
Total	no response (+unknown)	37	37	37	40	39(+3)
	N/A	59	66	239	74	7
	no	54	63	60	91	415
	Yes	384	368	198	329	70
	no/(yes+no)	0.12	0.15	0.23	0.21	0.86

A complication that was not anticipated in developing the inspection form was that there were two different forms of a system being switched off: The house could have power but the system was switched off, or the power to the house was switched off. The question had been targeted at determining which fraction of systems was intentionally disabled while the establishment served was occupied. The overall rate of switched-off systems that were observed during the study may not distinguish clearly between the two.

To further investigate the question of how many systems for occupied structures were intentionally switched off, vacant and unoccupied lots were evaluated against other systems and compared the fraction of apparently unpowered systems relative to the number for which power had been determined. The results are summarized in Table 27 and indicate that vacancy is of some importance. While overall 14% of the systems were indicated as switched off, there was a marked difference between systems assessed as vacant (54%) and other systems (6%). Among the smaller number of systems for which a power indicator was found 54% of vacant systems were without power, but only 17% of other systems. For those systems where activity of aerators had been determined, 59% of vacant systems indicated that they were not on, while only 14% of other systems did not show aeration.

Table 27. Vacancy as a Factor in System Operation

	Switched off	Power indicator off	Aeration off
# Determined	485	258	420
Vacant (n=89)	54%	54%	59%
Other (n=445)	6%	17%	14%

3.3.2.5 Alarm Observations

Alarms in alarm mode were encountered on 22 occasions or 4%. High water and/or air pressure accounted for eight instances, unknown reasons were indicated in six instances, other reasons were suspected in five cases and no response was given in three cases.

Alarms provide a means to know if the system is operating as intended. For NSF-40 certified ATUs and for dosing tanks audio and visual alarms are required. The following Table 28 summarizes the information obtained during the project. For those systems with a response, inspectors confirmed the presence of an alarm in 82% of the cases. This fraction is slightly higher than the fraction of confirmed alarms for dosing tanks (75%) for which a yes or no determination was made. The second step of the assessments was a confirmation that the alarm works. For unknown reasons, the observations on the testing of alarms were slightly more numerous than the number of alarms determined. Based on the answers given, slightly less than half of all alarms were functioning with both visual and audio signals. A few alarms (8% of control panels, 5% of dosing tanks) were functioning only in one mode. As a consistency check, the systems for which the initial system evaluation noted that an alarm was occurring had in 21 of 22 cases the presence of an alarm denoted for this observation, as well.

There was some variability between sampling teams and areas in these measures. Monroe County found the lowest fraction of assessed systems with a control panel alarm (40%), while in Wakulla Statewide sampling and overall the fraction was about 80%. Charlotte, Lee and Volusia/Brevard sampling resulted in a fraction of about 90%. Of the alarms that were found, the fraction of alarms that were confirmed to function both audibly and visually ranged from about a third in Volusia/Brevard and Wakulla Statewide to two-thirds in Monroe, Charlotte and Lee. Only one of the two alarm modes worked between about 2% in Charlotte to 19% in Monroe County. The remaining fraction did not necessarily indicate which alarms did not work, but could also indicate that the samplers were unable to test. These two observations were not always clearly separated. Successful testing required not only that the alarm was present and operational, but also that it was accessible, that there was a way to test the alarm, and that the samplers were familiar enough with the functionality to use it. The fraction of responses to the alarm test that indicated “unable to test” or not working ranged from a fifth in Monroe over a quarter in Lee and a third in Charlotte to somewhat over half in Volusia/Brevard and two-thirds Wakulla Statewide. This is consistent with a higher familiarity with systems, including alarms, of those samplers that sampled in their home counties.

Table 28. Observations of Control Panel and Dosing Tank Alarms

	Answer	Control Panel Alarm	Dosing Tank Alarm
Presence	Yes	402	98
	No	42	32
	N/A/unknown	44	332
	no response	46	72
Operational	Audio+Visual	195	49
	Audio	13	3
	Visual	19	3
	No/unable to test	185	58
	# Presence- # Operational	-10	-15

3.3.2.6 Flow Measurements

A means to assess sewage flow, usually a water meter, was present in 207 systems, nearly 40%. Due to lack of influent access (priority for repeat sampling and recording of water meter during the initial visit) and lack of repeat observations during repeat sampling, very few flow measurements were recorded over the duration of this study. Only seven systems contributed some water usage information and the periods of records varied. For the six systems with at least about a month of observation period, the average flow was 224 gpd, with a standard deviation of 89 gpd.

3.3.2.7 Access to Sewage

Access to sewage flow was a precondition to sampling the system. Determination if sewage flow could be accessed also provides an indication how feasible it was for FDOH inspectors and maintenance entities to at least visually examine effluent quality. The initial evaluation tool contained questions about access to sewage via sampling ports and via access to tanks that were part of the treatment system.

Table 29 provides a summary of the results.

3.3.2.7.1 Presence of Sampling Ports.

The first question was if a sampling port was present. A sampling port can allow access to sewage flow and possibly a visual and olfactory assessment of the effluent quality without having to open tanks of the treatment unit. In 308 cases, 58% of sites and 64% of clear responses, a sampling port was identified, while in 178 cases it was not identified. The location of sampling ports indicated, for the smaller set of responses, was overwhelmingly after the treatment system tanks and before the location of disposal, usually the drainfield occasionally boreholes in Monroe County. If a sampling port was present, the samplers were asked to indicate what type of sampling port it was.

Table 29 shows the resulting responses for those systems for which a sampling port had been indicated and the fraction of assessed systems for which a sampling port had been confirmed.

There was a large variation in the number of confirmed sampling ports between counties. While Charlotte County found sampling ports in 95% of evaluated sites, the statewide sampling only found them in 25% of sites. Sampling access ports with a diameter of four inches between ATU and drainfield have been required for ATUs since 1995, so the different extent of their presence could indicate how well construction requirements are implemented. Confounding such an assessment is that the requirement for PBTS is not as clear. For these, monitoring locations must be indicated by the design engineer, but a sampling port need not necessarily be present. For drip systems, a petcock is required, which frequently is located in the pump tank and suffers from the same access problems as the pump tank.

When a sampling port was present, there was also some variation in regards to the types of sampling ports. The FDOH recommended in 1999 and 2000 the use of crosses (HSEWOS 99-010) and P-traps (HSEWOS 00-004) to provide a sampling volume for effluent assessment. In contrast, among the systems overall and in systems visited by the Wakulla Statewide and Volusia/Brevard sampling teams, a Tee-configuration predominated. In Charlotte and Monroe counties, Tees and P-traps were equally prevalent, while in Lee county two-thirds of the systems contained a petcock sampling port for drip irrigation systems.

Table 29. Observation of Sampling Ports at Visited Advanced OSTDS

Sample Team (sampling ports =”yes”)	Fraction of visited systems with confirmed sampling port	Type of confirmed sampling port					
		Tee	Cross	P-trap	Petcock (drip)	other/ unknown	no response
Monroe (n=45)	71%	11%	4%	11%	0%	4%	69%
Charlotte (n=114)	95%	46%	1%	41%	2%	2%	9%
Lee (n=25)	53%	32%	0%	0%	64%	4%	0%
Wakulla Statewide (n=42)	25%	81%	0%	5%	2%	5%	7%
Volusia/Brevard (n=81)	59%	85%	7%	0%	4%	1%	2%
Total (n=308)*	58%	55%	3%	18%	7%	3%	15%

*One system with other monitoring port locations was assessed by project staff concurrently with FDOH county office

3.3.2.7.2 Access to Tanks

Two questions were posed in regard to access to tanks: was the treatment tank accessible, which would allow observations of the treatment and was a post-treatment or dosing tank present, which would provide a location to sample the treated effluent? Table 30 summarizes the results. Treatment tanks were overwhelmingly accessible, in 30% of the systems directly, in about 42% of systems via a riser. In nearly all cases, access covers were securely fastened and operable. In slightly less than 4% of the definite responses the access covers were not securely fastened, but only in one case was the access cover not operational.

Access to post treatment or dosing tanks was less common, in part due to the lack of such tanks. Nearly two thirds of system responses (63%) consisted of no response or N/A, and an additional 9% of systems for which such a tank was definitely not accessible. As in the case of access to treatment tanks, only in a few cases (11 and 3), was the manhole access cover not secured or not operating properly, respectively.

3.3.2.7.3 Feasibility of Obtaining an Influent Sample

In nearly two thirds of the responses the samplers deemed it not feasible to obtain an influent sample; in another eighth it appeared questionable. Influent samples were attempted to be taken from 100 systems. Among these systems, there was access to the pretreatment compartment for about half (48), while slightly fewer systems (43) required an attempt to take samples through a building sewer cleanout. Overall, it proved to be relatively difficult to obtain influent samples (only 83 total influent samples were taken).

Table 30. Summary of Access to Sewage Determinations

<table>
<tr><td>Item</td><td colspan="3">Yes</td><td>No</td><td>N/A</td><td>No Response (+unknown)</td></tr>
<tr><td>Effluent sample port installed?</td><td colspan="3">308</td><td>178</td><td>3</td><td>45</td></tr>
<tr><td>Access to treatment tank?</td><td>162 Directly</td><td>226 Riser</td><td>15 Riser and Directly</td><td>81</td><td>6</td><td>44</td></tr>
<tr><td>Access covers securely fastened?</td><td colspan="3">388</td><td>15</td><td>32</td><td>99</td></tr>
<tr><td>Access covers operable?</td><td colspan="3">399</td><td>1</td><td>33</td><td>101</td></tr>
<tr><td>Access to post-treatment or dosing tanks?</td><td>48 Directly</td><td>92 Riser</td><td>5 Riser and Directly</td><td>50</td><td>281</td><td>57 (+1)</td></tr>
<tr><td>Access covers securely fastened?</td><td colspan="3">149</td><td>11</td><td>88</td><td>286</td></tr>
<tr><td>Access covers operable?</td><td colspan="3">156</td><td>3</td><td>89</td><td>286</td></tr>
<tr><td rowspan="2">Influent sample feasible?</td><td colspan="3">100 (68 questionable)</td><td rowspan="2">306</td><td rowspan="2">-</td><td rowspan="2">60</td></tr>
<tr><td>48 access to pretreatment</td><td>43 building sewer</td><td>1 both</td></tr>
</table>

3.3.2.7.4 Effluent Sampling Port Observations

Presence of a sampling port allows a more detailed olfactory assessment of the effluent and operating conditions. The sampling teams entered identifiable results for this assessment for 236 systems, somewhat more than the 189 systems for which the samplers indicated that they had performed the assessment but only from about three quarters of systems with a confirmed sampling port.

Table 31 shows the results. In Monroe and Lee counties, fewer assessments were performed than in the other sampling teams. For Lee County, this difference is largely explained by the large fraction of petcocks in the assessed systems, for which the odor assessment is not applicable. The most complete assessments came from Charlotte and Volusia/Brevard County. Given the closer proximity of noses to effluent it is not surprising that compared to the odor impressions above ground from the sites, the fraction of at least faint odors increased from that shown earlier to about 22% overall. The fraction of clearly perceivable and strong odors among the recorded results varied between 6% and 13%, with an overall rate of 11%.

The number of odor quality assessments was slightly lower than the one for intensity assessments. A large fraction of these corresponded to sample access ports with no perceivable odors and correspondingly no applicable odor quality. The overall fraction of observations indicating septic smells was 18%, but it varied between 7% (Volusia/Brevard) and 28% (Charlotte). Volusia/Brevard reported three instances of sour/rancid/putrid smell and two instances of chemical smell, one of which was identified as laundry softener, while Monroe County reported one chemical smell stemming from the chlorine disinfection unit.

A cross tabulation of odor intensity and odor quality suggested some broad patterns for olfactory assessment but that some refinement may still be useful. While most observations of none perceivable odor were associated with no identified odor quality, in about a tenth of such systems, largely from Charlotte County, an odor quality was identified, usually the earthy/musty/moldy category. Similarly, even though the first identifiable intensity rating was faint but identifiable, observations of barely perceivable odor were usually identified with an earthy/musty/moldy quality. Faint but identifiable, clearly perceivable, or strong smells were increasingly identified as septic, chemical, or sour/rancid/putrid. Nearly two thirds of faint but identifiable, over two thirds of clearly perceivable and all of the strong odors were so identified, with septic being the predominant quality of the three. Overall, this presents a pattern in which more offending odors, or odors indicating an operational problem, are also rated as odors of higher intensity, which could be useful for identifying problematic systems. This pattern is influenced by observations from Charlotte County, where only about half of the assessments overall took place but identified all of the strong septic odors. Further analysis and quantification of the diagnostic value of odor assessments would be useful.

Table 31. Odor Observations in Sampling Ports: a) Odor Intensity; b) Odor Quality; c) Cross Tabulations of Intensity and Quality.

a)

Sample Team	# of odor assess-ments	Odor assessments/ confirmed sampling ports	Odor Intensity					Fraction at least faint but identifiable
			None perceive-able	Barely perceive-able	Faint but identify-able	Clearly perceive-able	Strong	
Monroe	26	58%	17	5	2	2	0	15%
Charlotte	99	87%	53	25	9	6	6	21%
Lee	8	32%	1	3	3	1	0	50%
Wakulla Statewide	32	76%	22	6	2	2	0	13%
Volusia/ Brevard	70	86%	18	33	10	8	1	27%
Total*	236	77%	111	72	27	19	7	22%

b)

Sample Team	# of odor assess-ments	Odor assessments/confirmed sampling ports	Odor Quality					Fraction Septic
			N/A	Earthy/ Musty/ Moldy	Septic	Chemical	Sour/ Rancid/ Putrid	
Monroe	13	29%	4	6	2	1	0	15%
Charlotte	98	86%	39 (+1dry)	31	27	0	0	28%
Lee	9	36%	2	5	2	0	0	22%
Wakulla Statewide	25	60%	18	4	3	0	0	12%
Volusia/ Brevard	73	90%	22	41	5	2	3	7%
Total*	219	71%	85	87	40	3	3	18%

c)

Odor Quality/ Odor Intensity		Odor Quality							
		No response	N/A	Other	Earthy/ Musty/ Moldy	Septic	Chemical	Sour/ Rancid/ Putrid	Total
Odor Intensity	No response	288	7	0	0	0	0	0	295
	Invalid	1	0	0	0	0	0	0	1
	N/A	0	2	0	0	0	0	0	2
	None perceivable	22	75	1	12	1	0	0	111
	Barely perceivable	4	1	0	59	7	1	0	72
	Faint but identifiable	0	0	0	10	15	1	1	27
	Clearly perceivable	0	0	0	6	11	0	2	19
	Strong	0	0	0	0	6	1	0	7
	Total	315	85	1	87	40	3	3	534

* One system was assessed by project staff concurrently with the FDOH local office

3.3.3 System Operation Evaluation (Step 4)

3.3.3.1 Settled Sludge Volume after 30 Minutes

Measurements of settled sludge and scum volumes were performed on advanced system in situations when there was access to the identified aeration compartment. This assessment was a lower priority and was not always performed. Overall, 151 measurements of settled sludge volume were performed or slightly more than a quarter of 525 advanced systems visited. The measurements stemmed largely from Charlotte (62), Volusia/Brevard (35), and Wakulla Statewide (44) with an additional five measurements each from Monroe and Lee counties. The treatment systems were extended aeration systems and also included a few mixed systems. Three quarters (76.8%) of systems had a settled sludge volume of 200 mL (20%) or less. Only seven systems (4.6%) had a settled sludge volume of 750 mL (75%) or more. This leaves about one in five systems with settled sludge volumes in the range expected for well-working activated sludge plants. The differences in settled sludge volumes between sampling teams were not significant.

The biomass color was predominantly brown (93), with 24 having other (frequently clear) or no color, 11 mustard, 5 black, two gray and one white observation. While there appeared to be a tendency for larger sludge volumes to have a more intense color (median values: black= 225 mL; brown=150 mL, Mustard=75 mL), these differences were not significant at the 10% level using the Kruskal-Wallis or Median tests.

Consistent with the many observations of little to no biomass, only 106 assessments of biomass structure were recorded with 53 flocced, 29 grainy, and 23 fluffy biomass observations.

The same measurement also provided information on floating solids or scum. In reviewing the results it became apparent that some samplers had recorded the clear supernatant on top of the settled sludge as floating solids volume. For purposes of analysis, any floating volume of 700 mL and above was interpreted to refer to the clear zone rather than floating volume. This left only 15 of 148 observations indicating some floating volume. In 12 of these cases the volume was only indicated as 1 mL, and the two highest values were only 50 mL. Thus, at least during the site visits, foaming scum did not appear to be a noticeable problem. On the other hand, some samplers reported having observed problems in the past with foam overflowing from advanced systems.

3.3.4 Sampling and Monitoring Location Completeness

Correlations were analyzed among the different sample teams, regarding whether monitoring locations were shown on the site plan, and whether there was access to sampling. Systems that had an initial field evaluation, construction permit information available during the permit file review, and access to the site where the system was located (i.e., homeowner gave permission, system was not behind a fence) were included (n=461; 86% of all systems). Then a comparison was done to assess whether the systems were sampled or not as well as whether monitoring locations were shown on the site plan or not. Table 32 shows a comparison of the results by sample team. The fraction of systems with shown monitoring locations varied more widely than the fraction of systems sampled. An evaluation in Section 3.2.3.4 revealed that FDOH in Charlotte County had the highest proportion of permit files that showed monitoring locations on the site plan. Charlotte also had the highest number of visited systems that had monitoring locations shown. Both Monroe and Charlotte had the highest proportions of visited systems where a sample was taken. A comparison of the fraction of sampled systems that had monitoring locations shown with the fraction among the assessed sites showed only minor differences (within three percent), indicating that the showing of monitoring locations did not greatly improve the chance of getting a sample.

Table 32. Comparison of Proportion of Systems Evaluated with Construction Permit Data and System Access that had Been Sampled or Had Monitoring Locations Shown, by Sample Team

Sample Team	System Sampled? (n=461)		Monitoring locations shown?	
	No	Yes	No/no response	Yes
Monroe (n=57)	11%	89%	88%	12%
Charlotte (n=118)	20%	80%	14%	86%
Lee (n=40)	50%	50%	68%	33%
Wakulla Statewide (n=124)	34%	66%	95%	5%
Volusia/Brevard (n=121)	37%	63%	79%	21%
Total (n=461)*	30%	70%	67%	33%

*One system without shown monitoring locations was assessed and not sampled by project staff concurrently with FDOH county office

3.3.5 Statewide Sample Analysis for Assessment of Operational Status and Performance

Table 33 shows a summary of the different laboratories used, which area of the state the samples came from, and how many samples were analyzed by type.

Table 33. Laboratories Used and Number of Samples Analyzed By Type

Lab Name	Sample Origin	Number of Samples					
		TP	$cBOD_5$	TSS	Total alkalinity	TN	Fecal Coliform
Xenco / Florida Testing Services	Statewide	614	500	533	44	614	0
Ackuritlab	Tallahassee Area	0	0	0	0	0	26
Benchmark	Charlotte County	0	0	0	0	0	110
CH2M Hill - OMI, Inc.	Monroe County	0	0	0	0	0	15
FDOH in Volusia County, Environmental Health Laboratory	Volusia County and Brevard County	6	6	6	0	6	101

3.3.5.1 Quality Control Analysis

3.3.5.1.1 Usability Assessment

Table 34 outlines the data quality objectives for the laboratory analysis. A usability assessment was done to evaluate whether the data quality objectives were met.

For each field or equipment blank QC sample the results were reviewed and assigned the appropriate code:

a. "Pass" – a. Analyte Flag = U or undetect, assign code "Pass" (all Alkalinity will have a "Pass" code

b. "H" – b. Analyte Result is in the following ranges, all "H" codes will include, assign code "H the following statement:" ("The QAC data for this sample was reported above undetect but below quality threshold. Data were determined to be valid for reporting."

   i. TSS < 5 mg/L and does not have a U flag

   ii. $cBOD_5$ < 5 mg/L and does not have a U flag

   iii. TKN < 1 mg/L and does not have a U flag

   iv. Nitrate Nitrite < 1 mg/L and does not have a U flag

   v. TN < 1 mg/L and does not have a U flag or <10% of sample

vi. TP < 0.5 mg/L and does not have a U flag or <10% of sample

vii. Fecal < 150 CFU/100 mL

c. "Fail" – c. Analyte Result is greater than the thresholds for an H code, assign the code "Fail"

2. Sort the data by Region, then Date.

3. Copy the more restrictive results up and down between the QC samples.

For $cBOD_5$, samples that were prepared and analyzed more than a day outside of their holding time were designated as unusable. For samples that had elevated reporting limits, the results were determined to be initially usable if the reporting limit did not exceed about two-thirds of other results.

The qualifier of most concern is "J", which indicated an estimated value due to not meeting one or more of the quality objectives of the method.

Table 34. Data Quality Objectives for Laboratory Analyses

Parameter	$cBOD_5$	TSS	TKN	NOx-N	TN	TP	Total Alkalinity
Method	SM 5210B	SM 2540D	EPA 351.2 † or SM4500-NH3C (TKN)	EPA 353.2 † or EPA300		EPA365.1 or EPA365.3	SM2320B
Number of Calibration Standards	N/A	N/A	6 (n/a for SM4500)	6		6	N/A
Calibration Acceptance Criteria (correlation)	N/A	N/A	Corr >0.995 (n/a for SM4500)	Corr >0.995		Corr >0.995	N/A
Calibration Blank Criteria	N/A	N/A	<0.3	<0.2		<0.03	N/A
QC Check Sample Recovery Criteria (%)	70-120	80-120	90-110 (77-161 for SM4500)	90-110 (80-120 for EPA300)		90-110 (80-120 for EPA365.3)	80-120
Matrix Spike Recovery Criteria (%)	N/A	N/A	90-110 (77-161 for SM4500)	90-110 (80-120 for EPA300)		90-110 (80-120 for EPA365.3)	N/A
Laboratory and Field Duplicate Samples Acceptance Criteria (%RPD)	25 (20 starting Jul. ’11)	20	20	25 (20 for EPA300)		20	20
Practical Quantitation Limit (mg/L)	2.0	4.0	0.30 (0.5 for SM4500)	0.20 (0.05 for EPA300)		0.03	4.0
Method Detection Limit (mg/L)	2.0	3.5	0.09 (0.28 for SM4500)	0.1 (0.008 for EPA300)		0.055 (0.007 for EPA 365.3)	2.2
Blank screening Method Detection Limit (mg/L)		3.5	0.28	0.1	0.1	0.055	2.2
Acceptability limit (“H”)		5	1	1	1	0.5	2.2

†Revision 2.0, 1993, will be used.

3.3.5.1.2 Sampling Quality Control Chemical Analysis

Chemical analyses were completed for 620 samples. The number of completed sample analyses varied by parameter, due largely to lower numbers of QC and tap water samples for $cBOD_5$ and TSS. Using total nitrogen results as the most complete set, 386 of the 620 samples consisted of effluent samples and 83 were influent samples. Table 35 shows the composition of the total nitrogen sample results. The 386 effluent samples included some instances where multiple samples were taken at one site, due to repeat visits, parallel treatment trains, or several locations along a treatment train. This represents about a 50% completion of the project target. The number of influent samples taken was more than 10% of the effluent samples and close to 100 samples which meets the desired number aimed for in the QAPP. This represents roughly the number of accessible pretreatment compartments or tanks encountered over the course of the study. Sixty tap water samples were taken, which exceeded the target of 10% of effluent samples, and was close to the number of influent samples as intended.

Table 35. Distribution of TN-sample results between Sample Types and Quality Control Samples

		Original/Duplicate				Total
		Original	Duplicate	2nd lab	Free-Fall	
Sample Type	EFF	386	30	6	2	424
	INF	83	4	0	0	87
	QC-blanks	49	0	0	0	49
	TAP	60	0	0	0	60
Total		578	34	6	2	620

Thirty four duplicate samples and 49 blank samples were analyzed, about 16% of effluent and influent sample results. These numbers exceeded the requirement set in the QAPP (10% of the total sample) and provided more than the anticipated amount of data to perform a data quality assessment. In addition, 6 replicate samples were analyzed by a second lab, and in two instances samples were obtained that compared the concentrations in a free falling effluent stream to the concentration in the pump tank measured at the same time.

Table 36 summarizes the overall data results for the chemical analysis results. All samples were received at acceptable temperatures. Nearly all samples were received and analyzed within holding times. Only two batches of $cBOD_5$ samples were prepared outside of holding times, resulting in a “Q” qualifier. One of these batches exceeded the holding time by three days and the results tended to be very untypically low, this batch was deemed unusable.

Table 36. Data Quality of Chemical Analysis Results

Parameter	Total Alkalinity	$cBOD_5$	TSS	TKN	NOx-N	TN	TP
Method	SM2320B	SM 5210B	SM 2540D	EPA 351.2 † or SM4500-NH3C (TKN)	EPA 353.2 † or EPA300	Calculated	EPA365.1 or EPA365.3
Method Detection Limit (mg/L)	2.2	2	3.5	0.09 (0.28 for SM4500)	0.1 (0.008 for EPA300)		0.055 (0.007 for EPA 365.3)
Result Screening Method Detection Limit (mg/L)	2.2	2	3.5	0.28	0.1	0.1	0.055
Acceptability limit ("H")	2.2	n/a	5	1	1	1	0.5
Number of sample results	43	519[1]	538	620	620	620	617
Samples with elevated MDL	0	93[1]	0	0	0	0	0
Samples with Qualifiers ("Q")	0	13[1]	0	0	0	n/a	0
Samples with Qualifiers ("J", "V" or exceeding result)	0	85[1]	0	16	18	n/a	9
Percent of samples meeting laboratory objectives	100%	63%	100%	97%	97%	100%	99%
Samples not bracketed by blanks	n/a	n/a	75	64	65	66	63
Samples with worst nearest blank result "H"	n/a	n/a	44	207	57	262	53
Samples with worst nearest blank result "fail"	n/a	n/a	0	9	87	100	37

[1]Note: $cBOD_5$ results that fell into multiple groups were counted only once in the highest row.

†Revision 2.0, 1993, will be used.

For nutrients, between 97 and 99% of data reported by the lab, qualification other than "U" for below detection limit was not required. For $cBOD_5$, only about two thirds of data were unqualified. For about 15% of samples either the reporting limit was increased or the results were qualified, which was generally a result of an under depletion of oxygen in either the sample or in the control.

The bracketing analysis was only performed for TSS and nutrients. It resulted in about 10% of samples not bracketed by blank samples. For TSS about 10% of samples were bracketed by at least one blank result that exceeded 3.5 mg/L but did not exceed 5 mg/L, and none exceeded 5 mg/L. For other parameters, the fraction of samples bracketed by at least one blank sample that exceeded the acceptance limits ranged from less than 2% (TKN) to about 16% (TN). Many of these samples themselves had concentrations below method detection or acceptability limits. This indicated that sample exceedance detection in a bracketing blank was not a systematic indicator for contamination problems in samples in temporal vicinity.

A more detailed look at the blank results is provided in Table 37. It distinguishes blank sample results by field blank (FBL), pre-cleaned equipment blank (PEB) and field-cleaned equipment blank (FEB). Not shown here is a comparison by sampling team, which did not show appreciable differences in results between groups.

Table 37. Results of Analyses of Blanks

Parameter	Total Alkalinity	$cBOD_5$	TSS	TKN	NOx-N	TN	TP
Number of QC-blank samples	3	14	32	49	49	49	48
FBL-total	0	0	2	12	12	12	11
FBL pass	n/a	n/a	2	8	9	8	10
FBL H	n/a	n/a	0	4	3	4	1
FBL fail	n/a	n/a	0	0	0	0	0
PEB-total	2	6	8	10	10	10	10
PEB pass	2	6	8	8	9	5	8
PEB H	0	0	0	1	1	4	2
PEB fail	0	0	0	1	0	1	0
FEB-total	1	8	22	27	27	27	27
FEB pass	1	5	20	17	23	13	24
FEB H	0	(2 MDL_ increase)	2	10	2	12	1
FEB fail	0	1	0	0	2	2	2

FBL=field blank; PEB=pre-cleaned equipment blank; FEB=field-cleaned equipment blank

Field blank results present information on how likely it is to detect a chemical even though it should not be there. The source for this could be either in the laboratory equipment, the quality of the distilled water used for the blank, or contamination during the filling of the sampling bottles. Field blanks were not analyzed for total alkalinity and $cBOD_5$, and only two analyses for TSS were completed. Eleven distilled water and one phosphorus calibration standard were used as field blanks for nutrients. The phosphorus calibration standard results were within 2% of the labeled phosphorus concentration. None of the blanks exceeded the acceptance criteria, two third of the nitrogen results and 90% of the phosphorus results were below detection limits.

Pre-cleaned equipment blanks represent conditions after the equipment had been field cleaned. In addition to the sources of contamination for field blanks, residual concentrations from samples or from the cleaning were possible sources of false positive results. None of the blanks analyzed for $cBOD_5$ or TSS showed detectable levels of the chemical of interest. Of the ten blanks for TKN and TP 80% did not show concentrations beyond the detection limit, this was 90% for the NOx analyses. One blank exceeded the acceptability limit for TKN and thus also for TN. This result occurred during the first sampling event, and it was speculated that some tap water could have contaminated the sample. In response, the QAPP was updated to require more rinsing before taking the sample.

Field cleaned equipment blanks were obtained at the end of a sampling day, after other samples had already been collected. They were collected by filling a container with distilled water and collecting this water with the equipment as if it was any other sample. These samples assess the effectiveness of rinsing between samples and the significance of carry-over between samples.

Of the 27 nutrient field equipment blank samples, no TKN and fewer than 10% of NOx and TP samples exceeded the acceptability limit. TKN appeared to be the parameter with most contamination issued with ten of 27 samples exceeding method detection limits to a limited extent. Between 10 and 20% of distilled water samples detected some presence of NOx and TP, but these were generally not the same samples for both parameters.

$cBOD_5$ results were mainly (five of eight) below detection limit, and two additional samples were below an increased detection limit that stemmed from higher dilution. Only one sample exceeded acceptability limits.

Over 90% of field equipment blanks resulted in no detectable TSS concentrations, with two samples showing low concentrations.

In summary, over 95% of analytical results for all parameters, except $cBOD_5$, met laboratory quality objectives and did not have a qualifier flag other than for low concentrations ("U", "I"). For most parameters (nutrients and TSS), the exceedances of acceptability criteria in blank samples were rare and sporadic, less than 10%. These consistent results indicate bracketing is not useful for identifying poor quality samples. All results were deemed usable.

$cBOD_5$ results appeared less reliable, partly because the laboratory added qualifiers (Appendix E) to sample results and partly because of the increase in detection limit for about 20% of samples. In most of these cases, the laboratory had expected higher BOD based on a screening test of chemical oxygen demand. It is unclear what the reasons for the oxygen depletion were, such as a characteristic of sewage samples or an issue with the laboratory procedures.

For $cBOD_5$, eight samples were prepared four days, instead of the maximum holding time of two days, after sampling and resulted frequently in non-detects. These were excluded from the data analysis. For the remaining effluent samples, the median $cBOD_5$ concentration was about 5 mg/L and 90% of samples did not exceed about 60 mg/L. Two non-detect samples with a reporting limit above the secondary grab sample standard of 40 mg/L were deemed unusable. Influent samples showed a median sample of about 70 mg/L and 90% of samples did not exceed 160 mg/L. All results had reporting limits below 160 mg/L and were used. One sample had a concentration about eight times the concentration of the next highest, and was excluded. This resulted in a total of 11 exclusions.

Sampling and analysis of duplicates resulted in 34 valid pairs for nutrients, 31 for $cBOD_5$, 30 for TSS, and 2 for total alkalinity. The relative deviation was used to quantify agreement between the two samples. Table 38 summarizes the results. For $cBOD_5$ (84%), TN (79%) and TP (88%), the project exceeded the goal of 75% of test results remaining within a relative deviation of 20%. For TSS (70%), TKN (71%), NOx (74%), the objective was not met, but the target was not missed by much. Over 90% of $cBOD_5$ and TP duplicates; and over 80% of TKN, NOx, and TN duplicates agreed within ±30%. The two total alkalinity duplicates agreed within 10%.

Table 38. Differences between Samples of the Same Sampling Point: Relative Percent Deviations (RPD) Between Duplicates and Analyses by Two Different Laboratories

Parameter	**Total Alkalinity**	**$cBOD_5$**	**TSS**	**TKN**	**NOx-N**	**TN**	**TP**
Comparison between duplicates							
Number of sample pairs	2	31	30	34	34	34	34
Fraction meeting 20% RPD	100%	84%	70%	71%	74%	79%	88%
Fraction meeting 30% RPD	100%	94%	70%	85%	82%	85%	91%
Average	1%	-3%	-2%	-2%	-7%	-7%	-6%
Median	1%	0%	0%	0%	1%	0%	0%
Comparison between labs							
Number of sample pairs	0	6	6	6	6	6	6
Fraction meeting 20% RPD		17%	33%	17%	83%	33%	83%
Average		-74%	51%	70%	-20%	36%	16%
Median		-92%	61%	71%	-5%	12%	-6%

The median relative deviation was zero, or close to it, while the average relative deviation was slightly negative. This stemmed from more duplicate samples having much lower concentrations than the original rather than much higher concentrations. A comparison of relative deviations and absolute relative deviations by analyte and by sample teams using the Kruskal-Wallis test or the Median test did not result in any significant differences at the 5% level. Overall, this suggests that the QAPP and training on common procedures were successful in establishing uniform data quality.

Samples from six sampling locations taken during two sample events were sent to two different laboratories and analyzed. Because the detection limits were somewhat different between the laboratories, a zero difference was determined if both laboratories provided a "U" result, that is a result below their respective detection limits. Only for NOx and TP was the agreement (83%) within the quality objective of less than 20% deviation. For NOx this was partly due to the fact that three samples were below the respective detection limits. For TSS and TN the results for a third of the samples deviated less than 20%, but for $cBOD_5$ and TKN, only one of the six samples did. Median and averages suggest that the second laboratory measured typically lower results for $cBOD_5$, and higher results for TSS and TKN. Both laboratories were NELAP-certified and no independent data were available that would allow determination if one measured more accurately than the other. The limited comparison indicates that between-lab variability can be important.

Two sets of samples provided an impression of the differences between the concentrations seen in samples obtained from the flow into a chamber (recirculating splitting box, and pump tank, respectively) and the concentrations of a sample from the chamber itself. The comparison suggested some additional reduction of TSS in the chamber and lesser differences for nutrients. But one of the systems appeared to not have been operating properly recently, and the other system did not achieve any measurable nitrification, therefore these results are not representative of the larger system population.

3.3.5.1.3 Representativeness of Sampling Location

During the project samplers attempted to obtain samples as clean as site conditions allowed. Florida regulations require installation of a sampling port for aerobic treatment units. While sampling ports in the form of cleanouts in the line between treatment units and drainfield have the advantage of sampling the flow after the treatment, they also have disadvantages. One disadvantage is that no flow may occur at the time of sampling and if there is no basin, no water may be available for sampling. Another concern is that flows are generally not high enough in gravity installations to scour the lines, so that some solids accumulation may occur that could impact samples. For these reasons, the project preferred pump chambers for sampling, and included flushing of sampling ports before sampling. A potential additional confounding element was that there could be treatment effects in every compartment after the aeration chamber. Aeration chambers were only rarely sampled, generally only in integrated fixed activated sludge treatment units that did not have a clarifier.

To assess the impact of sampling location on results overall, a Kruskal-Wallis analysis was performed for the effluent samples from aeration chambers, clarifiers, pump chambers, and sampling ports. A first analysis indicated that there were significant differences ($p<0.05$) in sampling results from different locations for $cBOD_5$, TSS, TKN, and fecal coliforms between these groups, but not for total nitrogen, total phosphorus, alkalinity, and odor intensity. Results for nitrate-nitrogen were nearly significant ($p=0.054$). Inspections of rankings indicated that sampling ports showed higher TKN (and lower nitrate), higher $cBOD_5$, and higher TSS concentrations. A second Kruskal-Wallis analysis between aeration chambers, clarifiers, and pump chambers indicated that only TSS concentration had significant differences between the three locations, with pump chambers tending to have lower concentrations.

This suggests that for total nutrient analysis the sampling location does not make a significant difference. This confirms findings from the Task 1 preliminary assessment of treatment systems study done in the Florida Keys (Section 1.4) that found that the presence of an aggregate filter and pump chamber did not make a difference in total nutrient concentrations. TSS is, as was seen in the preliminary assessment of treatment systems study done in the Florida Keys, most variable, with high concentrations in sampling ports and lower concentrations in pump chambers.

3.3.5.2 Sampling Chemical Analysis

These numbers include duplicates (also listed in brackets) and for some systems, multiple samples. Overall, the ratio of effluent samples to samples from locations that the samplers assessed to be representative of influent conditions is about five to one. The influent samples were subsequently screened for evidence of treatment influence. The presence of NOx-N concentrations above 5 mg/L indicated that 10 influent samples were treatment influenced. Possible reasons include the presence of recirculation and low flow conditions which may allow mixing between pretreatment and aeration tank.

Table 39. Number of Usable Results of Laboratory Chemical Analyses, Numbers in Brackets Indicate Duplicate Samples

Chemical Analysis Results	$cBOD_5$	TSS	TKN	Nitrate-Nitrite	Total Nitrogen	Total Phosphorus	Total Alkalinity
EFF	409[35]	417[34]	424[38]	424[38]	424[38]	423[38]	31[3]
INF	84[3]	85[3]	86[4]	86[4]	86[4]	85[4]	5
QC (blanks)	13	32	49[1]	49[1]	49[1]	49[1]	3
TAP	1	3	61	61	61	60	4
Total	507	537	620	620	620	617	43

3.3.5.3 Sampling Microbiological Analysis

Overall, 252 analyses for fecal coliforms were performed for the project by four laboratories. Temperature criteria for samples at arrival at the laboratories were met for 100% of the samples. Several samples for one of the laboratories did exceed holding times by less than 24 hours. One of the laboratories did provide qualifiers as “>” or “<”, but not in the standard format. For this laboratory, inspection of the lab sheets indicated that “>” represented a “Z” qualifier for “too numerous to count” and “<” represented a “U”. Further, several other results appeared to require a “B” qualifier for measurements outside the ideal range of 20-60 colony forming units. Of the 252 analyses only 32% were qualified by nothing other than a “U”.

The increased detection limits ranged from 5 up to 100 cfu/100mL. Compared to most of the values found in other, non-QC, samples, this still represents a very low number. Due to the several orders of magnitude spanned by sampling results the decadic logarithm of usable results was used to perform the calculations for the relative percent deviations.

Quality control samples were analyzed by three laboratories for three sampling groups. These samples were predominantly field equipment blanks. Two pre-cleaned equipment blanks and three tap water samples resulted in no detectable colony forming units, but a field blank resulted in low concentrations (15 cfu/100 mL). Among field equipment blanks without duplicates, six resulted in no detectable colonies at detection limits up to 100 cfu/100 mL, and four resulted in detections of not greater than 100 cfu/100 mL. Three results were between 200 and 500, one was 1440 cfu/100 mL, and one sample showed confluent growth with evidence of presence of fecal coliform (“N”). These results indicate some cross contamination in about half of the field equipment samples, but due to varying detection limit this may be an underestimate. About a quarter of field equipment blanks exceeded 200 cfu/100 mL, but only rarely (one each) were 800 cfu/100 mL exceeded or confluent growth observed. A Kruskal-Wallis test did not show significant differences for QC-results between the three laboratories, or groups of samplers.

The frequency of “B” and “Q” qualifiers (Appendix E) indicates that the numerical values of fecal coliform in about half of the samples should be understood as estimates. The results span several orders of magnitude. The cross contamination between samples, when it was detected, was mostly limited to less than 100 cfu/100 mL. For data analysis purposes, results of less than 100 cfu/100 mL cannot be distinguished from non-detects, and this value was used as a cut-off for low values. This value is also well below the regulatory standard of 200 cfu/100 mL. On the higher end, while three of ten “Z”-qualified samples (too many colonies to count) exceeded 2,000,000 cfu/100 mL, six samples only indicated that 3000 cfu/100 mL were exceeded. Because 3000 cfu/100 mL is well above secondary treatment standards, these values are still considered useable.

Overall, 12 sets of duplicate samples were analyzed. Eight of the 12 pairs met a relative percent deviation of 20% using the logarithmic value of the result. Introduction of the cut-off value of 100 cfu/100 mL brings two additional pairs into this range. Eight of the raw data pairs and eleven of the cut-off pairs met a relative deviation of 30%. There was a tendency of the duplicate showing higher concentrations than the original, this occurred in nine cases, while the reverse occurs only in two.

In looking at the relative percent deviations as a function of concentration it appears that average fecal concentration beyond about 1500 cfu/100 mL show smaller deviations than lower concentrations. This would suggest that one can be fairly certain that high concentrations are high, but less certain that low concentrations are low are precisely above or below treatment standards such as secondary treatment standards (200 cfu/100 mL annual average, 800 cfu/100mL grab sample).

3.3.6 Drainfield Monitoring Point Assessment

A small group of five additional systems were performance-based treatment systems with drip irrigation that included consideration of the drainfield for treatment of fecal coliforms. The systems were equipped with two drainfield monitoring points per system that were located one foot away from the drip lines, adjacent to the footer and header areas. In these systems the water table was shallow and the monitoring points accessed the shallow groundwater. Each monitoring point consisted of at least two feet of PVC down to four feet of slotted well head pipe at the bottom. One monitoring point was sampled per system.

For sampling, at least 500 mL of water was pumped from the monitoring point into the ISCO-sampler until the effluent appeared constant and clear and was backflushed into a separate container. That water was discarded. Then water was pumped from the monitoring point into the ISCO-sampler, mixed and filled the sampling containers. Field measurements with an YSI-650 were made in-situ in the monitoring point. Before and after each sampling location, the ISCO-sampler was heavily rinsed with 4L of distilled water to avoid cross-contamination and to obtain a representative sample. A Cl2 solution was used several times to effectively clean out any contamination or bacteria growth inside the tubes and sampler.

Dry well heads due to deeper water tables below the drainfield or perhaps due to the house being empty were sometimes encountered. Several homes required more than 500 mL of pumped water due to poor quality water (i.e., the wells being full of sand). All comments were noted on the field site evaluation forms.

Table 40 shows the results of the sampling in the shallow monitoring wells and pump chambers. Three of the five systems examined did not exceed the annual standard of 200 cfu/100 mL, one system exceeded the annual standard and barely met the grab sample standard of 400 cfu/100 mL, and two samples from one system far exceeded secondary fecal coliform standards. The sampling results point to difficulties in obtaining valid results. Water pumped from the monitoring well had a tendency to include turbidity. This was noted in the three systems where both the pump chamber and the monitoring wells effluent were characterized qualitatively at same time. The specific conductance measurements indicated that only systems with a least a 30% dilution met the 200 cfu/100 mL standard. The system with the highest fecal coliform counts showed specific conductance more typical for what was observed during this study than the systems with lower fecal coliform. One of the sampling events showed unusually low specific conductance and fecal coliform in the pump chamber together with an increase in fecal concentrations and specific conductance in the monitoring well. Finally, the system with the best oxygenated pump chamber effluent showed a slight increase in fecal coliforms in the monitoring wells.

Table 40. Results of Drainfield Monitoring in Shallow Monitoring Wells (MW) and Pump Chambers (PU)

Sampling point	fecal coliform (cfu/100 mL)	TSS (mg/L)	Specific Conductance (µS/cm)	DO (mg/L)	Odor quality	Clarity	Turbidity (Hach)	System ID
PU	83000	9	1005	0.45	EARTHY	Clear	30	16615
MW	3900	3200	1248	0.22	SEPTIC	Milky	1440	16615
PU	100	20	5	1.5	SEPTIC	Clear	0	16615
MW	5200	n/m	943	0.3	n/m	n/m	n/m	16615
PU	300	4	3100	6.46	EARTHY	Clear	9	14421
MW	400	760	2653	4.3	EARTHY	Cloudy	168	14421
PU	3500	3.5	2354	2.17	N/A	Clear	12	13128
MW	100	n/m	1630	3.76	n/m	n/m	n/m	13128
PU	450000	36	3016	0.14	SEPTIC	Cloudy	110	3808
MW	200	n/m	1891	3.6	n/m	n/m	n/m	3808
PU	600	80	3804	1.85	EARTHY	Clear	45	3203
MW	100	62	2430	3.52	SEPTIC	Clear	51	3203

The results are variable enough to conclude that including the soil as fecal treatment component does not always result in compliant fecal coliform concentrations. This challenges engineers, installers, maintenance entities, and regulators to move beyond unquestioned reliance on the soil and to develop better monitoring techniques.

3.3.6.1 Field Screening Assessments

Four-hundred and ninety-two samples were screened using qualitative screening methods (color, clarity, odor intensity, and odor quality), and 491 samples were also screened using a Hach instrument for apparent color and turbidity. These samples included influent, effluent, and tap water samples, and thus covered a wide range of concentrations.

Figure 19 illustrates the relationship between the field instrument measurements of turbidity and apparent color of the samples taken. Apparent is a linear relationship that is limited by the upper measurement limit of apparent color in the instrument that was used in four of the five groups. The instrument used in Charlotte County had a larger measurement range.

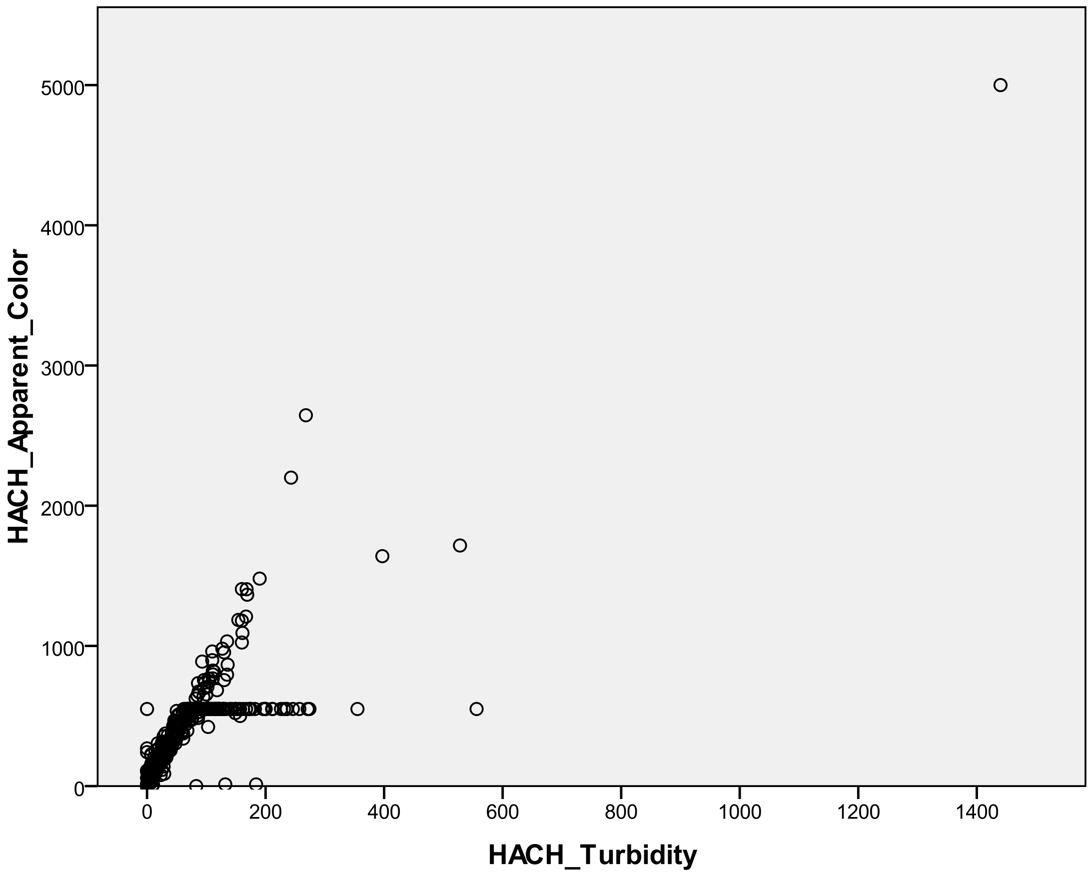


Figure 19. Relationship Between Turbidity and Apparent Color Measured by Hach Instruments During the Advanced OSTDS Study

The more qualitative descriptions of clarity and color were expected to be related to the measured turbidity and color. In assessing this correspondence the two measurements (visual and field instrument) of color and turbidity were compared.

Table 41 compares average odor intensity descriptions (0-4 scale) with descriptions of color and clarity. While there was a general trend that dirtier looking samples smelled stronger, there was also a standard deviation of about one intensity unit. This suggests enough variability such that determination of odor intensity alone will not be sufficient to predict color and clarity of the sample.

Table 41. Average Odor Intensity Assessments Based on Color and Clarity Assessments

Color	Mean	N	Std. Deviation
NONE	.50	135	.771
	1.00	6	1.095
OTHER	1.00	10	.943
WHITE	1.50	4	1.732
MUSTARD	1.63	24	1.279
TAN	1.80	219	1.287
GRAY	1.94	35	1.083
BROWN	2.00	41	1.204
BLACK	2.67	3	1.528
Clarity	**Mean**	**N**	**Std. Deviation**
	.67	6	1.033
Clear	1.00	307	1.077
Grainy	1.90	10	1.370
Cloudy	2.22	134	1.241
Flocked	2.25	4	.957
Muddy	2.33	3	1.155
Milky	2.92	13	1.115
Total	1.43	477	1.282

For a comparison of HACH measurements with other measures, only records with measurements that were distinct from zero were selected.. Figure 20 a) is a box plot of the measured turbidity for the various turbidity descriptions. The groupings of most turbidity measurements suggest that a sample can be seen as either clear or not clear. The turbidity values for cloudy, flocked, grainy, and muddy samples cluster around 100, while the few milky samples are higher. By contrast, clear samples cluster around 20. Figure 20 b) compares the apparent color measurements with the color descriptions of the samplers. Here, the transitions are somewhat more gradual, but again, no color observed is usually associated with very little color measured, while brown and black are associated with high color measurements. These results show the potential for visual assessments of water, further investigation is needed to address if observations are related to the quality as expressed by treatment standards.

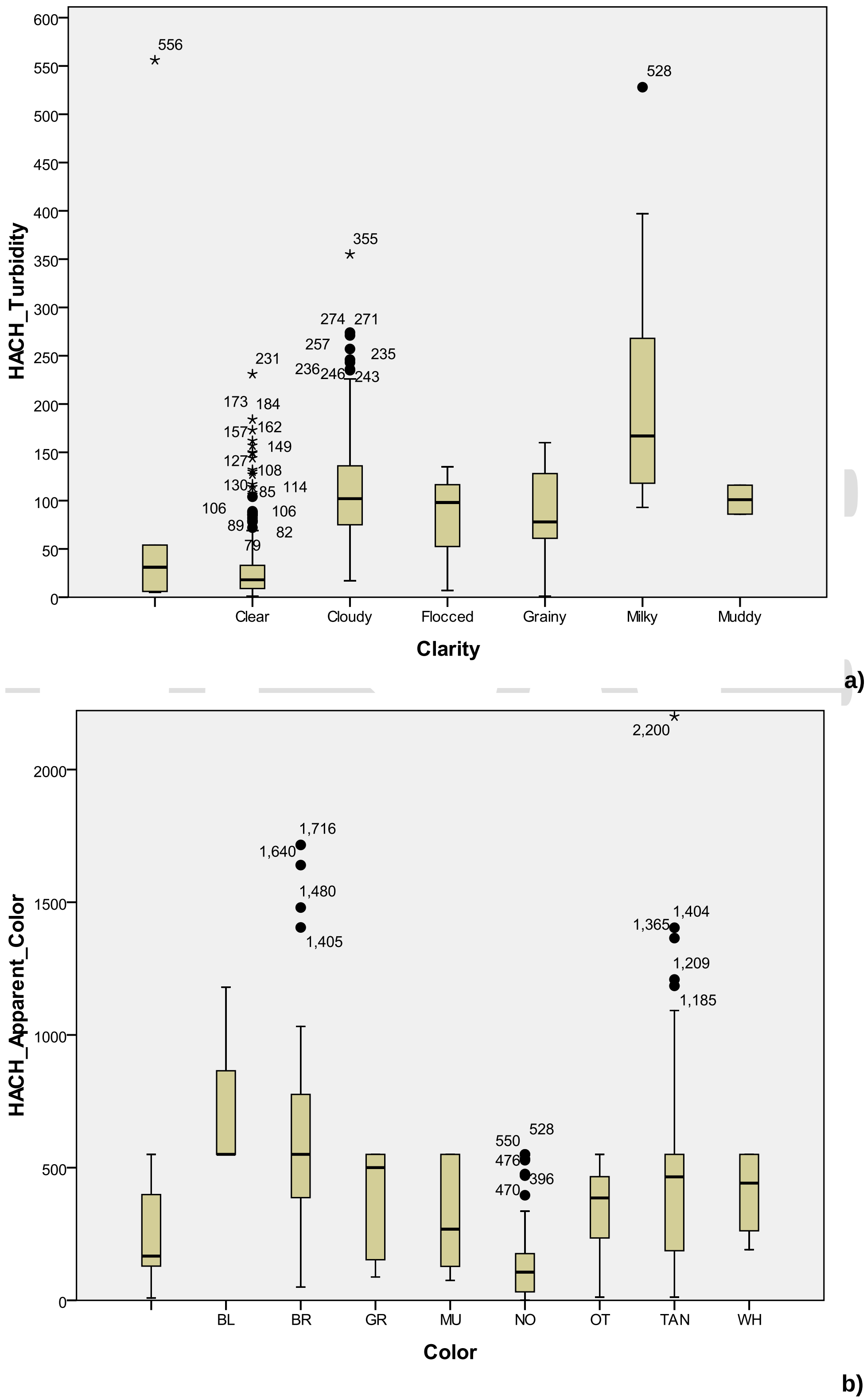


Figure 20. Comparison of Visual Observation and Field Instrument Measurements of OSTDS Sample Clarity and Color. a) Measurements of Clarity; b) Measurements of Color

3.3.6.1.1 Comparison of Hach Field Kit Measurements and Laboratory Analyses

Data was linked to match Hach field kit measurements with the results of chemical analyses. Of the 630 samples for which chemical or microbiological results were available, about 390 samples had information on field measurements of apparent color and turbidity, 79 samples for ammonia, 88 samples for nitrate, 54 for phosphate, and 368 samples for total alkalinity.

Graphically apparent color was compared to $cBOD_5$, TSS and TKN. For $cBOD_5$ and TKN, no linear relationship was apparent. For TSS a very broad pattern of increased concentrations with increased apparent color measurement and turbidity existed. The tendency was that color measurements below 100 corresponded with TSS values below 10 mg/L, and color measurements above 500 tended largely to be associated with TSS values above 20 mg/L. Figure 21 shows the lower ranges of measured TSS concentrations in comparison to field measurements. While not always visibly apparent, rank order correlations (Spearman's rho) provided a correlation coefficient between 0.7 and 0.8 between apparent color and $cBOD_5$ and TSS and between measured turbidity and $cBOD_5$ and TSS, and between 0.6 and 0.7 between apparent color and turbidity, and TKN.

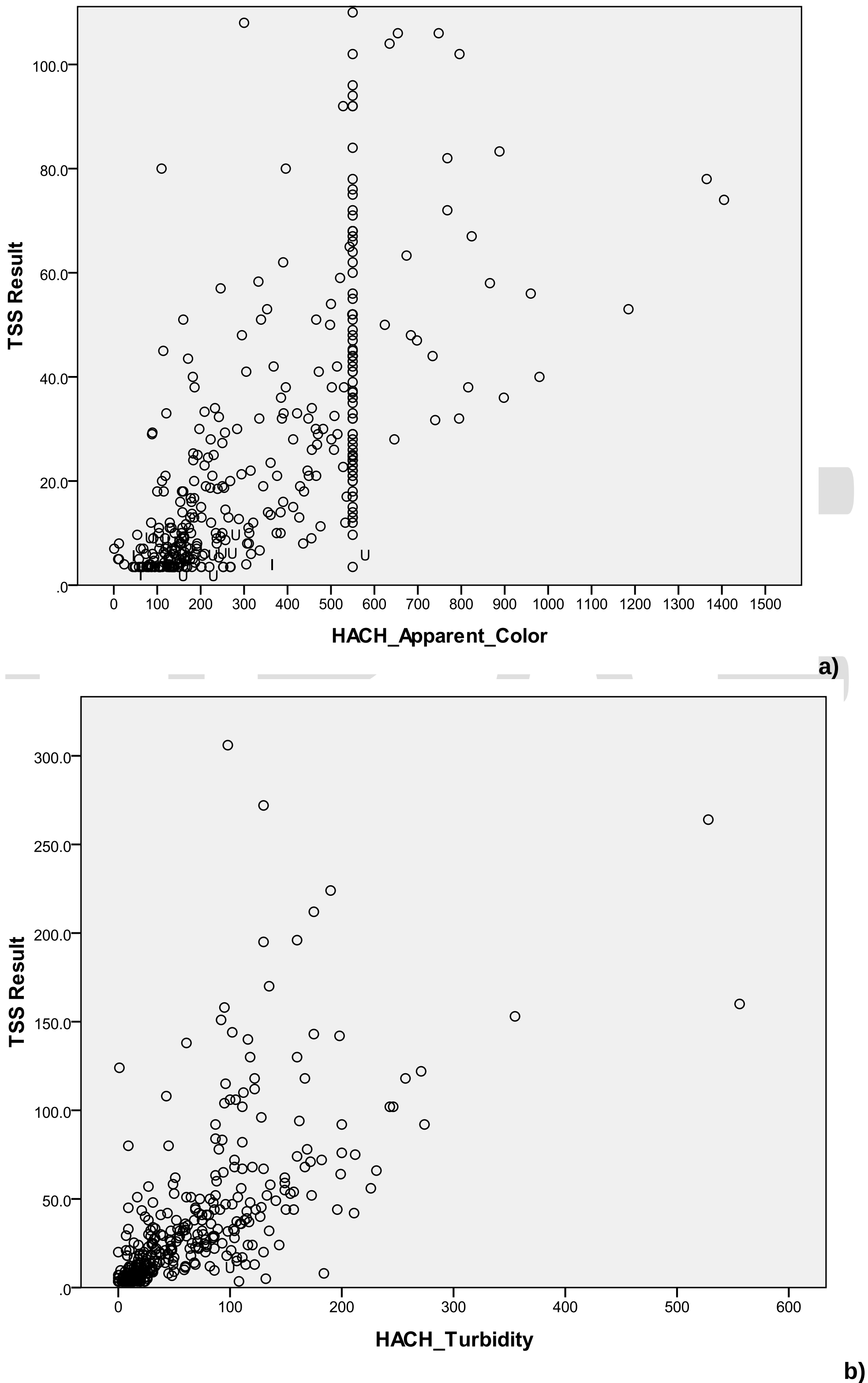
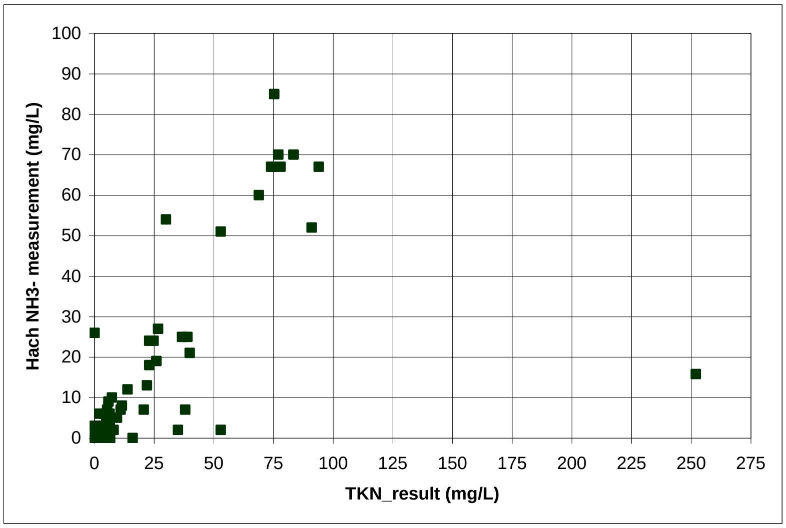


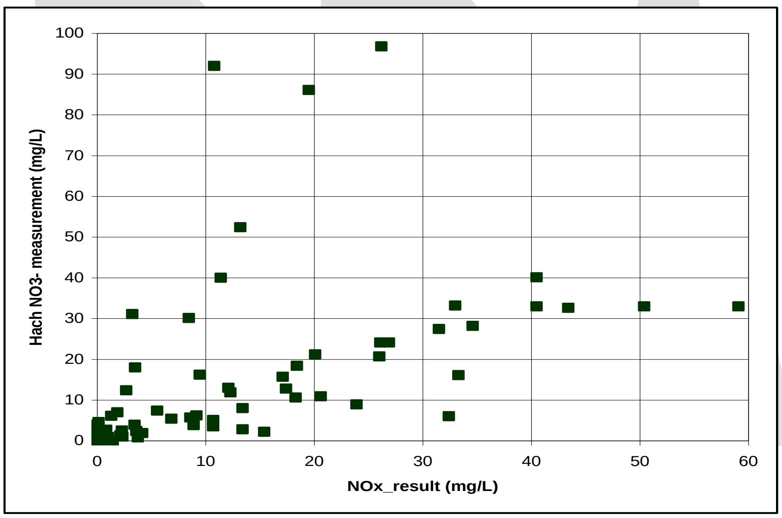
Figure 21. Concentrations of TSS Compared to Advanced OSTDS Field Instrument Measurements of a) Apparent Color and b) Turbidity. TSS-Scale is Not Fully Shown for Better Identification of Points

3.3.6.1.2 Field Test Kits for Nutrients

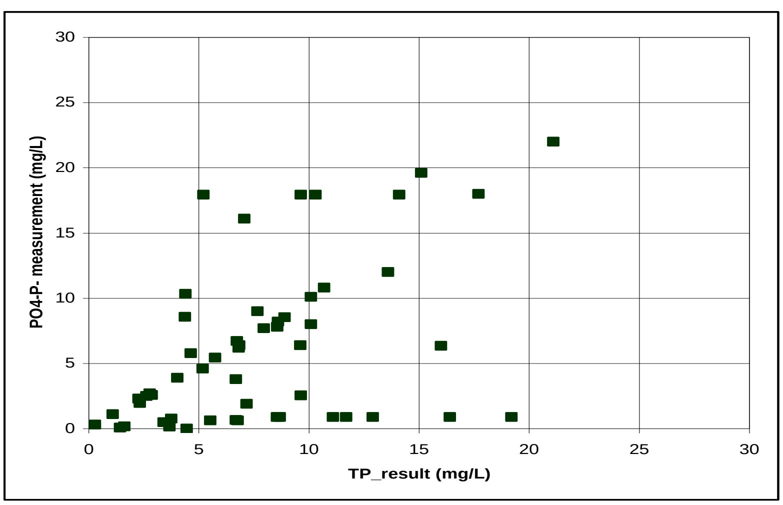
Measured concentrations were paired for TKN (lab) and ammonia-nitrogen (field), NOx (lab) and nitrate-nitrogen (field), and TP (lab) and orthophosphorus (field). The field tests measure only parts of what the laboratory measures, so it would be expected that the field test results would be below the laboratory measurements. The extent depends on how important organic ammonia (TKN), nitrite-nitrogen (NOx), and non-orthophosphorus (TP) are. Figure 22 shows the comparisons. There were general tendencies for laboratory and field test results to correlate, which were also indicated by correlation coefficients (Spearman's rho) of 0.83 for NOx, 0.80 for TKN, and 0.48 for TP. Data collected indicate that very close quality oversight is needed to make these screening tests routinely useful. For TKN, the overall impression (and correlation) is impacted by the outlying largest TKN concentration measured. The other pairs show a trend of field ammonia concentrations being 10-20% lower than TKN. For NOx, it appears that a group of samples are systematically overestimating laboratory measured concentrations, which could be associated with an error in reporting units. For most samples, nitrate appears to be the dominant species. For high concentrations, the field measurement limit of 33 mg/L for undiluted samples results in a flattening out of the relationship. Phosphorus samples results appear to show a stronger relationship between screening and laboratory results than indicated by the correlation coefficient, surrounded by considerable scatter. On the low side, the measurement limit for undiluted samples of 0.9 mg/L resulted in several low values. For the remainder of the scatter further work would be needed to assess if it stems from limitations of the methods or from implementation issues, such as differences in reporting units.



a)



b)



c)

Figure 22. Comparison of Laboratory and Field Screening Tests: a) TKN (Lab) and Ammonia-Nitrogen, b) NOx (Lab) and Nitrate-Nitrogen, c) TP (Lab) and Orthophosphorus

3.3.6.2 Variability of Performance Assessment

To assess the variability of performance of treatment systems and influent strength, samplers repeated visits to 25 sites. For most sites only two samples were obtained, but at two sites, a third effluent samples was obtained, and at one site, two sampling locations were sampled each time. The measure of variability is the percent relative difference for concentration measurements between one sampling event and the following sampling event. If both sampling results were below detection limits, a value of zero was assigned to the relative percent difference.

The results are shown in Table 42. They indicate a variability that far exceeds the variability of the sampling methodology as indicated by duplicate and blanks samples for all parameters except fecal coliform. By looking at the interquartile range one can see that fewer than 50% of effluent pairs remain within a relative deviation of 30% for all measurements except TP, for which 54% meet this threshold. Expressed differently, this indicates that concentrations vary frequently by a factor of two between visits, which corresponds to a relative percent difference of 67%. The influent concentrations are similarly variable as indicated by average relative percent differences. This similarity is surprising relative to an expectation that influent concentrations should be more variable than effluent concentrations given the averaging and mixing that occurs in the treatment unit. This could suggest that on the time-scale of repeat visits, months, variations in the loading occur that influence both influent and effluent. Interestingly, median and average effluent relative percent differences show that concentrations of TSS, TKN, and NOx tended to increase at later visits, while TP decreased. On the other hand, relative differences in influent concentrations suggest a decrease in most concentrations except NOx, which increased. Relative to the large range and variability of relative differences in the small sample size, this appears to be not a significant pattern but points to seasonality as something that could be further investigated.

Table 42. Relative Percent Differences between Sampling Results of Subsequent Visits at a Site

Effluent	$cBOD_5$	TSS	TKN	NOx	TN	TP	log fecal
Count	26	26	27	27	27	26	8
Average	-16%	25%	41%	25%	-9%	-36%	-21%
Stdev	115%	100%	132%	123%	77%	59%	33%
25-percentile	-107%	-50%	-22%	-77%	-77%	-55%	-28%
Median	0%	46%	25%	22%	2%	-18%	-11%
75-percentile	59%	78%	191%	126%	30%	-4%	3%
Influent	**$cBOD_5$**	**TSS**	**TKN**	**NOx**	**TN**	**TP**	**log fecal**
Count	22	22	22	22	22	21	3
Average	-26%	-26%	-16%	27%	-22%	-28%	-1%
Stdev	116%	85%	88%	117%	78%	51%	2%
25-percentile	-119%	-75%	-68%	-9%	-67%	-68%	-2%
Median	-29%	-48%	-30%	0%	-26%	-24%	0%
75-percentile	35%	22%	23%	118%	23%	3%	0%
TAP	**$cBOD_5$**	**TSS**	**TKN**	**NOx**	**TN**	**TP**	**log fecal**
Count	0	1	15	15	15	14	0
Average	n/a	0%	60%	48%	61%	-9%	n/a
Stdev	n/a	n/a	73%	86%	98%	64%	n/a
25-percentile	n/a	0%	18%	0%	-35%	-4%	n/a
Median	n/a	0%	87%	0%	77%	0%	n/a
75-percentile	n/a	0%	122%	137%	158%	0%	n/a

To provide further context, Table 43 shows information on the absolute concentration values of the assessment pairs. Looking at tap water samples first, it becomes apparent that the variability, while large, is relative to low absolute concentrations of nutrients, generally below 1 mg/L. The few influent and effluent concentrations of fecal coliform are consistent with a reduction in concentrations of around two log units during the course of aerobic treatment. Average influent concentrations of TN and TP are 53 mg/L and 8 mg/L, respectively. The average effluent concentrations are 37mg/L and 8 mg/L, indicating some consistency in a removal of about a quarter to a third for total nitrogen and less than 10% for total phosphorus. Influent and effluent concentrations vary noticeably both between sites and between visits. For $cBOD_5$ and TSS, the difference between average and median effluent concentration indicate the influence of a relatively few samples with higher concentrations. Estimated removal effectiveness would therefore vary depending on whether medians or averages are used in the assessment between 75% and 90% for $cBOD_5$ and between 57% and 72% for TSS.

Table 43. Average Concentrations of Sampling Pairs During Subsequent Visits at a Site

Effluent	$cBOD_5$	TSS	TKN	NOx	TN	TP	log fecal
Count	26	26	27	27	27	26	8
Average	36.1	37.0	16.8	20.2	37.0	7.8	4.0
Stdev	62.9	52.3	23.7	19.5	23.3	2.3	1.1
25-percentile	3.0	6.9	2.5	4.9	20.7	6.6	3.4
Median	8.6	16.5	5.2	17.2	34.6	7.8	3.8
75-percentile	24.9	47.6	24.7	27.5	52.3	8.6	5.1
Influent	$cBOD_5$	TSS	TKN	NOx	TN	TP	log fecal
Count	22	22	22	22	22	21	3
Average	145.9	86.1	50.2	2.7	52.9	8.2	6.2
Stdev	116.4	131.3	31.7	7.3	30.4	3.2	0.2
25-percentile	49.1	23.2	22.4	0.0	24.8	5.8	6.2
Median	117.5	59.5	40.9	0.2	49.8	8.3	6.3
75-percentile	242.3	83.3	76.2	1.5	76.6	9.6	6.3
TAP	$cBOD_5$	TSS	TKN	NOx	TN	TP	log fecal
Count	0	1	15	15	15	14	0
Average	n/a	0.0	0.4	0.5	0.9	0.7	n/a
Stdev	n/a	n/a	0.3	0.6	0.7	2.2	n/a
25-percentile	n/a	0.0	0.3	0.0	0.4	0.0	n/a
Median	n/a	0.0	0.4	0.1	0.8	0.0	n/a
75-percentile	n/a	0.0	0.6	0.8	1.1	0.2	n/a

3.3.7 Assessment for Random Samples[2]

Project staff performed field assessments, usually combined with sampling, of over 550 systems throughout Florida, of which 535 were confirmed advanced systems. Logistical challenges and time constraints prevented sampling in about ten southern Florida counties (with a total of 87 selected sites) and kept the completion rate in Monroe at about 25% of the 260 selected systems. Of the systems that had a field assessment, 480 were from the purely random selection and only these will be discussed further. The detailed field assessments encompassed an initial assessment, similar to the routine annual inspections that FDOH perform and, where feasible, field measurements and sampling. Lab samples were packed in ice and sent overnight to a NELAP certified lab.

The field assessment included a check to see if the system was operational (power was on, no sanitary nuisance existed, aeration resulted in bubbles and mixing of sewage, and alarms were

[2] For purposes of this section, only those systems that were selected as a purely random sample are included in the subsequent discussions and calculations (901 systems of 1014).

not on). Since the site visits were largely unannounced, these operational assessments can provide a general indication that could be applied to the larger population of advanced systems. Approximately five percent of the visited sites were vacant. Thirty percent of the sites visited were considered to be not operating properly (143 out of 480 systems). The main cause for a system to be non-operational was that the power indicator was off, followed by the aeration not working (Table 44). The most common combination of non-functional conditions was that the power was switched off, the power indicator was not on, and the aeration was not working. Since all three of these are a direct result of the power being off, this is not surprising, but it is interesting to note that the most common reason a system was not operational (20%) had to do with the power being off. If all power and aeration related operational status indicators are grouped together, three meta-groups remain: power/aeration related issues, sanitary nuisance related issues, and alarm issues. Power/aeration related issues consisted of 70% of all operational problems followed by sanitary nuisance issues (9%), alarm issues (8%), power and alarm issues (8%), and finally power and sanitary nuisance issues (6%).

Table 44. Distribution of Issues Leading to a Non-Operational Status for Non-Vacant Advanced Onsite Sewage Disposal and Treatment Systems

Reason For Non-Operational Status (non-vacant systems)		
	# Not OK	% Not OK
Power switched off	54	43%
Power indicator off	79	62%
Aeration not working	73	57%
Sanitary nuisance	20	16%
Alarm issue	19	15%

One means to provide an assessment of treatment performance was the comparison of effluent to “influent” data. Samplers obtained these samples by drawing from the clear zone of a pretreatment compartment or trash tank of systems. These samples represent sewage that already has undergone some settling and anaerobic treatment. In this way these samples are more comparable to septic tank effluent, although septic tanks tend to be typically larger than pretreatment/trash tanks by a factor of about three which allows for more settling and anaerobic treatment due to the larger size.

In reviewing the influent data, several samples showed high nitrate/nitrite nitrogen values. Samples with values above 5 mg/L nitrate/nitrite were excluded as inconsistent with an anaerobic pretreatment step (six of 47 samples). Possible causes are a misidentification of compartments in the field, or interaction between aeration treatment and pretreatment compartments. Table 45 summarizes the results of the pretreatment effluent sampling. The data show considerable and somewhat skewed variability with an interquartile range that is larger than the median value. The median value for $cBOD_5$ (76mg/L) is much lower than the median for septic tank effluent reported by Lowe et al. (2009) (216 mg/L) while the median values for TSS (68 mg/L) were similar to the 61 mg/L reported by Lowe et al. (2009). The median values for TN (46 mg/L) and TP (8.3 mg/L) in this study were both somewhat lower than the 60 mg/L and 9.8 mg/L, respectively reported by Lowe et al. The concentrations can also be compared to results from a pilot study for this project (Roeder, 2011). There, influent concentrations of advanced treatment systems that appeared to be most representative for pretreatment tank effluent showed median concentrations of 99 mg/L, 64 mg/L, 76mg/L and 10 mg/L for $cBOD_5$, TSS, TN and TP, respectively. Again, the current study showed lower nutrient concentrations, which could be related to differences in water usage.

Table 45. Pretreatment Effluent (Influent) Data Summary

"Influent" Pretreatment Effluent (mg/L)		$cBOD_5$	TSS	TKN	NOx	TN	TP
N	Valid	39	41	41	41	41	40
	Missing	2	0	0	0	0	1
Mean		115.2	92.0	51.9	0.3	52.3	9.0
Std. Deviation		100.0	111.4	37.6	0.7	37.3	5.6
Minimum		.0	7.0	.118	.019	2.970	.670
Maximum		393	630	181	3	181	34
Percentiles	10	14.0	20.0	11.8	0.0	12.0	3.3
	25	43.5	28.0	22.8	0.0	24.0	6.0
	50	76.4	68.0	45.8	0.1	45.9	8.3
	75	174.0	115.0	74.6	0.2	74.8	10.5
	90	259.0	147.2	103.5	1.3	103.5	14.3

The effluent concentrations are shown in Table 46. For the purposes of this analysis, the last sampling point of a treatment unit before dispersal in a drainfield, or borehole in Monroe County was used as representative of the overall treatment unit performance in cases when more than one sampling point had been sampled. The median concentrations for $cBOD_5$ (5.4 mg/L) and TSS (19 mg/L) show substantial removal of nutrients as compared to the influent concentrations. TN concentrations were also reduced. The TKN and nitrate-nitrite concentrations indicated that the extent of nitrification vary widely among systems. TP concentrations were only about 1 mg/L lower than before the aeration step. Based on the median effluent concentrations relative to median influent concentrations, the typical removal effectiveness of the advanced treatment units were 93% for $cBOD_5$, 72% for TSS, 34% for TN, and 10% for TP. The removal effectiveness for $cBOD_5$, TN, and TP was consistent with expectations for such treatment systems. The removal effectiveness of TSS was somewhat lower than expected, and suggests entrapment of inert solids during the sampling process.

Table 46. Effluent Concentration Summary for the Random Sample of Systems

Effluent (mg/L)		$cBOD_5$	TSS	TKN	NOx	TN	TP
N	Valid	308	308	308	305	307	307
	Missing	1	1	1	4	2	2
Mean		25.5	36.7	21.5	16.2	37.6	8.0
Std. Deviation		53.5	56.5	32.2	21.1	32.6	4.4
Minimum		2.000	3.500	0.087	0.008	0.517	0.007
Maximum		450	484	252	108	290	29
Percentiles	10	2.0	3.5	0.1	0.0	7.4	2.9
	25	2.2	6.8	1.5	0.2	16.2	5.3
	50	5.4	19.0	7.7	6.0	30.3	7.5
	75	23.7	42.0	27.9	26.2	51.5	10.0
	90	63.9	92.0	69.1	47.3	77.0	13.0

Two comparisons of effluent concentrations were performed, using the Kruskal-Wallis test. First, effluent concentrations from systems with an unsatisfactory operational status (about 20%) were compared to effluent concentrations from systems with a satisfactory operational status. Secondly, effluent concentrations from sampled systems that had been found with power switched off, with power indicator off, or where aeration did not appear to occur (about 15%) were compared to all other effluent samples. In both cases, the systems that appeared operational performed significantly ($p<0.05$) better than the non-operational ones for $cBOD_5$ and TN but not significantly different for TSS and TP. The operational systems under each definition did increase the removal effectiveness based on median concentrations for TN by about 4% to nearly 40% but did not do so for $cBOD_5$. The apparent lack of aeration power for treatment systems resulted in samples with nutrient concentrations that indicated lack of nitrification, no nitrogen removal, and reduced $cBOD_5$ removal (from 93% to 57%). The substantial fraction of low $cBOD_5$ effluent concentrations in samples from non-operational treatment systems and the measurement of high nitrite/nitrate concentrations in some of these samples indicate that the power operational status at the time of the visit was not completely predictive of effluent concentrations at the same time. This may for example, occur because of the hydraulic residence time in the treatment unit.

3.3.8 Comparison of Effluent Concentrations to Performance Expectations.

The collected data set allows a comparison between effluent concentrations and permit expectations. For performance based treatment systems, specific effluent concentrations are a part of the permit application process. The permit file review indicated that in many cases the treatment standards and the reason for utilizing performance-based treatment standards were not clearly of consistently specified. For purposes of comparison, the annual average concentration of the treatment level specification was used. For aerobic treatment units, effluent concentrations standards under operating conditions are not codified clearly in Florida. To pass the NSF-40 testing protocol, the tested aerobic treatment unit has to meet 30-day average concentrations for $cBOD_5$ (25 mg/L) and TSS (30 mg/L), and these values were used for this assessment. For both ATUs and PBTS, the random sample and all other sampled sites were distinguished.

Table 47 summarizes the exceedance results. About three quarters of the performance based treatment systems do not meet their respective treatment standards for TN and fecal coliforms and a third do not meet the standards for TP. For all of these parameters, the tendency was for the random sample to show somewhat better performance or fewer exceedances than the additional samples. This indicates that a performance-based treatment system is unlikely to meet its average performance expectation for total nitrogen and fecal coliform at the point of discharge.

About half of the performance-based treatment systems exceeded their treatment standards for TSS and somewhat more than a third exceeded the treatment standard for $cBOD_5$. The exceedance rates for random sample and additional treatment systems were about the same. About 15% fewer ATUs than PBTS units exceeded their $cBOD_5$ and TSS standards. This was in part due to the fact that the treatment standards for ATU (25/30) are less stringent than those for PBTS, but the treatment systems are largely identical.

Table 47. Frequency of Exceedance of Respective Average Treatment Standards in Sampled Systems

	$cBOD_5$	TSS	TN	TP	fecal
PBTS (random)	37% (n=30)	50% (n=30)	70% (n=23)	28% (n=18)	50% (n=4)
PBTS (other)	36% (n=22)	50% (n=22)	93% (n=14)	42% (n=12)	88% (n=8)
ATU (random)	22% (n=267)	36% (n=275)	n/a	n/a	n/a
ATU (other)	14% (n=7)	25% (n=8)	n/a	n/a	n/a

The difference between exceedance rates for ATUs and PBTS for $cBOD_5$ and TSS suggests that numerically lower effluent concentration standards are harder to meet than numerically higher standards for the same type of treatment systems and are therefore more frequently exceeded. To look further at this, the exceedance rates for given treatment levels were analyzed in each group. The results are summarized in

Table 48. The table shows the results for all samples and for samples from systems that appeared to be operating properly based on the site visit. For each identified performance standard, the table lists the exceedance rate, the median effluent concentration and the number of samples considered. A comparison by Kruskal-Wallis test indicated that effluent concentrations of PBTS did not differ significantly (P=0.05) between PBTS-treatment levels. For $cBOD_5$, TSS and TN, the treatment systems in Florida specified for a stricter standard were subsets of the treatment systems with looser standards, which, along with the variability and small sample size, may explain why there was no significant difference in effluent concentrations.

Except for TSS, all parameters showed an increase in exceedance rates with tighter standards. The increase in exceedance rates with more stringent performance standards was particularly pronounced for TP. A treatment standard of 10 mg/L is usually met already by septic tank effluent, and so most treatment systems with such a requirement meet it, but a treatment standard of 1 mg/L was never met. In this case, the lack of significant differences in the effluent concentrations between systems with a treatment standard of 10 mg/L, which generally do not employ a phosphorus removal step, and systems with a treatment standard of 1 mg/L, which do, raised questions about the efficacy of the employed treatment steps.

Exceedance rates for systems without operational problems were generally similar to the exceedance rates overall, in part because they constitute the largest fraction of systems that were sampled. Results discussed in Section 3.3.7 showed that the operational condition of the system influenced $cBOD_5$ and TN concentrations. This is reflected in improved exceedance rates for cBOD5 for operational systems shown in

Table 48. The lack of a marked improvement for TN-exceedance could stem from the standards being so much tighter than what is typically provided by a treatment system that the difference between operational and non-operational systems is not enough to result in marked differences of exceedance rates.

Table 48. Rates of Exceedance for Specified Treatment Standards

Parameter		All Samples			Samples from Operating Systems		
	Standard	Exceedance rate	Median	N	Exceedance rate	Median	n
$cBOD_5$	5	67%	7.3	9	67%	21.0	6
	10	33%	5.4	27	26%	5.4	23
	20	27%	5.4	15	18%	5.4	11
	ATU(25)	22%	5.4	283	16%	5.4	218
TSS	5	67%	9.0	9	67%	13.0	6
	10	44%	9.0	27	43%	8.0	23
	20	53%	22.7	15	55%	26.0	11
	ATU(30)	36%	19.0	283	33%	18.0	223
TN	10	86%	27.9	14	89%	28.9	9
	20	74%	41.9	23	71%	33.9	17
TP	1	100%	8.6	7	100%	8.6	7
	5	100%	9.5	1			
	10	9%	7.0	22	12%	7.0	11
Fecal Coliform	100	0%	100.0	1			
	200	82%	700.0	11	78%	600.0	9

Given the lack of significant differences in effluent concentrations between different PBTS, it is not clear whether PBTS in general perform differently from ATUs. In addressing this question all PBTS sample results were lumped together, even those that may not have had a nutrient treatment standard specified and analyzed for significant differences between them and ATUs. In order to provide comparisons to influent concentrations, the same calculations were done for both influent and effluent. The results for operational systems are shown in

Table 49; results were similar for all samples. Effluent concentrations showed significant differences for TSS and TN with effluent from ATUs tending to show higher concentrations for TSS and lower concentrations for TN than PBTS. Complicating the picture was the observation that influent concentrations of $cBOD_5$ and TN also were significantly higher in PBTS than ATU systems. A reason for higher concentrations of $cBOD_5$ and TN could be lower water use. On the other hand, TP, which should also show increasing concentrations with lower water use, did not do so. With both high influent and effluent concentrations for TN, removal effectiveness was of interest. Based on median concentrations ATUs remove 11% of TN, while PBTS remove 34%, with an overall estimate for all advanced systems of 32%. The overall estimate for TN removal effectiveness for the random sample discussed previously was also 34%.

Table 49. Summary of Effluent Test Results from Operating Advanced Systems based on Permitting Category

		$CBOD_5$		TSS		TN		TP		Fecal Coliform	
PBTS_Present		Effl.	Infl.	Effl.	Infl.	Effl.	Infl.	Effl.	Infl.	Effl.	Infl.
ATU	Mean	18.5	**82.1**	**37.7**	71.4	**33.8**	**40.2**	7.8	8.4	45816	668357
	Median	5.4	**53.8**	**18.0**	49.5	**26.5**	**29.9**	7.2	7.1	1560	3900
	N	218	**28**	**223**	28	**223**	**28**	222	27	122	3
	Std. Dev.	39.7	**81.7**	**60.3**	81.7	**29.3**	**30.9**	4.5	6.5	237344	1153238
PBTS	Mean	22.4	**163.9**	**16.8**	83.6	**40.9**	**68.3**	7.4	8.5	9905	87000
	Median	5.4	**146.5**	**8.0**	75.5	**36.9**	**55.9**	8.0	7.3	590	87000
	N	45	**10**	**45**	10	**45**	**10**	45	10	13	1
	Std. Dev.	56.2	**144.8**	**19.4**	50.1	**24.6**	**44.6**	2.7	3.4	31907	.
Total	Mean	19.2	103.7	34.2	74.6	35.0	47.6	7.7	8.5	42358	523018
	Median	5.4	75.8	16.4	58.5	28.7	42.5	7.3	7.1	1500	45450
	N	263	38	268	38	268	38	267	37	135	4
	Std. Dev.	42.8	106.3	56.1	74.2	28.6	36.6	4.2	5.7	225990	985460

(Bolded numbers indicate significant (0.05) differences between ATU and PBTS based on Kruskal-Wallis test)

3.3.9 Treatment Effectiveness based on Paired Influent and Effluent Concentrations

Another approach to estimate treatment effectiveness was to compare the paired influent and effluent concentrations for each system for which they exist. This compares influent and effluent of the same system, even though the effluent reflects the treatment that occurred on the effluent from some time ago, not the currently measured influent. As in the previous analyses, only data from the first sample event per system was utilized. Table 50 summarizes the treatment effectiveness for $cBOD_5$, TSS, TN, TP and the log-reduction of the few paired samples for fecal coliforms, for systems from the random sample, and for all pairs from systems without identified operational problems. The estimated median treatment effectiveness for these nutrients was very similar to those previously estimated based on the random sample population. The interquartile range is an indication how large the variability of treatment effectiveness based on an influent-effluent sample pair was in the sample population. The few fecal coliform pairs suggest a reduction by somewhat less than one logarithmic unit. This was less than the factor 30 or 1.5 log units reduction one obtains from the medians of influent and effluent concentrations shown in

Table 49.

ATUs and PBTS did not show significant differences in treatment effectiveness for all samples or for the random sample, even though median PBTS treatment effectiveness appeared slightly higher for TSS and TN.

Table 50. Percent Removal Effectiveness for Paired Influent-Effluent Advanced OSTDS Samples

		$cBOD_5$	TSS	TN	TP	log FC reduction
N (all)	Valid	49	50	50	49	6
	Missing	2	1	1	2	45
Percentiles	25	70%	34%	-12%	-15%	.26
	50	95%	75%	29%	5%	.86
	75	97%	88%	61%	27%	1.44
N (random)	Valid	40	41	41	40	4
	Missing	2	1	1	2	38
Percentiles	25	74%	27%	-19%	-15%	-.72
	50	95%	73%	27%	5%	.78
	75	97%	88%	63%	31%	.88
N (all OK operational)	Valid	37	37	37	36	3
	Missing	1	1	1	2	35
Percentiles	25	75%	28%	-9%	-13%	.81
	50	95%	82%	35%	5%	.90
	75	98%	91%	66%	37%	2.5

3.3.10 Comparison of Treatment Approaches

The comparison of results based on technical approaches was based on a selection of systems from manufacturers that utilized extended aeration, fixed film, and combined approaches. Over the course of the study, not all of the selected systems were found, visited and assessed. In the results, this impacted the less frequent fixed film technologies more than extended aeration. Additionally, one of the manufacturers of a combined technology had changed model configurations over time and also made extended aeration treatment systems for a particular market segment. This resulted in the reclassification of one treatment system but a limited number may have remained misclassified. Instead of the anticipated 180 assessments, only 79 were completed. The completion rate ranged from slightly under a third for fixed film to two thirds for extended aeration.

Table 51 summarizes the sampling results for the systems selected based on the treatment approaches. Using the non-parametric Kruskal-Wallis and Median tests, the differences between the three approaches were assessed for extended aeration (1), fixed film (2), and combined (3). The Kruskal-Wallis test tended to find more significant differences than the median test. Table 52 shows the results of comparing the three approaches. The upper right half shows the results of the Kruskal-Wallis test, the lower left shows the results of the median tests, each at a level of significance of 0.05. For example, the Kruskal-Wallis test indicated that the fixed film system had significantly lower dissolved oxygen concentration, oxygen saturation, and oxygen reduction potential, and higher TKN concentrations than either extended aeration or combined approaches. These observations were consistent with differences in aeration effectiveness. Combined approaches resulted in total nitrogen concentrations that were higher than extended aeration, but lower than fixed film systems. Combined approaches had also higher pH values than extended aeration or fixed film approaches. The significant differences of conductance and salinity between combined and fixed film approaches raised concern that some confounding effect may be present in fixed film systems, such as groundwater intrusion or water softeners recharge water. On the other hand, the higher concentrations of TKN and TN in fixed films systems suggested that dilution was not more common in these systems.

Table 51. Summary of Results for Three OSTDS Treatment Approaches

		DO (mg/L)	%Sat	ORP (mV)	Cond (µS)	Salinity (0/00)	pH	Total Alk. (mg/L)	$cBOD_5$ (mg/L)	TSS (mg/L)	TKN (mg/L)	NOx (mg/L)	TN (mg/L)	TP (mg/L)	Fecal_Coliform (CFU/100mL)
Approach 1	Extended aeration														
N	Valid	37	32	31	37	31	37	9	39	40	40	40	40	40	15
	Missing	3	8	9	3	9	3	31	1	0	0	0	0	0	25
Mean		2.7	33.0	58	1380	0.73	6.7	35.2	27.3	33.0	28.9	19.9	48.8	8.5	3927
Std. Deviation		2.1	27.5	142	1968	1.23	1.0	26.3	52.2	42.6	58.0	20.6	61.0	5.2	10645
Minimum		0.1	1.3	-318	320	0.23	3.4	0.7	2.0	3.5	0.1	0.0	1.6	0.3	100
Percentiles	25	0.8	9.3	-46	703	0.34	6.3	11.3	2.0	3.7	1.3	1.0	18.0	5.2	100
	50	2.5	27.5	83	966	0.45	6.8	33.8	5.4	10.5	5.4	14.2	29.1	7.2	550
	75	4.2	48.7	180	1316	0.58	7.4	66.1	25.0	46.3	23.2	31.0	53.7	10.2	2600
Maximum		8.0	103.9	281	12530	7.15	8.2	66.7	276.0	175.0	252.0	73.3	290.0	24.1	41800
Approach 2	Fixed film														
N	Valid	17	17	17	17	17	17	1	17	17	17	17	17	17	4
	Missing	0	0	0	0	0	0	16	0	0	0	0	0	0	13
Mean		1.4	17.7	-141	1302	0.64	6.9	58.2	64.6	17.6	35.3	11.3	46.5	6.1	2448
Std. Deviation		1.7	21.9	335	456	0.22	0.5		112.8	15.3	28.9	15.8	24.6	2.2	1850
Minimum		0.1	0.7	-860	800	0.39	6.0	58.2	2.0	3.5	2.0	0.0	16.6	2.5	260
Percentiles	25	0.3	3.3	-324	941	0.46	6.4	58.2	4.7	3.8	13.8	0.0	23.7	4.8	615
	50	0.7	8.5	-56	1106	0.54	7.0	58.2	13.0	14.0	23.6	9.5	43.6	5.7	2545
	75	2.3	30.8	45	1659	0.83	7.2	58.2	65.7	27.0	53.8	16.9	64.8	8.0	4183
Maximum		6.6	86.6	452	2114	1.07	7.9	58.2	343.0	54.0	93.5	60.0	93.5	10.2	4440
Approach 3	Combined														
N	Valid	22	21	18	22	20	22	6	22	22	22	22	22	22	6
	Missing	0	1	4	0	2	0	16	0	0	0	0	0	0	16
Mean		3.5	44.4	139	4327	2.87	7.2	124.2	9.9	15.3	13.5	11.2	24.7	6.2	17125
Std. Deviation		2.5	33.1	248	12464	8.63	0.7	53.4	13.8	12.2	19.9	14.0	19.4	3.6	37924
Minimum		0.1	1.1	-400	370	0.18	4.5	65.0	2.0	3.5	0.1	0.0	1.0	0.3	100
Percentiles	25	1.2	8.9	17	748	0.36	7.0	83.3	2.0	4.2	0.7	0.3	11.6	3.2	550
	50	3.3	42.0	191	846	0.41	7.4	119.5	2.9	14.3	2.7	7.7	21.4	6.9	2225
	75	5.7	76.3	293	1241	0.59	7.6	153.5	8.8	21.4	19.2	16.7	30.2	8.6	25875
Maximum		8.0	97.1	583	57290	38.01	8.1	221.0	44.5	45.3	77.1	57.7	77.1	14.1	94500

Among other possible factors that may explain the apparently less effective aeration in fixed film systems could be the following:

-fixed film systems tend to operate only when flow is occurring, while the other approaches run independently of flow. The higher aeration results of other approaches may reflect an over-aeration. The higher TKN concentrations in fixed film systems were more suggestive of under-aeration.

-fixed film systems in the study were predominantly not NSF-certified, but had been approved based on limited experimental and innovative testing in Florida. The results may indicate that systems certified by NSF have better aerating system. This could be further explored by looking at differences between treatment systems.

-fixed film systems could be less well maintained than other systems. There have been concerns about difficulties in finding a maintenance entity, in particular for the most common system, and hesitancy by system owners to replace the peat in peat filters, which were represented by four systems. On the other hand, within the study sample of systems, the fraction of systems identified with some operating problems was lower for fixed film systems (18%), than for combined (27%) and extended aeration (33%). It is conceivable that this reflects the need for a more thorough site assessment protocol rather than better operating conditions.

While statistically significant, the results were limited due to the small number of systems.

Table 52. Significant ($p \leq 0.05$) Differences between Treatment Approaches for the Technology Samples

Approach	1 lower than	1 higher than	2 lower than	2 higher than	3 lower than	3 higher than	
1 External aeration			DO, Sat, ORP	TKN		ORP, pH, alkalinity, TN	Kruskal-Wallis test
2 Fixed Film	TKN				cond, sal, $cBOD_5$, TKN, TN	DO, Sat, ORP, pH	
3 Combined	pH, alkalinity		DO, Sat, ORP	TKN, TN			
	Median test						

3.3.11 Analysis of Sample Results for Sites that Completed System Use/User Surveys

Out of the 550 total systems visited, owners of sixteen of the sites had also completed a system owner and user survey that was sent by Florida State University's Survey Research Lab (Section 2.4). Also, 29 system use surveys (Appendix A) were completed and returned, with 26 of these having been sampled. Five of these also completed a system owner and user survey from Section 3.4.

An analysis was performed looking at the sample results for those systems that completed a system use or a system owner and user survey (Sections 3.4 and 2.3.3.4). Information completed by the system owner or user was compared to the information in the permit file and information on the sampling results to assess whether there was a correlation between user knowledge about their system and system performance.

1. One of four secondary PBTS systems was out of compliance for Carbonaceous Biochemical Oxygen Demand ($cBOD_5$)
2. One advanced secondary PBTS system was out of compliance for Total Nitrogen (TN)
3. One of four PBTS systems was out of compliance for Total Suspended Solids (TSS)

Next an analysis was done comparing answers to a question from the FSU-SRL system owner and user perceptions survey which asked *"How many times have you experienced problems with your sewage system over the PAST YEAR?"* with the results of the operational assessment indicating whether the operational status was OK or Not OK. There was a small sample size (n=15) of users that responded to this question.

1. Of the 15 respondents, three users with an "OK" operational status, indicated they never had problems with their OSTDS over the past year
2. Two users with an operational status that was Not OK, and seven users with an OK operational status, indicated they had problems with their OSTDS once or twice over the past year
3. Two users with an operational status that was Not OK, and one user with an OK operational status, indicated they had problems with their OSTDS several times over the past year.

Additional data analysis was performed to determine if the number of times a user experienced problems with their system in the past year was related to having indicated that they have encountered problems with their system. The survey question specifically asked *"Within the LAST 5 YEARS, have you had any of the following problems?"* with the options being sewage on the ground, plumbing backup, drainfield damaged, tank damaged, parts broken / system stopped working, D-box / header damaged, or other. The sum of the total number of boxes checked was used to compare to the question asking *"How many times have you experienced problems with your sewage system over the PAST YEAR?"* A small sample size (n=16) of users responded. The data results displayed below indicated the following:

1. Of the 16 respondents, six users (five with an OK operation status and one with an operation status of Not OK) indicated that they have had no problems in the last five years.
2. Five users (two with an operational status that was Not OK and three users with an operational status that was OK) indicated they responded to at least one of the listed problems within the last 5 years.
3. Three users with an OK operational status indicated they responded to at least two of the listed problems within the last 5 years.
4. One user with an operational status that was OK indicated they responded to at least three of the listed problems within the last 5 years.
5. One user with an operational status that was Not OK indicated they responded to at least four of the listed problems within the last 5 years.

The overall review and analysis of the survey results from users of OSTDS, along with their corresponding wastewater sample results and system evaluations provided a limited assessment of the owner/user's perceptions regarding the management of their systems. Further evaluation of the secondary treatment standards and advanced secondary treatment systems indicated an association between OSTDS with mechanical and/or operational issues and results that exceeded performance standards) for various pollutants including $cBOD_5$, TSS, and TN. Additionally, the data analysis indicated the user's perceptions of the OSTDS issues were related to operational status of the system.

3.3.12 Quality of Maintenance Inspections

An analysis was done to assess whether there were any trends indicating the overall quality of maintenance inspections. The project did not collect information that could readily distinguish between "good" and "bad" maintenance entities. Non-vacant visited systems that were considered operational (power was on, no sanitary nuisance existed, aeration resulted in bubbles and mixing of sewage, and alarms were not on) were compared to several variables relating to past maintenance and inspections (i.e., was a maintenance contract included in the file, was at least one maintenance entity inspection performed during the review cycle, were at least two maintenance entity inspections performed during the review cycle, were there more than two maintenance entity inspections performed during the review cycle, whether requested maintenance entity inspections reports were received for the project, and whether the operating permit was current based on the information submitted). It should be noted that the maintenance information was recorded during the permit review and reflected an operating permit year ("review cycle") one to three years prior to the actual site visit.

To see if there was a positive correlation between functioning systems and maintenance, data were analyzed in the statistical software program Statistical Package for the Social Sciences (SPSS). Among the available Chi-Square tests for independence the results of the one-sided Fisher's Exact Test were looked at as a measure if the systems with previous records of maintenance were significantly more likely to appear operating properly than the systems without that previous maintenance.

There were a total of 477 active non-vacant advanced systems visited throughout Florida during this study. There was a statistically significant association between the system operational status and whether there was a maintenance entity contract, whether one or two inspections were conducted by the ME annually, and whether the operating permit was current. There was no statistically significant dependence between whether the annual FDOH inspection was done, more than two inspections were done by the ME, or the maintenance entity inspection report was received during the file review portion of the project.

So, the conclusions are as follows (level of significance):

1. Systems were more likely to be operating properly if the annual operating permit was current ($p=0.025$).

2. Systems were more likely to be operating properly if a maintenance entity contract was present ($p=0.030$).

3. Systems were more likely to be operating properly if one or two maintenance entity inspections are conducted per year ($p=0.093$ and 0.029, respectively). Systems with at least two maintenance inspections were functional 81% of the time, while at least one maintenance inspection resulted in 79% of the systems remaining operational. Only a sixth of systems did not have at least one maintenance entity inspection during the review period.

4. A record of completing the one annual FDOH inspection did not yield a statistically significant increase in operational systems ($p=0.360$). It is not clear if the lack of inspections was real or a function of poor record keeping. Only about a seventh of systems did not have a FDOH inspection indicated during the review period. Nearly a third of these (26 of 86) stemmed from one county.

5. Having more than 2 maintenance entity inspections per year did not yield a statistically significant increase in operational systems (p=0.376). Only about a quarter of systems had that many inspections.

6. Having the maintenance entity inspection report included in the operating permit file transmitted to the project did not yield a statistically significant increase in operational systems (0.462). This could be in part due to the fact that this variable measured if any reports were available at all regardless of whether the date on the report fell within the evaluated review cycle.

A more detailed review was done that showed that Franklin County seemed to be influencing the results of the analysis of the quality of maintenance inspections (Table 53).

Table 53. Significance of Fisher's One Tailed Test Comparing Completeness of Operating Permit Requirements and Operational Status of Treatment Units for Franklin County and the Rest of the State

	Franklin	**Rest of the State**	**Overall**
Inspect 1 ME	.038*	.240	.093
Inspect 2 ME	.111	.099	.029*
Inspect 1 FDOH	.418	.216	.360
OP current	.634	.026*	.025*
ME contract	.425	.051	.030*

* The level of significance is <0.05, the result is highly significant

3.3.13 Cost of Field Evaluations and Sample Analysis

An analysis was performed to assess the costs associated with performing field evaluations and sample analysis. The amount of time evaluators spent at each site was generally much greater than what would normally be expected for a site visit associated with an annual inspection by FDOH. This was because there was a greater level of detail required to be documented in the site assessment forms, field samples and analysis were performed using HACH kits and the YSI multiparameter probe, and samples were taken from each accessible compartment.

The overall percentage of sites that were visited that had a sample taken was 59% (Table 54). Charlotte and Monroe counties had the highest percentage of visited sites that were sampled, at 76% and 73% respectively. The Lee County and Wakulla Statewide sampling teams had the lowest percentage of visited sites that were sampled, at 42% and 48% respectively. A site was not sampled if permission was not granted, the location was inaccessible, there was no access to the sewage, or the house appeared to have been unoccupied for some time. The sampling done by FDOH Volusia County staff and the Wakulla Statewide teams were both mainly done in areas that were outside of the county in which the inspectors worked.

The sample suite including $cBOD_5$, TSS, TN, and TP were analyzed at a fixed price of $33/ OSTDS sample through the request for proposals advertised with this project. This was a competitive rate which was on the low side for comparable labs. The contract was with one lab, and each sample group had to ship samples to a central location for analysis. Shipping costs were paid separately and are not included in the calculations. The reason these were not included is because a county would not normally incur shipping charges, and would instead submit to a lab within the county.

The overall cost per OSTDS tested, which includes both salary and sample costs, came to $152.87. Lee County and the Wakulla Statewide sample teams had the lowest costs per site and Monroe and Volusia counties had the highest costs per site. The differences in these numbers are likely due to the number of samplers that went to a site. Lee and the Wakulla Statewide sample teams had one person out at a site for most of the time, and Monroe and Volusia counties generally had two or more people per site.

On average, two sites were visited per day. Volusia and Charlotte had a higher average than the other groups, which is likely for Volusia County due to the need to maximize site visits because of the long travel time to get to Brevard County. Charlotte County staff in general appears to be the most efficient sampling group overall.

There may be reductions in travel time and an increased familiarity with the systems that generated further cost efficiencies when evaluating advanced systems.

Table 54. Number of OSTDS Samples and costs Among Sample Groups

County	**Number of site evaluations**	**Number of sites sampled**	**Percentage of visited sites that were sampled**	**Salary cost per site**	**Cost for sample suite ($cBOD_5$, TSS, TN, TP)**	**Cost per site (salary + sample costs)**	**Average # of sites visited per day**
Charlotte	129	94	73%	$111.54	$33.00	$144.54	2.5
Lee	50	21	42%	$50.22	$33.00	$83.22	1.6
Monroe	74	56	76%	$205.95	$33.00	$238.95	2.24
Volusia	140	82	59%	$154.98	$33.00	$187.98	2.6
Other Statewide	187	89	48%	$83.90	$33.00	$116.90	2
Total	**580**	**342**	**59%**	**$119.87**	**$33.00**	**$152.87**	**2.188**

3.4 User Group Survey Results

Table 56 shows the results of the total population of surveys, the number that were sent, the number of surveys that were completed, and how many of those surveys were applicable to the project (i.e., they indicated that they had something to do with advanced OSTDS).

Table 55. User Group Survey Response Numbers

Sent to:	Population	# Sent	# Complete	# Applicable
System owners and users	16,802	3,793	660	660
Regulators	67	67	67	56
Installers	709	709	61	26
Maintenance Entities	226	226	33	33
Manufacturers	118	118	16	11
Engineers	164	164	19	13

3.4.1 System Owner and User Survey Results

Table 56 shows the overall distribution of the system owner and user population. Most of the surveys returned were by full-time residents that owned the home with the advanced system and for systems serving less than 4 people. Fifty-one percent of the people that returned a survey were located in the following counties: Monroe (17%), Brevard (13%), Charlotte (12%), and Lee (9%). Sixty percent of the responders had a college degree or higher and 17% had a high school degree or less. Fifty percent reported a total household income of over $85,000.

Table 56. System Owner and User Population

	# Sent	% of Total Population	% Completed
All types of systems	**3793**	**27.9%**	**17.4%**
ATUs	**2378**	**19.6%**	**18.9%**
ATU Residential	1279	14.8%	18.5%
ATU Commercial	549	100.0%	18.2%
ATU Unknown	550	18.6%	20.5%
PBTS	**1231**	**100.0%**	**15.8%**
PBTS Residential	1044	100.0%	18.2%
PBTS Commercial	31	100.0%	12.9%
PBTS Unknown	156	100.0%	0.6%
Innovative	**184**	**100.0%**	**8.2%**
Innovative Residential	175	100.0%	8.6%
Innovative Commercial	9	100.0%	0.0%

Seventy-nine percent stated that they had an ATU, 8% had a PBTS, 1% had an innovative system, and 7% did not know what type of system they had. Fifty percent of the responders knew their system manufacturer. Fifty-eight percent of systems were installed within the last five years.

Fifty-five percent reported never experiencing problems, 33% reported experiencing problems once or twice within last year, and 11% experienced problems several times. The major sources of problems were system malfunctions such as pump failures, electrical malfunctions, faulty alarms, and bad motors. Almost half of the responders used septic tank contractors or plumbers to fix problems, 35% relied on maintenance entities, while 10% report fixing the problems themselves.

Figure 23 shows how satisfied system owners/users were with their systems, with 79% being either very satisfied or satisfied. Table 57 shows a comparison between owner/user satisfaction and their reported annual income. Many of the responders did not fill in any information for annual income. In looking at differences in satisfaction based on income, there appears to be a fairly even distribution which indicates that income level may not influence satisfaction. Fifty-nine percent of the system owners and users would prefer to hookup to a municipal/county sewer system if the cost were equal. Figure 24 shows the breakdown of what the greatest advantages are for having an onsite system. The breakdown was pretty even among the categories, and most of the answers provided in the “other” category were those stating that there was no advantage to having an advanced system.

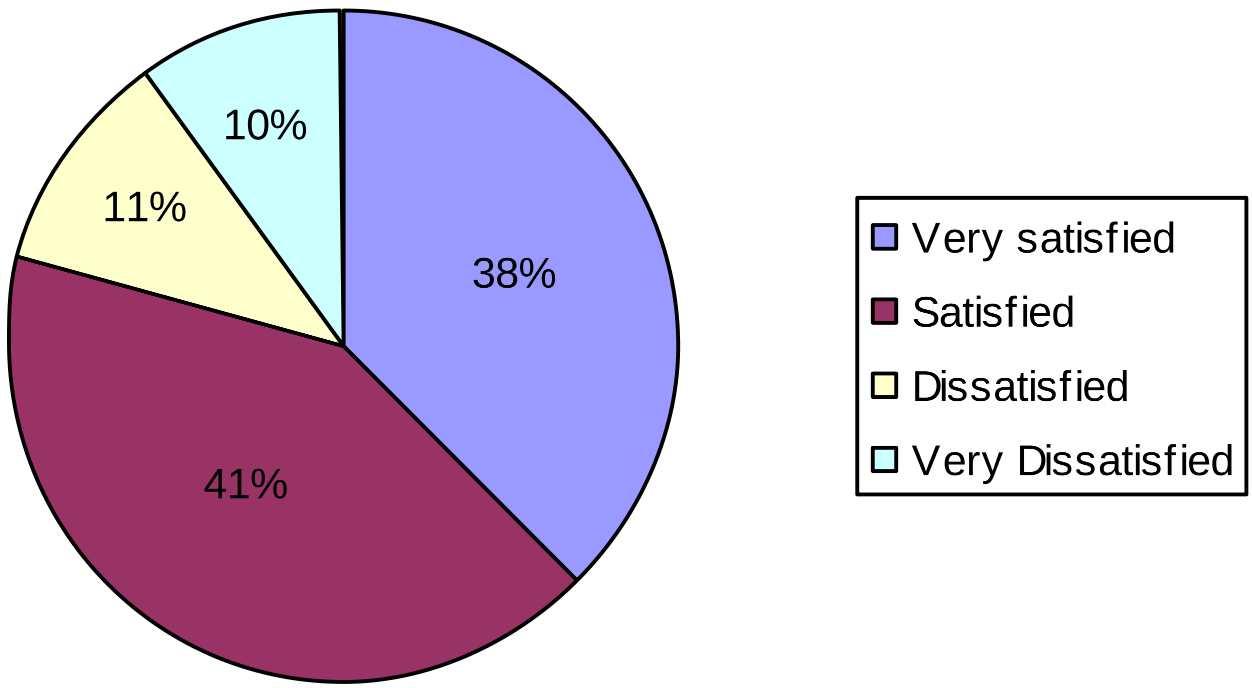


Figure 23. Advanced OSTDS Owner/User Satisfaction (Question: How Would You Describe Your Overall Satisfaction with Your Advanced Onsite Sewage System (Septic System)?)

Table 57. Comparison of System Owner/User Satisfaction with Annual Income

	Under $15,000	$15,000 to $25,000	$25,001 to $45,000	$45,001 to $65,000	$65,001 to $85,000	$85,001 to $100,000	Over $100,000	Blank	**Total**
Very Satisfied	4	3	24	29	18	27	78	51	**234**
Satisfied	7	14	23	41	20	13	79	60	**257**
Dissatisfied	1	3	5	10	7	4	22	14	**66**
Very Dissatisfied	4	4	4	9	0	6	15	18	**60**
Blank	1	0	3	1	1	2	3	4	**15**
Total	**17**	**24**	**59**	**90**	**46**	**52**	**197**	**147**	**632**

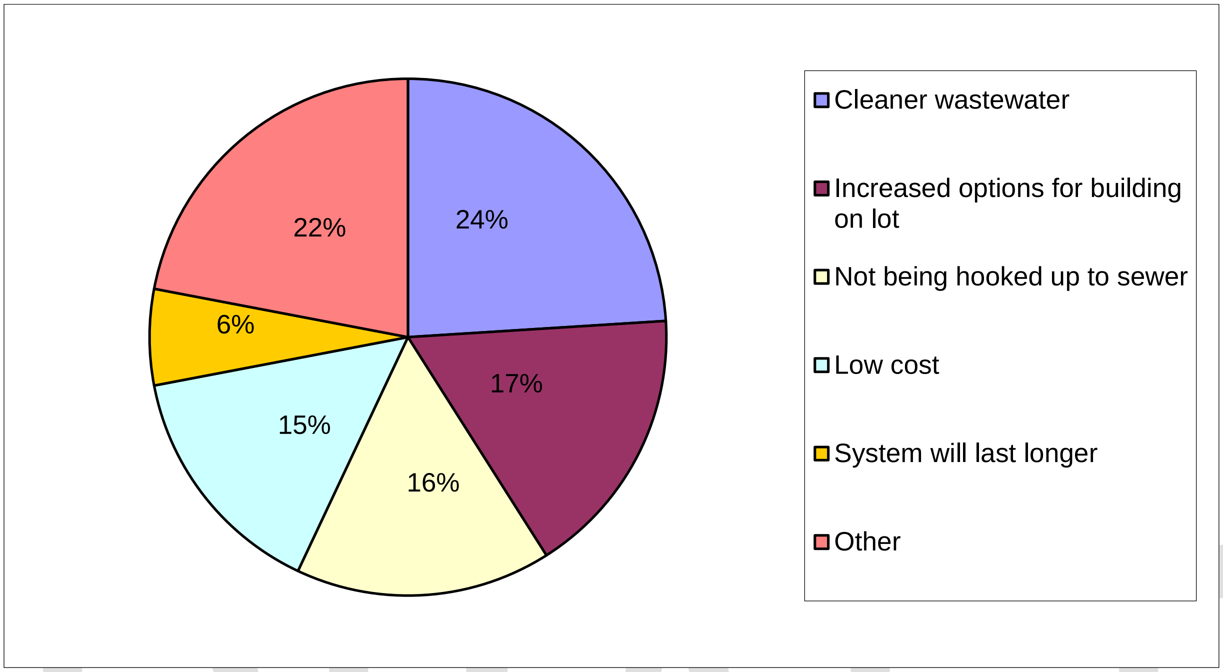


Figure 24. Greatest Advantage of Having an Advanced System According to System Owners and Users

Forty-two percent of owners and users inspect their own system every few months and 25% do not inspect their system at all. Fifty-five percent reported that their maintenance entity inspected their system twice a year. Eighty-six percent reported that their maintenance entity informed them of the results of the inspection. Forty-three percent reported that they were informed of inspection results from FDOH.

When asked about what preference they would have for receiving information from the FDOH regarding OSTDS, 69% indicated their preference would be through mailed brochures. Topics of interest related to advanced systems that system owners and users would like to learn about include:

- Owner maintenance
- System performance
- Cost
- Sewer hook-up
- Environmental issues
- Permitting/regulation
- Contractors/maintenance entities
- Operating instructions

Seventy-three percent had no difficulty in finding a maintenance entity for their system. Fifty-five percent pay between $200 and $500 per year for operating permits and a maintenance contract. The average repair cost for the previous year was $474 and the median cost was $200 with 28% having no expenses for repairs. The system owners and users satisfaction with their maintenance entity was very high, with 32% “Very Satisfied” and 51% “Satisfied”. Sixty-seven percent of owners and users stated that they will renew their agreement with the same maintenance entity. Only 15% reported that if there was an alternative they would switch maintenance entities.

Figure 25 shows a breakdown of the US EPA Management Model (US EPA 2003) which goes from homeowner awareness, to a maintenance contract, to an operating permit, to having a responsible maintenance entity (RME) operating and maintenance model, to having an RME ownership model. The majority of people would rather maintain the system or have a maintenance entity charge for maintenance in a lump sum, which are two of the lowest tiers on the management model.

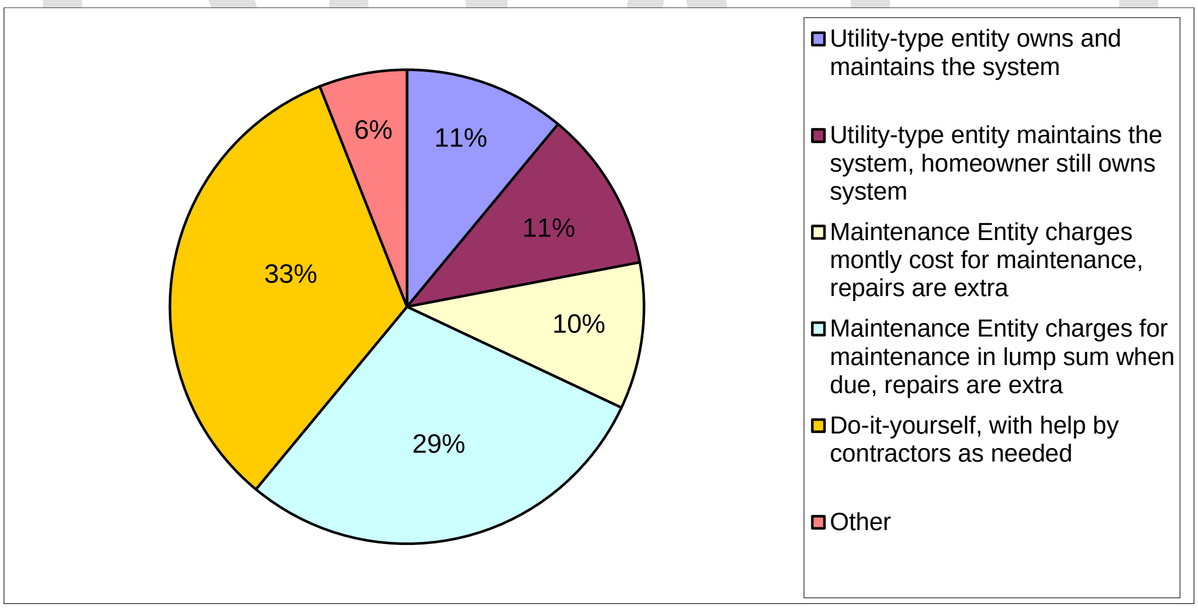


Figure 25. Who Do System Owners and Users Prefer To Deal With Regarding Permitting and Maintenance of Advanced Systems?

Two open-ended questions were asked to system owners/users. One asked what topics related to advanced onsite systems they would like to learn more about. Topics relating to owner maintenance, system performance, and cost ranked highest. Other topics included hooking up to sewer, environmental issues, permitting and regulation, contractors and maintenance entities, and operating instructions. Another question asked system owners/users what changes or improvements they would like to see related to the regulation, permitting, and management of advanced onsite systems in Florida. Two answers stood out among the others, and they related to regulation and management of systems as well as the cost of systems. Other changes and improvements that were commonly mentioned related to contractors and maintenance entities, sewer availability, system performance, system maintenance by the owner, inspections, and consumer information and education.

Some other results included:

- System owners and users of advanced systems in counties with the most advanced systems (Monroe, Brevard, and Charlotte) reported less frequent system problems over the past year.
- System owners and users who “never” experienced problems over the past year are “very satisfied” at twice the rate of those who experienced problems “once or twice”.
- System owners and users who fix problems themselves are less satisfied with their system than those who rely on others.
- Cost of yearly operation and maintenance was not a factor in determining overall system satisfaction.
- Fewer people using the system equal less frequent problems.

Some of the suggested changes or improvements given by the system owners and users included:

- Reduce cost of system.
- Fee for maintenance entities are too high and often times they do not come out for repairs.
- Inspections should consist of more than just a visual inspection given the cost.
- Consumers need more choices for maintenance entities to help drive lower costs.
- Operating permits should be done annually instead of bi-annually.

3.4.2 Regulator Survey Results

Eleven local FDOH offices returned the survey back stating they had no advanced systems in their county. All eleven of these counties did show up on our database list as having an advanced system (Table 1) but the database did not always accurately identify advanced systems (i.e., property has been connected to sewer, system did not receive final approval, system was actually for a different type of operating permit). The counties that stated they had no advanced systems were: Baker, Bradford, Calhoun, Desoto, Hardee, Holmes, Jackson, Jefferson, Liberty, Union, and Washington.

For those which completed a survey indicating that they had advanced systems, the following summarizes some of the results.

Figure 26 illustrates the number of advanced systems that were reported in the survey as being regulated by FDOH. The majority of counties do not have very many advanced systems.

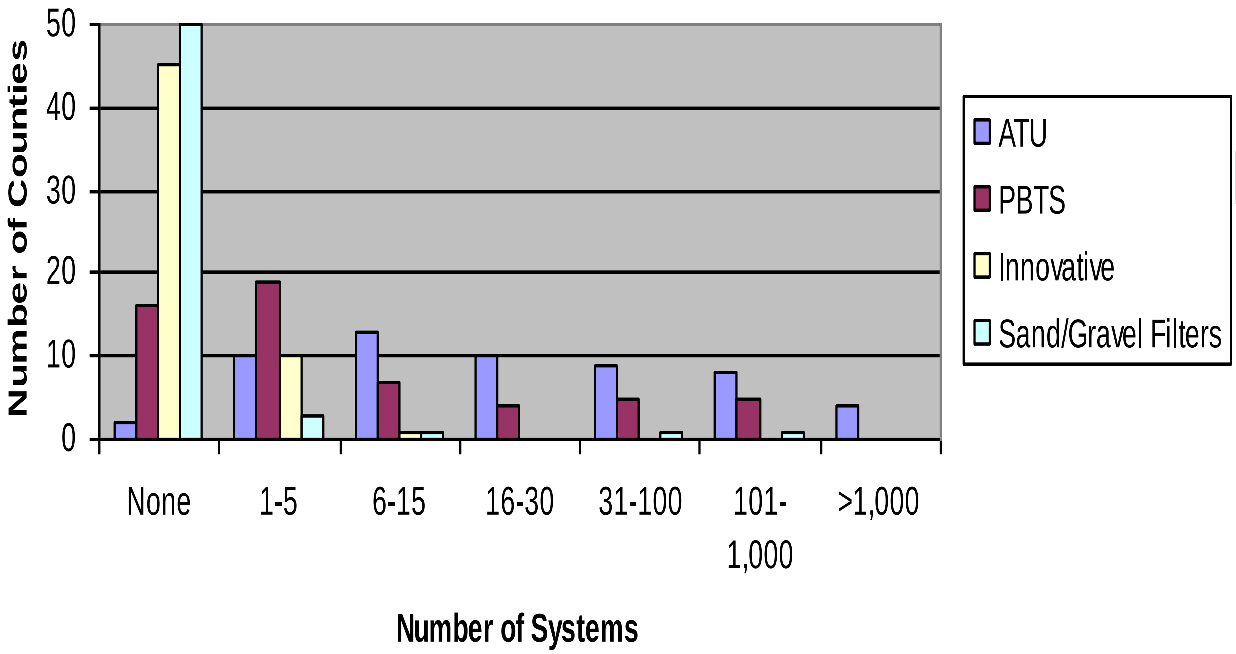


Figure 26. Number of Reported ATU, PBTS, Innovative, and Sand/Gravel Filter Systems Regulated by FDOH

At the time of the survey, twenty-eight of fifty-six local FDOH offices have less than one full time employee (FTE) assigned to conduct ATU/PBTS inspections, FDOH offices in 21 counties have 1-2 FTEs, and 4 have 3-5 FTEs. Monroe County has the most with 14 FTEs for the inspection function as of the time of the survey. Thirty-nine of 56 counties report that turnover of inspector personnel was not a problem in their county at this time. Regulators stated that the major contributors to turnover were salary issues, career advancement issues, and the complexity of the program.

Thirty-three counties had between 1 and 5 contractors installing systems. FDOH in Charlotte County reported the most contractors with 23. Fifty-one counties feel that the number of contractors was adequate for their county's needs. Thirty-three counties had between 1 and 5 licensed maintenance entities providing services. Sixteen counties felt that the number of licensed maintenance entities was inadequate to meet their county's needs.

Nearly all of the counties used the EHD for construction permit records and operating permit records. Less than ten counties indicated that they use the Carmody database to enter and maintain information. Most counties looked at paper files to keep track of monitoring requirements and inspection results.

Forty-five of 56 counties reported that they infrequently conducted sampling on advanced systems. The reasons for this limited sampling included: sampling is not required (27 of 45), limited resources (10 of 45), limited staff (7 of 45), and visual inspections sufficient to ensure compliance (10 of 45). Thirty-eight counties have developed checklists to use when conducting inspections. Nearly all of the counties performed the following activities during FDOH inspections of advanced systems:

- Check the general overall system appearance
- Check that the power is on
- Look for changes in the site conditions
- Check for any smells and/or sounds from the system
- Check for any wetness in the drainfield

Counties "rarely" found substantial changes to the permitted design during construction inspections. Most counties evaluated their own applications for ATUs and PBTS. Thirty-one of 44 counties send innovative system permits to the State Onsite Sewage Program Office Engineer for evaluation. Nine counties reported having passed ordinances that require standards for advanced systems that are more stringent than those required by the state: Brevard, Charlotte, Citrus, Collier, Franklin, Manatee, Orange, Volusia, and Wakulla counties.

Twenty-one of 56 counties reported having had no advanced systems that required compliance enforcement action over the past year. Monroe, Brevard, Lee, Franklin, and Charlotte counties had the largest number of advanced systems that required compliance enforcement action. Paperwork issues were the most prevalent reason requiring enforcement. The most successful strategies in achieving compliance for systems needing enforcement were sending the "notice to correct" letter and issuing citation and/or fines. Approximately 70% of all counties reported that systems in violation needed multiple enforcement actions to correct the problem.

Forty-five counties indicated that 75% to 100% of maintenance entities submit reports by paper. The majority of counties rated overall quality of maintenance entity reports as "good". The cost of the maintenance contract and not being able to choose between several maintenance entities were the most frequent complaints received from system owners and users.

3.4.3 Installer Survey Results

The main reasons for installing advanced systems according to system installers were because of lot size restraints, environmental issues, or because the systems work well. The main reasons for not installing advanced systems were because of low demand, having questions about how well the work, limited profit margin, and that they like working with conventional systems.

Ninety-two percent of installers that responded to the survey reported they were a maintenance entity as well. They reported that it generally took two weeks to a month to get a construction permit from FDOH. About half of the installers that responded use the Carmody system. When asked how they keep track of customer satisfaction, the result was pretty evenly split among not keeping track at all, leaving a card for customer comments, tracking customer complaints that they receive, of handling it with verbal communication.

3.4.4 Maintenance Entity Survey Results

The maintenance entities that responded to the survey reported that they worked about equally on ATUs and PBTS. About 60% said customers received a copy of the inspection report. There was about an even mix between those maintenance entities that use Carmody and those that use other methods to maintain their records.

Regarding maintenance contracts, the maintenance entities stated that an annual fee range of $100-$300 is typically charged. This fee covered all required inspections and routine maintenance, with 42% of the maintenance entities stating that this fee included sampling of the system as well.

Some of the most common tasks that the maintenance entities that completed the survey indicated that they did during routine inspections of advanced systems were:

1. Open covers to observe aerobic treatment chamber	97%
2. Trigger alarm	94%
3. Check that air supply is running	94%
4. Check for smell from treatment system	94%
5. Check clarity of water in treatment tank/clarifier	91%
6. Trigger pumps	88%
7. Measure sludge accumulation	88%
8. Open covers to observe trash tank/compartment	85%
9. Inspect/clean effluent filter	85%
10. Inspect/clean air filter	85%
11. Work through a manufacturer’s or distributor’s check list	82%
12. Observe and record general appearance of treatment system functioning	82%
13. Observe clarity of effluent in observation port	82%
14. Open covers to observe clarifier/dosing tank	79%
15. Check sounds from treatment system	76%
16. Check wetness in drainfield area	76%

Also, 73% said that they pump the tank approximately every three years, and over 50% said that they take effluent samples.

3.4.5 Manufacturer Survey Results

Over 70% of manufacturers that responded to the survey did not sell any ATUs or PBTS during the past year. Criteria and qualifications they required for maintenance contractors were to be state certified and trained by manufacturer. The manufacturer stated that tasks the maintenance contractor should do during inspection are to work through the product’s checklist, open up the tanks, check for odors, and replace any non-functioning parts.

3.4.6 Engineer Survey Results

Eighty-five percent of the engineers that responded to the survey designed fewer than 5 ATUs over the last year. Ninety-two percent designed fewer than 5 PBTS over the last year. Over 90% of engineers reported that they “rarely” have to re-engineer a design. About 70% of the engineers required sampling on the systems they design.

3.4.7 Combined Group Survey Results

The response rates for installers (9%), maintenance entities (15%), and engineers (12%) were lower than for the owner/user group (17%). More than half of the responding installers and about a third of the responding engineers indicated that they are not involved in the installation of advanced systems. This was likely a reflection of the small share that they constitute of the overall onsite sewage market as was the fact that 11 (of 67) counties reported not having a single advanced system installed in their county. Figure 27 shows the reported revenue that various user groups received from advanced systems. This figure shows how small of a proportion advanced systems are to these groups regular revenue stream.

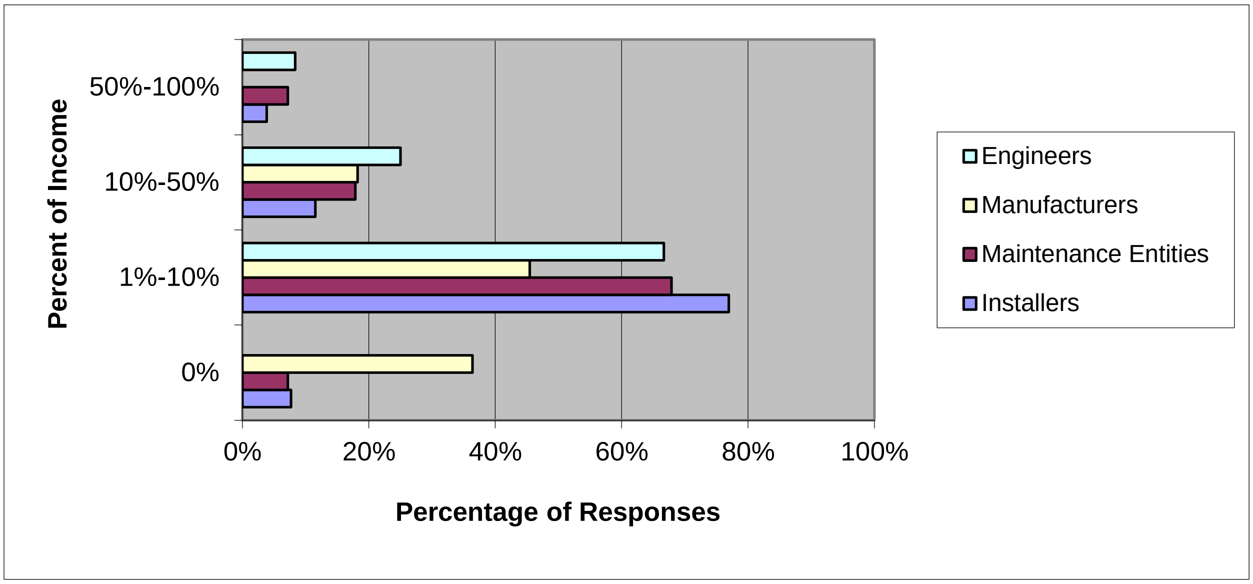


Figure 27. Revenue from Advanced Systems as Reported by Engineers, Manufacturers, Maintenance Entities, and Installers

The highest rated cause for failure between the installer, maintenance entity, and engineer groups came from malfunctioning treatment system parts, homeowner misuse, and the power being turned off. The lowest rated failure causes from these groups was engineer design or installation issues.

There were some distinct relationships shown between the different user groups. The manufacturers of advanced systems mainly interacted with installers. Engineers mainly interacted with FDOH and installers. Installers and maintenance entities mainly interacted with owners and the FDOH.

Figure 28 compares the responses from engineers, maintenance entities, installers, and regulators regarding their overall perception of treatment performance. All of these groups predominantly indicated that both ATU and PBTS performance was either good or excellent. When comparing this result with how satisfied homeowners were (Figure 23) this seems to indicate that advanced systems were fairly well accepted among the different user groups.

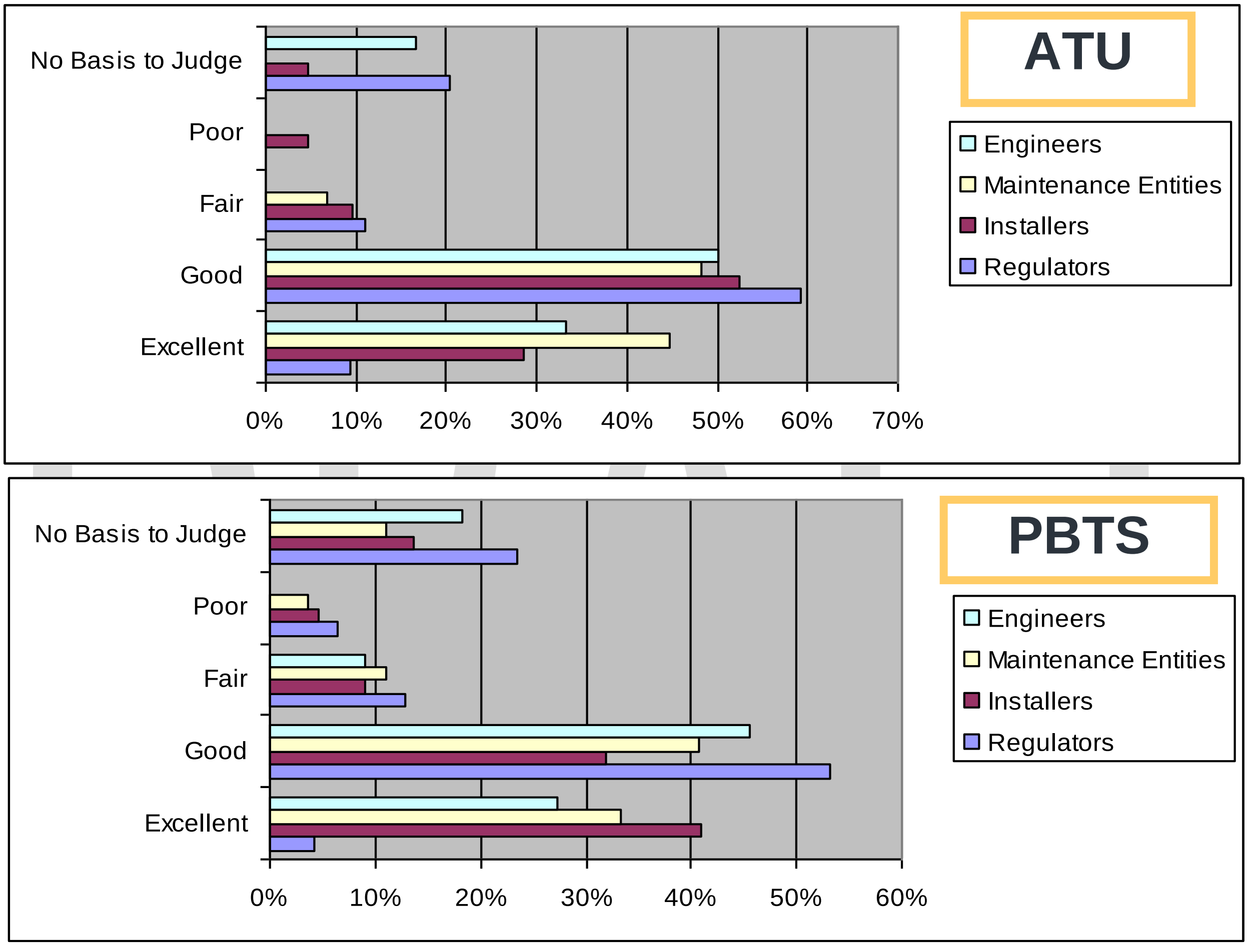


Figure 28. Comparison of the Perceptions of Overall Treatment Performance of Advanced Systems Between Groups (Question: How Would You Rate the OVERALL TREATMENT PERFORMANCE of the Advanced Systems You are Involved With?)

When these groups were asked for some general comments and suggestions about advanced systems, there were two main points that came up: the importance of consistency between county offices within FDOH and that advanced systems were expensive to install and maintain.

3.4.8 Analysis of Open-Ended Questions

The user group surveys included several opportunities for the responders to write open-ended answers to several questions. Questions with open-ended answers were grouped by general topic and analyzed. Several identical questions were asked to the regulator, installer, engineer, maintenance entity, and manufacturer user groups for identification of any similarities or trends.

3.4.8.1 Training Opportunities

One question asked about what training opportunities related to ATUs and PBTS would be of interest.

The regulators were asked this question in several parts to identify training needs for various groups: FDOH county office staff, maintenance entities, consumers, installers and engineers, and manufacturers. FDOH county office staff training needs included learning about the different approved product types, how to do inspections on advanced systems, and how to review the paperwork for these systems. Some of the training needs for maintenance entities were identified as basic rule training, training from the manufacturer on specific products, and inspection techniques. Training opportunities for consumers were identified as providing them with basic information on advanced systems, including maintenance requirements through pamphlets, public service announcements, or one on one education from the maintenance entity or FDOH. Training needs for installers and engineers were listed as basic rule training and continuing product education. At this point there are no training requirements for manufacturers, but the FDOH county offices indicated that having basic Florida rule training could be of benefit to the manufacturers.

Installers indicated their preference for training courses would be in advanced system design, installation, and maintenance. Several wanted training on specific products as well as on the Carmody system. They also indicated that they would like to be kept informed about training opportunities.

Engineers that design advanced systems indicated that they would like to see classes on advanced system design, installation, and maintenance; drainfield design; and FDOH rule requirements. Several engineers indicated that any training on various design concepts should be unbiased.

The maintenance entities mostly said that the current provided training was adequate. Some of the other topics of interest to the maintenance entities were advanced system design, installation, and maintenance, training on specific products, training on FDOH rule requirements, and research performed on onsite systems.

The manufacturers that responded to the survey felt that the current training that was provided was adequate. Some manufacturers indicated that they provided their own training. Training homeowners on the basics of system operation and maintenance was also mentioned.

3.4.8.2 Aspects of program currently working well

Another question asked about what aspects of the advanced system program in Florida was currently working well as it relates to construction permitting, design, installation, inspection, maintenance, and operating permitting.

Some of the aspects of the program that was currently working well according to the regulators included the permitting and inspection of advanced systems, that these type of systems allow for solutions to issues regarding lot flow allowances, that these systems are better for the environment, the accessibility of headquarters staff, and the centralized EHD. The main comment regarding what was not working well currently was the difficulty in keeping up with the paperwork required to keep track of continued maintenance of the system.

Approximately 60% of the installers stated that the system was working well. The remaining forty percent indicated that the systems were too expensive, there was inconsistency in implementation of the rule by some FDOH county offices, and that the permitting process was too difficult.

Nine out of ten engineers that responded to this survey question indicated that the current system was working well. One engineer indicated that the time required to obtain a construction permit was too long.

Overall, 65% of the maintenance entities said that the program was currently working well. The major area identified as needing improvement was the FDOH permitting process as it took too much time and was too complicated.

The majority of the manufacturers that responded to this question indicated that the system, as it is currently set up, was working well.

3.4.8.3 Changes and improvements to the program

A question was asked about what changes or improvements would be recommended regarding the regulation, permitting, and management of ATUs, PBTS, maintenance entities, innovative systems, and sand/gravel filters.

The regulators indicated that improvements could come by modifying permitting requirements, standardizing the inspection form, and simplifying the rule. Some specific suggestions were to have the operating permit be the responsibility of the homeowner (which was done legislatively as of July 1, 2013), increasing fees to allow for sampling, and improving EHD to better track inspections on advanced systems. For the ATU program several regulators suggested improvements could come by recording that an ATU was present on the property in the public property records. For innovative systems, regulators indicated that they would like to receive more support from the Onsite Sewage Program Office by keeping FDOH county offices involved during the permitting process and enforcement process and by having a centralized statewide database of innovative systems. For maintenance entity regulation, permitting, and management the regulators indicated that the enforcement process needed improvement, more training was needed, and permitting requirements should be modified. The main issue with enforcement was that the maintenance entities do not submit the paperwork on time. The focus for training of maintenance entities should be on expectations from FDOH regarding required paperwork. The regulators suggested modifying the permit requirements to allow more maintenance entities to do more maintenance on different systems.

Installers indicated that it would be beneficial for more maintenance entities to be qualified to service more systems. They also indicated that changes in the regulations would also improve the program, and that the permitting process should be simplified and streamlined. There were several installers that stated that an engineer was not needed for advanced systems.

The engineers responding to the survey suggested that an improvement to the advanced system program would be to simplify the permitting process. There appeared to be some disagreement on how to handle sampling for PBTS, though. Some thought the requirements should be relaxed for qualified systems while others thought the permit fees should be increased to have a third party sample the effluent. When asked about maintenance entity regulation, permitting, and management the engineers indicated that they would like to see it become easier for a maintenance entity to specialize in various products without interference from the manufacturer.

Many of the maintenance entities that responded to this question indicated that the current system was working well. Opportunities for improvement centered on improving the enforcement process, making regulation and permitting easier, reducing fees for operation and permitting, changing existing regulations , and improving the training process.

Some suggestions from manufacturers on how to improve the advanced system program overall were to put a greater emphasis on requiring maintenance and enforcing any violations, to adjust the regulation for systems that require nitrogen removal so that it was a percent reduction rather than a hard and fast number like 10 mg/L, to not allow homeowners to become maintenance entities, and to make the product approval process easier so small business owners were able to become competitive.

No summary was provided for sand/gravel filters due to the limited number of responses received.

3.4.8.4 Summary of Open-Ended Question Results

In summary there seem to be many user groups indicating that the permitting process was too difficult and there was a need for simplification. Another issue that seems to be common among the user groups was obtaining training from the manufacturer on how to permit, install, and service various advanced system products. Allowing more maintenance entities to service different products was a common concern between the user groups. Additional maintenance entities could improve service to homeowners by increasing contract options which could lead to competitive pricing.

3.5 Evaluation of Management Practices

As part of this project, data was collected to help assess management practices. These data included: past county program evaluations; the permitting, inspection, and maintenance records from systems selected for sampling (discussed in Section 2.5 and analyzed in Section 3.5); and results from a survey that was sent as a part of this overall project to gather information from different user groups (discussed in Section 2.4 and analyzed in Section 3.4). Day to day operations at the FDOH county offices were also evaluated when available to help identify any best management practices that were already in place. This section discusses how past county program evaluations and the permit records mentioned above were assessed. A database was created which facilitated a quantitative means of assessing management practices (Appendix G). A further assessment was done for a select group of counties to develop case studies.

It is important to define what is meant by “Best” when discussing Best Management Practices. For the purposes of this analysis, some of the items used to evaluate “Best” Management Practices include, but are not limited to:

1. Completeness of documentation
2. Fraction of systems with current permits
3. User group satisfaction
4. Operating conditions of systems
5. Sampling results

3.5.1 Programmatic Evaluations and Management Practices

A review of previous year evaluations from 2000 - 2010 provided historical data which were used as a baseline to identify common trends within a particular county and determine if there were any systematic trends. Capturing this information played a critical role in determining the strengths and weakness within the FDOH county office.

The database table developed to store information on the program evaluations had several data fields that were analyzed against various statistics from the advanced systems inventory database. These fields included: the total average score of all program evaluations in the system, average ATU score, average ATU maintenance entity permit files score, average other operating permits (including PBTS) score. Each data field had a score for each county that was evaluated during 2000 – 2010. In addition, a separate analysis was done for the previous completed program evaluation cycle in 2006 – 2008. This was done to see if there was any difference between the overall averages and the immediately preceding score. For example, a county may average low because they did poorly during two program evaluations in the early 2000's, but did a major reorganization of the program and scored very well during the last cycle.

There were no correlations between any of the scores when looking at the total number of advanced systems in a county. This would seem to show that there was no tendency for scores to get better or worse the more advanced systems a county had.

The following counties have the highest and lowest total average program evaluation scores from 2000-2010..

Top 5:

1. Volusia (98%)
2. Lake (95%)
3. Indian River (95%)
4. Osceola (93%)
5. Alachua (93%)

Bottom 5:

1. Taylor (57%)
2. Franklin (58%)
3. Santa Rosa (65%)
4. Wakulla (65%)
5. Broward (67%)

The following counties have the highest and lowest average ATU scores.

Tied for First (all 100%):

1. Broward
2. Hendry
3. Lake
4. Levy
5. Miami-Dade
6. Pinellas
7. Sumter

Bottom 5:

1. Wakulla (36%)
2. Okeechobee (40%)
3. Pasco (42%)
4. St. Johns (44%)
5. Taylor (46%)

The following counties have the highest and lowest average ATU maintenance entity permit file scores.

Top 5:

1. Highlands (83%)
2. St. Lucie (80%)
3. Sarasota (80%)
4. Flagler (80%)
5. Monroe (78%)

Bottom 5:

1. Taylor (0%)
2. Santa Rosa (13%)
3. Okeechobee (25%)
4. Putnam (25%)
5. Columbia (25%)

The following counties have the highest and lowest average other operating permit (including PBTS) scores.

Tied for First (all 100%):

1. Highlands
2. St. Lucie
3. Flagler
4. Sumter
5. Citrus
6. Suwannee
7. Dixie
8. Hendry
9. Gulf
10. Lafayette
11. Gilchrist
12. Baker
13. Manatee
14. Union

Bottom 5:

1. Hamilton (50%)
2. Nassau (50%)
3. Gadsden (51%)
4. Franklin (55%)
5. Palm Beach (56%)

The total overall score was ranked from highest score to lowest score, then the other scores (e.g. ATU scores, maintenance entity scores) were ranked similarly and were all compared individually to the total overall score. There did not appear to be a correlation between the overall score and any of the advanced system program specific scored items. This would seem to show that it was not likely that a FDOH county would have a high score on any of the advanced system program evaluation questions if it had a high overall average score for the county.

Next, several evaluations of scoring consistency were done to see which counties were consistent when comparing the ranked total overall average score with the various other scores. This evaluation looked at comparisons between individual advanced system program specific scored items. Lake County showed up as being consistently high scoring when comparing the overall score to the ATU score (ranked second in the overall average score and first in the ATU average score). Counties like Broward and Miami-Dade did not have a very high overall average score but had a perfect score on their ATU average score. Counties like Dixie, Manatee, Gilchrist, and Gulf had fairly low overall average scores but all had perfect scores for the average score from other operating permits (including PBTS). These counties did not have a very large number of advanced systems per Table 1, which combined both ATUs and PBTS.

All program evaluation scores relating to advanced systems were averaged together for each county, and produced the following results:

Highest average (most consistent among categories):

1. St. Lucie (93%)
2. Lake (92%)
3. Sarasota (92%)
4. Brevard (89%)
5. Sumter (89%)
6. Citrus (88%)
7. Pinellas (88%)

Lowest average (least consistent among categories):

1. Taylor (38%)
2. Wakulla (44%)
3. Putnam (52%)
4. Santa Rosa (53%)
5. Palm Beach (57%)

Some of the more consistent counties with a high overall program evaluation scores over the years were Volusia County and Alachua County. Some of the most improved counties when comparing the overall program evaluation score averages with recent program evaluation scores were Taylor County, Broward County, and Gadsden County. Some of the least improved counties when comparing the overall program evaluation score averages with recent program evaluation scores were Franklin County, St. Johns County, and Madison County.

When evaluating consistency between the average ATU scores over 2000 – 2009 and recent ATU program evaluation averages, the most consistently high scoring counties are Lake, Pinellas, Clay, and St. Lucie. The counties that had the most improved ATU average scores were Duval, Orange, and Okaloosa counties. The county that had the least improved ATU average score was Marion County.

There did not appear to be any correlation between the number of advanced systems a county had and the population of the county. There was also no correlation between the number of advanced systems and the population density.

3.5.2 System Record Completeness and Management Practices

Having a central location where permit information can be stored and accessed is accomplished through the EHD. This web-based system stores construction permit information and operating permit information. FDOH county offices all use the EHD system, but they also maintain a paper record file for each advanced system. Many FDOH county offices input operating permit data into the Carmody system, which allows for better communication with the maintenance entities and a tracking method for determining when inspections and/or permits expire.

FDOH county offices felt that their inventory of advanced systems; combining information from EHD, Carmody, and paper records; was about 90-100% complete. The work load for advanced systems varied between counties, mainly due to the variable number of advanced systems. Several of the counties had additional fees for advanced systems to help cover the cost of running the program.

Only twelve f 715 files did not include any operating permit information as part of the file review. Only 22 of 715 files did not include any construction permit information as part of the file review. All FDOH county offices maintained reasonably good records of advanced systems.

An assessment was done on the completeness of the permit files. Each requested permit file was examined to ensure that it contained the following documents:

1. Construction Permit Application
2. Site Evaluation
3. Construction Permit
4. Final Inspection
5. Site Plan
6. Operating Permit
7. Operating Permit Application
8. Maintenance Entity Contract
9. FDOH Inspection Reports
10. Maintenance Entity Inspection Reports

The most common missing files were the maintenance entity contract (39% were missing this information), the operating permit application (31% were missing this), and the operating permit (23% were missing this). A measure of completeness of the files was done to see whether there were any counties that particularly stood out (Figure 29). Out of the counties that had the highest number of advanced systems, Monroe County's files were approximately 71% complete. This was largely due to the fact that the data entry relied solely on the information in the EHD and the Carmody System and the difficulty in obtaining operating permit application documents and maintenance contract information from these systems. Charlotte County, on the other hand, had 98% of their files complete. This was due to the extensive documentation found on the counties eBridge site and the work that the samplers and other county staff did to obtain and send permit information as requested. Overall, the system files were 84% complete.

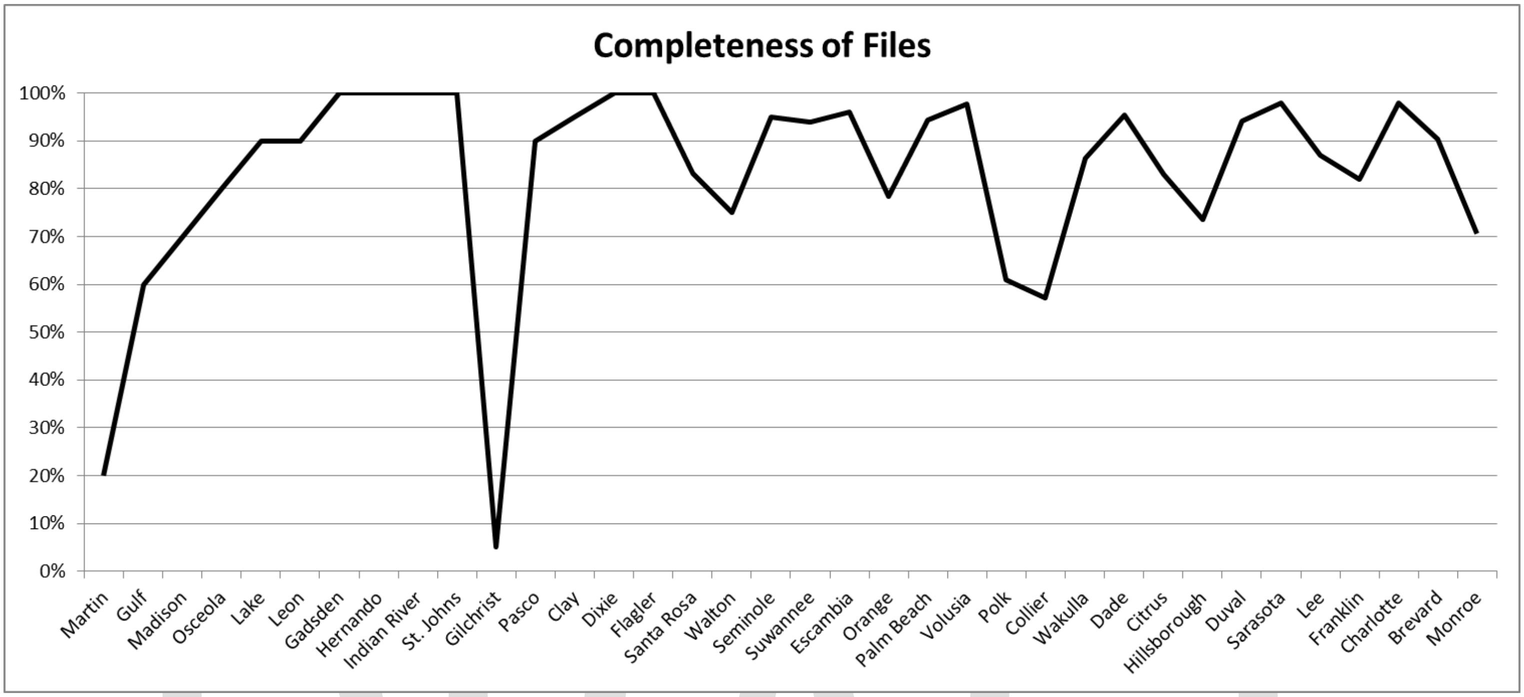


Figure 29. Completeness of Permit Files Sorted From Lowest to Highest Number of Files Reviewed For All Advanced System Files

The number of advanced systems was further reduced to look at the completeness of PBTS and innovative system files. Of the 715 advanced systems, 133 were PBTS or innovative systems. The basic assumption was that each permit file requested should, at a minimum, include the following files for a PBTS or innovative system, as per the requirements in Chapter 64E-6 F.A.C.:

1. System Design Calculations
2. System Design Criteria
3. Contingency Plan
4. Certification of Design
5. Operation and Maintenance Manual
6. Applicant Cover Letter

A total of 23 counties had PBTS and/or innovative files that were reviewed as a part of this project. Overall, the PBTS/innovative files were 55% complete. The top three counties with PBTS/innovative systems were Lee (22 systems), Monroe (21 systems), and Duval (19 systems). Again, there were some limitations to getting data from the EHD and Carmody systems for Monroe County, which resulted in only 5% of the files being complete. Lee and Duval counties had 63% and 64% respectively of the files complete.

Approximately 66% of the files were received after making the first request for information. Some FDOH county offices required multiple requests to have the files submitted, with 29% of them requiring one more reminder, and 5% of them needing two or more reminders. Twenty-four counties submitted 100% of the requested permit files on the first request. Several of these had permit information online, so project staff just needed to be trained on how to access the available data. Part of the reason for some delays in receiving permit information had to do with determining who to contact. Initially, staff members identified as being the contact for advanced systems per an initial survey that was conducted were contacted. Procedural changes later on in the project required that communication be directed to the Environmental Health Director for the county and they would forward the request to the appropriate staff member.

For each file reviewed, the initial date that a permit file was requested was recorded in the database. The date a file was received was also recorded in the database. A review was done and determined the mean number of days it took to receive a file was 153 days. Monroe County had a high number of systems and the highest mean time to receive the files due to the fact that they were not able to devote the man-power required to copy all of their files and also due to the fact that most permit information had been scanned on the "Septic Search ™" (http://septicsearch.com) website. The files for Monroe County were mostly obtained at the time of permit file review which occurred later on in the project. If Monroe County's information is removed from the analysis the average number of days it took to receive a file goes down to 95 days. This information could indicate several different points. It could indicate how responsive a county was, the efficiency of internal communication within a county, the ability to easily access permit records, and/or the completeness of the permit files.

A total of 42% of the submitted final inspection forms required changes from the data that was in EHD.

3.5.3 Program Evaluation Based on Permit File Review

A detailed evaluation of the permit file review database was done looking at several components relating to assessing how the FDOH county office runs their advanced system program.

For all of the advanced systems, only 5% of them never had an operating permit issued. These cases would be ones where the system did not receive final approval, where documentation was not provided in the files for review, or where documentation did not exist (i.e., FDOH never issued a permit).

One of the program evaluation questions asks whether the ATU operating permit is current. For the terms of this project an operating permit was deemed to be current if the date on the permit expired after 6/30/2010 (the approximate date data files were requested from the FDOH county offices) and the permit was issued before 9/30/2011 (a date that the sampling for the project ended). There were some examples of permit files that were received after the 9/30/2011 date that were current for the permit cycle (4.5%), but were marked as not being current in the database because they did not fall into the time period defined for the project. For those systems that had information on the operating permit form, 11% were not current. When only looking at ATU permit files for active or active but vacant systems, 79% were current. When looking at PBTS systems under these same assumptions, 82% had operating permits that were current. Counties with a large percentage of the reviewed files without a current operating permit in their files were Clay (50%), Suwannee (40%), Hillsborough (36%), Monroe (33%), and Walton (33%).

The majority of counties did have some indication in the file that inspections were being conducted by either the FDOH or the ME. Seven percent of the permit files did not have any evidence in the submitted paperwork that a FDOH inspection had been done and 11% had missing ME information.

Several of the program evaluation questions ask whether the ATU inspections are being performed as required. The current requirement was one annual inspection by FDOH and two annual inspections by the ME. Of all ATUs, 80% were inspected during the previous year by FDOH, 82% were inspected one time during the year by the ME, 58% were inspected two times by the ME, and 22% had been inspected by the ME more than two times.

The same analysis was performed looking at the inspection frequency for PBTS systems The number of inspections was slightly lower on average except there was a slight increase in systems that were inspected multiple times probably due to the fact that PBTS are more likely to have sampling requirements.

An analysis was done to see how common it was to see maintenance contract information in the file. Overall 72% had a maintenance contract. These types of contracts generally are for two years, so the expiration date for a current contract should be for some time after the permit files were requested. A query was done to see how many of these expired on or after June 30, 2010 and 86% were within this time period which shows that the counties that have this information in the file were likely to keep information current.

This same analysis was performed looking at the presence of a maintenance contract for PBTS systems, and the results showed that 85% of the files had a PBTS ME contract, and that 82% of them were set to expire on or after June 30, 2010, which also shows that the counties that have this information in the file were mostly keeping the information current.

The number of permits that had a notice of discontinuation / contract termination notice from the ME to the property owner was very low, with only eleven (1.5%) cases of this occurring (8 for ATU systems and 3 for PBTS systems).

A summary was made showing which files required monitoring of some sort for both ATU and PBTS permits. Only two percent of all ATU permit files required some sort of monitoring, and these files seemed to be concentrated mainly in a handful of counties. For PBTS systems, though, 44% required some sort of monitoring which was spread over many counties.

In an effort to get at how current ME inspections were for the files reviewed, an analysis was done excluding those with a recorded last ME inspection date one year prior to the date that data entry began, or 6/30/2009. Out of 582 ATU files, 463 (80%) had been inspected during the file review period. Out of 133 PBTS files, 81 (61%) had been inspected during the file review period.

Overall, the reason for enforcement action to be taken on a permit was most likely to be due to paperwork issues such as an expired operating permit and an expired maintenance agreement. Sometimes there was also an associated sanitary nuisance.

To assess each county individually and assign a score as to how well a county was running their advanced system program, an assessment of fields that was similar to the county program evaluations was done.

The items that provided a score for both the ATU and PBTS permits are:

- % of ATU/PBTS Permit Files that have a Current Operating Permit
- % that had an ATU/PBTS FDOH inspection #1
- % of counties that had an ATU/PBTS ME inspection #1
- % of counties that had an ATU/PBTS ME inspection #2
- % of ATU/PBTS files that had the ME contract expiration date greater than or equal to 6/30/2010

The counties that did not have any ATU permits reviewed were: Alachua, Baker, Bradford, Broward, Columbia, Desoto, Duval, Gadsden, Glades, Hamilton, Hardee, Hendry, Highlands, Holmes, Indian River, Jefferson, Levy, Manatee, Marion, Nassau, Okaloosa, Okeechobee, Putnam, St Lucie, Sumter, St. Johns, and Taylor. The counties that did not have any PBTS permits reviewed were: Alachua, Baker, Bradford, Broward, Columbia, Desoto, Dixie, Flagler, Gilchrist, Glades, Gulf, Hamilton, Hardee, Hendry, Hernando, Highlands, Holmes, Jefferson, Lake, Leon, Levy, Madison, Manatee, Marion, Martin, Nassau, Okaloosa, Osceola, Okeechobee, Pasco, Putman, St Lucie, Sumter, Santa Rosa, Taylor, and Walton.

The final ATU and PBTS scores were averaged to come up with an overall score (Table 58).

Table 58. Overall Average Advanced System Scores by County for ATU and PBTS

County	Number of ATU Systems Reviewed	ATU Score	Number of PBTS Systems Reviewed	PBTS Score	Total Average Advanced System Score
Brevard	122	77%	9	62%	70%
Charlotte	110	81%	9	91%	86%
Citrus	12	93%	1	80%	87%
Clay	1	60%	1	60%	60%
Collier	3	47%	8	58%	52%
Dade	7	94%	4	80%	87%
Dixie	2	40%	-	-	40%
Duval	-	-	19	65%	65%
Escambia	4	75%	1	80%	78%
Flagler	2	80%	-	-	80%
Franklin	56	78%	2	90%	84%
Gadsden	-	-	1	80%	80%
Gilchrist	2	0%	-	-	0%
Gulf	1	40%	-	-	40%
Hernando	1	100%	-	-	100%
Hillsborough	8	75%	6	83%	79%
Indian River	-	-	1	60%	60%
Lake	1	100%			100%
Lee	27	82%	22	67%	75%
Leon	1	100%	-	-	100%
Madison	1	20%	-	-	20%
Martin	1	80%	-	-	80%
Monroe	162	61%	21	63%	62%
Orange	4	45%	2	70%	58%
Osceola	1	100%	-	-	100%
Palm Beach	1	60%	6	73%	67%
Pasco	2	100%	-	-	100%
Polk	8	13%	1	0%	6%
Santa Rosa	3	73%	-	-	73%
Sarasota	21	82%	3	87%	84%
Seminole	2	80%	2	100%	90%
St. Johns	-	-	1	40%	40%
Suwannee	4	55%	1	20%	38%
Volusia	6	73%	3	93%	83%
Wakulla	2	70%	9	82%	76%
Walton	4	45%	-	-	45%
Total	582	72%	133	70%	71%

A bivariate correlation was done to compare multiple variables against one another, including some of the results from the operation assessment discussed in Section 3.3.3. The results of both Pearson and Spearman correlation coefficients were analyzed and summarized:

- There was a significant correlation between county permit files that did not have construction permit information and those that did not have operating permit information.
- In general, the completeness of the county files correlated to how much construction and operating permit information was available. On the other hand, the permit information specifically required for a PBTS (system design calculations and criteria, treatment description, contingency plan, certification of design, operation and maintenance manual, and applicant's cover letter) did not correlate with how much construction and operating permit information was available.
- There was a relationship between county ATU permit files that had operating permit information and the percentage of operating permits that were issued.
- How complete a county ATU file was had some bearing on how many of the required inspections were completed.
- Counties that had ATU and PBTS files that did not indicate an operating permit was ever issued were also less likely to have evidence of having done inspections on a system.
- If there was a current ATU operating permit, the county was more likely to do an annual inspection.
- County ATU and PBTS permit files that contained information on the maintenance entities contract were more likely to be a complete and up-to-date.
- The average county ATU program score showed a positive correlation with the presence of having a current operating permit.
- Counties that had records with information on the first ATU ME inspection were more likely to have information on the second ATU ME inspection. This was still significant, but less so, for PBTS ME inspections.
- Counties that had files which contained the ME contract were significantly more likely to conduct annual inspections themselves as well as have record of the ME annual inspections.
- The overall ATU program evaluation score calculated for the counties had a strong correlation to those files that had a current ME contract.

- Counties that had ATU ME contracts in their file were also likely to have PBTS ME contracts. This seemed to indicate that there was no overarching difference in how counties handle the maintenance of the paperwork for ATU and PBTS systems.
- Counties that had higher ATU program evaluation scores based on the record review were also likely to have higher PBTS program evaluation scores, and vice versa.
- There did not appear to be any correlations between either the ATU or PBTS overall program evaluation scores and the number of ATU or PBTS systems. This would indicate that having more or less systems does not affect how well the program was run. Other factors, such as completeness of files and conducting inspections are more important.
- There was a correlation between the percentage of operating permits that were not current and the system not operating properly.
- There was a correlation between the operating permit not being current and the alarm not working.
- There was a correlation between the percentage of counties that had record of a second annual ATU ME inspection and the operational status of a system.
- There was a correlation between the fraction of records in each county that documented at least one PBTS ME inspection and the operational status of a system in that county.
- Systems that were vacant were less likely to be operating properly.
- It was more likely for the power to be switched off for PBTS permits that do not have a current operating permit.
- For PBTS systems that required monitoring, there was more of a chance for the power indicator to be on.
- Systems that had a sanitary nuisance present at the time of inspection were related to the operating permit not being current and the completeness of the PBTS information in the permit file.

3.5.4 Sample Results / Operational Assessments and Management Practices

One problem encountered during the field evaluations for advanced systems during this project was limited access to the system. Many of the systems had no risers or other access to grade.

Having easy access to the treatment units, without excavation of the system, would have yielded more data points for in-situ measurements and subsequent samples.

An opposite problem that was encountered was when the lid to the treatment unit was not secured or was damaged in some way. This was another concern brought up by the FDOH county offices.

Seasonal use of a system was a common occurrence in Florida. Many of these seasonal users shut down the system when leaving. Vacant properties were found to be more likely to have the power switched off. FDOH and maintenance entity required that the system have power to do the inspection, so coordination and communication was required to avoid wasted effort.

3.5.5 User Group Surveys and Management Practices

The answers provided in the user group surveys were compared to some general statistics and the county program evaluation information to determine if there are any best management practices that could be discovered from this information.

There was no correlation between the total number of advanced systems and the county average for those homeowners that indicated that they experienced problems with their advanced system. The program evaluation scores also did not correlate to those homeowners that indicated they had a problem with their system.

When evaluating how satisfied a homeowner was with their advanced system overall, there did not seem to be any correlation to how well a county did on their program evaluations or the number of advanced systems. This seemed to indicate that satisfaction with a system does not seem related to the work of the FDOH local county offices and that the number of advanced systems does not relate to customer satisfaction

An evaluation was done looking at whether there were any correlations between program evaluation scores and whether the homeowner inspects their system, and no correlations were found. There were no correlations between whether the FDOH county office informed the homeowner of the results of their inspections and program evaluation scores.

There were no correlations between the most recent average maintenance entity inspection scores and the average homeowner response to the question on whether there was any difficulty in finding a maintenance entity. There was also no correlation between the most recent average maintenance entity inspection scores and the homeowner's average satisfaction with their maintenance entity.

There was a strong correlation (R2=0.9476) between the actual number of ATUs found in the inventory by county, and the number of ATUs that the regulators stated in their user group survey. There was a weak correlation (R2=0.5697) between the number of PBTS found in the inventory by county, and the number of PBTS that the regulators stated in their user group survey.

There was a weak correlation (R2=0.4972) between the number of full time employees (FTEs) a county had that dealt with advanced systems and the total number of advanced systems. There was no correlation between the number of FTEs and the overall homeowner satisfaction. There was also no correlation between the number of FTEs or the turnover rate and the average program evaluation scores. The total number of years of experience did not correlate with the average program evaluation scores.

There was a very weak correlation between the number of contractors that work in a county and the number of advanced systems in a county. There was a weak correlation between the number of maintenance entities in a county and the number of advanced systems the regulators reported as having in their county.

There was no correlation between those counties that stated on the survey that they used a checklist to perform inspections on advanced systems and the program evaluation scores. Whether or not a county had an ordinance requiring advanced systems did not affect the program evaluation scores or how satisfied homeowners were.

There was a strong correlation between the number of systems that require enforcement and the total number of advanced systems indicated by the regulators. Some counties that were outliers in this correlation were Lee and Franklin counties, which had a lot of enforcement actions relative to the number of systems; and Charlotte County, which had lots of systems with little enforcement.

The overall treatment performance regulator survey response did not correlate with the program evaluation scores.

3.5.6 Advanced System Management Practices Interviews with FDOH County Offices and Maintenance Entities

Some FDOH county offices and maintenance entities were selected to quantify and characterize steps in the management of advanced systems. The counties and maintenance entities are among those with many systems and/or for which survey results indicated a relatively high satisfaction by user groups. Each selected entity participated in a characterization of the status of management of advanced onsite systems. The characterization included: detailed information on the number and types of advanced systems; compliance and enforcement rates; systems used for tracking compliance; the presence and responsiveness of maintenance entities and FDOH county offices; the role of education of stake holders; and management costs. The collected experiences and viewpoints from the FDOH county offices' and maintenance entities' staff members outlined strengths as well as areas for further improvement in the management of advanced onsite systems.

In order to perform an evaluation of stakeholder's thoughts on best management practices for advanced systems in Florida, a determination was made on which counties could be characterized as performing well in this program. There were three main categories evaluated: the historical program evaluation results for criteria related to advanced systems, those counties that do well with handling the paperwork portion of the program, and those that have systems that are performing well out in the field.

Advanced system programs within the FDOH county offices were grouped in four major categories: extra-large (>700 advanced systems), large (100-700 advanced systems), medium (25-99 advanced systems), and small (0-24 advanced systems). The number of advanced systems was determined from the project database, which compiled information from multiple sources to identify advanced systems in Florida, and overestimates the number of systems.

Table 59 shows a breakdown of the county advanced system programs that were included in each of the four grouped categories.

Table 59. Breakdown of Results of Grouping County Programs by Number of Advanced Systems

Number of Advanced Systems by County			
Extra-Large	**Large**	**Medium**	**Small**
Brevard	Broward	Clay	Alachua
Charlotte	Citrus	Flagler	Baker
Franklin	Collier	Gulf	Bay
Lee	Duval	Hendry	Bradford
Monroe	Escambia	Hernando	Calhoun
	Hillsborough	Highlands	Columbia
	Lake	Indian River	DeSoto
	Leon	Jackson	Dixie
	Marion	Levy	Gadsden
	Miami-Dade	Martin	Gilchrist
	Orange	Nassau	Glades
	Osceola	Okaloosa	Hamilton
	Palm Beach	Pasco	Hardee
	Polk	Pinellas	Holmes
	Santa Rosa	Putnam	Jefferson
	Sarasota	Sumter	Lafayette
	Seminole	Suwannee	Liberty
	St. Johns	Taylor	Madison
	St. Lucie	Walton	Manatee
	Volusia		Okeechobee
	Wakulla		Union
			Washington

A final determination of which county programs to look into further involved a detailed evaluation of data on two major criteria: paperwork and system operation. These two criteria were determined to be the most indicative of a program that ran effectively.

3.5.6.1 Paperwork Evaluation

A county with an efficient and accurate way of handling paperwork for advanced systems would be one that would be a good candidate for interviewing to determine best management practices. The paperwork evaluation looked at historical program evaluation scores, completeness of permit files, and program evaluation scores of reviewed files.

3.5.6.1.1 Historical program evaluations of ATU programs

The evaluation of the historical program evaluation scores were broken up into three parts: average of all ATU scores from 2000-2010, average of all ATU maintenance entity permit file scores from 2000-2010, and the consistency of the ATU program when comparing the most recent completed evaluation to the overall average from 2000-2010. Consistency was determined by ranking first those that were 100% consistent, then by evaluating various combinations of the two scores based on criteria such as the greatest improvement in scores, those with consistent top/middle/bottom scores, and those that had a decrease in program evaluation scores.

3.5.6.1.2 Paperwork Evaluation during the Project:

The evaluation for the completeness of the permit files as assessed during the project's permit file review was broken up into three parts: those that had the most complete permit files (i.e., the file had the basic required documents: Construction Permit Application, Site Evaluation, Construction Permit, Final Inspection, Site Plan, Operating Permit, Operating Permit Application, Maintenance Entity Contract, FDOH Inspection Reports, and Maintenance Entity Inspection Reports), those with the quickest turnaround time for responding to a file request, and the percentage of systems that had current operating permits.

In addition, during the project, the permit files were evaluated using the same criteria as applied during program evaluations for advanced systems.

3.5.6.2 System Operation Evaluation

A county that demonstrates properly operating advanced systems in the field would be a candidate to be interviewed to determine best management practices. The system operation evaluation (0) looked at the system operational status (i.e., power on, aerator blowing, no sanitary nuisance) and sampling results.

An assessment was done for the systems evaluated in the field to determine the operating condition. A properly operating system was likely one that was managed and maintained properly.

A non-parametric Kruskal-Wallis test was done on the effluent sample results to see if there were any statistical differences between county program for the results of $cBOD_5$, TSS, TKN, Nitrate-Nitrite, TN, and TP. The resulting statistics showed that there was a significant difference in the results by county program. Most ATUs have requirements for $cBOD_5$ and TSS levels, and some require nitrogen reduction. Having a low TKN result can be a good indicator of how much aeration is going on. Nitrate-Nitrite was not listed because a low concentration could either indicate lack of aeration, good denitrification, or high dilution. TP was not listed because very few treatment systems address it, such that low concentrations of TP likely results from dilution. The statistical analysis performed for these results provided a mean rank for each county by analyte.

3.5.6.3 Analysis to Select Counties to Interview

For both the paperwork and the system operation criteria, the assessments were performed for each county for which there were data. The results were ranked, and the ranks were averaged to come up with the final results. The characterization for both the paperwork and the system operation included: information on the number and types of advanced systems; compliance and enforcement rates; systems used for tracking compliance; the presence and responsiveness of maintenance entities and FDOH county offices; the role of education of stakeholders; and management costs. Some of this information came from the system permit file review and system field evaluation results, and some came from interviews with the FDOH county office and maintenance entities. The interview questionnaires for FDOH county offices and maintenance entities can be found in Appendix A and Appendix F of this document.

Table 60 shows the results of the evaluation of the counties. The resulting ranks were divided into thirds and grouped into the top, middle, and bottom thirds. The selection of systems researched in this study was mainly randomly selected, and not all of the selected systems were visited in the field due to logistical issues. It is important to note that this evaluation did not evaluate all counties, and that those counties who were evaluated could have had a different result if different systems were selected to be evaluated.

An evaluation was done looking at the appropriateness of the division of the resulting ranks into thirds. Each criteria used in the evaluation were looked at to see if there were any major discrepancies between what was listed as a top / middle / or bottom third. While there were some instances where the overall scores ranked on the high or low end of the spectrum, most of the criteria were adequately represented when splitting into thirds.

Table 60. Results of Advanced System Program Evaluations, Paperwork Evaluations, and System Operation Evaluations by County Programs, Grouped by Size and Resulting Rank

Size of advanced system program	Total Counties	Historical Advanced System County Program Evaluation			
		Top Third (67-100%)	Middle Third (34-66%)	Bottom Third (0-33%)	Not Evaluated
Extra-Large (>700 advanced systems)	5	2	2	1	0
Large (100-700 advanced systems)	21	8	5	8	0
Medium (25-99 advanced systems)	19	6	6	4	3
Small (0-24 advanced systems)	22	2	5	4	11
Total	67	18	18	17	14
Size of advanced system program	**Total Counties**	**Advanced System Paperwork Evaluation**			
		Top Third (67-100%)	Middle Third (34-66%)	Bottom Third (0-33%)	Not Evaluated
Extra-Large (>700 advanced systems)	5	0	2	3	0
Large (100-700 advanced systems)	21	7	7	4	3
Medium (25-99 advanced systems)	19	4	1	4	10
Small (0-24 advanced systems)	22	1	2	1	18
Total	67	12	12	12	31
Size of advanced system program	**Total Counties**	**Advanced System Operation Evaluation**			
		Top Third (67-100%)	Middle Third (34-66%)	Bottom Third (0-33%)	Not Evaluated
Extra-Large (>700 advanced systems)	5	1	2	2	0
Large (100-700 advanced systems)	21	4	4	4	9
Medium (25-99 advanced systems)	19	2	2	3	12
Small (0-24 advanced systems)	22	2	0	0	20
Total	67	9	8	9	41

The five counties with extra-large advanced system programs and the counties ranked in the top third in at least one of the three program aspects were selected to have interviews to determine what sort of management practices were in place to make programs run efficiently in each of the criteria. The interviews followed up on the regulator survey from 2009 and discuss the questions listed in Appendix F. Based on the responses from the FDOH county office interviews, maintenance entities were interviewed to discuss the questions listed in Appendix F. A total of 28 counties were selected to be interviewed, including Brevard, Broward, Charlotte, Citrus, Clay, Miami-Dade, Escambia, Flagler, Franklin, Hendry, Hernando, Hillsborough, Indian River, Lake, Lee, Leon, Levy, Monroe, Osceola, Pasco, Pinellas, Polk, St. Johns, St. Lucie, Sarasota, Seminole, Sumter, and Volusia counties. All of the counties, except for Indian River who respectfully declined, were interviewed.

3.5.6.4 Analysis of Interview Responses

3.5.6.4.1 FDOH County Offices Interview Responses

The interviews were conducted during the summer of 2013, three years after the initial survey and two years after the field work. Responses were entered into a spreadsheet and the responses were grouped when appropriate to assist with data analysis in SPSS. For each question response, frequencies were counted for each grouped answer. Several crosstabs were done looking at the question response as it related to the county size, the historical advanced system program evaluation score, the advanced system paperwork evaluation score, and the advanced system operation evaluation score. Each of the questions analyzed are listed below along with an analysis of the interview responses.

County Size

Fifty percent of the counties interviewed were in the "large" size category (100-700 advanced systems). The large counties that were interviewed were mainly in the top tier for both the paperwork and system operation scores. Twenty percent of the counties interviewed were in the “extra-large” size category (>700 advanced systems, and thirty percent were in the “medium” category (25-99 advanced systems). “Extra-large” counties had scores that fluctuated between the bottom, middle, and top thirds for each scoring group, showing that there was no clear trend for this group. “Medium” counties tended to do better with paperwork scores than with system operation scores. No “small” counties (0-24 advanced systems) were interviewed.

Work Structure

There does not seem to be a major difference in how many counties have one specialized person managing the advanced system program as opposed to having multiple people. It appears that the extra-large counties tend to have multiple inspectors handling assigned systems from start to finish. It does not appear that work structure relates to how well a county does on their program evaluation score, their paperwork score, or system operation score. It appears that for those counties that choose to have multiple inspectors evaluating systems from start to finish, that there is a high percentage (78%) that are in the top third of scores for their county program evaluations.

When Do Operating Permits Expire?

There appears to be an even split between counties that have operating permits expire based on the system approval anniversary date and those that group operating permits annually. Extra-large counties do not appear to group operating permits quarterly or annually. It does not appear that how operating permit expiration dates were grouped relates to how well a county does on their program evaluation score, their paperwork score, or system operation score.

Are Foreclosures an Issue?

Most interviewed counties indicated that foreclosures were not an issue. Those that did indicate that foreclosures were an issue were the extra-large counties. None of the medium sized counties indicated that foreclosures were an issue. The greater the number of advanced systems, the more of an issue foreclosures were. There was a general tendency for counties that scored well on paperwork and system operation to have indicated that foreclosures were not an issue. For example, of the counties that measured in the top third of scores for the county program evaluation, 79% indicated they did not have foreclosure issues.

Is the Carmody System Used?

Most of the interviewed counties did not use Carmody. Between 78 - 90 percent of the counties that scored in the top third for paperwork do not use Carmody. All of the extra-large counties indicated that they use Carmody, which is likely due to the increased complexity of the advanced system program in those counties. Counties that do not use Carmody generally track systems in Excel spreadsheets. These results indicated that Carmody was a useful tracking and management tool for counties that have a high number of advanced systems, but that use of the program appears unrelated to how well paperwork was maintained or how well the system operated. There were opportunities to utilize the system to help counties streamline the process of reporting and enforcement.

County Perception of Paperwork Issues

Paperwork issues, such as expired operating permits and maintenance contracts, were generally indicated as occurring with relative frequency (65% of the interviewed counties indicated this occurred sometimes or often). There did not appear to be any relationship between how well a county scored on their paperwork or system operation and whether they indicated there were generally paperwork issues. This was interesting because those that thought they often had problems were about equally likely to have a top ranking or a bottom ranking score. The county's perception of issues may not be a good indicator for how well a program worked.

County Perception of System Operational Issues

The counties interviewed said that system operational issues (73%) were seldom. The medium sized counties indicated that operational issues were rare to none, with only one large and one extra-large county indicating that operational issues occur often. This seemed to indicate that the fewer systems there are to manage, the easier it is to think the systems are operating effectively. The top third in grouping paperwork had the most number of seldom operational issues. This was interesting because those interviewees that thought the systems were operating properly were just as likely to be in the bottom or the top rank of how well systems were actually operating. The county's perception of issues may not be a good indicator for how well a program works.

Most Common Operational Issues

The most common operational issue indicated by the counties was that the power was on but the blower did not work. Other common issues were broken/missing/unsecured lids, alarms being on, and power failures. The majority of the operational issues occurred in all of the counties no matter of the size. Counties that scored well on either paperwork or system operation did not seem to see fewer operational issues.

Notification Prior to Operating Permit Expiration

Many counties notified the maintenance entity and/or homeowner prior to expiration of the operating permit. After looking at the data there appeared to be a tendency for higher paperwork and system operation scores if advanced notice was given. Having a consistent pre-notification system in place would be a best management practice, especially now because of the rule change that requires homeowners to be responsible for renewing their operating permits as opposed to the maintenance entity. Perhaps even multiple pre-notifications could result in higher compliance.

Total Number of Reminder Letters (including any preliminary letters)

Two to three reminder letters are sent, on average, by the counties to notify maintenance entities and/or homeowners of expiring operating permits. Large and extra-large counties tended to send more reminder letters per system than medium counties, which was possibly due to the increased number of systems, the reduced one-on-one interaction with homeowners and maintenance entities. Counties that had fewer advanced systems were more likely to have a one-on-one relationship with the maintenance entity or homeowner. Communication channels appeared to be simpler for these counties than for those counties with many advanced systems.

Citation Issued After Which Enforcement Letter

Forty-two percent of the interviewed counties did not issue a citation. Of those that did issue a citation, over 50% issued the citation after the second notice. There was only one extra-large county that did not issue a citation. Issuing citations does not appear to improve paperwork or system operation scores. This was probably because the systems that need to go through the enforcement process were generally a small fraction of the total number of systems.

When Compliance is Achieved

Seventy-five percent of the counties interviewed indicated that for the majority of systems compliance was achieved after the first notice was sent. None of the smaller counties indicated that they had to go to the citation stage before the majority of systems were in compliance. For extra-large counties that answered the question, there was an even 50-50 split between those systems that were compliant after the first notice and those that were compliant before the citation stage (i.e., required multiple notices).

Counties that Indicated Operational Issues Go Through Sanitary Nuisance Process

Most counties did not indicate that they issue a sanitary nuisance for advanced systems with operational issues (72%). It does not appear, after review of the data, that it makes a difference in the paperwork or system operation scores on whether a sanitary nuisance was issued for operational issues. This does not necessarily mean that this was not a best management practice, though, because there were generally fewer systems that require this. The sanitary nuisance process, as described in Chapter 386, Florida Statutes, outlines correctional procedures and criminal, legal, or administrative proceedings to correct a nuisance that threatens or impairs public health.

Time for Resolution of Issues

Seventy-two percent of the counties indicated that generally it took less than or equal to one month before either paperwork or system operation issues were resolved. Several counties mentioned that there are some systems that are notoriously late or non-compliant year after year, and those generally require a great deal of staff time to address. The majority of systems, though, were compliant. The maximum time indicated as an average compliance time, was 6 months. Forty percent of extra-large counties indicated that it took between 2-6 months on average to get compliance. This was the highest rate out of all the county sizes and likely relates to the increased number of systems.

Proactive Measures for Vacant Properties

Counties were asked whether they performed any proactive measures to keep track of vacant properties. Of the counties interviewed, 65% performed proactive measures (e.g., check the property appraiser, visit the property annually, or both), and 35% did not do anything. For extra-large counties, the proactive measures mainly involved checking the property appraiser to see if ownership had changed. This measure saved time and resources and was something that could be done by any level of staff, regardless of qualifications and experience in the advanced system program. In most extra-large counties, resources were strained, so efficiencies were needed. Large sized counties were more likely to send an inspector to the field to check on the site. Medium sized counties were most likely to do nothing. There did not seem to be a major trend that indicated that keeping up with vacant properties improved paperwork or system operation scores. This was not surprising because generally vacant properties were a small percentage of the overall advanced system population, so efficiencies here were unlikely to relate back to overall program scores but scores could improve with an increase in the availability of resources.

Outreach or Education Efforts

Outreach or education efforts in counties increased with the number of advanced systems. Eighty percent of the extra-large counties, 40%of the large counties, and none of the medium sized counties did some sort of outreach or education. It did not appear that performing outreach and education affects paperwork or system operation scores, but that should not discourage a county from performing these measures. Outreach and education are activities that can improve communication and build relationships, which are both important to running the program effectively.

County Appears Consistent With Enforcement

One of the overall evaluations that was done for each county after the interviews was to generate a feel for whether the county appeared to be consistent with enforcement efforts for advanced systems or not. Consistency came up several times as being a best management practice that could make the enforcement process go smoother. For some counties it was apparent that there either was consistency (n=10) or no consistency (n=7), others were more difficult to assess (n=9). Of those for which a consistency determination could be made, there did not seem to be any trend related to whether the size of the county made a difference. After analyzing the data, those counties that were consistent with their enforcement process for advanced systems did tend to have higher scores for their paperwork evaluation. There did not appear to be any relationship between how well a system operated in the field and consistent enforcement.

3.5.6.4.2 Maintenance Entity Interview Responses

General Statistics

A total of 31 maintenance entities were recommended by the FDOH county offices to be interviewed to gather information on best management practices for advanced systems. All of these maintenance entities were contacted and eight were interviewed. The amount of business that the maintenance entities indicated came from advanced systems varied significantly, going from 3% to 100%. The average percentage of business that came from advanced systems was 35%. An average of 55 advanced systems were maintained by the interviewed maintenance entities. Annual fees for maintenance varied as well, with the median price of $350 which generally covered two inspections per year, plus a system check-up/cleaning. Any required repairs and/or sample collection and analysis were additional fees.

Notification of Inspection to Homeowner

Homeowners were not normally contacted prior to a maintenance visit, only when there was a specific request to do so. However, the entities did generally perform some sort of follow-up by either leaving information on the door or sending information via mail or email.

Maintenance Entity Perception of Paperwork and Operational Issues

Most of the maintenance entities indicated that paperwork issues were seldom or never an issue (75% of those interviewed).

Operational issues were a seldom occurrence according to 88% of the interviewed maintenance entities. Most of the maintenance entities indicated that malfunctioning system parts were the most common reason for failure or problems with the systems they maintain. Seventy-five percent of the maintenance entities indicated that power issues, as in the power being physically switched off, or there being some sort of power failure, were also frequent problems with the systems they maintain.

Is the Carmody System Used?

The maintenance entities interviewed were split 50-50 regarding whether they used the Carmody system for tracking and managing their maintenance records. The main reasons given for those that did not use Carmody were because the FDOH county office did not use it or that they have so few systems that the extra complexity of using the system was not worth the effort.

Perception of Treatment Performance for Maintained Systems

Most of the maintenance entities indicated that the treatment performance for advanced onsite sewage systems was good or excellent and based that decision on various criteria such as whether the blower was working and sample results.

Outreach or Education Efforts

All of the maintenance entities interviewed educate homeowners on advanced systems. There were some maintenance entities that were very involved with reaching out to various user groups, such as realtors, system installers, engineers, and builders. Many of the maintenance entities indicated that a brochure, website, or other marketing method, targeted to homeowner on basic care and maintenance requirements for an advanced system, would be very beneficial.

3.5.6.5 Interview Results for Best Management Practices from FDOH County Offices and Maintenance Entities

3.5.6.5.1 Recordkeeping

Both the FDOH county offices and the maintenance entities said that it would be good to utilize technology more and share tools to make things more automated and easier. The use of Carmody appears to help many maintenance entities and FDOH county offices with organization of records, tracking of scheduled maintenance and annual FDOH inspections, and inspection results. The program also has the ability to save FDOH county offices and maintenance entities time and resources by increasing the efficiency of communication between each other (instant access to reports) and the homeowner (inspection results posted on septicsearch.com). This program appears to be less useful for FDOH local offices or maintenance entities with only a handful of advanced systems, and does require a basic working knowledge of computers. It appeared that both maintenance entities and FDOH county offices were more likely to use the system if the other also uses the system.

The FDOH county offices had several other ideas that could improve recordkeeping practices. They suggested finding ways to mail merge data from existing databases to make communication easier. They said that the new functionality that allows for online payments will help with compliance. There were several enhancements to EHD suggested by the county FDOH offices to make reporting and billing easier and data gathering more consistent. Many counties found it useful to standardize the operating permit expiration dates yearly, quarterly, or monthly so that billing and notifications were done in batches. There are also tasks that can be done by clerical staff to make inspector time more efficient (i.e., gather Carmody data, check property appraiser for sale of vacant properties).

3.5.6.5.2 System Maintenance

Regarding system maintenance, the FDOH county offices and maintenance entities were in agreement that maintenance was the key to making sure these systems were working. The quality of maintenance between different maintenance entities appears to differ and this was where many of the performance issues come from. Both FDOH county offices and maintenance entities mentioned the potential benefits of having a statewide standardized inspection form for maintenance entities. Manufacturers of advanced systems often have their own inspection checklists, but there are some standard activities that should be common among all advanced systems and these could be included on the form. Both the maintenance entities and the FDOH county offices would like to see a method developed that provides instant notification to all parties when there was some sort of an issue with a system (sanitary nuisance, expired permit or contract, new property owner, etc.) Having this type of notification would facilitate communication between the groups to form a unified strategy to resolve the issue. One of the keys to system maintenance is communication with the homeowner regarding basic system care. If a system is not maintained properly, it can cost the homeowner quite a bit of money to get a new maintenance entity to take over a system. A good standard of practice regarding system construction would be to install risers to grade to improve access for maintenance. Several of the FDOH county offices mentioned the benefit of doing joint inspections with the maintenance entity. While this may not be realistic for counties with thousands of advanced systems, going out on an annual basis with each maintenance entity to look at a few systems would improve relationships and could also provide valuable educational opportunities.

3.5.6.5.3 Enforcement

Many of the maintenance entities mentioned that having consistent and fair enforcement by the county FDOH office was needed. The FDOH county offices also overwhelmingly stated that enforcement was one of the key parts of the advanced system program that needed improvement. Having consistent enforcement was central to providing credibility with the stakeholders. Enforcement did not need to be complicated or time consuming if common sense was applied and there was good communication. Both the maintenance entities and FDOH county offices stated that FDOH should consistently send maintenance entities and homeowners advanced notice regarding permit renewals. Also, several FDOH county offices suggested that having a system easement recorded in the property title, which was also easy to find, would be a useful method to notify new homeowners when they purchased a home with an advanced system on the property. These types of proactive measures have the potential to significantly reduce the amount of time spent on enforcement. Having a good relationship between the FDOH county offices and local government can be extremely beneficial. Several FDOH county offices provided examples of some of the relationships they have: assistance from county code enforcement for sanitary nuisance response, legal assistance from a county special magistrate, incorporation of beneficial requirements for advanced systems in county ordinances, etc. Several counties go through the sanitary nuisance process to handle advanced systems with operational issues to take advantage of the standards of practice in that program. A common comment from the maintenance entities during the interview was that the new rule requirement making the homeowner responsible for obtaining the operating permit will lead to more enforcement issues for FDOH, while the majority of the FDOH county offices said that this would be a benefit as it would take the maintenance entity off the hook for what was essentially a homeowner issue. Almost all of the maintenance entities suggested that the current rules need to be simplified to make compliance easier, interpretations consistent, and reduce the occurrence of illegal work. Many of the FDOH county offices also requested that the rule be made simpler and focus more on the environmental and public health impacts rather than paperwork issues. Enforcement against maintenance entities performing work without the proper licenses, permitting, or manufacturer training/approval was another thing the maintenance entities indicated was needed.

3.5.6.5.4 Fiscal

The maintenance entities interviewed had several good ideas regarding the fiscal aspects of advanced systems. There was an economic element to this business, and it should be affordable to do the right thing to protect the environment. The program was underfunded and underappreciated, according to one interviewed FDOH county office. Both FDOH county offices and the maintenance entities agreed that the FDOH should maintain adequate staffing levels in the advanced system program to bring consistency in program implementation. One county suggested that by increasing fees the staffing issue could improve. Several counties do have county fees in addition to the state fees outlined in county ordinances. For systems that require sampling, there was a suggestion by a maintenance entity to include the sample fees with the permit fees and have FDOH perform the sampling. There were several comments made suggesting that maintenance entities and FDOH could change their current payment schedule to allow for installment billing and automatic payments from homeowners. There was also a suggestion for the maintenance entity to go to a deductible/insurance business model where the homeowner pays a fee that goes toward system repairs. This model would encourage the maintenance entity to use better/longer lasting parts and become more invested in maintaining the system. Overall, there was a feeling that there was a correlation between quality of work performed and price and this went for both the FDOH county offices and the maintenance entities.

3.5.6.5.5 Communication

There were two main components to comments from the maintenance entities and FDOH county offices regarding communication: training/education and communication between user groups. One maintenance entity stated that professionals working in the onsite sewage industry need to work together to build up the status of the industry. People working in this profession should understand that their work was producing clean water for current and future generations. A common comment regarding training was that manufacturers should provide more training to FDOH, installers, and maintenance entities. Having regular contractor/maintenance entity meetings with FDOH was another useful tool in maintaining good relationships. Educating FDOH legal staff on advanced systems was another opportunity for improvement. Homeowners also need education, targeted specifically to advanced systems, on basic care and use of the system, benefits to water quality, as well as the homeowner’s legal responsibilities. An information sheet, brochure, website, or other marketing tool that can be sent or referenced with all notices from either FDOH or the maintenance entity was seen as being overwhelmingly needed by both interviewed groups. Having open communication between the homeowner, maintenance entity, and FDOH county office was important to reduce the amount of time spent on enforcement. Point of sale inspections could help with disclosure of the advanced system to new homeowners. There should be education to realtors, planners, builders, and property managers on the benefits of having an advanced system and proper system maintenance.

Communication between all user groups can be improved. The homeowner would like to be informed that the system was in compliance, and both FDOH and the maintenance entity have a responsibility to provide that information to the homeowner. Effective communication methods include door hangers left at the site, email/mail/phone notification after an inspection, and directing the homeowner to http://septicsearch.com for those counties/maintenance entities that use the Carmody system. FDOH, the homeowner, and the maintenance entities all need to work together to resolve operational issues with the system. Finding ways to merge database information into various form letters would be one method to make communication between user groups easier. It was also critical to maintain a certain level of trust between the user groups.

4 Conclusions and Recommendations

Onsite Sewage Treatment and Disposal Systems (OSTDS) under the jurisdiction of the FDOH serve approximately one-third of all households in the state. While most of Florida's OSTDS are conventional OSTDS, or septic systems, there are other advanced systems capable of providing additional or advanced pretreatment of wastewater prior to disposal in the drainfield. There are two large permitting categories in Florida onsite regulations that qualify as advanced treatment: Aerobic Treatment Units (ATUs) (Rule 64E-6.012 Florida Administrative Code (FAC)), which are generally permitted based on certification by the National Sanitation Foundation International (NSF); and performance-based treatment systems (PBTS) (Chapter 64E-6, part IV FAC), which are permitted based on design by a professional engineer experienced in wastewater treatment. Advanced systems differ in three aspects from conventional treatment systems that consist of a septic tank with drainfield. First, the design of advanced systems is more variable than the prescriptive approach for conventional systems. Second, these systems need more frequent evaluation and maintenance, which is the reason they require operating permits. Third, while the failure definition for advanced systems is vague, their performance expectations are more specific than simply the absence of sewage on the ground surface. The first two issues have been challenges for the permitting process. Site specific performance specifications are not captured completely in the databases that are used statewide for tracking permits: one developed by FDOH for conventional system permitting for the state, and one that was developed for maintenance entity inspection tracking by Carmody, Inc. The third issue has made it hard to determine how well advanced systems are working in Florida.

Proper management of advanced onsite systems is a key to their success. Management of onsite systems has many facets. Each of the groups of people dealing with onsite systems in some way manages a part of their life cycle, be it the design, permitting, selling, installation, operation, maintenance, use, repair, control, and eventual abandonment. Few are involved in all phases of a system's life, with the possible exceptions of regulators and installing maintenance entities.

There has been no systematic assessment of effluent quality of advanced systems in Florida. The emphasis of this study was to assess the effectiveness of pretreatment in advanced OSTDS before discharge to the drainfields and to construct a list of best management practices to improve system performance. The objectives of the overall project were to:

1. Quantify the reduced loading of contaminants from advanced Onsite Sewage Treatment and Disposal Systems (OSTDS) to the environment;

2. Assess the operational status of systems under the current management framework, including a comparison of system functioning to the expected permit levels of performance;

3. Survey perceptions of user groups regarding the management of such systems;

4. Validate elements of a monitoring protocol for consistent assessment of systems; and

5. Document best management practices.

After compiling information from multiple sources, it was estimated that there were about 17,000 advanced systems in Florida as of 2010. After corrections based on information received during permit review of and site visits to a sample of systems, this estimate was revised to about 12,000. Approximately 13% of the sites visited during this project that had a confirmed active advanced system were vacant or unoccupied. Over 60% of the advanced systems in Florida are contained in these five counties: Monroe, Charlotte, Brevard, Franklin, and Lee. Advanced systems in the state are generally fairly new, with 2006 as the median year when the advanced system permit was approved. The majority of installations for advanced systems are for new residential single-family homes with an estimated sewage flow of 300 gallons per day. Over 50 % of the permitted drainfields associated with advanced systems were mounded drainfields, only 26% of those with a final inspection had a pump. This could indicate that many of the sites requiring mounded drainfields have been built up so that the building plumbing is at a level to allow for gravity flow to the drainfield. The top four drainfield products used for advanced systems were mineral aggregate (28%), Infiltrator chambers (18%), drip irrigation (16%), and PTI multi-pipe systems (15%). Some sort of pretreatment, either as a compartment within the ATU or as a separate tank, was found in 59% of the systems evaluated. ATUs are the predominant category of advanced systems, PBTS are only a tenth as frequent. The top five manufacturers used in Florida are Consolidated, Aqua-Klear, Hoot, Norweco, and Clearstream. The top five products used in Florida are Nayadic, Aqua-Klear, Hoot, Singulair, and Clearstream, which correspond to the distribution of the respective manufacturers.

Overall, there is growth in the advanced systems program. In early 2000 36 of 67 counties that did not get evaluated on ATUs and as of 2011 only 11 counties responded that they did not have any advanced systems, which shows an increase of 25 counties (37%) over the past 11 years.

The following sections provide a response to each of the project objectives:

4.1 Quantify the Reduced Loading of Contaminants from Advanced Onsite Sewage Treatment and Disposal Systems (OSTDS) to the Environment

A detailed sampling protocol was developed, validated, and refined to obtain field observations and measurements as well as laboratory chemical and microbiological analysis for a mostly random sample of systems throughout the state. A total of 715 systems were selected for potential sampling. Of those, 550 total systems were visited and 350 of these were sampled for $cBOD_5$, TSS, TKN, NOx, TN, TP, and sometimes for fecal coliform.

Up to 620 chemical analyses of samples were completed from various points along the treatment train. More than 95% of the chemical analysis results met lab standards, with the exception of $cBOD_5$ (63%). Both the field and equipment blanks were mostly below detection, with some low concentrations, and less than 10% having sporadic high concentrations. At least 70% of duplicate samples met the 20% relative percent difference target, and no systematic bias was observed. There were no detectable differences in quality between the different sampler groups however there did appear to be, based on a limited assessment, potential for differences between the results submitted by different certified laboratories.

Both influent and effluent concentrations were variable. Treatment effectiveness was calculated from median, or typical, values in several ways with similar results. Median effluent concentrations indicated about a ninety-five percent removal for $cBOD_5$, about three-quarters removal for TSS, one-third for TN, and nearly none for TP. These are generally consistent with the treatment steps employed, while the lower than expected TSS removal may be in part related to the sampling process.

The generally effective pretreatment for $cBOD_5$ and TSS suggests that drainfields are less likely to fail for advanced systems than for conventional systems. In sandy soils, processing of $cBOD_5$ and TSS is the limiting factor on acceptable drainfield loading rates. The appropriateness of design standards is supported by the observation of a rate of only about 2% of surfacing or drainfield failures during the field work for this study. Lack of a comparable drainfield failure survey for conventional systems impedes a quantification of the load reduction to surface water runoff by decreasing the number of failures. As a point of comparison, a 2000 survey of an area in Leon County with a history of frequent failures measured a 6% drainfield failure rate and a 20% disconnection rate of washing machines from the onsite systems (Thorpe and Krottje, 2000).

Total nitrogen reduction by advanced systems was typically about a third, with an interquartile that ranged from barely any reduction to two thirds. This estimate is lower than estimates from two recent studies that focused on treatment systems with a design standard of 10 mg/L. These studies, the Florida Keys pilot study for this project (Roeder, 2011) and a study by the FDEP and Florida State University on treatment systems in Wakulla County (Harden et al., 2010), estimated around 50% nitrogen reduction. Both of these studies encountered higher influent concentrations than this study and focused on treatment systems with higher nitrogen reduction claims than usual in the systems addressed in this study.

Total phosphorus reduction was not observed in the sampled advanced systems. In large part, this reflects the fact that common treatment technologies do not address total phosphorus removal.

While fairly variable and of uneven quality, fecal coliform reduction can be summarized as providing approximately one to two orders of magnitude reduction between influent and effluent. Effluent from aerobic treatment systems did not generally meet secondary treatment standards. A small sample of monitoring points underneath drip drainfields indicated that even under those conditions, exceedance of treatment expectations could occur frequently.

4.2 Assess the Operational Status of Systems Under the Current Management Framework, Including a Comparison of System Functioning to Expected Permit Levels of Performance

The field assessment included evaluations to determine if the power was on, if there was no sanitary nuisance, that aeration was occurring, and if the alarms were off. Approximately 30% of all the visited sites were not operating properly and would have required follow-up activities by FDOH, such as notifying the maintenance entity and homeowner to resolve the problem. Seventy percent of the operational issues found during field visits were due to the power being turned off and/or aeration not working.

Influent strength varied with lower concentrations for $cBOD_5$ and TN than other recent studies and similar values for TSS and TP. Properly operating treatment units typically met average annual secondary treatment standards for $cBOD_5$ and TSS, and achieved some limited TN reduction. The median of the sampling results showed that, for $cBOD_5$, TSS, TN, and TP, the performance standard for advanced secondary grab samples were typically being met. For nutrients, the grab sample standards (40mg/L for TN, 20 mg/L for TP) were of limited usefulness because they were close to (TN) or much higher (TP) than typical influent concentrations. As such, meeting the grab sample standard did not indicate that nutrient reduction was occurring and objectives of nutrient reduction in the watershed were being met.

In general, exceedance rates of annual average treatment standards increased with increasing standards. About three quarters of performance based treatment systems did not meet their annual average TN and fecal coliform standards. None of the PBTS with a TP performance standard stricter than advanced secondary met that standard. For $cBOD_5$ and TSS, more than half of the PBTS for which advanced wastewater levels were specified for this parameters, did not meet them. A smaller sample for fecal coliforms also indicated that standards were frequently not met, even after soil passage. The results indicated that average treatment standards for TN and TP treatment technologies are usually not met by PBTS.

The study found that sample results were directly affected by whether the system had power and was aerated. In particular, $cBOD_5$ and TN effluent concentrations were significantly higher when the power was off and/or aeration was not working. These results pointed to a need for revisions to the design assumptions and technology review.

To assess the variability of performance of treatment systems and influent strength, samplers repeated visits to 25 sites. The results indicated that there was a great deal of variability for both influent and effluent concentrations among repeat sample results. This similarity was surprising relative to an expectation that influent should be more variable than effluent given the averaging and mixing that occurs in the treatment unit. This suggests that variations in the loading occur that influence both influent and effluent. Estimates of treatment effectiveness based on the repeated samples were similar to estimates based on one sample per system, indicating that for the overall population of advanced systems, variability does not affect treatment effectiveness estimates.

4.3 Survey Perceptions of User Groups Regarding the Management of Such Systems

Surveys were sent to system owners and users, regulators, installers, maintenance entities, manufacturers, and engineers to allow a representative sample from each group voice their views and opinions as well as to measure the practices and perceptions of these user groups about the management of advanced onsite systems. Also, one-on-one interviews were conducted with key stakeholders in FDOH county offices and MEs recommended by the county offices. The collected experiences and viewpoints from these groups outlined strengths as well as areas for further improvement in the management of advanced onsite systems.

For the system owners and users, 55% reported that they have not had any problems with their system over the previous year. For those that indicated they had a problem, the major sources of problems were system malfunctions such as pump failures, electrical malfunctions, faulty alarms, and bad motors. The highest rated cause for failure described by the installer, maintenance entity, and engineer groups came from malfunctioning treatment system parts, homeowner misuse, and the power being turned off. The lowest rated failure causes from these groups was engineer design or installation issues. There seems to be agreement between the user groups that malfunctioning system parts were of great concern.

Almost 80% of all of the system owners and users indicated that they were either very satisfied or satisfied with their advanced system.

There was no correlation between the total number of advanced systems and the county average for those homeowners that indicated that they experienced problems with their advanced system. The program evaluation scores also did not correlate to those homeowners that indicated they had a problem with their system. Further analysis of the survey results found that counties with many advanced systems do just about as good a job making homeowners satisfied as those counties that only have a few advanced systems.

A subsequent survey was given to users at sites that were sampled as a part of this project. For those that responded, there was an association between systems that had an unsatisfactory operational status and systems that had results that exceeded performance standards for various pollutants. Additionally, the analysis indicated the perceptions of issues with the system users were related to the operational status of the system.

System owners/users said that topics for advanced systems that they would like to learn more about were owner maintenance, system performance, and cost. Other topics included hooking up to sewer, environmental issues, permitting and regulation, contractors and maintenance entities, and operating instructions. Owners/users indicated they would like to see changes or improvements to the program regarding the regulation, permitting, and management of advanced onsite systems in Florida. Two answers stood out among the others, and they related to regulation and management of systems as well as the cost of systems. Other changes and improvements that were commonly mentioned related to contractors and maintenance entities, sewer availability, system performance, system maintenance by the owner, inspections, and consumer information and education. When regulators were asked what the most common complaints were from homeowners about advanced systems they said that cost of the maintenance contract and not being able to choose between several maintenance entities were the most frequent complaints received.

When the user groups were asked for some general comments and suggestions about advanced systems, there were two main points that came up: the importance of consistency between county offices within FDOH and that advanced systems are expensive to install and maintain.

When the responses from engineers, maintenance entities, installers, and regulators were compared regarding their overall perception of treatment performance, all of these groups predominantly indicated that both ATU and PBTS performance was either good or excellent and based that decision on various criteria such as whether the blower was working and sample results. When comparing this result with how satisfied homeowners were this seems to indicate that advanced systems were fairly well accepted among the different user groups.

Many user groups indicated that the permitting process needed to be simpler. Another issue that seems to be common among the user groups was obtaining training from the manufacturer on how to permit, install, and service various advanced system products. Allowing more maintenance entities to service different products was a common concern between the user groups. Additional maintenance entities could improve service to homeowners by increasing contract options, which could lead to competitive pricing.

4.4 Validate Elements of a Monitoring Protocol for Consistent Assessment of Systems

A field evaluation procedure should assess whether the system has power, that no sanitary nuisance exists, that aeration results in bubbles and mixing of sewage, and that there are no alarms sounding. These data points provide an assessment of the operational status of a system and were found to correlate to sampling results. Having two ME visits in an annual cycle also correlated positively to the operational status of an advanced system. In addition, there was a correlation between systems that had a current operating permit and their operational status being satisfactory, indicating the importance of keeping the system paperwork up to date.

Knowing where the system was and what the system components were on an easy to read site plan would provide the inspector, maintenance entity, and homeowner valuable information that would assist these parties with maintenance and management of advanced systems. Only about 54% of the site plans reviewed during this project showed the system monitoring locations on the site plan. Also, having a standardized maintenance inspection form for maintenance entities and FDOH operating permit inspection form would ensure that there is more consistency in the minimum activities required at a site. In the permitting stage for advanced systems it would be beneficial to have clear documentation and recording in the FDOH EHD regarding the specified and required treatment standards.

One problem encountered during the field evaluations for advanced systems during this project was limited access to the onsite system. Many of the systems had no risers or other access to grade. Having easy access to the treatment units, without excavation of the system, would have yielded more data points for in-situ measurements and subsequent samples. This would also allow for easier access to assess system performance utilizing field screening methods as well as easier access to repair mechanical malfunctions.

The results of the pilot study in the Florida Keys indicated that there was no significant difference in sample results between taking a composite sample over a grab sample. This allowed for a much simpler sampling process and confidence that sample results would be representative.

The effluent sampling location could be the clarifier; a pump chamber; a sampling port; or, for some combined or fixed film systems, the aeration chamber. Each of these locations may or may not be accessible for sampling depending on how the system was installed. To assess the impact of sampling location on results overall, an analysis was performed for the effluent samples from aeration chambers, clarifiers, pump chambers, and sampling ports. The analysis revealed that there were no significant differences in sample results and odor intensity based on sample location, for total nutrient concentrations. Samples taken from a monitoring port tended to have higher TKN, $cBOD_5$, and TSS concentrations. Comparing locations other than monitoring ports, only TSS differed significantly, and pump chambers tended to have the lowest concentrations. These results suggest that for nutrient monitoring, the sampling location was less important and that TSS was most sensitive to the sample location. While this bodes well for monitoring of nutrient concentrations, it was of concern that sampling ports provide high results for cBOD5 and TSS, which were the design parameters for ATUs.

Field screening methods were a possible option to indicate system operational status without the expense of sample analysis. After comparing the sample results with the field screening results, there appeared to be some association between odor, color, and clarity. There were some associations between visual color and clarity and the field test results for apparent color and turbidity. Correlations were found between apparent color and $cBOD_5$ and TSS, and between measured turbidity and $cBOD_5$ and TSS; less for TKN. No correlation was found between field screening methods and TN and TP results. There were good correlations between field NO3 results and NOx lab results, as well as for field NH3 results and TKN lab results. There was not much of a correlation between field PO_4 results and TP lab results.

A common comment during the user group surveys and observation during the advanced system paperwork file review was that there was a lack of sampling for these systems. Only two percent of all ATU permit files reviewed during this project required some sort of monitoring, and these files seemed to be concentrated mainly in a handful of counties. For PBTS systems, though, 44% of them required some sort of monitoring which was spread over many counties. For PBTS systems that required monitoring, there was more of a chance for the power to the system to be on. A combination of easier access to treatment systems with clear and consistent sampling requirements tied to the system type and performance level would allow for a better and more transparent understanding of how these systems work under real-world conditions. To make this understanding more useful; regulators, engineers, and maintenance entities need tools available to improve the performance of treatment systems. These tools range from the obvious and frequently implemented (power on, aeration working), over rarely needed and done (replacement of treatment media in fixed film and phosphorus adsorption systems) to some that may require additional treatment steps or new technology (improving nitrogen removal).

Besides having a clear understanding of what a monitoring inspection would consist of, there is a need to ensure that the inspection occurs on a regular interval. The current requirement is one annual inspection by FDOH and two annual inspections by the ME. For both FDOH and MEs, some of the things that affect whether a regular inspection occurs is making sure there are enough people to do the job that needs to be done as well as having a consistent and accurate system in place to notify when inspections need to be done and how best counties with a large number of advanced systems can group them to increase travel efficiencies.

4.5 Document Best Management Practices

In order to evaluate best management practices (BMPs) for advanced systems in Florida, it is important to first define what is meant by "best". For the purposes of this analysis, some of the items used to evaluate "best" management practices include, but are not limited to:

1. Documentation is complete, accurate, and current
2. System operating conditions
3. System sampling results
4. User group recommendations

Data sources used to determine best management practices came from historical program evaluations for each FDOH county office and multiple components performed as a result of this project (permit file reviews, field evaluation results, sample results, user group surveys, and one-on-one interviews with key stakeholders). After a review of these various information sources relating to management practices, several consistent issues emerged and methods to address these issues were noted.

The number of advanced systems a county or maintenance entity monitors has a substantial effect on how best management practices should be implemented. Those with fewer advanced systems may not need a complicated and detailed tracking program to keep track of their systems, while this type of program may be essential for a county or maintenance entity with numerous advanced systems. There are many best management practices that are good to implement across the board, regardless of how many advanced systems there are. Each of the suggested best management practices should be considered individually based on the current needs for the county or maintenance entity.

Five major categories of best management practices were identified and are discussed in detail:

1. Recordkeeping practices – Implementing good recordkeeping practices can be beneficial to multiple user groups by providing quick access to system details, tracking of compliance, data confidence, and improved communication.

2. System maintenance practices – Maintenance is the key to make sure advanced systems are working. A system that is not maintained can be very costly to the homeowner and to the environment.

3. Enforcement practices – Striving to reduce enforcement while making sure required enforcement is consistent and fair is the key to maintenance and management.
4. Fiscal practices – There is an economic element to the business of advanced systems, and fees should be affordable to do the right thing to protect the environment but not too cheap that the plan review and monitoring of the system cannot be done.
5. Communication practices – Increased training/education and communication between user groups will lead to improved relationships, less enforcement, and increased protection of public health and the environment.

4.5.1 Recordkeeping Practices

Having a **central location** where statewide permit information can be stored and accessed is accomplished through the EHD. This web-based system stores construction permit information and operating permit information. Many FDOH county offices input operating permit data into the Carmody system, which is another database system developed by a third-party through a grant administered by the FDEP. The use of Carmody appears to help many maintenance entities and FDOH county offices with organization of records, tracking of scheduled maintenance and annual FDOH inspections, and inspection results. The program also has the ability to save FDOH county offices and maintenance entities time and resources by increasing the efficiency of communication between each other (instant access to reports) and the homeowner (inspection results posted on septicsearch.com). This program appears to be less useful for FDOH local offices or maintenance entities with only a handful of advanced systems, and does require a basic working knowledge of computers. All of the counties that had more than 700 advanced systems indicated that they used the Carmody system, which indicates that Carmody is a useful tracking and management tool for counties that have a high number of advanced systems. It appeared that both maintenance entities and FDOH county offices are more likely to use the system if the other also uses the system. There did not seem to be a relationship, though, between using Carmody and results for paperwork completeness and system operation. There are opportunities to utilize the system to help counties streamline the process of reporting and enforcement. There were several enhancements to EHD suggested by the county FDOH offices to make reporting and billing easier and data gathering more consistent. Many counties found it useful to standardize the operating permit expiration dates yearly, quarterly, or monthly so that billing and notifications are done in batches. There are also tasks that can be done by clerical staff to make inspector time more efficient (i.e., gather Carmody data, check property appraiser for sale of vacant properties).

It is important to have a **complete and accurate system file** on an advanced system in order to have the best information available for inspections and enforcement issues. This has been shown, during the file review for this project, to make a difference in how many monitoring inspections were completed. Most of the files reviewed had some sort of construction or operating permit information included in the file. There appeared to be a difference between the completeness of the paperwork files for advanced systems and whether the system was an ATU or a PBTS/Innovative system. The ATU files overall were 84% complete, while the PBTS/Innovative system files were 55% complete. Regarding the accuracy of the data, 42% of the submitted final inspection forms required changes from the data that was in EHD. The permit files reviewed showed that there is uniformity in several aspects of paperwork upkeep. Overall, the permit file review revealed that FDOH county offices were reviewing the application and construction paperwork within the timeframes defined in the rules that govern the program. Over 91% of the files reviewed had a signed and approved construction permit in the file. Of those permit files for which the construction permit was available, 93% also included a signed and approved final inspection form. This shows that for a fairly high number of systems review and approval by FDOH could be documented. There could be issues, though, with consistency in data entry into EHD, with 44% of the hardcopy final inspection files reviewed requiring changes from the data that were entered into EHD. One possible reason for this was the process for extracting data from EHD and the standard practice of inputting a new final inspection form for each inspection. When the data was extracted only the final inspection data associated with the final approved form were brought over, which often does not provide the most complete record if the final approval was not given at time of construction approval. There was a median period of 34 to 55 days between construction and final approval depending on the type of advanced system which indicates that generally more than one final inspection form was completed. Data entry errors can be a result of several factors either by itself or in combination: user quality control issues, missing data fields in EHD, and/or a potential lack of clarity over what information is required to go where in the database.

There appears to be a relationship between having an **up-to-date advanced system file** and the likelihood that these systems will be inspected and maintained as well as operate properly. Operating permits were largely current (92%) in the files that were reviewed and approximately 11% of the systems were missing maintenance entity information. Overall, the files that were reviewed included the required FDOH and maintenance entity inspection documentation as well as having the maintenance contract on file. One of the main complaints from the FDOH county offices was the difficulty in keeping up with the paperwork required to keep track of continued maintenance. Building efficiencies in the current data systems can help with this. Utilizing a web-based document imaging and storage system and/or an online compliance and management system can be beneficial to record maintenance and issues found during inspections. The Carmody system does have an application that can be used on a smartphone or tablet device to allow for instant documentation and reduction of paperwork efforts.

Recording sample/performance information when available in a centralized database would be a method for FDOH to assess the performance levels for advanced systems. Lee County records indicated that all of the PBTS systems selected for this project were sampled as directed by the design engineer, and the sample results are provided to the FDOH county office. The Carmody system has sample reporting built into the database to allow for tracking of sampling compliance. There is the ability to enter the minimum / maximum sample result limitations and the data can be summarized to show how many in a specific county are in compliance with the permitted levels.

Synchronization between data sources such as EHD and Carmody can also beneficial to minimize data entry duplication and resulting errors/conflicts as well as to ensure there is access to data between multiple user groups. Automated data transfers to Carmody began in the fall of 2012. The data that are sent are extracts of all OSTDS construction permitting and inspection data from EHD. Also, the FDOH website currently shows up-to-date information from EHD for OSTDS construction permits and approvals. The website could also include information on operating permits. Finding ways to mail merge data from existing databases would make communication easier. Having synchronization between data sources should help with future efforts to track advanced systems, simplify the paperwork handling process, and reduce enforcement.

Having an **online billing system** to allow for quick payment of bills and reduce the amount of paperwork and staff time spent processing payments. A new online billing platform in the Bureau of Environmental Health has been rolled-out. The purpose of the project was to develop a system so that environmental health permit renewals can be done online, which is an increase in efficiency for the both the FDOH and its customers. There are long-term plans to expand the system to include creation of initial operating permit applications. Many FDOH county offices have standardized operating permit expiration dates, which makes the online billing option easier.

4.5.2 System Maintenance Practices

One of the keys to system maintenance is **increased homeowner awareness/education** regarding basic system care. There seems to be agreement between advanced system user groups that malfunctioning system parts were of great concern. Issues with the malfunctioning parts could be reduced through communication with the homeowner as well as regular system maintenance including a thorough examination/tune-up of the system. If a system is not maintained properly, it can cost the homeowner quite a bit of money to get a new maintenance entity to take over a system. Making sure that the power remains on for an advanced system appears to be one of the most important things that a homeowner could do to ensure performance.

A **statewide standardized form outlining minimum maintenance and inspection requirements for advanced systems** which captures elements that are critical to assessing and maintaining system functionality would be a useful tool in moving toward consistency in this program. There is no current approved statewide form available for FDOH county offices or maintenance entities to utilize to conduct an inspection of an advanced OSTDS. The Onsite Sewage Program Office issued a guidance memorandum to local county offices which indicates the items that is expected to be checked during an inspection (HSES 10-006). The elements of this memorandum were included in the initial site evaluation protocol. Various FDOH county offices have created their own methods for conducting inspections of advanced OSTDS. A draft statewide form has been developed and may be implemented in the near future. A copy of the draft form is available in Appendix H. One FDOH county office suggested that the number of FDOH inspections be increased to two times per year and to increase the permit fee to reflect this change. The second inspection was to be done at the same time as the maintenance entity inspection to allow the FDOH to have closer monitoring and understanding of proper system operation.

Quality maintenance inspections performed on a routine basis is also important. Evidence that maintenance entity inspections are being conducted improved the likelihood that the operational status of a system would be good. This study did not characterize differences in the quality of documented maintenance entity inspections, which reportedly varies widely. Several of the FDOH county offices mentioned the benefit of doing joint inspections with the maintenance entity. While this may not be realistic for counties with thousands of advanced systems, going out on an annual basis with each maintenance entity to look at a few systems would improve relationships and could also provide valuable educational opportunities.

Having **appropriate equipment and having access to the system** are essential for successful FDOH and maintenance entity inspections. Equipment can include physical tools such as a tank lid lifter, Sludge Judge, flashlight, screwdriver, etc.; as well as basic site specific paperwork such as an accurate as-built site plan showing the location and configuration of all system components as well as monitoring locations. A good standard of practice regarding system construction would be to install risers to grade to improve access for maintenance. Knowing where everything is, and having access, can improve the quality of inspections and simplify maintenance efforts. Charlotte County had 92% of their site plans showing monitoring locations and the field staff performing the evaluations for this project had a higher success rate than other samplers when it came to accessing systems for sampling.

Having **clear monitoring/sampling requirements** printed on the operating permit will help bring clarity to the homeowner, maintenance entity, and FDOH regarding what is required for this system. Maintenance entities document generally only a small fraction of the activities that manufacturers proscribe in their operation manuals. A combination of easier access to treatment systems with clear and consistent sampling requirements tied to the system type and performance level would allow for a better and more transparent understanding of how these systems work under real-world conditions.

Sufficient access to resources such as parts and certified maintenance entities is also critical to ensuring the system is maintained. One suggestion from a FDOH county office was to require manufacturers of advanced systems to authorize at least two maintenance entities within 100 miles. The statute currently requires manufacturers to demonstrate that there is at least one maintenance entity in Florida that is approved to service a unit, and this has been a source for customer and inspector dissatisfaction when the maintenance entity is located several hours from a system needing service. Another FDOH county office suggested that the manufacturer or design engineer should be required to have at least two people available to service the unit. This will give owners of these systems more flexibility to hire someone they like. With just one approved person to do the maintenance, the owners feel they are being forced into a contract without any competition.

Notification of system malfunctions between user groups would increase the likelihood that the issue is resolved quickly. Both the maintenance entities and the FDOH county offices would like to see a method developed that provides instant notification to all parties when there is some sort of an issue with a system (sanitary nuisance, expired permit or contract, new property owner, etc.) Having this type of notification will facilitate communication between the groups to form a unified strategy to resolve the issue.

Another practice that is important to maintain is **consistency between the FDOH county offices and maintenance entities**. The Onsite Sewage Program Office has several staff in place to ensure consistency is being maintained between the counties. Regional consistency meetings are regularly scheduled to discuss issues and procedures. The quality of maintenance between different maintenance entities appears to differ and this is where many of the performance issues come from. Industry groups, such as the Florida Onsite Wastewater Association and the Florida Environmental Health Association could also provide opportunities to improve consistency.

Performance of **proactive measures to keep track of vacant properties** (e.g., check the property appraiser, visit the property annually, or both) is another practice that could improve system maintenance. Systems that were vacant were less likely to be operating properly. Vacant systems often have the power turned off and do not receive any use. Among the identified systems, a substantial fraction (13%) were vacant or not currently in use. The vacancy rate is a combination of the effects of seasonal or vacation use (snow-birds) and empty properties for other reasons, such as eviction due to foreclosure, change in tenants, and renovations. The vacant status of systems can change over the course of a permit year. Often, time-intensive enforcement action is taken by the FDOH county office prior to receiving verification that a property has been foreclosed and is vacant. Notification from the homeowner to the maintenance entity and the maintenance entity to the FDOH county office would be beneficial for those properties that have a seasonal use. This communication between these groups would allow for coordination of inspections and proper contact information for notifications. Performing proactive measures regarding vacant properties saves time and resources and is something that can be done by any level of staff, regardless of qualifications and experience in the advanced system program. There did not seem to be a major trend in the data indicating that keeping up with vacant properties improves paperwork or system operation scores. This is not surprising because generally vacant properties are a small percentage of the overall advanced system population, so efficiencies here are unlikely to relate back to overall program scores but can improve on the availability of resources.

4.5.3 Enforcement Practices

Having a **standardized and consistently applied enforcement process** appears to be the most critical part of the advanced system program in Florida that needs improvement. At of the time of this report, many FDOH county offices utilize different processes and many did not implement the enforcement process consistently over time due mainly to issues with having enough staff to perform the work of the program. Paperwork issues, such as failure to renew the operating permit or maintenance contract, were the most prevalent reason requiring enforcement by the FDOH county office. Of all the enforcement actions listed in the permit files, 86% of them had to do with paperwork issues. The current enforcement process entails that the FDOH county office spend a great deal of time remedying the violation. Seventy-five percent of the counties interviewed indicated that for the majority of systems compliance was achieved after the first notice was sent, but for the rest, multiple enforcement actions are required to correct the problem. Seventy-two percent of the counties interviewed during this project indicated that generally it took less than or equal to one month before either paperwork or system operation issues were resolved. Several counties mentioned that there are some systems that are notoriously late or non-compliant year after year, and those generally require a great deal of staff time to address. Counties with more advanced systems tended to have a longer time getting issues resolved and likely relates to the increased number of systems requiring enforcement. There is no one solution to the enforcement issue that makes for a simple and consistent process. The two most common current enforcement strategies are sending the “notice to correct” letter and by issuing a citation and/or implementing fines. The issuance of citations was identified as the most common enforcement process among the counties interviewed (58%), but was not always recognized as being routinely successful. In Brevard County, they have utilized the Carmody system to have a box that can be checked by the maintenance entities to indicate there is no contract. Within 48-hours Brevard County sends a letter to the homeowner notifying them that a contract is required. By taking a proactive step toward notifying the appropriate parties of permit expirations, time is saved on the back end when enforcement is needed for non-compliance. Several counties utilize the sanitary nuisance process, as described in Chapter 386, Florida Statutes, which outlines correctional procedures and criminal, legal, or administrative proceedings to correct a nuisance that threatens or impairs public health. Enforcement against maintenance entities performing work without the proper licenses, permitting, or manufacturer training/approval is another thing the maintenance entities indicated is needed. Overall, consistency was mentioned as the most important element of enforcement. After analyzing the data, those counties that were consistent with their enforcement process for advanced systems did tend to have higher scores for their paperwork evaluation. Having consistent enforcement is central to providing credibility with the stakeholders. Enforcement does not need to be complicated or time consuming if common sense is applied and there is good communication.

Having the **advanced system recorded in the official property records** will help avoid common enforcement issues such as failure to renew the operating permit. This is a requirement for PBTS, but not for ATUs, which is the performance category that includes the majority of the advanced systems in the state. Many new homeowners are unaware their property has an advanced system, and having this information officially recorded and disclosed to them upon the purchase of a property can improve compliance and reduce enforcement.

Implementing a consistent pre-notification system to notify homeowners and maintenance entities of upcoming permit renewal requirements could be a simple and effective way of ensuring compliance with minimal effort. Many counties evaluated during this project notified the maintenance entity and/or homeowner prior to expiration of the operating permit. After looking at the data, there appeared to be a tendency for higher paperwork and system operation scores if advanced notice is given. This has the potential of being more beneficial now due to a rule change effective July 1, 2013 which required homeowners to be responsible for renewing their operating permits as opposed to the maintenance entity. Many other business models, such as those for insurance and magazine subscriptions, utilize this pre-notification approach and often have multiple pre-notifications which could result in higher compliance. These types of proactive measures have the potential to significantly reduce the amount of time spent on enforcement.

Develop a standard timeframe for reminder letters notifying homeowners and maintenance entities that the system is no longer in compliance. Two to three reminder letters are sent, on average, by the counties to notify maintenance entities and/or homeowners of expiring operating permits. Counties with more than 100 advanced systems tended to send more reminder letters per system than those with less than 100 advanced systems. This is possibly due to the increased number of systems, the reduced one-on-one interaction with homeowners and maintenance entities, which results in the necessity for more frequent communication prior to compliance. Counties with fewer advanced systems are more likely to have a one-on-one relationship with the maintenance entity or homeowner, with communication being easier than in a county with many advanced systems.

Building good relationships between the FDOH county offices and local government can be extremely beneficial to the enforcement process. Several FDOH county offices provided examples of some of the relationships they have: assistance from county code enforcement for sanitary nuisance response, legal assistance from a county special magistrate, incorporation of beneficial requirements for advanced systems in county ordinances, etc.

Many of the FDOH county offices and maintenance entities suggested to **simplify the current rules** and to focus more on the environmental and public health impacts rather than paperwork issues. The current rules need to be simplified to make compliance easier, interpretations consistent, and reduce the occurrence of illegal work. There is a possible need for revisions to the design methodology and technology review process outlined in the rule to simplify the process. There is a need to evaluate whether the current rules are identifying the most correct enforcement actions. At this point, this is identified as a potential program enhancement, but discovering how to simplify the rules, while simultaneously protecting public health and the environment, will be a process that will require intensive research and proper vetting with all stakeholders.

4.5.4 Fiscal Practices

Ensuring there are enough resources to do the job is critical in making sure advanced systems are managed and maintained. In order to ensure proper management and maintenance of advanced systems, there needs to be a clear understanding of what a monitoring inspection would consist of (as described in Section 4.4 and Section 4.5.2), and there is a need to ensure that the inspection occurs on a regular interval. For both FDOH and MEs, some of the things that affect whether a regular inspection occurs is making sure there are enough people to do the job that needs to be done as well as having a consistent and accurate system in place to notify when inspections need to be done and how best those with a large number of advanced systems can group them to increase travel efficiencies. Both FDOH county offices and the maintenance entities agreed that the FDOH should maintain adequate staffing levels in the advanced system program to bring consistency in program implementation. Several of the FDOH county offices indicated that current cost of running the program is more than the funding amount generated by permit fees. Permit file review and enforcement for these systems is more time intensive than for a conventional system. Ensuring proper resource levels goes beyond what can be done as a best management practice in the advanced system program, but development and implementation of a risk management plan outlining resource requirements, as well as performance measurements, would indicate to upper level management when a resource level exceeds the required baseline levels.

Reduction in the cost of advanced systems was mentioned by almost all user groups as an important step in the advanced system program. Advanced systems can be expensive to install and maintain. Homeowners would like to see options for lower-cost systems. FDOH is currently conducting a legislatively mandated study to develop cost-effective nitrogen reducing systems. More information regarding this study can be found on: http://www.doh.state.fl.us/environment/ostds/research/Nitrogen.html. Aligning costs in a way that make the system last longer could potentially be one method to reduce overall costs. There was a suggestion for maintenance entities to go to a deductible/insurance business model where the homeowner pays a fee that goes toward system repairs. This model would encourage the maintenance entity to use better/longer lasting parts and becomes more invested in maintaining the system. Overall, there was a feeling that there is a correlation between quality of work performed and price for both the FDOH county offices and the maintenance entities.

There were several comments made suggesting that maintenance entities and FDOH could **change current payment schedules to allow for installment billing and automatic payments** from homeowners. This practice could also reduce enforcement actions for paperwork issues by making the payment process more regular and automated.

4.5.5 Communication Practices

Training and education between user groups is important to making sure advanced systems are maintained properly. Outreach or education efforts in counties increased with the number of advanced systems. A common comment regarding training was that manufacturers should provide more training to FDOH, installers, and maintenance entities. Having regular contractor/maintenance entity meetings with FDOH is another useful tool in maintaining good relationships. FDOH regularly posts current information on advanced systems at http://www.myfloridaeh.com/ostds, which includes a list of approved systems, along with their third-party testing results; as well as a statewide list of approved maintenance entities and which systems they are approved to service. Educating FDOH legal staff on advanced systems is another opportunity for improvement. Homeowners also need education, targeted specifically to advanced systems, on basic care and use of the system, benefits to water quality, as well as the homeowner's legal responsibilities. An information sheet, brochure, website, or other marketing tool that can be sent or referenced with all notices from either FDOH or the maintenance entity was seen as being overwhelmingly needed by both interviewed groups. There should be regular education to realtors, planners, builders, and property managers on the benefits of having an advanced system and proper system maintenance. Outreach and education are activities that can improve communication and build relationships, which are both important to running the program effectively.

Having **open communication between user groups** is important to reduce the amount of time spent on enforcement and improve system operation. Communication between all user groups is something that can always be improved on. The homeowner would like to be informed that the system is in compliance, and both FDOH and the maintenance entity have a responsibility to provide that information to the homeowner. There also needs to be a level of trust between the user groups, and open communication can help build that trust. Effective communication methods include door hangers left at the site, email/mail/phone notification after an inspection, and directing the homeowner to http://septicsearch.com for those counties/maintenance entities that use the Carmody system. FDOH, the homeowner, and the maintenance entities all need to work together to resolve operational issues with the system. FDOH also has a Technical Review and Advisory Panel and a Research Review and Advisory Committee, made up of many varied interest groups, which assist FDOH in revising the rule and advising on research efforts for OSTDS. Meetings of these two groups are public meetings, and distribution of documents up for discussion at these meetings are posted on the FDOH website and emailed to interested parties.

4.6 Recommendations for Further Study

While the results of this study have answered many questions about the current performance and management of advanced OSTDS in Florida, there are several new questions that deserve further study.

1. Continuing with analysis of the data collected during this project. There was an incredible amount of data collected during this project, and further analysis is warranted. One example is that there is a need for a more thorough validation of screening methods for nutrient analysis.

2. Performing a detailed state-by-state review of existing code requirements for advanced systems and survey experts on issues they face, would be another useful next step.

3. Looking at implementing some of the EHD and website enhancements that the FDOH county offices and maintenance entities suggested would be beneficial.

4. Developing a statewide standardized form outlining minimum maintenance and inspection requirements for advanced systems that captures elements critical to assessing and maintaining system functionality would be a useful tool in moving toward consistency in this program.

5. Evaluating the effectiveness and cost of more effective nutrient reduction technologies. The FDOH Nitrogen Reduction Strategies Study will be completed in 2015, and results from that study can be considered in relation to the results of this study.

6. Developing a risk management plan and writing performance measures that FDOH could use to assess whether there are concerns with staffing or other resource issues in the advanced system program would be another useful item to research further.

7. Finding out whether program evaluation tools are measuring the right things, measuring unnecessary things, or if there are more effective things to measure, would be a possible next step.

8. Developing a homeowner awareness and education campaign specifically targeted to advanced OSTDS, on basic care and use of the system, benefits to water quality, as well as the homeowner's legal responsibilities. An information sheet, brochure, website, or other marketing tool that can be sent or referenced with all notices from either FDOH or the maintenance entity was seen as being overwhelmingly needed by both interviewed groups.

9. Selecting a county as a pilot county to implement the best management practices developed as a result of this project and measuring the effectiveness would be another logical next step.

10. Meeting with FDOH legal staff to develop an efficient enforcement procedure.

11. Designing and implementing workshops to be held at the annual meetings for industry professional organizations such as the Florida Onsite Wastewater Association and the Florida Environmental Health Association, to discuss further best management practices and how to improve the program.

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6 Acknowledgements

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7 Notice

The information contained within this paper does not necessarily reflect the official opinion of the Florida Department of Health and no official endorsement should be inferred.

Appendix A System User Survey and Cover Letter

FLORIDA DEPARTMENT OF HEALTH

Rick Scott
Governor

H. Frank Farmer, Jr., M.D., Ph.D.
State Surgeon General

May 27, 2011

Dear Sir/Madam:

You are receiving this note because your onsite sewage treatment and disposal system (OSTDS, commonly referred to as a septic tank) includes advanced treatment, such as an aerobic treatment unit or a performance based treatment system. Your system has been randomly selected for assessment and sampling.

To help us better understand how your onsite system is used, we have included the attached survey form. Your participation is voluntary, but important and will assist the Department in planning and administering its onsite sewage programs. If you wish to participate, please complete the enclosed survey and return it in the envelope provided for your convenience. The survey should take about 4 minutes to complete.

In addition, we are looking for a few systems that can be sampled a few more times during the coming year. If you are willing to participate, please indicate so on the survey.

The Florida Department of Health's Bureau of Onsite Sewage Programs develops and implements statewide rules for permitting the installation, maintenance, and repair of OSTDS within the state, including advanced systems. The Bureau also manages a state funded research program that applies for and receives grants to conduct research on OSTDS in Florida. This project is funded by a grant from the United States Environmental Protection Agency.

More information about the Bureau is available on our website:
http://myfloridaeh.com/ostds/research
The results of this project will be made available there, too.

Should you have any questions, please feel free to call Ms. Elke Ursin at (850) 245-4070 or contact her by e-mail at Elke_Ursin@doh.state.fl.us.

Thank you for your assistance.

Sincerely,

Gerald R. Briggs
Bureau Chief

NOTE: Florida has a very broad public records law. Most written communications to or from state officials regarding state business are public records available to the public and the media upon request. Therefore your responses to this survey may be subject to public disclosure.

DIVISION OF
Environmental Public Health

Bureau of Onsite Sewage Programs
4052 Bald Cypress Way, Bin A08 • Tallahassee, Florida 32399-1701
Phone: (850) 245-4070 • Fax: (850) 922-6969 • http://www.floridashealth.com

System User Survey

Name: ______________________________ Date: ____________
Address: ______________________________ Project System ID: ____________

Home/Residents

1. Is this your first home with an on-site wastewater treatment system? YES / NO
2. Have you received any septic system user information? YES / NO
3. Did you receive as-built/construction drawings for the system? YES / NO
4. Type of use: Permanent / Seasonal If seasonal, number of months used per year ______
5. Number of people living in the home: ______
6. Adults: ____ M ____ F
   Children <13 years: ____ M ____ F
   Teenagers 13-17 years: ____ M ____ F
7. Number of bedrooms: __________
8. Number of bathrooms: ____________
9. Water supply: Private well / public water / other supply ______________________
10. Do you have an in-home business? YES / NO If "yes", what type? ________________

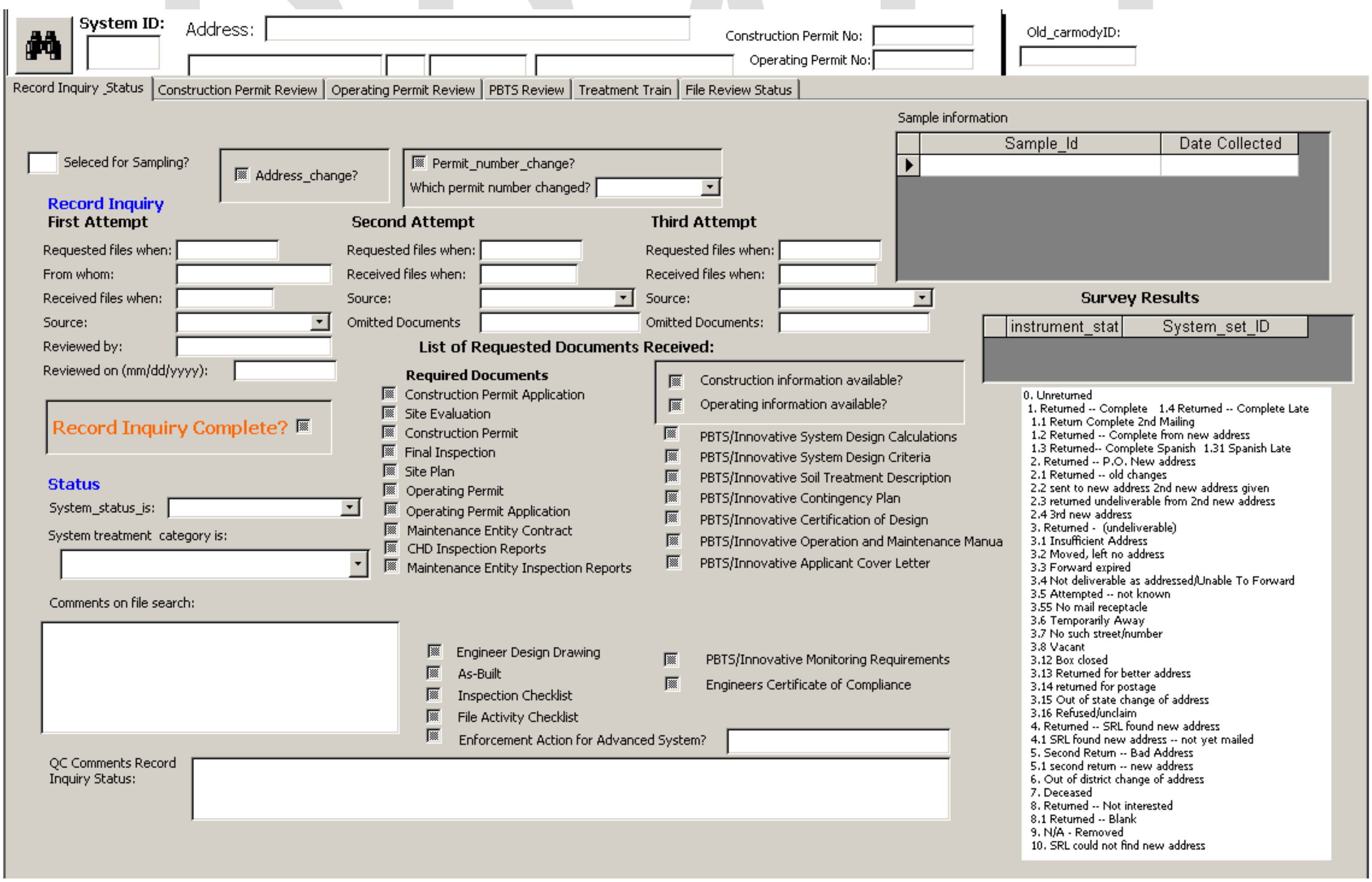
Appliances and Cleaning Products

11. Home equipped with water conserving fixtures/appliances? YES / NO
12. Garbage disposal? YES / NO Use: ________ times/week
13. Dishwasher used? YES / NO Use: ________ times/week
14. Laundry: Maximum _____ loads per day consecutive loads: YES / NO Total _____ loads/week
15. Brand of laundry detergents used? __________________________ powder / liquid
16. Bleach used? YES / NO powder / liquid Use: ______ cups/load _______ loads/week
17. Water temperature for washing? Hot / Warm / Cold
18. Whirlpool tub? YES / NO Use: ________ times/week
19. Is a drain cleaner used? YES / NO Type: ____________ Frequency of use:_____
20. Do you use septic system additives? YES / NO If "yes", what products? ___________________
21. Hand-washing soap brand? _________________ Antibacterial? YES / NO
22. Number of rolls of toilet paper used per week? ______________
23. Toilet cleaning product brand? ______________________
24. Cleanings/week _________________
25. Continuous cleaner used in toilet tank? YES / NO
26. Please list commonly used cleaning supplies:
    Shower __________________________
    Kitchen ______________________________
    Floors ______________________________
    Other ______________________________
27. Please list any antibacterial products used:_________________________
28. Water treatment device: YES / NO
29. Is a water softener used? YES / NO
30. Back flushes to: _________________________
31. Reverse osmosis? YES / NO
32. Discharges to: __________________________
33. Air conditioner unit(s)? YES / NO
34. Condensate drains to: _________________________
35. Footing drains or basement sump pumps connected into the system? YES / NO
36. Is the sump pump working? YES / NO
37. **Would you like to volunteer your system to be sampled periodically throughout the year?** YES / NO
38. **Additional comments:**

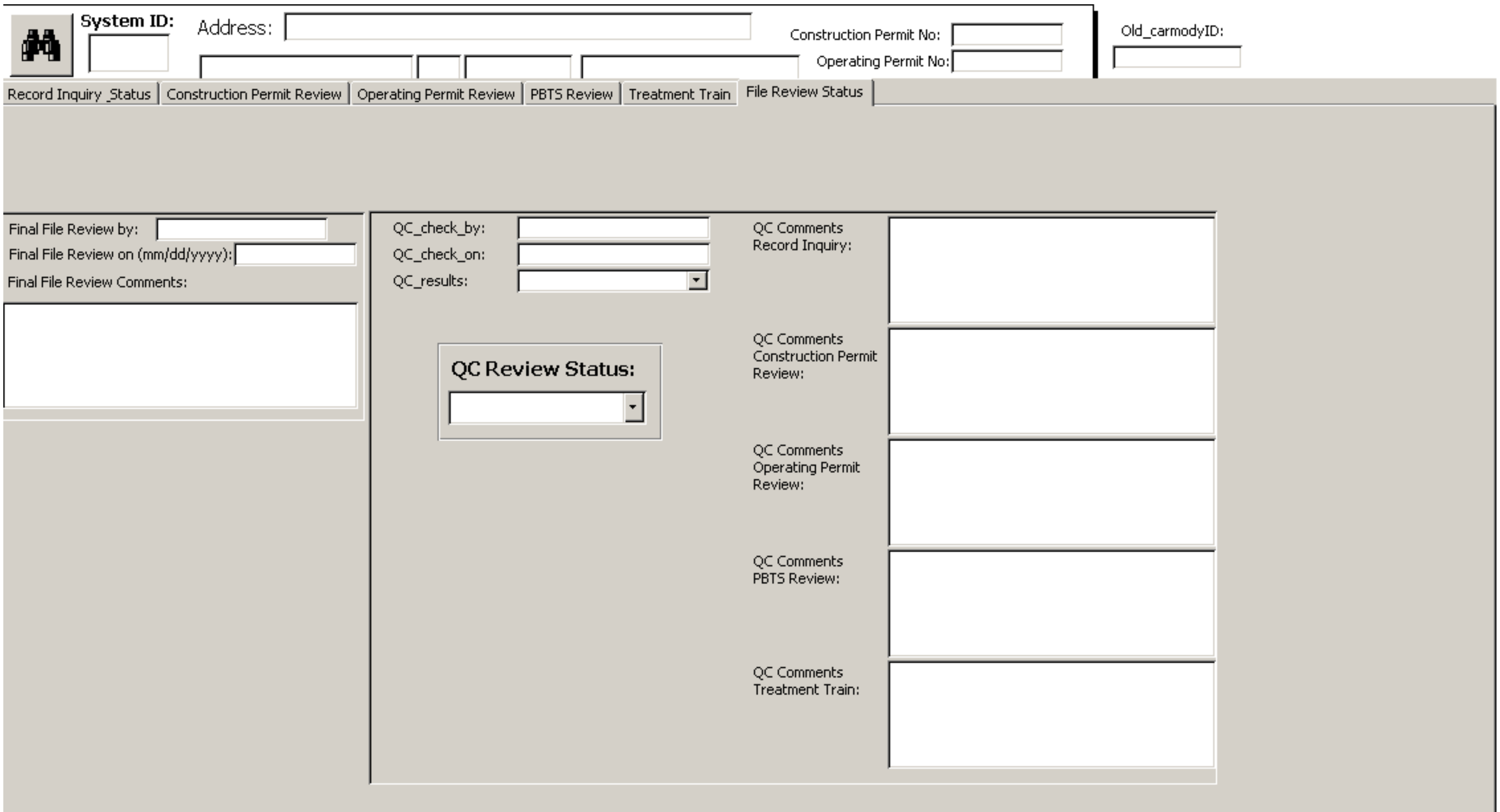
Appendix B Database Description and Forms for Permit Review and Site Evaluations

A) Step 1: Record ID Results

This section of the database provides information on the results of the Step 1 permit file review which consisted of assessing the completeness of the permit files as well as documenting basic information on document requests, the status of the permit file review, and quality control review information.



Screenshot of Step 1 Record Review Form Page 1



Screenshot of Step 1 Record Review Form Page 2

Table: Step1_recordID_results

Field Name	Data Type	Description
System_set_ID	Integer	System ID number assigned for this project
Address_change	Yes/No	Were address changes needed? (address usually located on the upper portion of the document)
Permit_number_change	Yes/No	Were permit number changes (OP or CP) needed? (permit number located on the upper right corner of the construction permit)
Which permit number change	Text	If there was a permit number change,

		which was it "add CP";"add OP";"change CP";"change OP"
System_status_is	Text	Status of system based on initial information from FDOH county office: abandoned before file request; abandoned after file request; active; active but conventional system; not existent; not_on_file; permit_for_ME_IM_or_facility
System_treatment system category_is	Text	Category of system based on permit files: "ATU"; "PBTS non_innovative"; "Innovative"; "PBTS innovative"; "Keys interim"; "other"
Construction_info_available?	Yes/No	Does the file contain construction information (permit or drawings)? (if any information is received regarding construction permit check this box)
Operating_info_available?	Yes/No	Does the file contain operating permit, maintenance entity and inspection information? (if any information is received regarding operating permit check this box)
Comments_on_file_search	Memo	Additional comments about finding the file and the system
Requested_files_when	Date/Time	On what date did were the files requested from FDOH county office?
Requested_files_from_whom	Text	From whom were the files requested from FDOH county office?
Received_files_when_1st attempt	Date/Time	On what date did were the files received by state health office in response to the first attempt?
Source_Field 1st	Text	What was the source of document collection? Carmody, EHD or County files, Laserfiche
Reviewed_1st by	Text	Who reviewed the file?
Reviewed_1st on (mm/dd/yyyy)	Date/Time	What date did the review occur?
2nd_attempt_Ommitted_documents	Text	This represents the second attempt to notify CDH regarding omitted documents?
2nd_ Date_Requested	Date/Time	Date the second request was made for

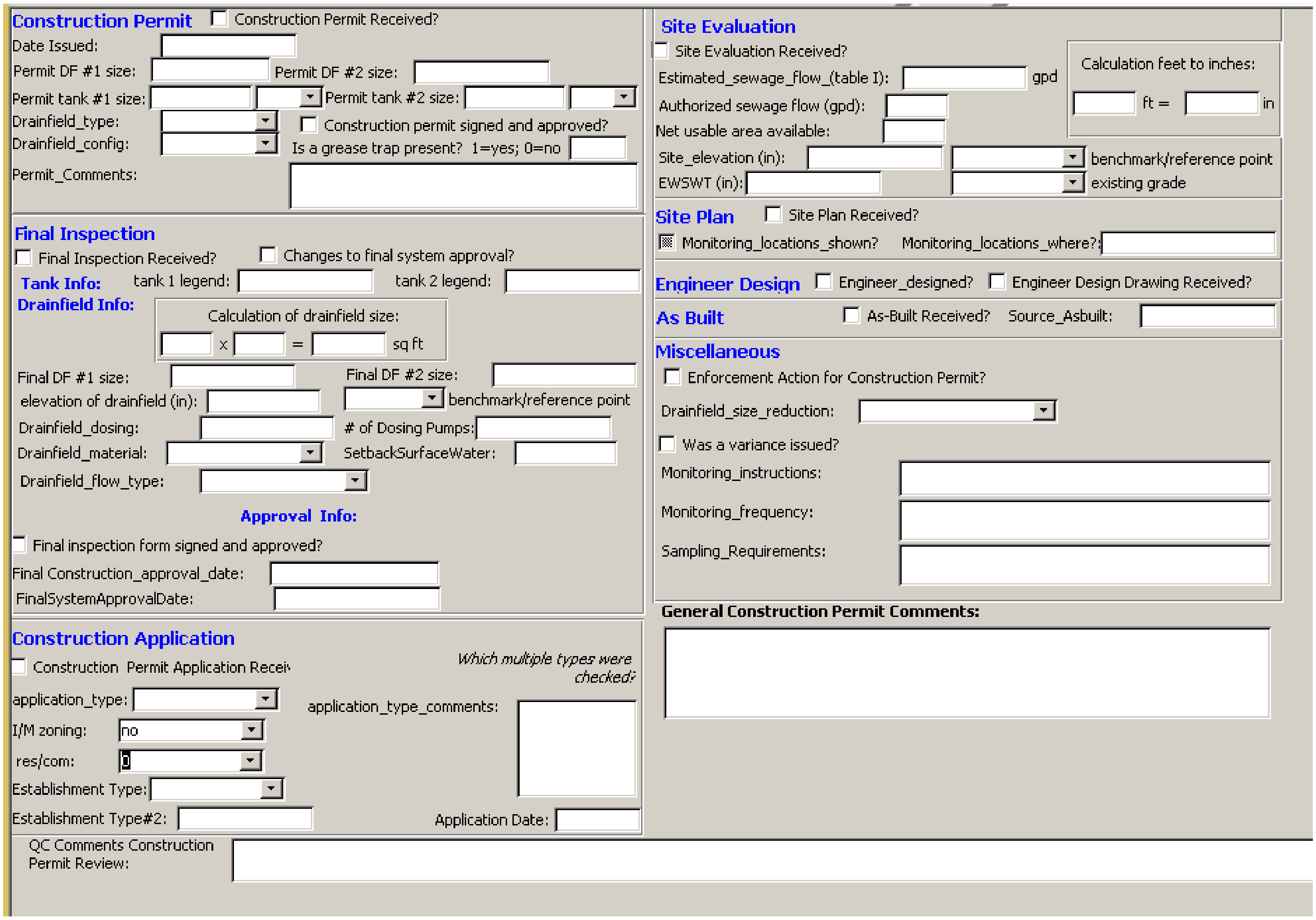
		omitted documents?
Received_files_when_2nd attempt	Date/Time	On what date did were the files received by SHO in response to the second attempt?
Source_Field 2nd	Text	What was the source of document collection? Carmody, EHD or County files, Laserfiche
3rd_attempt_Ommitted_document	Text	This represents the third attempt to notify FDOH county office regarding omitted documents?
3rd_Date_Requested	Date/Time	Date the third request was made to notify FDOH county office regarding omitted documents?
Received_files_when_3rd attempt	Date/Time	On what date did were the files received by state health office in response to the third attempt?
Source_Field 3rd	Text	What was the source of document collection? Carmody, EHD or County files, Laserfiche
Reviewed_final by	Text	Who reviewed the file? (The final review of all documents)
List_of_requested_documents_rece ived	Text	List of requested documents that have been received
All requested documents received?	Yes/No	Did we receive all documents requested?
Reviewed_final comments	Text	Final comments on source data collection
Reviewed_final on (mm/dd/yyyy)	Date/Time	What date did the review occur?
Complete	Yes/No	All documents are accounted for or no additional information is needed
Construction_ Permit_Application Received	Yes/No	Is DH4015 p.1 included in the file or in EHD?
Site_Evaluation_Received?	Yes/No	Has this file been received? (typically acquired from form DH4015 page 3)
Construction_Permit_Received?	Yes/No	Is DH4016 included in the file or in EHD?
Final_Inspection_Received?	Yes/No	Has this file been received? (Form 4016 page 2 of 3)
Site_Plan_Received?	Yes/No	Is a site plan included in the file? (scaled drawing which included the approximate location of system and drainfield)
Engineer_Design_Drawing_Receiv ed?	Yes/No	Are the drawings by the engineer present? (drawing of the systems created

		by an engineer)
As-Built_Received?	Yes/No	Is an as-built in the file? (unscaled drawing of system and drainfield)
Operating_Permit_Received?	Yes/No	Has this file been received? (Form DH4013 (03/97))
Operating_Permit_Application_Received?	Yes/No	Has this file been received? (Form DH 4081 page 1)
Operating_Permit_Application_Comments	Text	Comments regarding operating permit application (Generally located on form DH4013 under condition of operation)
Maintenance_Entity_Contract_Received?	Yes/No	Has this file been received? (Approved maintenance entity provider)
Inspection_Checklist_Received?	Yes/No	Has this file been received? (This checklist represents what the FDOH county office uses to uniformly inspect advanced systems)
File_Activity_Checklist_Received?	Yes/No	Has this file been received? (This checklist represents any written log and/or journal regarding the system)
CHD_Inspection_Reports_Received?	Yes/No	Has this file been received?
Maintenance_Entity_Inspection_Reports_Received?	Yes/No	Has this file been received? (This document contains service provided at the time of the ME inspection)
Enforcement_Action_For_Advanced_System_Received?	Yes/No	Has this file been received? (List the last documented enforcement action)
PBTS/Innovative_System_Design_Calculations_Received?	Yes/No	Has this file been received? (Typically found with required PBTS Engineer documents)
PBTS/Innovative_System_Design_Criteria_Received?	Yes/No	Has this file been received? (Typically found with required PBTS Engineer documents)
PBTS/Innovative_Soil_Treatment_Description_Received?	Yes/No	Has this file been received? (Typically found with required PBTS Engineer documents)
PBTS/Innovative_Contingency_Plan_Received?	Yes/No	Did the engineer provide contingency instructions? (Typically found with required PBTS Engineer documents)
PBTS/Innovative_Certification_of_Design_Received?	Yes/No	Is the certification of design included in the application package? (Typically found

		with required PBTS Engineer documents)
PBTS/Innovative_Operation and_Maintenance_Manual_Received?	Yes/No	Did the engineer include an operation and maintenance manual? (Typically found with required PBTS Engineer documents)
PBTS/Innovative_Applicant_Cover_Letter_Received?	Yes/No	if this is an innovative system, are homeowner acknowledgement form and FDOH county office/State Health Office review form included?
PBTS/Innovative_Cert_of_compliance_received?	Yes/No	Did the engineer provide a certificate of compliance after the installation? (Typically found with required PBTS Engineer documents)
PBTS/Innovative_Monitoring_Requirements_Recieved?	Yes/No	Did the engineer provide a list of monitoring requirements for the system? (Typically found with required PBTS Engineer documents)
QC_check_by	Text	Initials of QC checker
QC_check_on	Date/Time	Short date of QC check
QC_results	Text	Result of QC review: complete and agrees with records; partial and agrees with records; missing some fields; data entry errors; missing some and errors
QC Comments Step 1	Memo	Comments on the QC review for Step 1
QC Review Status	Text	Status of QC review (final, follow-up)
DateModified	Date/Time	Date that this field was modified, autoentered
Primary key	Long Integer	Primary key for this table

B) Step 2a: Construction Permit File Results

This section of the database provides information on the results of the Step 2a permit file review which consisted of reviewing construction permit file information.



Screenshot of Step 2a Construction Permit Review Form

Table: Step2a_const_permit_file_results

Field Name	Data Type	Description
System_set_ID	Integer	System ID number assigned for this project
CP_Soil_Profile complete?	Yes/No	Is the soil profile filled out correctly and completely DH4015 p.3?
Employee#SignPermit	Long Integer	Employee number from the CEHP who signed off on the permit
CP_permit signed and approved	Yes/No	Is the construction permit signed and approved in the file?

final inspection form signed and approved?	Yes/No	Is the final inspection signed and approved in the file?
FinalSystemApprovalDate	Date/Time	Final date when system was final approved
Enforcement_Action	Yes/No	Is there enforcement action document relative to construction included in the file (including failed construction inspections)?
Source_Asbuilt	Text	Who drew the as-built?
CP_comments	Memo	Comments on completeness of construction permit file
Permit_Comments	Memo	Comments from the actual construction permit
Engineer_designed	Yes/No	Was the system designed by an engineer?
application_type	Text	Application type checked on application form DH4015 p.1
application_type_comments	Text	Comments on application (variance, which multiple types were checked?)
CP_Commercial/residential	Text	Does the construction permit show this as commercial or residential system?
ResidentialOrCommercialText	Text	Does the operating permit show this as commercial or residential system?
Establishment_type	Text	Type of establishment DH4015 p.1
Establishment_type2-New	Text	Type of establishment DH4015 p.1 for second type of establishment using system
Usable property_size (acres)	Single	Property size given on site evaluation or similar DH4015 p.3 in acres
Usable property_size (feet)	Double	Property size given on site evaluation or similar DH4015 p.3 in square feet
Estimated_sewage_flow_(tableI)	Single	Estimated sewage flow (Table I) DH4015 p.3
Authorized sewage flow (gpd)	Long Integer	Authorized sewage flow DH4015 p.3
Site_elevation (in)	Single	Elevation of proposed site (in) DH4015 p.3
Changes_to_Site_Evaluation	Yes/No	Check this box if changes to the site evaluations data dump occurred?
site elevation above/below	Text	Indicator of elevation of site above/below
EWSWT elevation (in)	Single	What is the estimated wet season water

		table as shown on the site evaluation? Inches below = -
EWSWT elevation above/below	Text	Indicator of elevation of EWSWT above/below
Application_date	Date/Time	When was system construction permit originally applied for? (mm/dd/yyyy) DH4015 p.1
ApplicationCompleteDate	Date/Time	Date when application was complete
Permit_Issue_date	Date/Time	When was permit issued (DH4016 p.1)
Construction_approval_date	Date/Time	When was construction approval given on DH4016 p.2
Construction_permit_approval_date_changed?	Yes/No	Was a change to the EHD-obtained construction permit approval date made based on the permit review?
Changes_to_Construction_permit_application	Yes/No	Check this box if changes to the Construction permit data dump occurred?
Changes_to_final_system_approval_date?	Yes/No	Was a change to the EHD-obtained final system approval date made based on the permit review?
permit_source	Text	Source of information on permitting (flow, authorized flow, setbacks, application)
tank 1 legend	Text	Legend 1 of tank (DH4016 p.2)
tank 2 legend	Text	Legend 2 of tank (DH4016 p.2)
Grease_Trap	Long Integer	Is a grease trap present? 1=yes; 0=no
Drainfield_Cp_Application_Size	Text	Drainfield size annotated on Construction permit application. (DH 4016 p.2)
DF1_Permit	Double	Size of drainfield #1 on the construction permit
DF2_Permit	Text	Size of drainfield #2 on the construction permit
Tank1Units	Text	Units for tank #1 (gal/gpd)
Tank2Units	Text	Units for tank #2 (gal/gpd)
Tank1	Double	Size of tank #1 on the final inspection
Tank2	Double	Size of tank #2 on the final inspection
Drainfield_TypeCode	Double	Unique identifier from EHD for the drainfield type (same as number in Drainfield_Materials table)
DocumentNumber	Text	Document number from EHD
DrainfieldInstallation_DosingPumpsNumber	Double	Number of dosing pumps

DF1_Final	Double	Size of drainfield #1 on the final inspection
DF2_Final	Text	Size of drainfield #2 on the final inspection
IndustrialManufacturingOrEquivalent	Text	Is this industrial/manufacturing or its equivalent?
Drainfield_flow_type	Text	How does water get into drainfield and soil? "drip";"gravity";"lift-dosed";"LPDS";"unknown"
Drainfield_dosing	Text	Is there a dosing pump -> dosing from DH4016 p.2?
Drainfield_type	Text	Drainfield type relative to ground surface "fill"; "mound"; "standard/subsurface"; "unknown"
Drainfield_config	Text	Drainfield configuration "bed"; "trench"; "unknown"
Drainfield_material	Text	What is the material used in the drainfield (manufacturer; product)
elevation_of_constructed_drainfield_(in)	Double	Numerical value of constructed elevation of drainfield above/below benchmark (DH 4016 p.2)
elevation_of_constructed_drainfield_above/below	Text	Indicator of constructed elevation of drainfield above/below benchmark (DH 4016 p.2)
ElevationOfProposedSystemSiteInchesOrFeet-New	Text	Is the elevation of the system site in inches or feet?
Drainfield comments	Text	Any additional comments on drainfield?
Authorized sewage flow increase	Yes/No	Was authorized sewage flow increase allowed due to PBTS?
SetbackSurfaceWater	Text	What is the setback to the surface water from the final inspection?
Setback reductions_horizontal?	Yes/No	Was a horizontal setback reduction allowed due to PBTS?
Setback reductions_vertical	Yes/No	Was a vertical setback reduction allowed due to PBTS?
Drainfield_size_reduction	Text	What drainfield size reduction was taken for the pretreatment (common numbers are 0, 25, 30, 40%)
Monitoring_locations_shown?	Text	Are monitoring locations shown or indicated in the file?

Monitoring_locations_where?	Text	What are the monitoring locations, if indicated?
Operating_manual_available?	Text	Is there an operation manual, including inspection procedures for this unit or references included?
Monitoring_instructions	Memo	What are the monitoring instructions?
Monitoring_requirements	Memo	What are the monitoring requirements?
Sampling_Requirements_in_permit	Text	Are sampling requirements specified?
Variance?	Yes/No	Has a variance been applied for?
QC Comments Step 2a	Memo	Comments on the QC review for Step 2a
DateModified	Date/Time	Date that this field was modified, auto entered
Primary Key	Long Integer	Primary key for this table

C) Step 2b: PBTS Review Results

This section of the database provides information on the results of the Step 2b PBTS review which consisted of reviewing information in the permit files.

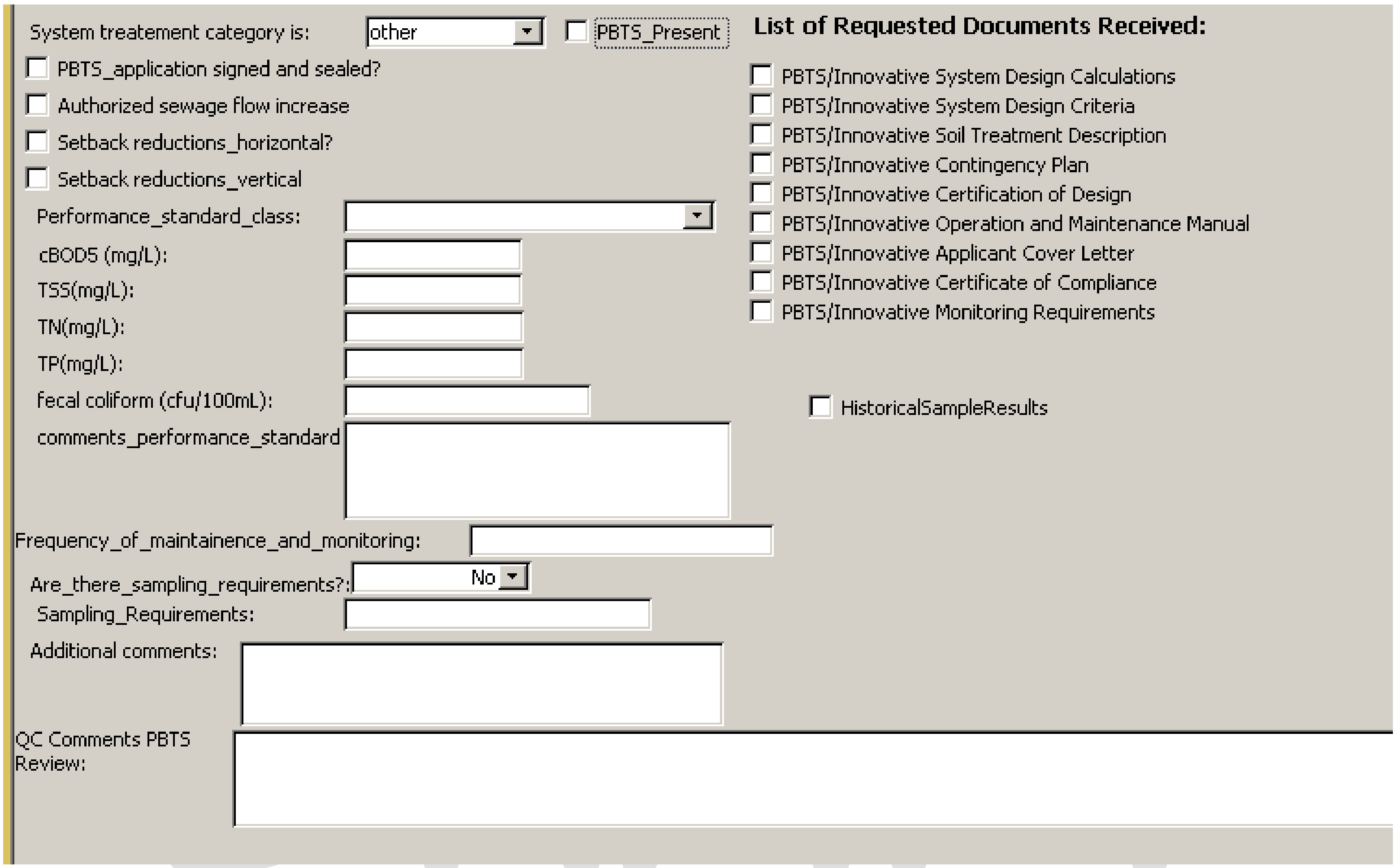


Figure 4. Screenshot of Step 2b PBTS Review Form

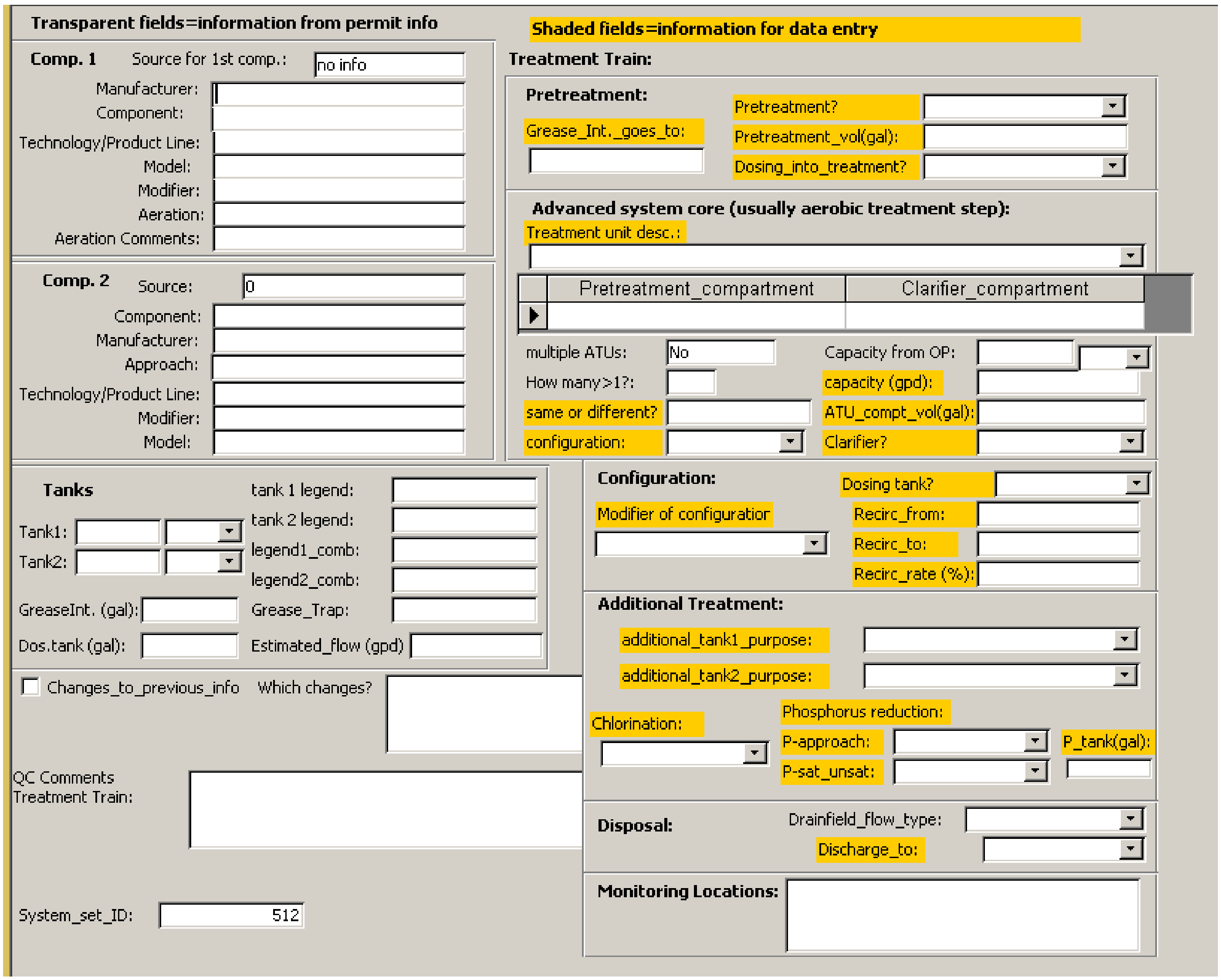
Table: Step2b_PBTSreview_results

Field Name	**Data Type**	**Description**
System_set_ID	Integer	System ID number assigned for this project
PBTS_Present	Yes/No	Is this a PBTS?
PBTS_application signed and sealed?	Yes/No	Is the PBTS application package signed and sealed? (4015 page 1)
Performance_standard_class	Text	Qualitative performance standard: "advanced sec.";"adv.sec. $cBOD_5$/TSS (drip/DFred.)"; "advanced ww."; "adv.ww. $cBOD_5$/TSS (drip/DFred.)"; "baseline";

		"Florida Keys"; "secondary"; "sec. $cBOD_5$/TSS (drip/DFred.)"; "ATU";"nitrogen"; "DFred."; "not specified"; "unknown"
$cBOD_5$ (mg/L)	Long Integer	Numerical performance standard (if specified)
TSS(mg/L)	Long Integer	Numerical performance standard (if specified)
TN(mg/L)	Long Integer	Numerical performance standard (if specified)
TP(mg/L)	Long Integer	Numerical performance standard (if specified)
fecal coliform (cfu/100mL)	Long Integer	Numerical performance standard (if specified)
comments_performance_standard	Text	Comments on performance standards (e.g., if not based on annual averages)
Engineer_required_maintainance/monitoring	Text	What frequency of maintenance and monitoring did the engineer specify?
Are_there_sampling_requirements?	Yes/No	Did the engineer specify sampling requirements?
Sampling_Requirements	Text	What are the sampling requirements?
Additional comments	Memo	Additional comments on the engineer's work
DateModified	Date/Time	Date that this field was modified, autoentered
QC Comments Step 2b	Memo	Comments on the QC review for Step 2b
HistoricalSampleResults	Yes/No	Are there any historical sample results for this system?
Primary Key	Long Integer	Primary key for this table

D) Step 2c: Treatment Train Results

This section of the database provides information on the results of the Step 2c review on the



treatment train information.

Figure 5. Screenshot of Step 2c Treatment Train Form

Table: Step2c_treatmenttrain_results

Field Name	Data Type	Description
System_set_ID	Integer	System ID number assigned for this project
Changes_to_previous_info	Yes/No	Was any of the previous information changed?
Which changes?	Memo	What information was added or changed?
Multiple_treatment_units_#	Long Integer	How many treatment units are there for this system permit?
Multiple_treatment_units_same	Text	If there are multiple units are they the same or different?
Multiple_treatment_units_config	Text	If there are multiple treatment units, are they in series or in parallel? "in series"; "parallel"; "unknown"
Dosing_into_treatment	Text	Is the treatment system(s) (in contrast to the drainfield) dosed?
Trash or pretreat tank/compartment	Text	Is there a trash tank or compartment present? Tank; 1st compartment; Absent
Pretreatment_vol(g)	Long Integer	Pretreatment tanks/compartment volumes (g)
Manufacturer_list	Long Integer	Manufacturer of treatment system (database info)
Manuf_Prodline_modif_model	Long Integer	Manufacturer_Product line_modifier_model of treatment system (database info)
Modifier of configuration	Text	Modifier of treatment system "with recirc";
ATU_compartment_vol(g)	Long Integer	Treatment compartment volume (g)
ATU_treatment_capacity (gpd)	Long Integer	Nominal treatment capacity (gpd)
Recirc_presence	Text	None (usual); present (drip systems will have recirculation present); questionable; unknown
Recirc_from	Text	From which compartment/tank does recirculation start (e.g., branch from discharge pipe to...)
Recirc_to	Text	To which compartment/tank does recirculation flow to
Recirc_rate	Text	Ratio recirculation flow/discharge flow
Clarifier_qualitative	Text	Compartment within ATU; separate tank;

		absent; unknown
Clarifier_vol(g)	Long Integer	Clarifier volume (gallons)
additional_tank1_qualitative	Text	Filter or recirculation tank or compartment description qualitative: absent; mineral aggregate; P-removal; recirculation; other
additional_tank2_qualitative	Text	Filter or recirculation tank or compartment description qualitative: absent; mineral aggregate; P-removal; recirculation; other
P-reduction approach	Text	P-reduction material: NONE; AOS; LECA; BRICK_CHIPS; MID-FLOC
P_red_tank_vol(g)	Long Integer	P-reduction tank or compartment volume (gal)
P-red_sat_unsat	Text	If P-reduction provided: saturated upflow; saturated downflow; unsaturated downflow
DOSE_tank_qualitative	Text	Dosing tank description: absent; part of ATU; part of filter tank; separate tank; other
DOSE_tank_vol(g)	Long Integer	Dosing tank/compartment volume (gal)
DOSE_PUMP	Text	None; lift dose; low-pressure dose; drip irrigation
Chlorination	Text	None; in dosing tank; in separate tank; in P-filter tank
Discharge_to	Text	WELL; DRAINFIELD
Monitoring_locations where	Memo	Description of monitoring locations
Grease_interceptor_to	Text	Where does the grease interceptor discharge to
DateModified	Date/Time	Date that this field was modified, auto entered
QC Comments Step 2c	Memo	Comments on the QC review for Step 2c
Primary Key	Long Integer	Primary key for this table

E) Step 2d: Operating Permit File Results

This section of the database provides information on the results of the Step 2d permit file review which consisted of reviewing operating permit file information.

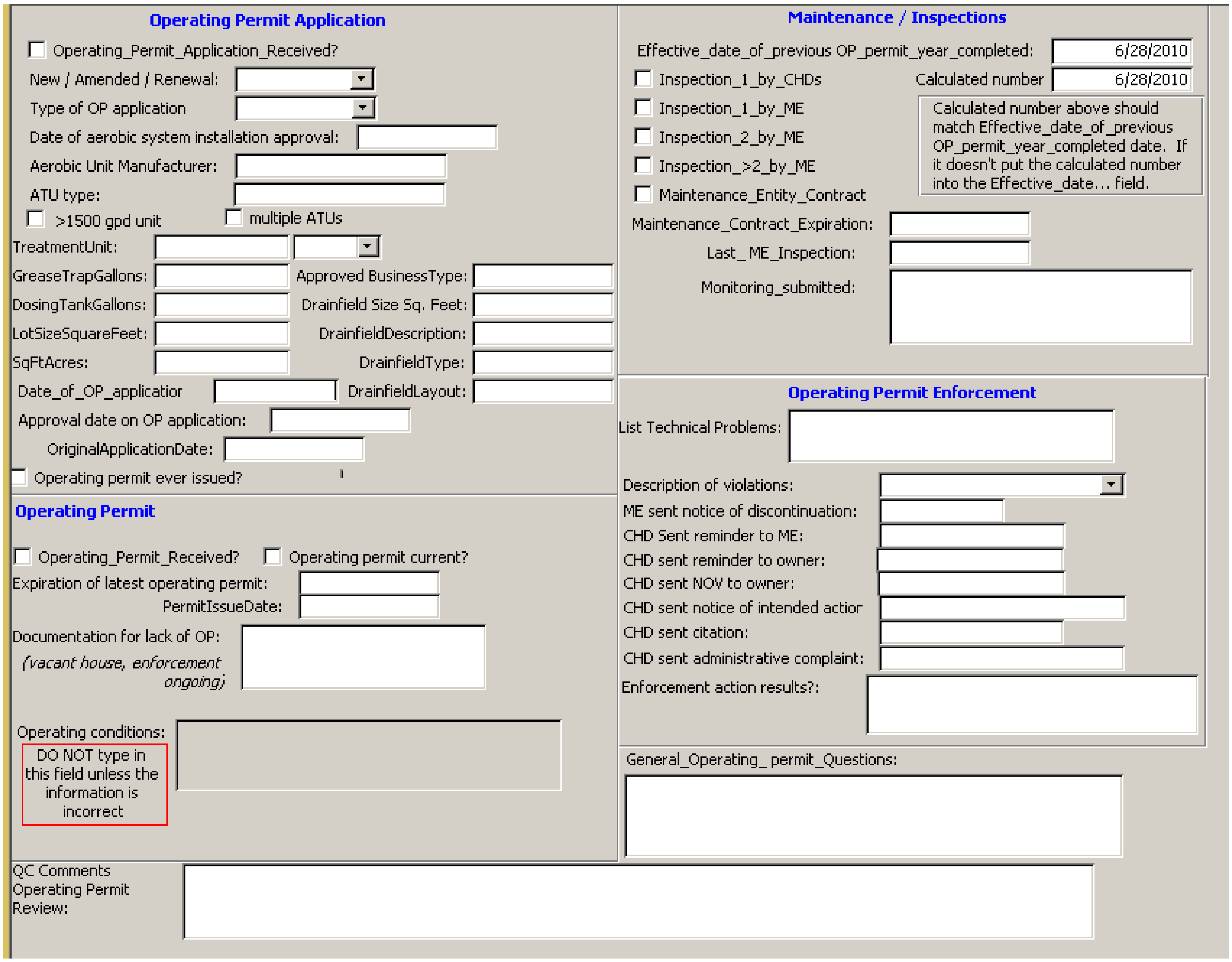


Figure 6. Screenshot of Step 2d Operating Permit Review Form

Table: Step2d_operating_permit_file_results

Field Name	**Data Type**	**Description**
System_set_ID	Integer	System ID number assigned for this project
General_operating_permit_question	Text	General questions and/or changes with regards to operating permit documentation
Application_for_OP	Yes/No	Is the OP application on file?
Date_of_OP_application	Date/Time	Date of most recent OP application on file
OriginalApplicationDate	Date/Time	Date of the original OP application
Approval date on OP application	Date/Time	Approval date on latest OP application
Operating_permit_approval_date_changed?	Yes/No	Was a change to the EHD-obtained most recent OP application permit approval date made based on the permit review?
Type of OP application	Text	Aerobic / Commercial / IM (indicate if multiple)
Aerobic	Long Integer	Is the aerobic system checkbox checked?
Commercial	Long Integer	Is the commercial system checkbox checked?
IndustrialManufacturing	Long Integer	Is the industrial/manufacturing system checkbox checked?
PerformanceBased	Long Integer	Is the performance-based system checkbox checked?
TypeOfOP-Checkboxes	Text	Result of which check box was checked, indicates the type of operating permit (Aerobic, Commercial, Industrial/Manufacturing, PBTS)
New OP application?	Text	Is this a new, amended or renewal OP application?
Installation_approved_date	Date/Time	Installation approval date per operating permit application
Manufacturer on OP_app	Text	Manufacturer per information on operating permit application
ATU_type_on OP_application	Text	ATU type per information on operating permit application
>1500 gpd unit	Text	Is >1500 gpd indicator on OP application yes or no
multiple ATUs	Text	Are multiple ATUs used on site indicated on OP application?

PBandInnovativeID	Double	ID number for PBTS and Innovative System from EHD
Operating permit ever issued?	Yes/No	Has an operating permit ever been issued?
TreatmentUnitCapacity	Double	Capacity of treatment unit listed on the operating permit application
TreatmentUnitUnits	Text	Is the Treatment Unit Capacity in gallons or gpd?
GreaseTrapGallons	Double	Capacity of the grease trap listed on the operating permit application
DosingTankGallons	Double	Capacity of the dosing tank listed on the operating permit application
DrainfieldSizeSquareFeet	Double	Size of the drainfield listed on the operating permit application
DrainfieldDescription	Text	Description of the drainfield listed on the operating permit application
LotSizeSquareFeet	Double	Lot size in square feet listed on the operating permit application
SqFtAcres	Text	Is the lot size in square feet or acres?
ApprovedBusinessTypes	Text	Types of approved businesses
DrainfieldType	Text	Type of drainfield (mound, subsurface, etc.)
DrainfieldLayout	Text	Layout of drainfield (trenches, bed, etc.)
Operating conditions on OP	Memo	What, if any conditions are on the OP (none, sampling, etc.)
Expiration of latest operating permit	Date/Time	Expiration date of latest operating permit
PermitIssueDate	Date/Time	Date OP was issued
How many days past due?	Long Integer	How many days is the permit past due?
Operating permit current?	Yes/No	Is there a current operating permit present? Current = 6/30/10 or later
Documentation for lack of OP	Text	Is there a reason given for the lack of a current operating permit (vacant house, enforcement ongoing)?
Changes_to_OP_permit_Application	Yes/No	Check this box if changes were made to the operating permit application data dump
Changes_to_Operating_permit	Yes/No	Check this box if changes were made to the operating permit data dump
Effective_date_of_previous OP_permit_year_completed	Date/Time	Date of beginning of most recent permit year completed by 3/31/2010 (first half of

		permits issued 4/1/2008-3/31/2009, second half of permits issued 4/1/2007-3/31/2008, year before permit issued after 3/31/09, 3/31/2009 for systems w/o permit on 3/31/09
Inspection_1_by_CHDs	Yes/No	Is there an inspection report completed by the FDOH county office for the permit year?
Inspection_1_by_Me	Yes/No	Is there a first inspection report completed by the ME for the permit year?
Inspection_2_by_Me	Yes/No	Is there a second inspection report completed by the ME for the permit year?
Inspection_>2_by_Me	Yes/No	Are there additional inspection reports completed by the ME for the permit year (ATU>1500 gpd; boreholes in Keys)?
Maintenance_Entity_Contract	Yes/No	Is there a valid ME contract included in the files?
Maintenance_Contract_Expiration	Date/Time	When does the most recent ME contract expire?
Last_ ME_Inspection	Date/Time	What was the date of the most recent ME inspection?
Monitoring_submitted	Memo	Was sampling result were submitted by ME?
Technical Problems?	Memo	What were any technical problems noted on the inspection reports or elsewhere?
Description of violations	Text	Describe any violations documented in the file
Violation observed when?	Date/Time	When was the violation observed? (most recent occurrence)
ME sent notice of discontinuation	Date/Time	When did the ME send a notice to the FDOH county office that the owner will not continue maintenance agreement? (most recent occurrence)
CHD Sent reminder to ME	Date/Time	When did the FDOH county office send a reminder to ME to renew operating permit? (most recent occurrence)
CHD sent reminder to owner	Date/Time	When did the FDOH county office send a reminder to owner to get operating permit/maintenance contract? (most recent occurrence)

CHD sent NOV to owner	Date/Time	When did the FDOH county office send a notice of violation to owner about ME/OP requirement? (most recent occurrence)
CHD sent notice of intended action	Date/Time	When did the FDOH county office send a notice of intended action to owner/ME? (most recent occurrence)
CHD sent administrative complaint	Date/Time	When did the FDOH county office send an administrative complaint to owner/ME? (most recent occurrence)
CHD sent citation	Date/Time	When did the FDOH county office send a citation to owner/ME? (most recent occurrence)
Enforcement action results?	Memo	What enforcement action results are documented in the file
PBandInnovativeID2	Text	ID number 2 for PBTS and Innovative System from EHD
ATU_type_on OP_application2	Text	Type of ATU on OP application #2
PBandInnovativeID3	Text	ID number 3 for PBTS and Innovative System from EHD
ATU_type_on OP_application3	Text	Type of ATU on OP application #3
PBandInnovativeID4	Text	ID number 4 for PBTS and Innovative System from EHD
ATU_type_on OP_application4	Text	Type of ATU on OP application #4
PBandInnovativeID5	Text	ID number 5 for PBTS and Innovative System from EHD
ATU_type_on OP_application5	Text	Type of ATU on OP application #5
PBandInnovativeID6	Text	ID number 6 for PBTS and Innovative System from EHD
ATU_type_on OP_application6	Text	Type of ATU on OP application #6
DateModified	Date/Time	Date that this field was modified, auto entered
General Questions	Text	List any general questions/comments about this record
QC Comments Step 2d	Memo	Comments on the QC review for Step 2d
Primary Key	Long Integer	Primary key for this table

F) Step 3 & 4: Field Evaluation

This section of the database provides information on the results of the Step 3 & 4 field evaluation.

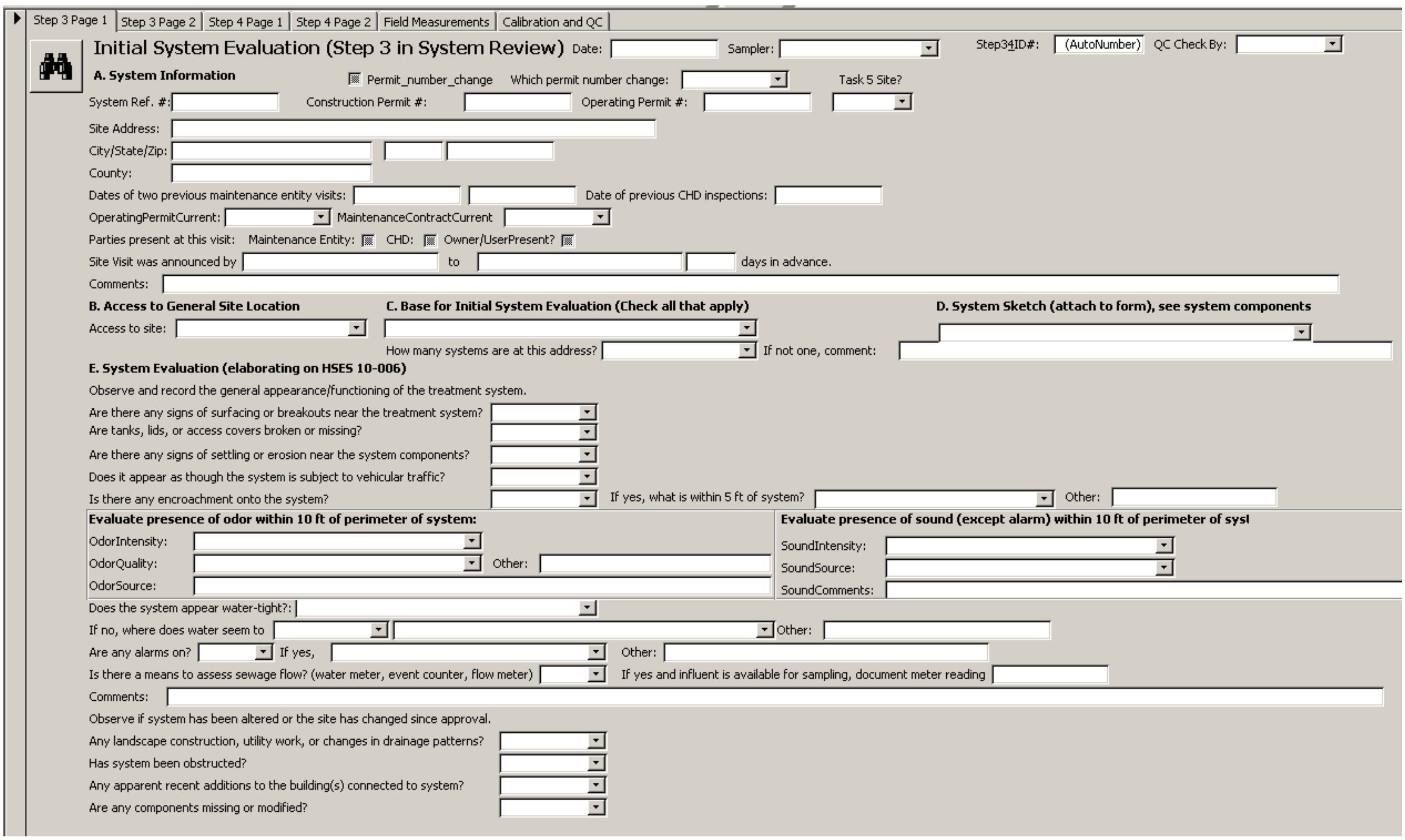


Figure 7. Screenshot of Step 3 & 4 Field Evaluation Data Entry Form Step 3 Page 1

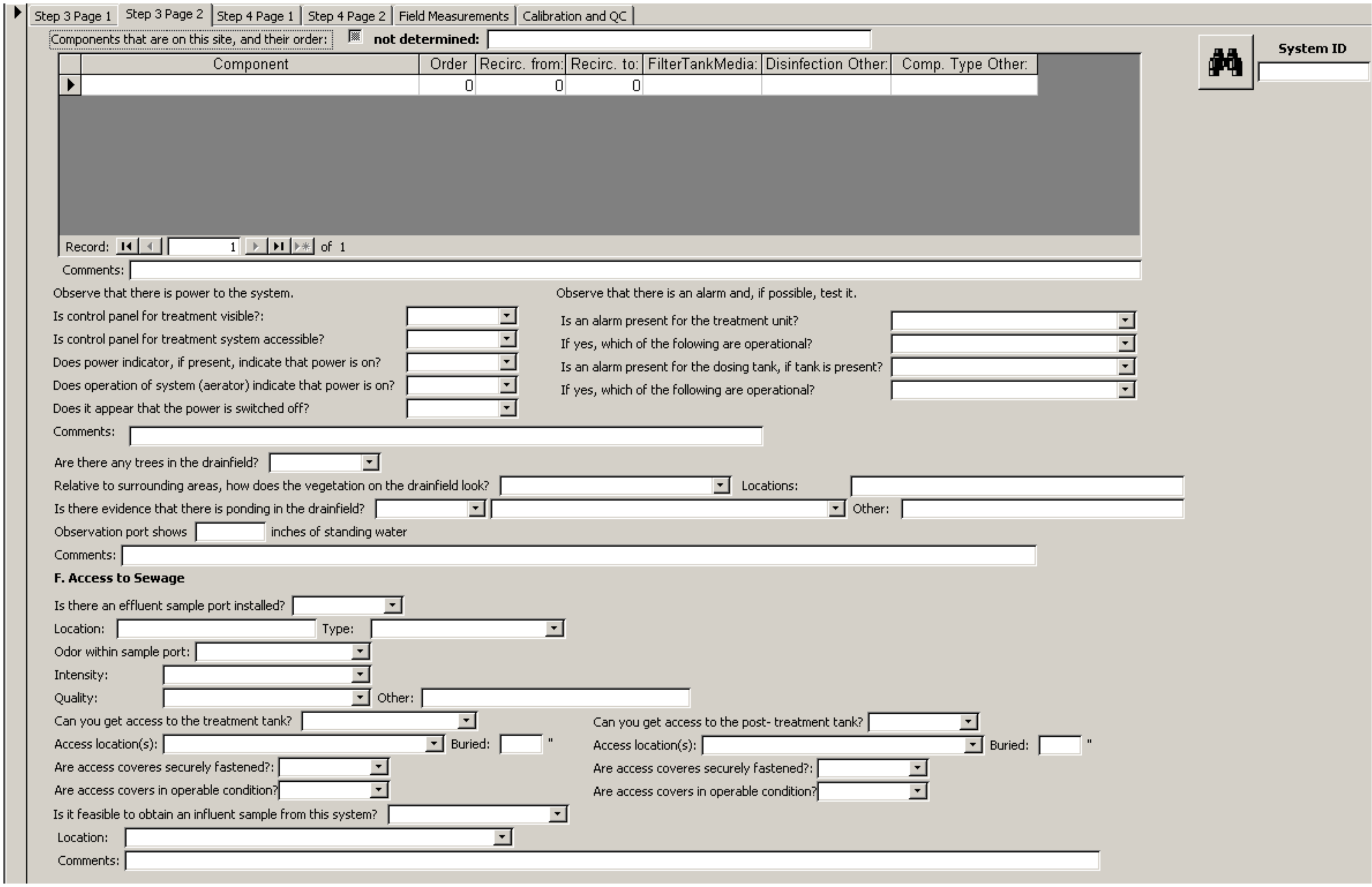


Figure 8. Screenshot of Step 3 & 4 Field Evaluation Data Entry Form Step 3 Page 2

Table: Step3&4_field_evaluation

Field Name	Data Type	Description
Step3&4ID	Long Integer	Unique value to identify this sample event
QC Comments Step 3	Memo	Comments on the QC review for Step 3
Step3FormDate	Date/Time	Date of initial system evaluation
Step3FormSampler	Text	Name of sampler for initial system evaluation
System_set_ID	Long Integer	System ID number assigned for this project
Date#1PreviousMEVisit	Date/Time	Date of first previous ME visit

Date#2PreviousMEVisit	Date/Time	Date of second previous ME visit
DatePreviousCHDInsp	Date/Time	Date of the previous FDOH county office inspection
OperatingPermitCurrent	Text	Is the Operating Permit current?
MaintenanceContractCurrent	Text	Is the Maintenance Contract current?
MaintenanceEntityPresent?	Yes/No	Is the maintenance entity present for this site visit?
CHDPresent?	Yes/No	Is the FDOH county office present for this site visit?
Owner/UserPresent?	Yes/No	Is the Owner/User present for this site visit?
SiteVisitAnnouncedBy	Text	Who announced the site visit
SiteVisitAnnouncedTo	Text	Who was notified of the site visit
SiteVisitAnnounced#Days	Long Integer	How many days in advance was the site visit announced?
SystemInfoComments	Memo	Comments on the system information gathered
AccessToSite	Text	Permission given, Open, Obstructed (locked gate/fence), Denied, Other
BaseForInitialSystemEvaluation	Text	Observation from afar, Observation of above-ground parts and control panels, Probing of system location, Permit records
HowManySystems	Text	None found, One, More than one
CommentsIfNoSystems	Memo	If there is not a system, provide a comment
SystemSketchSource	Text	Source of the system sketch
Surfacing/Breakouts	Text	Are there signs of surfacing or breakouts near the treatment system?
Tank/Lid/CoverBroken/Missing	Text	Are tanks, lids, or access covers broken or missing?
Settling/erosion	Text	Are there any signs of settling or erosion near the system components?
VehicularTraffic	Text	Does it appear as though the system is subject to vehicular traffic?
Encroachment	Text	Is there any encroachment onto the system?
EncroachmentWithin5Ft	Text	If yes, what is within 5ft of system?
EncroachmentWithin5FtOther	Text	If Other was checked for Encroachments within 5 ft, what is the reason

OdorIntensity	Text	Evaluate intensity of odor within 10ft of perimeter of system
OdorQuality	Text	Evaluate quality of odor within 10ft of perimeter of system
OdorQualityOther	Text	If Other was checked for Odor Quality, what is the description
OdorSource	Memo	What is the source of the odor, if present?
SoundIntensity	Text	Evaluate intensity of sound (except alarm) within 10ft of perimeter of system
SoundSource	Text	Evaluate source of sound (except alarm) within 10ft of perimeter of system
SoundComments	Memo	Any comments on the sound evaluation?
Watertight	Text	Does the system appear water-tight?
WaterEnterOrLeave	Text	If not watertight, does the water seem to enter or leave the system?
WaterEnter/LeaveFrom	Text	If not watertight, where does the water enter or leave?
WaterEnter/LeaveFromOther	Text	If water enters/leaves from "other", what is the description?
AlarmsOn	Text	Are any alarms on?
AlarmsOnReason	Text	What alarm is on
AlarmsOnReasonOther	Text	If "other" was checked for the reason the alarm is on, describe here
AssessSewageFlow	Text	Is there a means to assess sewage flow? (water meter, event counter, flow meter)
MeterReading	Long Integer	If there is a means to assess sewage flow and influent is available for sampling, document meter reading
SystemEvaluationComments	Memo	Comments on the system evaluation
Alterations/SiteChanges	Text	Any landscape construction, utility work, or changes in drainage patterns?
Obstructed	Text	Has system been obstructed?
Additions	Text	Any apparent recent additions to the building(s) connected to system?
ComponentsMissing/Modified	Text	Are any components missing or modified?
ComponentsNotDetermined	Yes/No	Were the components not determined?
ComponentsNotDeterminedReason	Memo	Reason why components were not determined, if applicable

ComponentsComments	Memo	Comments on components list
ControlPanelVisible	Text	Is control panel for treatment system visible?
ControlPanelAccessible	Text	Is control panel for treatment system accessible?
PowerOnFromIndicator	Text	Does power indicator, if present, indicate that power is on?
PowerOnFromAerator	Text	Does operation of system (aerator) indicate that power is on?
PowerOff	Text	Does it appear that the power is switched off?
PowerComments	Memo	Comments on the power assessment
AlarmPresent	Text	Is an alarm present for the treatment unit?
AlarmPresentYes	Text	If yes, which of the following are operational?
DosingTankAlarm	Text	Is an alarm present for the dosing tank, if tank is present?
DosingTankAlarmPresentYes	Text	If yes, which of the following are operational?
TreesInDF	Text	Are there any trees in the drainfield?
DrainfieldVegetation	Text	Relative to surrounding areas, how does the vegetation on the drainfield look?
VegetationLocation	Memo	Location of drainfield vegetation listed in "drainfield vegetation" field
Ponding	Text	Is there evidence that there is ponding in the drainfield?
PondingDescription	Text	Description of ponding
PondingDescriptionObPortInches	Long Integer	Number of inches of standing water in observation port
PondingDescriptionOther	Text	Ponding description if "other" selected
DrainfieldComments	Memo	Comments on the drainfield evaluation
SamplePort	Text	Is there an effluent sample port installed?
SamplePortLocation	Text	Where is the sample port?
SamplePortType	Text	Type of sample port
SamplePortOdor	Text	Was the odor checked, not checked, or N/A?
SamplePortOdorIntensity	Text	Evaluate intensity of odor within the sample port

SamplePortOdorQuality	Text	Evaluate quality of odor within the sample port
SamplePortOdorQualityOther	Text	If Other was checked for Sample Port Odor Quality, what is the description?
TreatmentTankAccess	Text	Can you get access to the treatment tank?
AccessLocation	Text	Location of access to treatment tank
AccessLocationBuried	Long Integer	Number of inches access location is buried
AccessCoversFastened	Text	Are access covers securely fastened?
AccessCoversOperable	Text	Are access covers in operable condition?
Post-TreatmentTankAccess	Text	Can you get access to the post-treatment tank?
Post-TreatmentTankAccessLocation	Text	Location of access to post-treatment tank
Post-TreatmentTankAccessLocation Buried	Long Integer	Number of inches access location to post-treatment tank is buried
Post-TreatmentTankAccessCovers Fastened	Text	Are access covers to post-treatment tank securely fastened?
Post-TreatmentTankAccessCoversOperable	Text	Are access covers to post-treatment tank in operable condition?
InfluentSample	Text	Is it feasible to obtain an influent sample from this system?
InfluentSampleLocation	Text	Location of influent sample
AccessToSewageComments	Memo	Comments on access to sewage
Step4FormDate	Date/Time	Date of system operation evaluation
Step4FormSampler	Text	Name of sampler for system operation evaluation
Region	Long Integer	Region sampler works in: 1=Monroe, 2=Charlotte, 3=Lee, 4=Statewide, 5=Volusia, 6=Headquarters
Time	Date/Time	Time of assessment
CloudCover%	Long Integer	Percent cloud cover
RainfallCurrent	Text	1 None 2 Light 3 Moderate 4 Heavy
RainfallPrev7Days	Long Integer	Amount of rainfall over the previous 7 days in inches
DateLastPumpout	Date/Time	Date of the last pumpout

AerationPresent	Text	Is an aeration chamber present?
AerationAcess	Text	Is there access to the aeration chamber?
AerationMixing	Text	Is there mixing in the aeration chamber
AerationMixingComment	Memo	Comments on mixing in aeration chamber
SSVSampleTaken	Text	Was a Settled Sludge Volume Test sample obtained?
SSVSettledBegin	Long Integer	Volume in mL/L of settled sludge at beginning
SSVFloatingBegin	Long Integer	Volume in mL/L of floating sludge at beginning
SSVBeginTime	Long Integer	Number of minutes after obtaining sample when volume of settled and floating sludge was measured
SSVSettledEnd	Long Integer	Volume in mL/L of settled sludge at end
SSVSettledEndQualifier	Text	Qualifier for SSV Settled End
SSVFloatingEnd	Long Integer	Volume in mL/L of floating sludge at end
SSVEndTime	Long Integer	Number of minutes after obtaining sample when volume of settled and floating sludge was measured
BiomassColor	Text	Color of biomass
BiomassColorOther	Text	If Other was checked for Biomass Color, what is the description
BiomassStructure	Text	Structure of biomass
Supernatant	Text	Cloudy or clear
Attached-GrowthPlugging	Text	Attached-growth media plugging?
Attached-GrowthFloating	Text	Attached-growth media floating?
Attached-GrowthMediaReplaced	Text	Attached-growth media replaced?
MediaFilter	Text	Is there a media filter?
MediaFilterDevice	Text	What is the device for the media filter?
MediaFilterDistribution	Text	Is there uniform distribution over the media filter?
MediaFilterOperation	Text	Is the media filter operating properly?
MediaFilterPonding	Text	Is there ponding associated with the media filter?
MediaFilterComments	Memo	Comments on the media filter
MediaFilterSumpPonding	Text	Is there ponding in the media filter sump?
GravityDrainage	Text	Is gravity drainage operational?
SolidsBuildupSump	Text	Is there solids buildup in the sump area?
UnderdrainVents	Text	Are under drain vents present?

UnderdrainVentsOperable	Text	Are the under drain vents operable?
ChlorinationSystem	Text	Is there a chlorination system present?
ChlorinationManufacturer	Text	Manufacturer of chlorination system
Chlorinator	Text	Info on the chlorinator
Dechlorinator	Text	Info on the de-chlorinator
ChlorinationSystemModel	Text	Model number of the chlorination system
ChlorinationMethod	Text	Tablet, Liquid
ChlorinationCondition	Text	Does the unit appear in good condition?
ChlorinationLocation	Long Integer	Location of chlorination: Location in/after tank #___
TabletChlorinatorOperable	Text	Chlorinator appears operable
ChlorineTabletsPresent	Text	Are chlorine tablets in place?
TabletsTouchEffluent	Text	Are the tablets in contact with effluent?
ContactChamberOperable	Text	Is the contact chamber operable?
FreeChlorineResidual	Double	Free chlorine residual ppm
TotalChlorineResidual	Long Integer	Total chlorine residual ppm
EffluentScreenLocation	Text	Location of effluent screen / tertiary filter
EffluentScreenClogging	Text	Evidence of clogging of effluent screen / tertiary filter?
QC Check By	Text	Who performed QC check
Task 5 Site	Yes/No	Was this a Task 5 site?

G) Step 3 & 4: Components

This section of the database provides information on the results of the component details from the Step 3 & 4 field evaluation.

Table: Step3&4_Components

Field Name	**Data Type**	**Description**
ComponentID#	Long Integer	Automatic generated number for this system's component information
System_set_ID	Long Integer	System ID number assigned for this project
ComponentEvalDate	Date/Time	Date that the component was evaluated
ComponentType	Text	Type of component
ComponentOrder	Long Integer	Order of the component (1-10)

ComponentTypeRecirculationFrom	Long Integer	If recirculation was selected as a component type, which component is it coming from
ComponentTypeRecirculationTo	Long Integer	If recirculation was selected as a component type, which component is it going to
ComponentTypeFilterTankMedia	Text	If filter tank was selected as a component type, what sort of media is it?
ComponentTypeDisinfectionOther	Text	If disinfection was selected as a component type and the type of disinfection was listed as other, what is it?
ComponentTypeOther	Text	If other was selected as the component type and it is not a sampling port, what is it?
ComponentFunction	Text	Function of component
ComponentFunctionOther	Text	If other was selected as the component function, what is it?
ComponentMaterial	Text	Material of component CO-concrete FG-fiberglass PE-polyethylene OT-other ___________
ComponentMaterialOther	Text	Description of the component material if it is other
Tank structural condition	Text	0-structually sound, 1-rebar exposed, 2-spalling, 3-corrosion, 4-roots inside of compartment, 5-cracks, 6-deflection, 7-inlet seal missing/broken, 8-outlet seal missing/broken, 9-holes, 10-lid broken/missing, 11-manhole cover missing/broken, 12-other
ConditionOther	Text	If other was listed for the tank structural condition, what is it?
LiquidLevelOutlet	Text	Liquid level relative to outlet (in) (NA for pump tank)
LiquidLevelOutletAbove/Below	Text	Liquid level relative to outlet above or below
LiquidLevelInlet	Text	Liquid level relative to outlet (in) (NA for pump tank)
LiquidLevelInletAbove/Below	Text	Liquid level relative to outlet above or below

LiquidLevelHigher	Text	Evidence liquid level has been higher
LiquidLevelDropped	Text	Evidence liquid level dropped (no pump)
Non-sewageInflow	Text	Evidence of non-sewage inflow
Watertight	Text	Appears to be watertight (no visual leaks)
OilyFilm/Sheen	Text	Oily film/sheen present
OdorIntensity/Quality	Text	Intensity: 0 None perceivable 1 barely perceivable 2 faint but identifiable 3 easily perceivable 4 Strong Quality: SEP Septic EARTHY Earthy/Musty/Moldy CHEM Chemical SOUR Sour/Rancid/Putrid OTH Other_____ N/A
SampleTaken	Yes/No	Sample taken?
ScumDepth	Long Integer	Depth of scum in inches
ScumColor	Text	Color of scum BL Black BR Brown MU Mustard GR Gray WH White TAN Tan OTH Other_____ NO None
ScumColorOther	Text	Description of other color for scum color if selected
ScumClarity/Structure	Text	CLEAR Clear CLOUD Cloudy MILK Milky MUD Muddy FLOC Flocked GRA Grainy FLU Fluffy
ClearZoneDepth	Long Integer	Depth of clear zone in inches
ClearZoneColor	Text	Color of clear zone BL Black BR Brown MU Mustard GR Gray WH White TAN Tan OTH Other_____ NO None
ClearZoneColorOther	Text	Description of other color for clear zone color if selected
ClearZoneClarity/Structure	Text	CLEAR Clear CLOUD Cloudy MILK Milky MUD Muddy FLOC Flocked GRA Grainy FLU Fluffy
SludgeDepth	Long Integer	Depth of sludge in inches
SludgeColor	Text	Color of sludge BL Black BR Brown MU Mustard GR Gray WH White TAN Tan OTH Other_____ NO None
SludgeColorOther	Text	Description of other color for sludge color if selected
SludgeClarity/Structure	Text	CLEAR Clear CLOUD Cloudy MILK Milky MUD Muddy FLOC Flocked GRA

		Grainy FLU Fluffy
Comments	Memo	Comments on component
YSIStationDescription	Text	Description of station where YSI readings were taken (i.e., pump tank). Should match type of component field.
YSIDate	Date/Time	Date in yy/mm/dd for YSI reading
YSITime	Date/Time	Time in hr:min YSI reading was taken
YSIWaterTemp	Double	Water temperature
YSIDO	Double	Dissolved oxygen
YSI%Sat	Double	Percent saturation
YSI%SatTrend	Text	Trend for dissolved oxygen
YSIORP	Double	Oxygen reduction potential
YSICond	Double	Specific Conductance
YSISalinity	Double	Salinity
YSIpH	Double	pH
Step3&4ID	Long Integer	Primary key from Step3&4_field_evaluation table
SampleLocation	Text	AC-aeration chamber CL-clarifier DS-disinfection ND- not determined OT-other MF-media filter PO-phosphorus sorption PU- pump/dosing/ recirc chamber SP-sampling port TT-trash/pretmt tank PEB-pre-cleaned EB FBL-field blank FEB-field-cleaned EB

H) Step 4: Field Analysis Form

This section of the database provides information on the results of the Step 4 field analysis form.

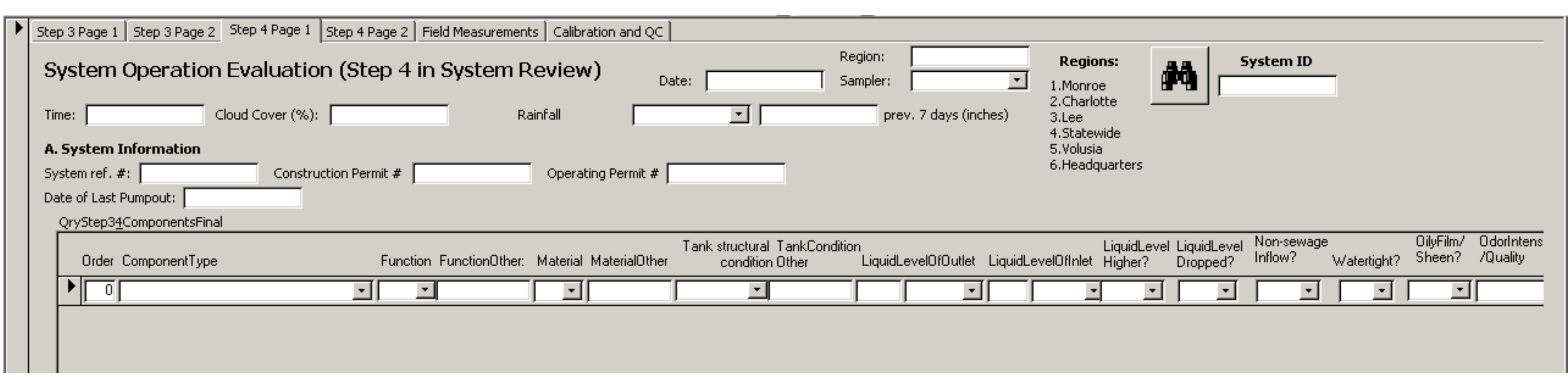


Figure 9. Screenshot of Step 3 & 4 Field Evaluation Data Entry Form Step 4 Page 1 Part 1

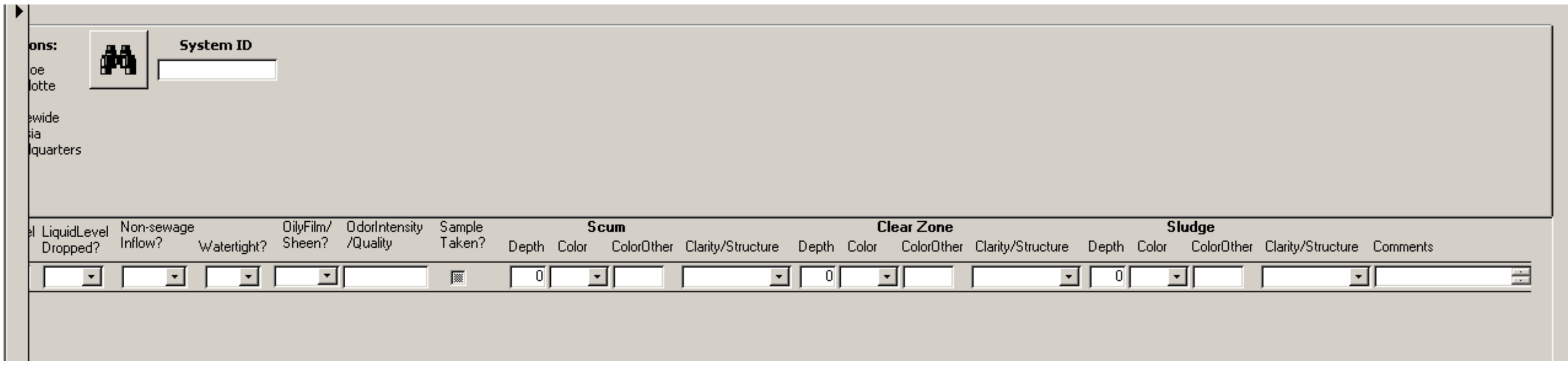


Figure 10. Screenshot of Step 3 & 4 Field Evaluation Data Entry Form Step 4 Page 1 Part 2

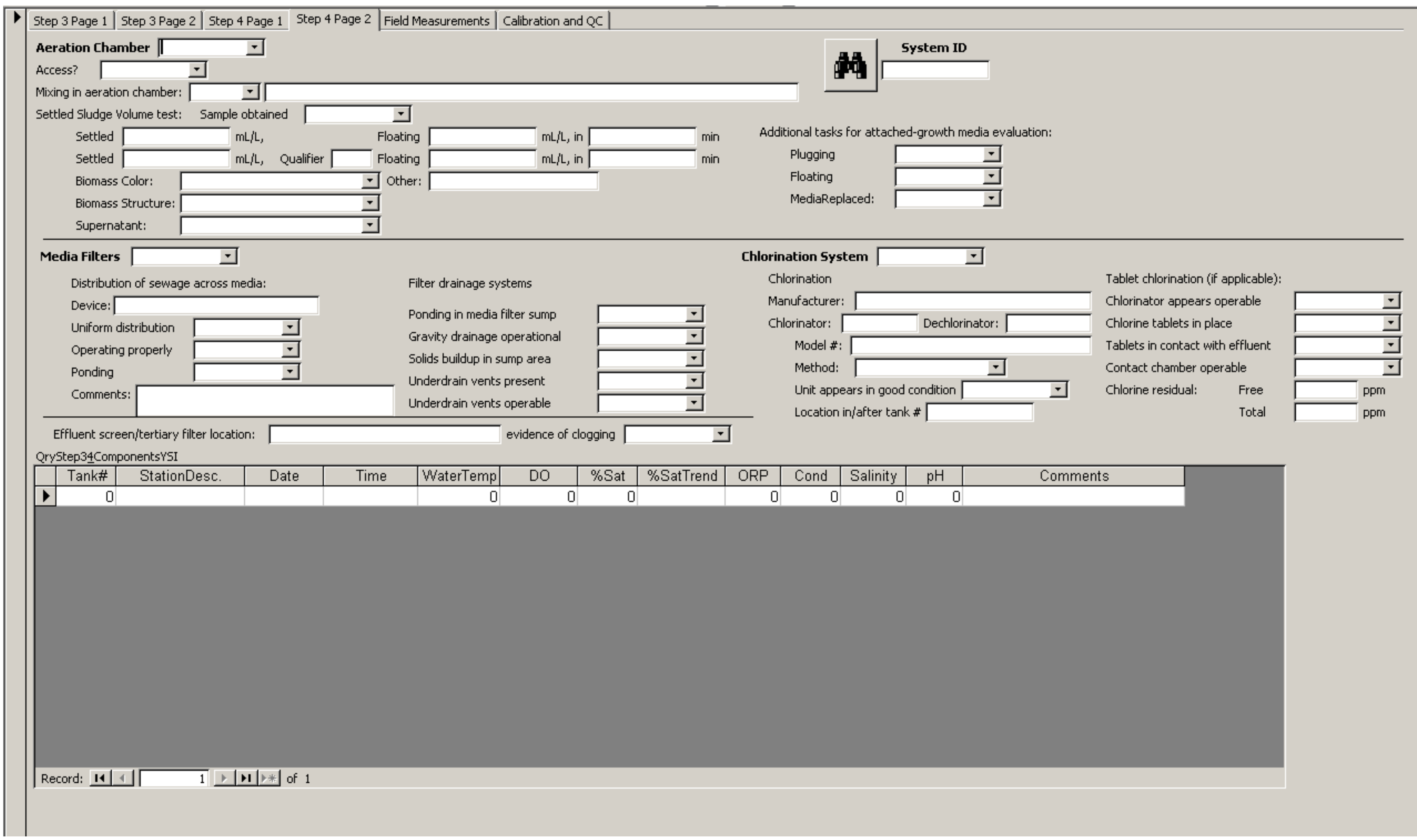


Figure 11. Screenshot of Step 3 & 4 Field Evaluation Data Entry Form Step 4 Page 2

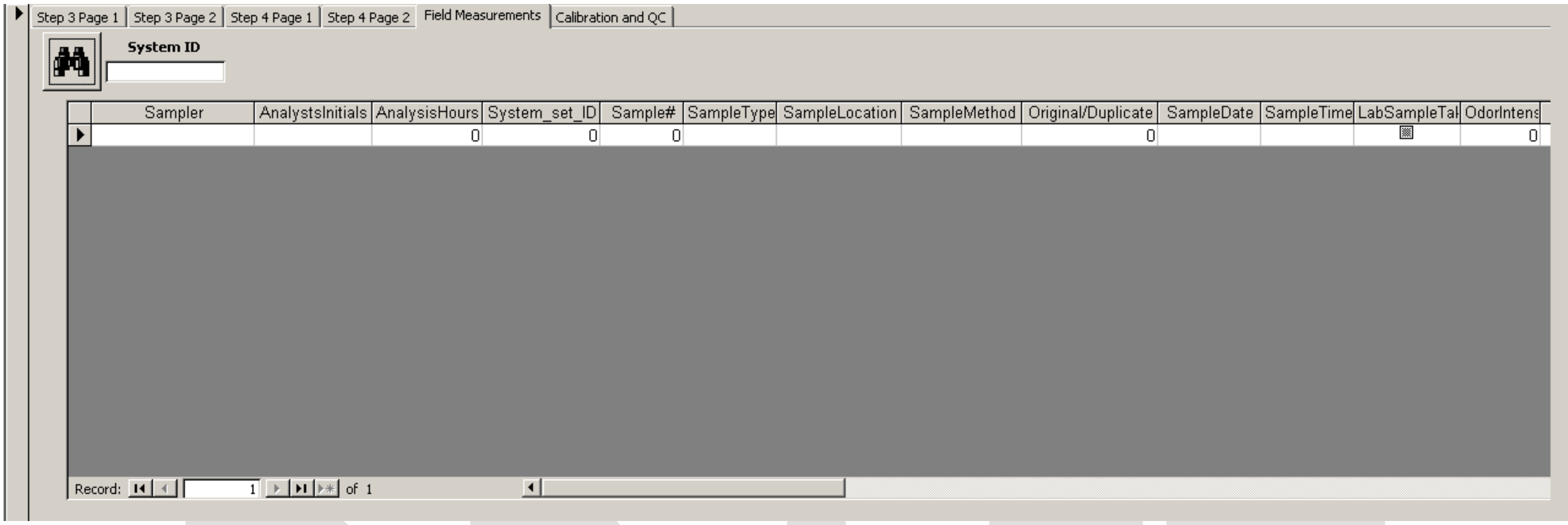


Figure 12. Screenshot of Step 3 & 4 Field Evaluation Data Entry Form Field Measurements Part 1

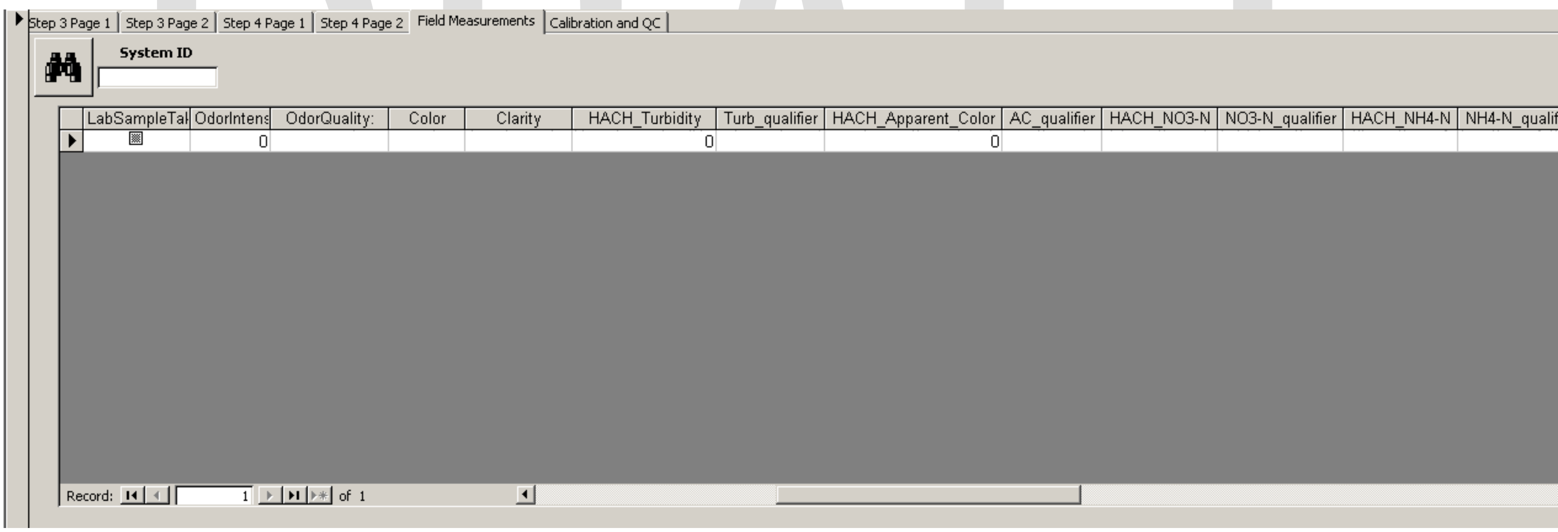


Figure 13. Screenshot of Step 3 & 4 Field Evaluation Data Entry Form Field Measurements Part 2

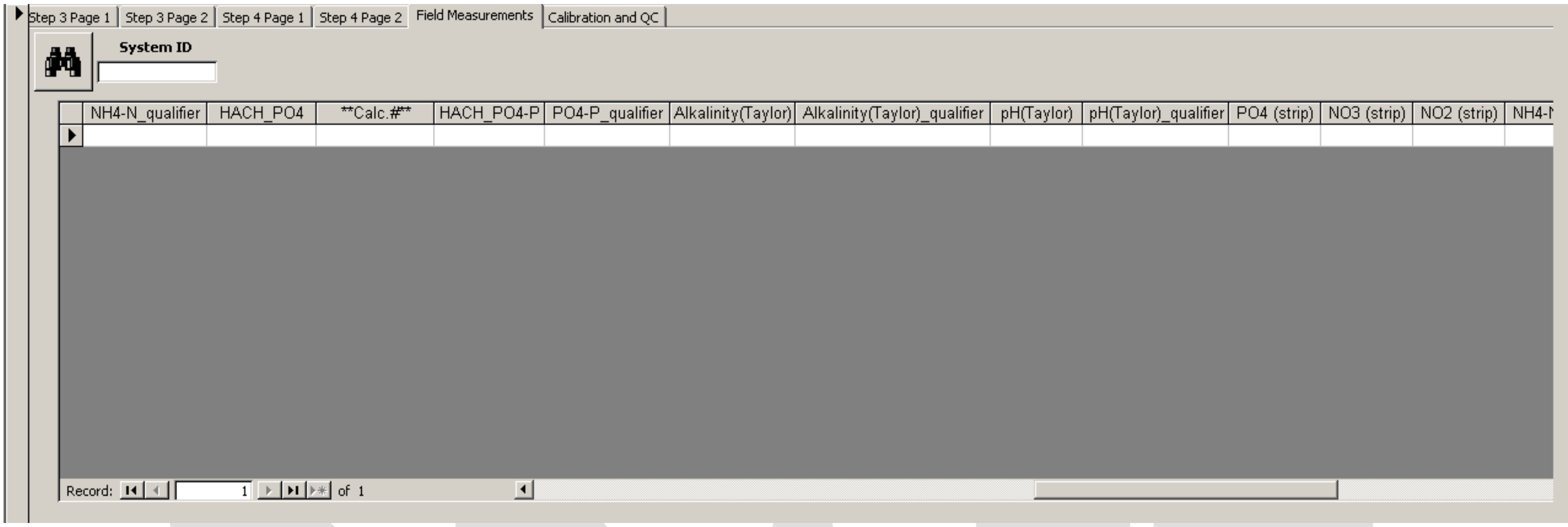


Figure 14. Screenshot of Step 3 & 4 Field Evaluation Data Entry Form Field Measurements Part 3

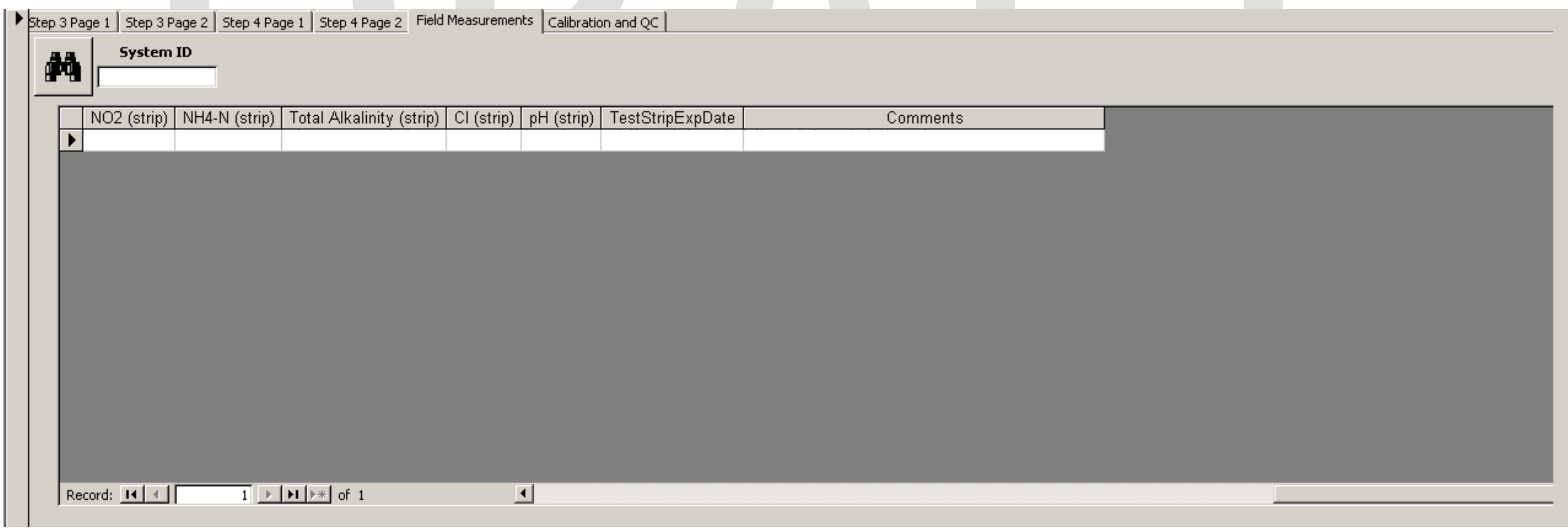


Figure 15. Screenshot of Step 3 & 4 Field Evaluation Data Entry Form Field Measurements Part 4

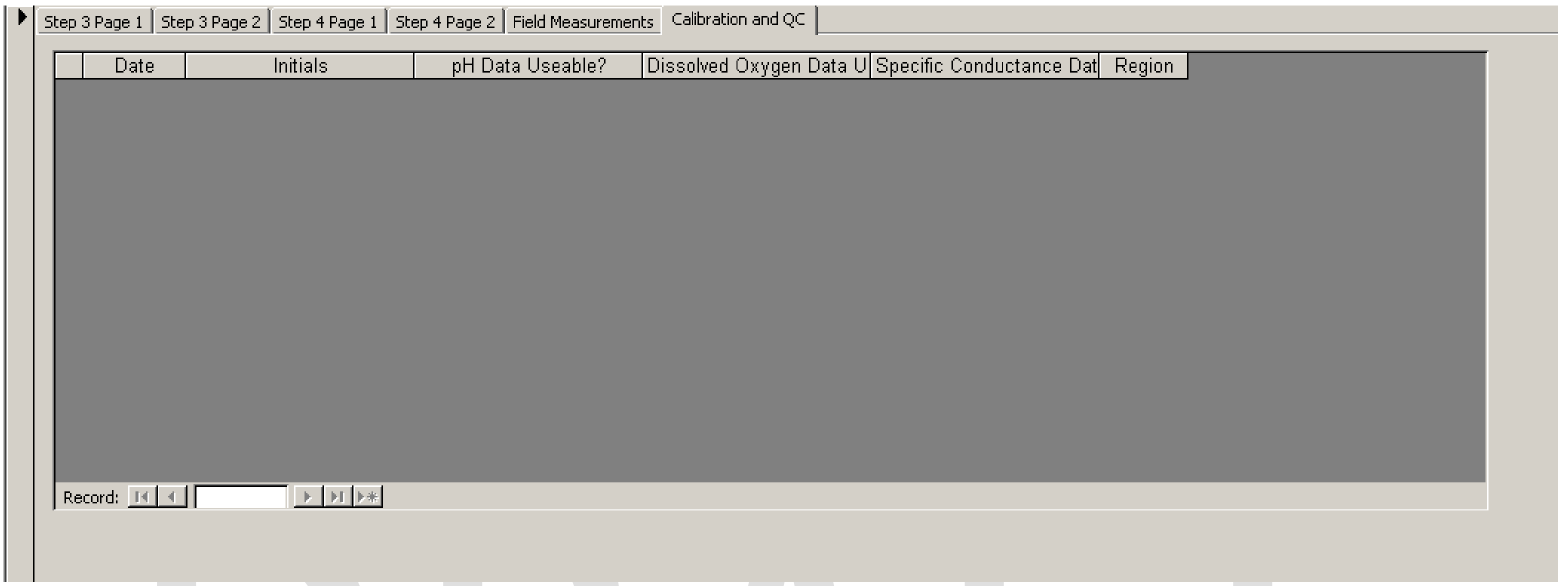


Figure 16. Screenshot of Step 3 & 4 Field Evaluation Data Entry Form Calibration and QC Results

Table: Step4_field_analysis_form

Field Name	**Data Type**	**Description**
System_set_ID	Long Integer	System ID number assigned for this project
FieldAnalysisID	Long Integer	Automatically generated number to associate with this sample
Sampler	Text	Name of the sampler
TestStripExpDate	Date/Time	Date that the test strip brand/lot expires
Sample#	Long Integer	Number of the sample within this sampling event (1-6)
SAMPLE_DATE	Date/Time	Date - Short
SAMPLE_TIME	Date/Time	Time - Medium
SampleType	Text	Eff =effluent Inf=Influent Tap=tap water QC=quality control
SampleLocation	Text	AC-aeration chamber CL-clarifier DS-disinfection ND- not determined OT-other MF-media filter PO-phosphorus sorption PU- pump/dosing/ recirc chamber SP-sampling port TT-trash/pretmt tank PEB-pre-cleaned EB

		FBL-field blank FEB-field-cleaned EB
SampleMethod	Text	i=intermediate container d=directly from free fall, spigot etc. p=peristaltic pump
Original/Duplicate	Integer	01-original sample 02-duplicate
LabSampleTaken	Yes/No	Was a lab sample taken?
Color	Text	BLack BRown MUstard GRay WHite TAN OTher _____ NOne
Clarity	Text	Clear Cloudy Milky Muddy Flocced Grainy Fluffy
OdorIntensity	Long Integer	0 None perceivable 1barely perceivable 2 faint but identifiable 3 clearly perceivable 4 strong
OdorQuality	Text	Septic Earthy/Musty/Moldy Chemical Sour/Rancid/Putrid Other_____ N/A
HACH_Apparent_Color	Long Integer	Value for apparent color from HACH Colorimeter DR/890
HACH_Apparent_Color_qualifier	Text	Qualifier for apparent color from HACH Colorimeter DR/890
HACH_Turbidity	Long Integer	Value of turbidity from HACH Colorimeter DR/890
HACH_Turbidity_qualifier	Text	Qualifier for turbidity from HACH Colorimeter DR/890
HACH_NH4-N	Double	Value of NH3-N from HACH Colorimeter DR/890
HACH_NH4-N_qualifier	Text	Qualifier for NH3-N from HACH Colorimeter DR/890
HACH_NO3-N	Double	Value of NO3-N from HACH Colorimeter DR/890
HACH_NO3-N_qualifier	Text	Qualifier for NO3-N from HACH Colorimeter DR/890
HACH_PO4	Double	Value of PO4 from HACH Colorimeter DR/890
HACH_PO4-P	Double	Value of PO4-P (=PO4 *.3261) from HACH Colorimeter DR/890
HACH_PO4-P_qualifier	Text	Qualifier for PO4-P from HACH Colorimeter DR/890
pH(Taylor)	Double	Taylor Kit pH
pH(Taylor)_qualifier	Text	Qualifier Taylor Kit pH
Alkalinity(Taylor)	Double	Taylor Kit total alkalinity

Alkalinity(Taylor)_qualifier	Text	Qualifier Taylor Kit total alkalinity
PO4 (strip)	Double	Test strip (mg/L) PO4
NO3 (strip)	Double	Test strip (mg/L) NO3-N
NO2 (strip)	Double	Test strip (mg/L) NO2-N
NH4-N (strip)	Double	Test strip (mg/L) NH3-N
Total Alkalinity (strip)	Double	Test strip (mg/L) total alkalinity
Cl (strip)	Double	Test strip (mg/L) Cl
pH (strip)	Double	Test strip
AnalystsInitials	Text	Initials of analyst
AnalysisHours	Long Integer	Analysis done within ___ hours
Comments	Memo	Comments on field analysis
QC to do	Text	Lab values seem odd, need checking; comments of changes
DateCreated	Date/Time	Date that this field was created, auto entered
DateModified	Date/Time	Date that this field was modified, auto entered
pH YSI Calibration Successful?	Yes/No	Was the YSI calibration successful for pH?
DO YSI Calibration Successful?	Yes/No	Was the YSI calibration successful for dissolved oxygen?
ORP YSI Calibration Successful?	Yes/No	Was the YSI calibration successful for specific conductance?
QC Comments Step 4b	Memo	Comments on the QC review for Step 4b
Step3&4ID	Long Integer	Step 3&4 ID number

I) Lab Results

This section of the database provides information on the lab results of the sampling efforts. Information from several labs has been combined into one table along with an analysis of the quality control review.

Table: TblSamplersRegion

Field Name	Data Type	Description
Step5_lab_results_System ID	Double	System ID number assigned for this project
Step5_lab_results_Sample Type	Text	Eff =effluent Inf=Influent Tap=tap water QC=quality control
Step5_lab_results_Sampling Location	Text	AC-aeration chamber CL-clarifier DS-disinfection ND- not determined OT-other MF-media filter PO-phosphorus sorption PU- pump/dosing/ recirc chamber SP-sampling port TT-trash/pretmt tank PEB-pre-cleaned EB FBL-field blank FEB-field-cleaned EB
Step5_lab_results_Sampling Method	Text	i=intermediate container d=directly from free fall, spigot etc. p=peristaltic pump
Step5_lab_results_Original/Duplicate	Text	01-original sample 02-duplicate
Step5_lab_results_Sampler	Text	Sampler name
Wo_Number	Double	Work order number from the analyzing lab
Step5_lab_results_Sample_Id	Text	Sample ID from chain of custody form
Lab_Sample_Id	Text	Lab assigned sample ID number
Matrix	Text	W – water, WW – wastewater
Date Collected	Date/Time	Date sample was collected
Time Collected	Date/Time	Time sample was collected
Date Received	Date/Time	Date sample was received
Time Received	Date/Time	Time sample was received
Sample_temp_preservation intact?	Text	Was the sample temperature and preservation intact?
FDOH NELAP certification number	Text	FDOH NELAP certification number
Total Alkalinity_Method	Text	Analysis method for Total Alkalinity
Total Alkalinity Result	Double	Total Alkalinity result
Total Alkalinity RL	Double	Total Alkalinity reporting limit
Total Alkalinity MDL	Double	Total Alkalinity method detection limit
Total Alkalinity Units	Text	Units Total Alkalinity was measured in
Total Alkalinity DF	Double	Dilution factor for Total Alkalinity
Total Alkalinity Analysis Date	Date/Time	Total Alkalinity analysis date
Total Alkalinity Analysis Time	Date/Time	Total Alkalinity analysis time
Total Alkalinity Flag	Text	Total Alkalinity flag

Total Alkalinity Comments	Text	Total Alkalinity Comments
Total CBOD_Method	Text	Analysis method for $cBOD_5$
$cBOD_5$ Result	Double	$cBOD_5$ result
$cBOD_5$ RL	Double	$cBOD_5$ reporting limit
$cBOD_5$ MDL	Double	$cBOD_5$ method detection limit
$cBOD_5$ Units	Text	Units $cBOD_5$ was measured in
$cBOD_5$ DF	Double	Dilution factor for $cBOD_5$
$cBOD_5$ Analysis Date	Date/Time	$cBOD_5$ analysis date
$cBOD_5$ Analysis Time	Date/Time	$cBOD_5$ analysis time
$cBOD_5$ Flag	Text	$cBOD_5$ flag
$cBOD_5$ Comments	Text	$cBOD_5$ Comments
TKN Method	Text	Analysis method for TKN
TKN Result	Double	TKN result
TKN RL	Double	TKN reporting limit
TKN MDL	Double	TKN method detection limit
TKN Units	Text	Units TKN was measured in
TKN DF	Double	Dilution factor for TKN
TKN Analysis Date	Date/Time	TKN analysis date
TKN Analysis Time	Date/Time	TKN analysis time
TKN Flag	Text	TKN flag
TKN Comments	Text	TKN Comments
Nitrate-Nitrite Method	Text	Analysis method for Nitrate-Nitrite
Nitrate-Nitrite Result	Double	Nitrate-Nitrite result
Nitrate-Nitrite RL	Double	Nitrate-Nitrite reporting limit
Nitrate-Nitrite MDL	Double	Nitrate-Nitrite method detection limit
Nitrate-Nitrite Units	Text	Units Nitrate-Nitrite was measured in
Nitrate-Nitrite DF	Double	Dilution factor for Nitrate-Nitrite
Nitrate-Nitrite Analysis Date	Date/Time	Nitrate-Nitrite analysis date
Nitrate-Nitrite Analysis Time	Date/Time	Nitrate-Nitrite analysis time
Nitrate-Nitrite Flag	Text	Nitrate-Nitrite flag
Nitrate-Nitrite Comments	Text	Nitrate-Nitrite Comments
TSS Method	Text	Analysis method for TSS
TSS Result	Double	TSS result
TSS RL	Double	TSS reporting limit
TSS MDL	Double	TSS method detection limit
TSS Units	Text	Units TSS was measured in
TSS DL	Double	Dilution factor for TSS
TSS Analysis Date	Date/Time	TSS analysis date
TSS Analysis Time	Date/Time	TSS analysis time

TSS Flag	Text	TSS flag
TSS Comments	Text	TSS Comments
Total Nitrogen Method	Text	Analysis method for Total Nitrogen
Total Nitrogen Result	Double	Total Nitrogen result (calculated by adding TKN and Nitrate-Nitrite)
Total Nitrogen RL	Double	Total Nitrogen reporting limit
Total Nitrogen MDL	Double	Total Nitrogen method detection limit
Total Nitrogen Units	Text	Units Total Nitrogen was measured in
Total Nitrogen DF	Double	Dilution factor for Total Nitrogen
Total Nitrogen Analysis Date	Date/Time	Total Nitrogen analysis date
Total Nitrogen Analysis Time	Date/Time	Total Nitrogen analysis time
Total Nitrogen Flag	Text	Total Nitrogen flag
Total Nitrogen Comments	Text	Total Nitrogen Comments
Total Phosphorus Method	Text	Analysis method for Total Phosphorus
Total Phosphorus Result	Double	Total Phosphorus result
Total Phosphorus RL	Double	Total Phosphorus reporting limit
Total Phosphorus MDL	Double	Total Phosphorus method detection limit
Total Phosphorus Units	Text	Units Total Phosphorus was measured in
Total Phosphorus DF	Double	Dilution factor for Total Phosphorus
Total Phosphorus Analysis Date	Date/Time	Total Phosphorus analysis date
Total Phosphorus Analysis Time	Date/Time	Total Phosphorus analysis time
Total Phosphorus Flag	Text	Total Phosphorus flag
Total Phosphorus Comments	Memo	Total Phosphorus Comments
Total Alkalinity QC	Text	QC results for Total Alkalinity
cBOD$_5$ QC	Text	QC results for cBOD$_5$
TKN QC	Text	QC results for TKN
Nitrate-Nitrite QC	Text	QC results for Nitrate-Nitrite
TSS QC	Text	QC results for TSS
Total Nitrogen QC	Text	QC results for Total Nitrogen
Total Phosphorus QC	Text	QC results for Total Phosphorus
Step5_lab_results_QC Comments	Text	Comments on QC results
Step5_lab_results_Region	Double	Region where sample was taken
Step5_fecal_lab_resultstable_ Sampler	Text	Sampler name for fecal sample collection
Step5_fecal_lab_resultstable_Syste m ID	Double	System ID number assigned for this project for fecal sample taken
Step5_fecal_lab_resultstable_Sam ple Type	Text	Eff =effluent Inf=Influent Tap=tap water QC=quality control
Step5_fecal_lab_resultstable_Sam	Text	AC-aeration chamber CL-clarifier DS-

pling Location		disinfection ND- not determined OT-other MF-media filter PO-phosphorus sorption PU- pump/dosing/ recirc chamber SP-sampling port TT-trash/pretmt tank PEB-pre-cleaned EB FBL-field blank FEB-field-cleaned EB
Step5_fecal_lab_resultstable_Sampling Method	Text	i=intermediate container d=directly from free fall, spigot etc. p=peristaltic pump
Step5_fecal_lab_resultstable_Original/Duplicate	Text	01-original sample 02-duplicate
Step5_fecal_lab_resultstable_Sample_Id	Text	Sample ID from fecal sample chain of custody form
Fecal_Lab_Sample_Id	Text	Fecal lab assigned sample ID number
Fecal Date Collected	Date/Time	Date sample was collected
Fecal Time Collected	Date/Time	Time sample was collected
Fecal Date Received	Date/Time	Date sample was received
Fecal Time Received	Date/Time	Time sample was received
Fecal Sample temp_preservative intact?	Text	Was the sample temperature and preservation intact?
Fecal Lab FDOH NELAP certification number	Text	FDOH NELAP certification number
Fecal Method	Text	Analysis method for Fecal Coliform
Fecal Result	Double	Fecal Coliform result
Fecal RL	Text	Fecal Coliform reporting limit
Fecal MDL	Text	Fecal Coliform method detection limit
Fecal Units	Text	Units Fecal Coliform was measured in
Fecal DF	Double	Dilution factor for Fecal Coliform
Fecal Analysis Date	Date/Time	Fecal Coliform analysis date
Fecal Analysis Time	Text	Fecal Coliform analysis time
Fecal Flag	Text	Fecal Coliform flag
Fecal Comments	Text	Fecal Coliform Comments
PREPDATE	Date/Time	Date fecal sample was prepped
PREPTIME	Text	Time fecal sample was prepped
Fecal QC	Text	QC results for fecal samples
Step5_fecal_lab_resultstable_QC Comments	Text	Comments on QC results for fecal samples
Step5_fecal_lab_resultstable_Region	Double	Region where fecal sample was taken

Appendix C Quality Control and Data Entry Processes

Advanced System Permit File Review Data Entry Process

1. Record Inquiry Status Data Entry
    a. Check to see that the address and permit numbers are correct. If not, fix it and fill out the box with the "Permit number change?" checkbox in it.
    b. In the Record Inquiry section, complete the information regarding how many attempts were made to obtain data.
    c. Click to check the red "Record Inquiry Complete?" box once the permit files have been obtained.
    d. Fill out the status, system treatment category, and any comments.
    e. For the "List of Requested Documents Received" section, if there is any "construction permit information available" or "operating permit information available", check the appropriate boxes. The Required Documents will become checked as data is filled out in other form tabs.
    f. Check any of the other boxes on the right side of the "Comments on file search" box when appropriate.
2. Construction Permit Review
    a. This is self-explanatory; each section corresponds to one of the FDOH standard permitting forms.
    b. In the final inspection box:
        i. Check "Changes to final system approval" if there was data in the fields originally and any of the information was incorrect or missing.
        ii. "Drainfield dosing" will be a yes or no answer
        iii. "# of Dosing Pumps" will be 0 if there is no pump there. Leave it blank if a determination cannot be made.
        iv. There are two places on this form where calculators have been inserted to assist in data entry. One is in the final inspection box, for when the FDOH county office just put drainfield dimensions and it needs to be calculated to square feet, and another is in the Site Evaluation box to convert to inches if the FDOH county office entered the elevations in feet. Data in these calculation boxes are not stored.
3. Operating Permit Review
    a. This is self-explanatory.
    b. In the Operating Permit box, make sure to check the box "Operating permit current?", only if the permit has an expiration date that is AFTER 6/30/10 AND the permit was issued BEFORE 9/30/11. This only indicates if there was an operating permit current at least during some time during the project.
    c. In the Maintenance / Inspections box, check to see that the "Effective date…" is the same as the "Calculated number". If not, change the "Effective date" to match what is in "Calculated number".

   d. Check the appropriate boxes on what inspections were done within 1 year of the date in the "Effective date of previous OP permit year completed" field (i.e., if the calculated number is 8/2/2009, the number of FDOH county office and ME inspections that were done between 8/2/2008 – 8/2/2009 would be entered).
   e. Enter the most recent maintenance entity inspection date (before the site visit) in the "Last ME Inspection" date field.
4. PBTS Review
   a. If this permit is for a PBTS, you will hear a ding and a red PBTS will appear in the top right of the form, viewable from all pages. This is to remind you to fill out this form. This is self-explanatory; just remember to fill it out if appropriate.
5. Treatment Train
   a. This tab summarizes the available information into a description of the treatment system. Enter any of the information that is known for this unit based on the information at hand. ONLY enter data in the YELLOW highlighted fields.
6. File Review Status:
   a. When all available data for this record have been reviewed, go to the "File Review Status" tab, type in the name of the reviewer in the "Final File Review by" field, the date the review was completed, and any comments.

Laboratory Sample Data Results Quality Control and Data Entry/Import Process

For those sent by the main project lab (Xenco / Florida Testing Services LLC) the following process was used to quality control check the results after they had been imported into the project lab results spreadsheet:

1. Enter a new line item with Sample Taken Date (from Chain of Custody), Sampler, Lab ID#, and appropriate number of Analyte Units. Double check that spreadsheet calculated costs match invoice.
2. Check that the number of charged analysis matches the number on the Chain of Custody form (COC).
3. Go through the results looking for:
   a. Flags (must have proper criteria listed)
   b. MDLs, also look for results that are lower than MDLs (MDLs can be higher than the value in the table below as long as the listed MDL / # of dilutions <u>less than or equal to</u> the MDL in the table below)
   c. % RPD's in lab QC section (if all are less than 20% then it's OK, if 20% or more see

Table 8)

4. Check that the case narrative summary (page 4 of report) comments are included in the correct section of the excel spreadsheet.
5. Go through the SampleResultsCombinedFromLab.xls spreadsheet and make sure that the SampleID column is input correctly (should have 5 components separated by dashes) and that the data transferred to the five previous columns correctly.
6. Enter sampler name from chain of custody.
7. Write an email with all issues to the contact at the lab to resolve the issues.

Fecal Laboratory Sample Data Results Quality Control and Data Entry/Import Process

For sampling results reported by the various labs conducting fecal coliform analysis (see Section 2.3.2.2.2), the following process was used to quality control check the results after they had been imported into the project fecal lab results spreadsheet:

1. Go to the lab tab in the Lab Reports binder and verify that unit price matches invoiced price and units match the chain of custody.
2. Data entry:
   a. Enter sampler name from chain of custody.
   b. Copy Sample ID from lab results spreadsheet, highlight all cells to convert, click on data: text to columns, next, delimiters: check other and put in a – then next, destination click and highlight cells in row for columns B-F, then finish.
   c. Enter in the rest of the results in the fecal columns.
   d. Check that qualifiers are correct.
   e. Fix any formatting issues
3. Go into the database and open the linked table and note any fields that didn't import correctly (#Num!) and fix.
4. Email any issues to the contact person.

Appendix D System Evaluation Forms

Initial System Evaluation (Step 3 in System Review) Date:_______Sampler:____________________

A. System Information

System Ref. #: ___________Construction Permit # __________________Operating Permit # __________________

Site Address:____

City/State/Zip:____

County:____

Dates of two previous maintenance entity visits:_____________________Date of previous CHD inspection:______

Operating Permit current: **Yes** ___ **No** ___ Maintenance Contract current: Yes ___ No____

Parties present at this visit: Maintenance Entity__________________CHD:__________Owner/User:______________

Site Visit was announced by_______________ to _____________________ ____ days in advance.

Comments:____

____

B. Access to General Site Location

1. Access to site: ☐ Permission given ☐ Open ☐ Obstructed (locked gate/fence) ☐ Denied ☐ Other

C. Base for Initial System Evaluation (Check all that apply)

☐ Observation from afar ☐ Observation of above-ground parts and control panels
☐ Probing of system location ☐ Permit records

How many systems are at this address? ☐ none found ☐ one ☐ more than one

If not one, comment: ____

D. System Sketch (attach to form), see system components

☐ from final construction inspection ☐ from site plan ☐ created during site visit
☐ from engineer's as-built ☐ other file material

E. System Evaluation (elaborating on HSES 10-006)

1. Observe and record the general appearance/functioning of the treatment system.

a. Are there any signs of surfacing or breakouts near the treatment system? Yes ___ No____
b. Are tanks, lids, or access covers broken or missing? Yes ___ No____ NA____
c. Are there any signs of settling or erosion near the system components? Yes ___ No____
d. Does it appear as though the system is subject to vehicular traffic? Yes ___ No____
e. Is there any encroachment onto the system? If yes, what is within 5ft of system? Yes ___ No____
 ☐ Building ☐ Driveways ☐Utility easements ☐ Patios ☐ Decks ☐ Gardening ☐ Pets ☐Other________
f. Evaluate presence of odor within 10ft of perimeter of system:
 Intensity: ☐ None perceivable ☐ barely perceivable ☐ faint but identifiable ☐ clearly perceivable ☐ strong
 Quality: ☐ Septic ☐ Earthy/Musty/Moldy ☐ Chemical ☐ Sour/Rancid/Putrid ☐ Other_____ ☐ N/A
 Source of odor, if present: ____
g. Evaluate presence of sound (except alarm) within 10ft of perimeter of system:
 Intensity: ☐ None perceivable ☐ Quiet ☐ Clearly Perceivable ☐ Loud
 Source: ☐ Compressor/Aspirator/Blower ☐ Pump ☐ Other ☐ N/A
 Comments: ____
e. Does the system appear water-tight? Yes____No_____Unable to determine______
 If no, where does water seem to ☐ enter or ☐ leave system ?
 ☐ access cover ☐ lid ☐ inlet/outlet ☐ ports ☐ tank ☐ riser attachment to tank ☐ other_____
f. Are any alarms on? Yes____No_____
 If yes, ☐ Air pressure ☐ High water ☐ Remote ☐ Unknown ☐ Other_____________
g. Is there a means to assess sewage flow? (water meter, event counter, flow meter) Yes____No_____
 If yes **and** influent is available for sampling, document meter reading ___________________
h. Comments: ____

2. Observe if system has been altered or the site has changed since approval.

a. Any landscape construction, utility work, or changes in drainage patterns? Yes ___ No____ ND____
b. Has system been obstructed? Yes ___ No____
c. Any apparent recent additions to the building(s) connected to system? Yes ___ No____ ND____

d. Are any components missing or modified? Yes ___ No____ ND____
e. Components that are on this site, and their order: ☐ **not determined: _____________________________**

Component	Order	Component	Order
☐ pretreatment/ trash (☐ part of ATU ☐ separate)		☐ grease interceptor	
☐ treatment unit (☐ aeration ☐ media filter)		☐ clarifier (☐ part of ATU ☐ separate)	
☐ pump tank/compartment (s)		☐ filter tank (media ___________________)	
☐ recirculation from____ to ____		☐ disinfection (☐ chlorine ☐ other________)	
☐ drainfield (☐mound/fill / ☐ below grade)		☐ other (Sampling Port;________________)	

f. Comments: ____

3. Observe that there is power to the system.
   a. Is control panel for treatment system visible? Yes ___ No____ N/A____
   b. Is control panel for treatment system accessible? Yes ___ No____ N/A____
   c. Does power indicator, if present, indicate that power is on? Yes ___ No____ N/A____
   d. Does operation of system (aerator) indicate that power is on? Yes ___ No____ N/A____
   e. Does it appear that the power is switched off? Yes____No____ N/A____
   f. Comments: ____
4. Observe that there is an alarm and, if possible, test it.
   a. Is an alarm present for the treatment unit? Yes ___ No____ N/A____
   b. If yes, which of the following are operational? Audio ___ Visual_____ Unable to test_____
   c. Is an alarm present for the dosing tank, if tank is present? Yes ___ No____ N/A____
   d. If yes, which of the following are operational? Audio ___ Visual_____ Unable to test_____
5. Observe the drainfield area and record conditions.
   a. Are there any trees in the drainfield? Yes ___ No____ N/A____
   b. Relative to surrounding areas, how does the vegetation on the drainfield look?
      ☐ Same ☐ More vegetation. ☐ Uneven vegetation ☐ Less vegetation
      Location(s): ____
   c. Is there evidence that there is ponding in the drainfield? Yes ___ No____ N/A____
      ☐ Standing water on the drainfield surface ☐ Saturated soil only above ☐all ☐some drainfield area
      ☐ Observation port shows ____ inches of standing water ☐ Other ___________________
   d. Comments: ____

F. Access to Sewage

1. Is there an effluent sample port installed? Yes ___ No____ N/A____
   a. Location: _______________Type: ☐ P-trap ☐ Tee ☐ Cross ☐ Distribution box ☐ Petcock (drip) ☐ Other
   b. Odor within sample port: checked ___ not checked __ N/A____
   c. Intensity: ☐ None perceivable ☐ barely perceivable ☐ faint but identifiable ☐ clearly perceivable ☐ strong
   d. Quality: ☐ Septic ☐ Earthy/Musty/Moldy ☐ Chemical ☐ Sour/Rancid/Putrid ☐ Other_____ ☐ N/A
2. Can you get access to the treatment tank? ☐ Directly ☐ Riser ☐ No ☐ N/A
   a. Access location(s): ☐ Inlet ☐ Outlet ☐ Center ☐ Located at grade ☐ Buried_________" ☐ Not determined
   b. Are access covers securely fastened? Yes ___ No____ N/A____
   c. Are access covers in operable condition? Yes ___ No____ N/A____
3. Can you get access to a post-treatment or dosing tank? ☐ Directly ☐ Riser ☐ No ☐ N/A
   a. Access location(s): ☐ Inlet ☐ Outlet ☐ Center ☐ Located at grade ☐ Buried_____" ☐ Not determined
   b. Are access covers securely fastened? Yes____No_____N/A___
   c. Are access covers in operable condition? Yes____No_____N/A___
4. Is it feasible to obtain an influent sample from this system? Yes ___ No____ Questionable____
   a. Location: ☐ Through building sewer cleanout to first compartment ☐ Access to pretreatment compartment
5. Comments: ____

System Operation Evaluation (Step 4 in System Review)

Date:_________Sampler:___________
Time:_______ Cloud Cover (%):________ Rainfall:_____________current _____________ prev. 7 days (inches)

A. System Information

System Ref. #: __________Construction Permit # _________________Operating Permit # _________________
Date of Last Pumpout:_______________________________________

Tank/Compartment # accessed (Section E.2.e from initial system eval.)						
Function						
Material						
Tank Structural Condition						
Liquid level relative to outlet (in) (NA for pump tank)		☐Above ☐Below	☐Above ☐Below	☐Above ☐Below	☐Above ☐Below	☐Above ☐Below
Liquid level relative to inlet (in) (NA for pump tank)		☐Above ☐Below	☐Above ☐Below	☐Above ☐Below	☐Above ☐Below	☐Above ☐Below
Evidence liquid level has been higher						
Evidence liquid level dropped (no pump)						
Evidence of non-sewage inflow						
Appears to be watertight (no visual leaks)						
Oily film/sheen present						
Odor (Intensity/Quality)						
Sample taken?		☐Yes ☐ No	☐Yes ☐ No	☐Yes ☐ No	☐Yes ☐ No	☐Yes ☐ No
Scum	Depth (in)					
	Color					
	Clarity/Structure					
Clear Zone	Depth (in)					
	Color					
	Clarity/Structure					
Sludge	Depth (in)					
	Color					
	Clarity/Structure					
Comments						

Current Rainfall Code 1 None 2 Light 3 Moderate 4 Heavy

Function Code AC aeration chamber CL clarifier DS disinfection
PU pump/dosing/recirc chamber TT trash/pretreatment NN not known OT Other _____
MF media filter (except phosphorus) PO phosphorus sorption media

Material Code CO concrete FG fiberglass PE polyethylene OT other __________

Structural Condition Code
0 structurally sound
1 rebar exposed 2 spalling 3 corrosion present 4 roots inside of compartment
5 cracks present 6 deflection noted 7 inlet seal missing/broken 8 outlet seal missing/broken
9 holes present 10 lid broken/missing 11 manhole cover missing/broken 12 other (list)

Odor Code
Intensity: 0 None perceivable 1 barely perceivable 2 faint but identifiable 3 easily perceivable 4 Strong
Quality: SEP Septic EARTHY Earthy/Musty/Moldy CHEM Chemical SOUR Sour/Rancid/Putrid OTH Other_____ N/A N/A

Color Code BL Black BR Brown MU Mustard GR Gray WH White TAN Tan OTH Other_____ NO None

Clarity/Structure Code CLEAR Clear CLOUD Cloudy MILK Milky MUD Muddy FLOC Flocced GRA Grainy FLU Fluffy

Aeration Chamber □ N.A. □ Yes □ No

1. Aeration chamber:
   Access? □ Yes □ No
   Mixing in aeration chamber: □ Yes □ No Comment: ____
   Settled Sludge Volume test: Sample obtained □ Yes □ No
   Settled __________mL/L, Floating ______mL/L in _______ min
   Settled __________mL/L, Floating ______mL/L in 30 min
   Biomass color: □ Black □ Brown □ Mustard □ Gray □ White □ Other ________
   Biomass structure: □ fluffy □ flocced □ grainy
   Supernatant: □ cloudy □ clear
2. Additional tasks for attached-growth media evaluation:
   a. Plugging □ Yes □ No
   b. Floating □ Yes □ No
   d. Media replaced □ Yes □ No □ Unknown

Media Filters □ N.A. □ Yes □ No

1. Distribution of sewage across media:
   Device: ______________________________
   Uniform distribution □ N.D. □ Yes □ No
   Operating properly □ N.D. □ Yes □ No
   Ponding □ N.D. □ Yes □ No
   Comments: ______________________________________
2. Filter drainage systems
   Ponding in media filter sump □ N.D. □ Yes □ No
   Gravity drainage operational □ N.D. □ Yes □ No
   Solids buildup in sump area □ N.D. □ Yes □ No
   Underdrain vents present □ N.D. □ Yes □ No
   Underdrain vents operable □ N.D. □ Yes □ No

Chlorination System □ N.A. □ Yes □ No

1. Chlorination

Manufacturer: ________________________________
Chlorinator: ________ Dechlorinator:_________
Model #: __________________________________
Method: □ Tablet □ Liquid
Unit appears in good condition. □ Yes □ No
Location in/after tank # ___________

2. Tablet chlorination (if applicable):
   Chlorinator appears operable □ N.D. □ Yes □ No
   Chlorine tablets in place □ N.D. □ Yes □ No
   Tablets in contact with effluent □ N.D. □ Yes □ No
   Contact chamber operable □ N.D. □ Yes □ No
3. Chlorine residual: □ Free _______ ppm
   □ Total_______ ppm

Effluent screen/tertiary filter location: evidence of clogging □ N.A. □ Yes □ No

SYSTEM NUMBER / TANK NUMBER	STATION DESCRIPTION	PARAMETER	DATE	TIME	WATER TEMP	DO	%SAT DO	Trend	ORP	COND	SALINITY	PH
		UNIT	yy/mm/dd	hr:min	Celsius	mg/L	%		mV	µS/cm	ppt	su

Advanced Systems Assessment Field Analysis Form

Sampler:

Test Strip brand/lot/expiration date

Sample Identification									Olfactory/Visual				HACH Colorimeter DR/890						Taylor Kits		Test Strip / Other				
SYSTEM I.D.	Sample Number	Sample Type	Sampling Location	Sampling Method	original/dup	Date mm/dd/yy	Time hh:mm	Lab Sample Taken (y/n)	Odor Intensity	Odor Quality	Color	Clarity	Turbidity	Apparent Color	NO3-N	NH4-N	PO4	PO4-P (=PO4 *.3261)	Total Alkalinity	pH					
									code	code	code	code	FAU	units Pt-Co	mg/L	mg/L	mg/L	mg/L	mg/L CaCO3	su					
	1																								
	2																								
	3																								
	4																								
	5																								
	6																								
Analyst's Initials:																									
See Table 8 — Analysis done within ___hours:																									

Sample Type	Eff =effluent Inf=Influent Tap=tap water QC=quality control
Sampling Location	For Eff: AC-aeration chamber CL-clarifier DS-disinfection ND- not determined OT-other MF-media filter (except phosphorus) PO-phosphorus sorption media PU- pump/dosing/ recirc chamber SP-sampling port; For Inf: TT-trash/pretreatment tank; for QC: PEB=pre-cleaned EB FBL=field blank FEB=field-cleaned EB
Sampling Method	i=intermediate container d=directly from free fall, spigot etc. p=peristaltic pump
original/dup	01-original sample 02-duplicate 1
Odor Intensity	0 None perceivable 1barely perceivable 2 faint but identifiable 3 clearly perceivable 4 strong
Odor Quality	Septic Earthy/Musty/Moldy Chemical Sour/Rancid/Putrid Other_____ N/A
Color	BLack BRown MUstard GRay WHite TAN OTher _____ NOne
Clarity	Clear Cloudy Milky Muddy Flocced Grainy Fluffy

Sample Number	Additional Comments on Sample
1	
2	
3	
4	
5	
6	

Appendix E Laboratory Flagging Criteria

A	Value reported is the mean (average) of two or more determinations. This code shall be used if the reported value is the average of results for two or more discrete and separate samples. These samples shall have been processed and analyzed independently. Do not use this code if the data are the result of replicate analysis on the same sample aliquot, extract or digestate.
B	Results based upon colony counts outside the acceptable range. This code applies to microbiological tests and specifically to membrane filter colony counts. The code is to be used if the colony count is generated from a plate in which the total number of coliform colonies is outside the method indicated ideal range. This code is not to be used if a 100 mL sample has been filtered and the colony count is less than the lower value of the ideal range.
F	When reporting species: F indicates the female sex. Otherwise it indicates RPD value is outside the acceptable range.
H	Value based on field kit determination; results may not be accurate. This code shall be used if a field screening test (i.e., field gas chromatograph data, immunoassay, vendor-supplied field kit, etc.) was used to generate the value and the field kit or method has not been recognized by the Department as equivalent to laboratory methods.
I	The reported value is between the laboratory method detection limit and the laboratory practical quantitation limit.
J	Estimated value. A "J" value shall be accompanied by a narrative justification for its use. Where possible, the organization shall report whether the actual value is less than or greater than the reported value. A "J" value shall not be used as a substitute for K, L, M, T, V, or Y, however, if additional reasons exist for identifying the value as estimate (e.g., matrix spiked failed to meet acceptance criteria), the "J" code may be added to a K, L, M, T, V, or Y. The following are some examples of narrative descriptions that may accompany a "J" code: J1. No known quality control criteria exist for the component; J2. The reported value failed to meet the established quality control criteria for either precision or accuracy (the specific failure must be identified); J3. The sample matrix interfered with the ability to make any accurate determination; J4. The data are questionable because of improper laboratory or field protocols (e.g., composite sample was collected instead of a grab sample). J5. The field calibration verification did not meet calibration acceptance criteria. J6. QC protocol not followed. J7. B/A results for Chlorophyll does not meet 1 – 1.7 ratio.
K	Off-scale low. Actual value is known to be less than the value given. This code shall be used if: 1. The value is less than the lowest calibration standard and the calibration curve is known to be nonlinear; or 2. The value is known to be less than the reported value based on sample size, dilution. This code shall not be used to report values that are less than the laboratory practical quantitation limit or laboratory method detection limit.
L	Off-scale high. Actual value is known to be greater than value given. To be used when the concentration of the analyte is above the acceptable level for quantitation (exceeds the linear range or highest calibration standard) and the calibration curve is known to exhibit a negative deflection.

M	When reporting chemical analyses: presence of material is verified but not quantified; the actual value is less than the value given. The reported value shall be the laboratory practical quantitation limit. This code shall be used if the level is too low to permit accurate quantification, but the estimated concentration is greater than the method detection limit. If the value is less than the method detection limit use "T" below.
N	Presumptive evidence of presence of material. This qualifier shall be used if: 1. The component has been tentatively identified based on mass spectral library search; or 2. There is an indication that the analyte is present, but quality control requirements for confirmation were not met (i.e., presence of analyte was not confirmed by alternative procedures).
O	Sampled, but analysis lost or not performed.
Q	Sample held beyond the accepted holding time. This code shall be used if the value is derived from a sample that was prepared or analyzed after the approved holding time restrictions for sample preparation or analysis.
T	Value reported is less than the laboratory method detection limit. The value is reported for informational purposes, only and shall not be used in statistical analysis.
U	Indicates that the compound was analyzed for but not detected. This symbol shall be used to indicate that the specified component was not detected. The value associated with the qualifier shall be the laboratory method detection limit. Unless requested by the client, less than the method detection limit values shall not be reported (see "T" above).
V	Indicates that the analyte was detected in both the sample and the associated method blank. Note: the value in the blank shall not be subtracted from associated samples.
Y	The laboratory analysis was from an unpreserved or improperly preserved sample. The data may not be accurate.
Z	Too many colonies were present for accurate counting. Historically, this condition has been reported as "too numerous to count" (TNTC). The "Z" qualifier code shall be reported when the total number of colonies of all types is more than 200 in all dilutions of the sample. When applicable to the observed test results, a numeric value for the colony count for the microorganism tested shall be estimated from the highest dilution factor (smallest sample volume) used for the test and reported with the qualifier code.
?	Data are rejected and should not be used. Some or all of the quality control data for the analyte were outside criteria, and the presence or absence of the analyte cannot be determined from the data.

Appendix F User Group Surveys for Regulators, System Owners/Users Maintenance Entities, Engineers, Installers, and Manufacturers

FLORIDA DEPARTMENT OF HEALTH

Advanced Onsite Systems in Florida:
Survey of Regulators

The Florida Department of Health, Division of Environmental Health, Bureau of Onsite Sewage Programs is conducting a study to measure the practices and perceptions of regulators about the management of advanced onsite sewage treatment and disposal systems (OSTDS). Advanced treatment systems for the purposes of this study include aerobic treatment units (ATUs), performance-based treatment systems (PBTS), innovative systems, and sand or gravel filters. Your participation in this study will help us identify the strengths of current practices and experiences as well as areas where improvement may be needed. The FSU Survey Research Laboratory is collecting the information for the Bureau.

We appreciate your assistance. Your opinion is valuable and will assist the Florida Department of Health in planning and administering their onsite sewage programs.

The results of this study will be posted on our website: http://myfloridaeh.com/ostds/research

NUMBER OF SYSTEMS

1. How many of the following systems are in your county?

Aerobic Treatment Units (ATU) ___________

Performance-Based Treatment Systems (PBTS) ___________

Sand or Gravel Filters ___________

Innovative Systems ___________

INSPECTION PERSONNEL

2. How many FTEs are assigned to conduct ATU/PBTS inspections by your county health department?

Number of FTEs ___________

3. Please indicate the number of people in your county health department with the following years of experience inspecting advanced systems:

Experience	**Number of People**
Less than 1 year	___________
1 to 2 years	___________
3 to 5 years	___________
Over 5 years	___________

4. How would you describe turnover of personnel who conduct inspections on advanced systems in your county health department?

- ☐ Not a problem
- ☐ Somewhat a problem
- ☐ A Problem
- ☐ A Serious Problem
- ☐ A Very Serious Problem

Please describe what, in your opinion, are the major contributors to turnover.

CONTRACTORS AND MAINTENANCE ENTITIES

5. How many CONTRACTORS INSTALL advanced systems in your county?

a. Number of Contractors ____________

b. Is this number adequate to meet your county's need?

☐ Yes ☐ No

6. How many LICENSED MAINTENANCE ENTITIES provide maintenance services for advanced systems in your county?

a. Number of Licensed Maintenance Entities ____________

b. Is this number adequate to meet your county's need?

☐ Yes ☐ No

INFORMATION MANAGEMENT AND RECORDKEEPING

7. Please indicate which of the following methods your county health department uses to ENTER AND MAINTAIN INFORMATION (such as design flow, wastewater type, tank sizes, manufacturer, model) for <u>each type</u> of advanced system. *[Please ✓ All That Apply.]*

	ATUs	PBTS
EH Database construction permit records	☐	☐
EH Database operating permit records	☐	☐
Carmody database	☐	☐
Spreadsheets/Tables	☐	☐
Paper files	☐	☐
Other electronic database(s)	☐	☐

8. How does your county health department keep track of THE MONITORING REQUIREMENTS for different types of <u>ATUs</u> and <u>PBTS</u>? *[Please ✓ All That Apply.]*

Monitoring Requirement Examples
ATUs *-- >1500 gpd, residential/commercial.*
PBTS *-- setback and authorized flow allowance, secondary, advanced secondary, Florida Keys.*

- ☐ EH Construction database
- ☐ EH Facilities database
- ☐ Carmody database
- ☐ Spreadsheet/table
- ☐ Electronic database
- ☐ Look at paper files
- ☐ Other *[Please Specify.]* _______________
- ☐ Monitoring not required
- ☐ County health department does not keep track

9. How does your county health department keep track of the MONITORING AND INSPECTION RESULTS for ATUs and PBTS?

- ☐ EH database Operating permits
- ☐ Carmody database
- ☐ Spreadsheet/table
- ☐ Electronic data base
- ☐ Look at paper files
- ☐ Other *[Please Specify.]* _______________
- ☐ Monitoring not required
- ☐ County health department does not keep track

10. How could your county health department RECORDKEEPING PROCESS for advanced systems be improved and made more efficient?

MONITORING AND SAMPLING

11. How would you describe the extent to which your county uses sampling to monitor ATU and PBTS compliance?

- ☐ **Limited sampling** *[Please indicate all the reasons that apply.]*
  - ☐ Sampling not required
  - ☐ No access to system
  - ☐ Limited staff
  - ☐ Limited resources (money)
  - ☐ Visual inspection is sufficient to ensure compliance
  - ☐ Other *[Please Specify.]* ______________________________
- ☐ **Sample the systems that look bad when conducting annual inspection or following-up on a complaint.**
- ☐ **Sample for special projects.**
- ☐ **Sample a percentage of the systems in the county regularly at least once a year with the inspection.** *[Please indicate the percentage of the systems you sample.]*

  ____________ % of advanced systems sampled
- ☐ **Sample all systems.**
- ☐ **Other** *[Please Specify.]* ______________________________

12. a. Has your county health department developed a checklist or form to use when conducting inspections of advanced systems?

- ☐ **Yes** Please attach a copy of the inspection form you use.
- ☐ **No**

b. What activities are typically included during an inspection?
[Please ✓ All That Apply.]

- ☐ Do inspection at the same time a maintenance entity is doing a maintenance visit
- ☐ Open tanks to observe inside of system
- ☐ Leave surface undisturbed
- ☐ Open observation port
- ☐ Trigger alarm
- ☐ Trigger pumps
- ☐ Observe that power is on
- ☐ Check that air supply is running
- ☐ Observe if site conditions have changed
- ☐ Observe smell from treatment system
- ☐ Observe sounds from treatment system
- ☐ Record water meter reading
- ☐ Record presence, number, or duration of alarms
- ☐ Observe ponding depth in drainfield
- ☐ Observe wetness in drainfield area
- ☐ Observe and record general appearance of treatment system functioning
- ☐ Check presence and supply of chlorination tablets if system includes them
- ☐ Other: *[Please describe.]* ______________________________

PERMITTING

13. How common is it to find SUBSTANTIAL CHANGES TO THE PERMITTED DESIGN during construction inspections?

- ☐ Rarely
- ☐ Sometimes
- ☐ Frequently
- ☐ Most of the Time

14. When applications come in who evaluates them? *[Please ✓ All That Apply.]*

Applications for …	Evaluates Applications: County Health Department Engineer	County Health Department Staff	Bureau Engineer	Other *[Please Specify.]*	
ATUs	☐	☐	☐	☐	______________
PBTS	☐	☐	☐	☐	______________
Innovative Systems	☐	☐	☐	☐	______________

15. Knowing that a limited number of INNOVATIVE SYSTEMS APPLICATIONS are allowed to be installed, where do you check to find out how many permits for a given system are already filed? *[Please ✓ All That Apply.]*

- ☐ County Health Department files
- ☐ Applicant
- ☐ Contractor
- ☐ State Health Office Mediator
- ☐ Bureau Engineer
- ☐ Other *[Please Specify.]* ______________

16. Has your county passed any ordinances that require standards for advanced systems that are MORE STRINGENT than those required by the State?

☐ **Yes** Please describe.

☐ **No**

COMPLIANCE ENFORCEMENT AND CORRECTIVE ACTION

17. Please indicate the number of advanced systems in your county that required COMPLIANCE ENFORCEMENT action in the past year.

a. Number of advanced systems requiring enforcement action. ____________

b. What percentage of these systems required multiple enforcement or corrective actions to achieve compliance? __________%

18. COMPLIANCE ENFORCEMENT actions required in the past year were most often due to:

- ☐ Paperwork issues such as failure to pay fees on time or failure to provide updated paperwork when requested
- ☐ Technical / sewage issues such as the system not working correctly
- ☐ Other *[Please Specify.]* ____________________________

19. In general, how often is each of the following successful in ACHIEVING COMPLIANCE for systems that require corrective action?

Achieve Compliance	RARELY	SOME OF THE TIME	MOST OF THE TIME	ALL OF THE TIME	DON'T KNOW
a. Notice to correct	☐	☐	☐	☐	☐
b. Citation/ fine	☐	☐	☐	☐	☐
c. Administrative complaint	☐	☐	☐	☐	☐
d. Revocation of permit	☐	☐	☐	☐	☐
e. Re-engineering of system	☐	☐	☐	☐	☐
f. Other *[Please Specify.]*________	☐	☐	☐	☐	☐

MAINTENANCE ENTITY PERFORMANCE

20. Please indicate the percentage of reports submitted by maintenance entities in the following format:

	PERCENT SUBMITTED BY FORMAT					
Maintenance Entity Reports	5% or Less	10%	25%	50%	75%	100%
Paper	☐	☐	☐	☐	☐	☐
Carmody Database	☐	☐	☐	☐	☐	☐
Other *[Please Specify].* _______________	☐	☐	☐	☐	☐	☐

21. How would you rate the OVERALL QUALITY of maintenance entity reports submitted to your county?

EXCELLENT	GOOD	FAIR	POOR
☐	☐	☐	☐

22. When COMPARING INSPECTION REPORTS about the same system by the maintenance entity and the county health department, would you say:

- ☐ Both usually agree
- ☐ Maintenance entity reports usually indicate better performance
- ☐ County inspections usually indicate better performance
- ☐ Depends on maintenance entity

23. How does your county obtain the results of effluent sampling performed by maintenance entities? *[Please ✓ All That Apply.]*

- ☐ County receives copy from lab
- ☐ Maintenance entity reports results to County Health Department
- ☐ County Health Department does not get reports; maintenance entities keep results
- ☐ Effluent sampling by maintenance entity does not take place
- ☐ Other *[Please Specify.]* ____

24. In customer COMPLAINTS OR COMMENTS related to their maintenance entity, how often do customers express concern about:

Customer Complaints	RARELY	SOME OF THE TIME	MOST OF THE TIME	ALL OF THE TIME
Cost of maintenance contract	☐	☐	☐	☐
Being able to choose between several maintenance entities	☐	☐	☐	☐
Level of service	☐	☐	☐	☐
Other *[Please Specify].* ___________	☐	☐	☐	☐

TRAINING AND EDUCATION NEEDS

25. Please tell us about any training needs for county staff, maintenance entities, or consumers that you would like to be made available regarding advanced systems.

a. **County Health Department Staff Education / Training Needs:**

b. **Maintenance Entity Education / Training Needs:**

c. **Consumer Education / Training Needs:**

d. **Installer/Engineer Education / Training Needs:**

e. **Manufacturer Education / Training Needs:**

GENERAL ASSESSMENT

26. How would you rate the OVERALL TREATMENT PERFORMANCE of the systems in your county?

Type of System	EXCELLENT	GOOD	FAIR	POOR	NO BASIS TO JUDGE
a. ATU	☐	☐	☐	☐	☐
b. PBTS	☐	☐	☐	☐	☐

27. Please tell us about what aspects of the advanced system program in Florida are currently working well as it relates to construction permitting, design, installation, inspection, maintenance, and operating permitting:

28. Please tell us about any changes or improvements you would like to see in regards to the following:

a. ATU regulation, permitting, and management:

b. PBTS regulation, permitting, and management:

c. Maintenance entity regulation, permitting, and management:

d. Innovative System regulation, permitting, and management:

d. Sand / Gravel Filter regulation, permitting, and management:

BACKGROUND INFORMATION

Please give us information for contacting you if we have a question.

County Health Department :	
Address:	
Phone:	
Fax:	
E-mail:	
Contact Name:	
Position:	

Thank you for taking the time to help us with this study.

Please return the survey in the business reply envelope or fax to:

Fax

FSU Survey Research Laboratory
850.644.0792

Use Business Reply Envelope or Mail to:

FSU Survey Research Laboratory
Florida State University
MC 2221
Tallahassee FL 32306-2221

FLORIDA DEPARTMENT OF HEALTH

Advanced Onsite Systems in Florida: Survey of Owners and Users

The Florida Department of Health, Division of Environmental Health, Bureau of Onsite Sewage Programs is conducting a study to measure the practices and perceptions of owners and users about the management of advanced onsite sewage treatment and disposal systems (OSTDS). Advanced treatment systems for the purposes of this study include aerobic treatment units (ATUs), performance-based treatment systems (PBTS), innovative systems, and sand or gravel filters. Your participation in this study will help us identify the strengths of current practices and experiences as well as areas where improvement may be needed. The FSU Survey Research Laboratory is collecting the information for the Bureau.

Your participation is voluntary, but important and will assist the Florida Department of Health in improving wastewater management. If you wish to participate, please complete the enclosed survey and return it in the postage paid business reply envelope provided for your convenience. Thank you for your participation.

The results of this study will be posted on our website: http://myfloridaeh.com/ostds/research

CHARACTERISTICS OF YOUR ADVANCED ONSITE SEWAGE SYSTEM

1. You have been identified as having an advanced Onsite Sewage Treatment and Disposal System. What type of ADVANCED SYSTEM do you have?

- ☐ Aerobic Treatment Unit
- ☐ Performance-Based Treatment system
- ☐ Sand or gravel filter
- ☐ Innovative System *[Please Specify.]* ____________________
- ☐ Other *[Please Specify.]* ____________________
- ☐ Don't Know

- ☐ No, my home/business does not have a septic system → Please return the survey in the envelope provided.
- ☐ My home/business does not have an ADVANCED system *[standard septic tank, drainfield system]* →

2. Please provide the name of your system's manufacturer.

- ☐ Manufacturer of system ____________________
- ☐ Don't know the name of the manufacturer

3. When was your system installed?

☐ Within the past year	☐ 6 to 10 years ago
☐ 2 to 3 years ago	☐ More than 10 years ago
☐ 4 to 5 years ago	☐ Don't Know

OPERATION AND MAINTENANCE

4. How many times have you experienced problems with your sewage system over the PAST YEAR?

- ☐ Never
- ☐ Once or Twice
- ☐ Several Times
- ☐ Just about weekly

5. Within the LAST 5 YEARS, have you had any of the following problems?
[Please ✓ all that apply.]

- ☐ Sewage on ground
- ☐ Plumbing backup
- ☐ Drainfield damaged
- ☐ Tank damaged
- ☐ Parts broken/ system stopped working
- ☐ D-box/ header damaged
- ☐ Other *[Please Specify.]* ____
- ☐ No problems in the last 5 years

6. If you experienced problems, what was the CAUSE OF PROBLEMS?
[Please ✓ all that apply.]

- ☐ System damage
- ☐ Water table too high
- ☐ Weather/ flooding
- ☐ Roots
- ☐ System malfunction
- ☐ Too much water (hydraulic overload)
- ☐ Inadequate drainage (area too wet)
- ☐ Soils
- ☐ Other *[Please Specify.]* ____
- ☐ No problems in the last 5 years

7. Who do you USUALLY rely on to fix problems with your system?

- ☐ Self
- ☐ Maintenance entity
- ☐ Septic tank contractor/ plumber
- ☐ County Health Department
- ☐ Other *[Please Specify.]* ____

8. How satisfied are you with the way problems with your system are handled?

☐ Very Satisfied ☐ Satisfied ☐ Dissatisfied ☐ Very Dissatisfied

☐ Other *[Please Specify.]* ____

ASSESSMENT OF YOUR ADVANCED SYSTEM

9. How would you describe your overall satisfaction with your advanced onsite sewage system (septic system)?

☐ Very Satisfied ☐ Satisfied ☐ Dissatisfied ☐ Very Dissatisfied

10. In your opinion, what is the GREATEST ADVANTAGE of having one of these systems?
[Please ✓ One.]

- ☐ Low cost
- ☐ Cleaner wastewater
- ☐ System will last longer
- ☐ Not being hooked up to sewer system
- ☐ Increased options for building on lot *[possible to build what we want to build on lot]*
- ☐ Other *[Please Specify.]* ____

Page 2 **Survey of Owners and Users** *[«track»]*

11. If cost was equal, would you prefer to:

- ☐ Continue to use an advanced onsite system
- ☐ Hookup to a municipal/ county sewer system
- ☐ Use simpler conventional septic system and pay savings into a water quality improvement trust fund

SYSTEM INSPECTION AND MONITORING

12. Do you periodically inspect your own system?

- ☐ Yes, at least every few months
- ☐ Yes, about once or twice a year
- ☐ No, I don't inspect it at all

13. How often is your onsite septic system inspected by your MAINTENANCE ENTITY?

- ☐ Never
- ☐ Only when there is a problem
- ☐ Less than 2 times a year
- ☐ Twice a year
- ☐ 3 or more times a year
- ☐ Don't Know

- ☐ I don't have a maintenance entity

14. Are you informed of the RESULTS OF INSPECTIONS conducted by:

	Yes	**No**
County Health Department	☐	☐
Maintenance entity	☐	☐

- ☐ I don't have a maintenance entity

EDUCATION ABOUT YOUR ADVANCED SYSTEM

15. What way would you prefer to receive INFORMATION FROM YOUR COUNTY HEALTH DEPARTMENT about your advanced onsite system? *[Please ✓ all that apply.]*

- ☐ Mailed brochures
- ☐ Utility bill inserts
- ☐ E-mails
- ☐ Newspapers
- ☐ TV/ Radio
- ☐ Information posted on department website
- ☐ Public meetings/ workshops
- ☐ Presentations to civic groups (e.g., Rotary Club)
- ☐ Other *[Please Specify.]* ________________________________

16. Please tell us about topics related to advanced onsite systems that you would like to learn more about.

OPERATING PERMITS AND MAINTENANCE FOR ADVANCED ONSITE SEWAGE SYSTEMS

17. How difficult was it to find a maintenance entity for your system?

- ☐ Very difficult to find
- ☐ Somewhat difficult to find
- ☐ Not difficult at all
- ☐ I don't have a maintenance entity

18. What do you estimate is the COST of your:

a. Operating permits and maintenance contract (agreement) for one year $ ___________

b. Repairs and other items not covered by your maintenance contract last year $ ___________

19. How would you rate your satisfaction with the services provided by your maintenance entity?

☐ Very Satisfied ☐ Satisfied ☐ Dissatisfied ☐ Very Dissatisfied

- ☐ No basis to judge
- ☐ Other *[Please Specify.]* ____________________________________

20. When your current agreement comes up for renewal will you:
[Please ✓ all that apply.]

- ☐ Renew maintenance agreement with same entity
- ☐ Switch to a different maintenance entity because of price
- ☐ Switch to a different maintenance entity because of low level of service
- ☐ I would like to switch but there is no alternative
- ☐ Other *[Please Specify.]* ____________________________________

21. If you had your choice, who would you PREFER TO DEAL WITH the permitting and maintenance of your advanced onsite system?
[Please ✓ One.]

- ☐ Utility-type entity owns the system and charges monthly cost that includes all maintenance, repairs, replacement, operating permit, etc.
- ☐ Utility-type entity charges monthly cost that includes all maintenance, repairs, replacement, operating permit, etc. You remain the owner of the system.
- ☐ Maintenance entity that charges monthly cost for standard maintenance and operating permits. Repairs are extra.
- ☐ Maintenance entity that charges for maintenance and operating permits in one lump sum when they are due. Repairs are extra.
- ☐ Do-it-yourself, with help by contractors as needed.
- ☐ Other *[Please Specify.]* ____________________________________

Page 4 **Survey of Owners and Users** *[«track»]*

GENERAL COMMENTS

22. Please tell us about any changes or improvements you would like to see related to the regulation, permitting and management of advanced onsite sewage treatment and disposal systems in the State of Florida:

BACKGROUND INFORMATION

In what COUNTY is your system located?

____

How many months of the year is this SYSTEM IN USE?

________________months a year

Do you OWN OR RENT the property?

- ☐ Own
- ☐ Rent

Your SYSTEM SERVES a.....

- ☐ Single family house
- ☐ Duplex/ apartment/ condominium
- ☐ Modular/ Mobile home
- ☐ Business
- ☐ Other *[Please Specify.]:* _______________

Are you a FULL TIME or SEASONAL resident?

- ☐ Full Time
- ☐ Seasonal

HOW MANY people use your system?

__________ people

In what year were you BORN?

____

You are:

- ☐ Female
- ☐ Male

What is the highest grade or year of school you have COMPLETED?

- ☐ 8 years or less
- ☐ 9 to 11 years
- ☐ High school
- ☐ Business or technical school
- ☐ Community college
- ☐ Completed college
- ☐ Graduate or professional school

Which of the following best describes your TOTAL HOUSEHOLD INCOME in 2009?

- ☐ Under $15,000
- ☐ $ 15,000 to $25,000
- ☐ $25,001 to $45,000
- ☐ $45,001 to $65,000
- ☐ $65,001 to $85,000
- ☐ $85,001 to $100,000
- ☐ Over $100,000

Thank you for your participation.

Please Return This Survey in the Business Reply Envelope
or Mail to:
FSU Survey Research Laboratory
Florida State University
MC 2221
Tallahassee FL 32306-2221

FLORIDA DEPARTMENT OF HEALTH

Advanced Onsite Systems in Florida: Survey of Engineers

The Florida Department of Health, Division of Environmental Health, Bureau of Onsite Sewage Programs is conducting a study to measure the practices and perceptions of engineers about the management of advanced onsite sewage treatment and disposal systems (OSTDS). Advanced treatment systems for the purposes of this study include aerobic treatment units (ATUs), performance-based treatment systems (PBTS), innovative systems, and sand or gravel filters. Your participation in this study will help us identify the strengths of current practices and experiences as well as areas where improvement may be needed. The FSU Survey Research Laboratory is collecting the information for the Bureau.

Your participation is voluntary, but important and will assist the Florida Department of Health in improving wastewater management. If you wish to participate, please complete the enclosed survey and return it in the postage paid business reply envelope provided for your convenience. Thank you for your participation.

The results of this study will be posted on our website: http://myfloridaeh.com/ostds/research

SYSTEMS DESIGNED

1. Does your firm/company design advanced treatment systems such as aerobic treatment units (ATUs), performance-based treatment systems (PBTS), and/or innovative systems?

☐ **NO** **Please tell us why you do not work on advanced systems and skip to Question 10 in the Training and Education Needs Section on page 5.**

☐ **YES** *[Please answer the following.]*

a. Please list the TYPES AND MANUFACTURERS of the advanced treatment systems normally used in your designs.

b. What are the reasons you design the systems listed above?

c. **How many of the following systems did your company DESIGN FOR USE IN FLORIDA during the last year?**

Type of System	**Number of Systems**
Aerobic Treatment Unit (ATU) *[Aerobic Treatment Unit only, i.e. not part of a PBTS]*	_________ **systems**
Performance-Based Treatment System (PBTS), *[Not counting innovative systems]*	_________ **systems**
Innovative Systems	_________ **systems**
Sand or Gravel Filters	_________ **systems**

d. **What percentage of your company's annual revenue comes from DESIGNING ADVANCED SYSTEMS FOR USE IN FLORIDA?**

__________**%** **of annual company revenue**

PERMITTING AND OPERATION

2. **Do you normally handle construction and operating permitting with the County Health Department for the advanced systems that you design?**

☐ **Yes** *[Please answer the following]*

HOW MANY DAYS does it typically take from filing a construction permit application to construction permit issuance?

ATU only	___________	**Innovative Systems**	___________
PBTS	___________	**Sand or Gravel Filters**	___________

☐ **No** Please tell us who handles permits for the advanced systems you design.

3. **How common is it to find SUBSTANTIAL CHANGES TO THE PERMITTED DESIGN during construction inspections?**

☐ Rarely
☐ Sometimes
☐ Frequently
☐ Most of the Time

4. How often does your firm/company have to re-engineer one of its designs for an advanced system in Florida because the system had problems that occurred after the installation was complete?

- ☐ Rarely
- ☐ Some of the time
- ☐ Most of the time
- ☐ All of the time

5. How often is each of the following a reason one of your advanced system designs needs to be re-engineered?

Reason for Re-engineering	RARELY	SOME OF THE TIME	MOST OF THE TIME	ALL OF THE TIME	DON'T KNOW
a. Homeowner misuse	☐	☐	☐	☐	☐
b. Malfunctioning treatment system parts	☐	☐	☐	☐	☐
c. Engineer design	☐	☐	☐	☐	☐
d. Installation	☐	☐	☐	☐	☐
e. Dosing Pump Failure	☐	☐	☐	☐	☐
f. Drainfield Failure	☐	☐	☐	☐	☐
g. Other *[Please Specify.]*	☐	☐	☐	☐	☐

6. How would you rate the OVERALL TREATMENT PERFORMANCE of the systems you have designed:

Type of Advanced System	EXCELLENT	GOOD	FAIR	POOR	NO BASIS TO JUDGE
a. ATU	☐	☐	☐	☐	☐
b. PBTS	☐	☐	☐	☐	☐

MAINTENANCE, MONITORING, AND SAMPLING

7. Do you require sampling for the advanced systems you design?

☐ **YES** Please tell us about the reasons sampling is required, and what sampling frequency you recommend.

☐ **NO** Please tell us about the reasons sampling is not required.

8. In the operation and maintenance manual for a performance-based treatment system or similar system, which tasks do you usually specify for the maintenance entity to perform? *[Please ✓ all that apply.]*

Forms and Checklists

- ☐ Work through a manufacturer's or distributor's check list
- ☐ Work through the engineer's check list if engineered-designed
- ☐ Work through the County Health Department's check list
- ☐ Work through own check list

System Access

- ☐ Open covers to observe aerobic treatment chamber
- ☐ Open covers to observe trash tank/compartment
- ☐ Open covers to observe clarifier/dosing tank
- ☐ Leave surface undisturbed
- ☐ Open observation port

Equipment Checks

- ☐ Trigger alarm
- ☐ Trigger pumps
- ☐ Check that air supply is running

Maintenance Actions

- ☐ Inspect/clean effluent filter
- ☐ Inspect/clean air filter
- ☐ Inspect/clean air diffusers
- ☐ Pump tank(s) every _____ years
- ☐ Replace parts

Assessment of Operating Conditions

- ☐ Check clarity of water in treatment tank/clarifier
- ☐ Check for smell from treatment system
- ☐ Check sounds from treatment system
- ☐ Measure sludge accumulation
- ☐ Check how well solids settle in aerobic treatment chamber
- ☐ Record water meter reading
- ☐ Record number of dosing events or pump runtime (for dosed systems)
- ☐ Record presence, number, or duration of alarms
- ☐ Check and record pressure (drip systems)
- ☐ Check ponding depth in drainfield
- ☐ Check wetness in drainfield area
- ☐ Check presence and supply of chlorination tablets if system includes them
- ☐ Observe and record general appearance of treatment system functioning

Assessment of Effluent Quality

- ☐ Observe clarity of effluent in observation port
- ☐ Use test strips to assess effluent concentrations
- ☐ Use chemistry kits to assess effluent concentrations
- ☐ Take effluent samples for laboratory analysis
- ☐ Take groundwater samples

☐ **Other** *[Please describe.]*

CONTACT WITH OTHER ENTITIES

9. To what extent does your firm/company INTERACT WITH EACH OF THE FOLLOWING ENITITIES CONCERNING THE ADVANCED SYSTEMS YOUR FIRM DESIGNS?

Entity	RARELY INTERACT	SOME OF THE TIME	MOST OF THE TIME	ALL OF THE TIME	OTHER [PLEASE SPECIFY.]	
a. Maintenance Entities for systems	☐	☐	☐	☐	☐	________
b. Owners of systems	☐	☐	☐	☐	☐	________
c. County Health Department Staff	☐	☐	☐	☐	☐	________
d. Manufacturers of system components	☐	☐	☐	☐	☐	________
e. Installers of systems	☐	☐	☐	☐	☐	________

TRAINING AND EDUCATION NEEDS

10. Please tell us about educational/training opportunities related to advanced systems that you would like to be made available to individuals in your profession.

GENERAL ASSESSMENT

11. Please tell us about what aspects of the advanced system program in Florida are currently working well as it relates to construction permitting, design, installation, inspection, maintenance, and operating permitting:

12. Please tell us about any changes or improvements you would like to see to the following:

a. ATU regulation, permitting, and management:

b. PBTS regulation, permitting, and management:

c. Maintenance entity regulation, permitting, and management:

d. Innovative System and/or Sand or Gravel Filter regulation, permitting, and management:

BACKGROUND INFORMATION

Please give us information for contacting you if we have a question.

Name of Your Firm :
Address:
Phone:
Fax:
E-mail:
Contact Name:
Position:

Thank you for taking the time to help us with this study.

Please return this survey in the business reply envelope or fax to:

Fax

FSU Survey Research Laboratory
850.644.0792

Use Business Reply Envelope or Mail to:

FSU Survey Research Laboratory
Florida State University
MC 2221
Tallahassee FL 32306-2221

FLORIDA DEPARTMENT OF HEALTH

Advanced Onsite Systems in Florida: Survey of Installers

The Florida Department of Health, Division of Environmental Health, Bureau of Onsite Sewage Programs is conducting a study to measure the practices and perceptions of installers about the management of advanced onsite sewage treatment and disposal systems (OSTDS). Advanced treatment systems for the purposes of this study include aerobic treatment units (ATUs), performance-based treatment systems (PBTS), innovative systems, and sand or gravel filters. Your participation in this study will help us identify the strengths of current practices and experiences as well as areas where improvement may be needed. The FSU Survey Research Laboratory is collecting the information for the Bureau.

Your participation is voluntary, but important and will assist the Florida Department of Health in improving wastewater management. If you wish to participate, please complete the enclosed survey and return it in the postage paid business reply envelope provided for your convenience. Thank you for your participation.

The results of this study will be posted on our website: http://myfloridaeh.com/ostds/research

SYSTEMS INSTALLED

1. Does your company install advanced treatment systems, such as aerobic treatment units (ATUs), performance-based treatment systems (PBTS), sand or gravel filters, and/or innovative systems?

☐ **YES** *[Please answer the following.]*

a. Please list the TYPES AND MANUFACTURERS of the advanced treatment systems your company is certified to install.

b. What are the reasons you install the systems listed above?

c. How many of the following systems did your company INSTALL IN FLORIDA during the last year?

Aerobic Treatment Unit (ATU only, i.e. not part of a PBTS) _________ systems

Performance-Based Treatment System (PBTS), not counting innovative systems _________ systems

Innovative Systems _________ systems

Sand or Gravel Filters _________ systems

d. What percentage of your company's annual revenue comes from INSTALLING ADVANCED SYSTEMS IN FLORIDA?

___________% of annual company revenue

☐ **NO - Please tell us why you do not install advanced systems.**

2. Are you a MAINTENANCE ENTITY?

☐ **YES**

☐ **NO - Please tell us why you are not a maintenance entity.**

REPAIR

3. Please estimate the average number of repair calls your company performs per year for a typical system.

ATU only ____________

PBTS ____________

Innovative Systems ____________

Sand or Gravel Filters ____________

4. How often are each of the following a REASON FOR FAILURE OR PROBLEMS with the systems you install?

Reason for Failure or Problems	NEVER	SOME OF THE TIME	MOST OF THE TIME	ALL OF THE TIME	DON'T KNOW
a. Homeowner misuse	☐	☐	☐	☐	☐
b. Malfunctioning treatment system parts	☐	☐	☐	☐	☐
c. Engineer design	☐	☐	☐	☐	☐
d. Installation	☐	☐	☐	☐	☐
e. Dosing Pump Failure	☐	☐	☐	☐	☐
f. Drainfield Failure	☐	☐	☐	☐	☐
g. Power to unit turned off	☐	☐	☐	☐	☐
h. Other *[Please Specify.]* _________	☐	☐	☐	☐	☐

5. How would you rate the OVERALL TREATMENT PERFORMANCE of the systems you install?

Type of System Installed	EXCELLENT	GOOD	FAIR	POOR	NO BASIS TO JUDGE
a. ATU	☐	☐	☐	☐	☐
b. PBTS	☐	☐	☐	☐	☐
c. Innovative Systems	☐	☐	☐	☐	☐
d. Sand or Gravel Filters	☐	☐	☐	☐	☐

CONTACT WITH OTHER ENTITIES

6. To what extent does your firm/company INTERACT WITH EACH OF THE FOLLOWING ENITITIES CONCERNING THE ADVANCED SYSTEMS YOU INSTALL?

Entity	RARELY INTERACT	SOME OF THE TIME	MOST OF THE TIME	ALL OF THE TIME	OTHER [PLEASE SPECIFY.]
a. Owners of systems	☐	☐	☐	☐	☐ ________
b. County Health Department Staff	☐	☐	☐	☐	☐ ________
c. Manufacturers of system components	☐	☐	☐	☐	☐ ________
d. Engineers of the systems you install	☐	☐	☐	☐	☐ ________
e. Maintenance Entities for systems	☐	☐	☐	☐	WE ARE THE MAINTENANCE ENTITY ☐

7. What method does your company use to determine CUSTOMER SATISFACTION WITH THE PERFORMANCE of the advanced systems you install? *[Please ✓ all that apply.]*

☐ Track customer complaints received
☐ Leave card for customer comments with service call/inspection
☐ Questionnaire sent with bill
☐ Don't keep track
☐ Other *[Please Specify.]* ____________________

8. Do you normally handle construction and operating permitting with the County Health Department for the systems you install?

☐ **Yes**

How many days does it typically take from filing a construction permit application to construction permit issuance?

ATU only ________ Innovative Systems ________
PBTS ________ Sand or Gravel Filters ________

☐ **No Please tell us who handles permitting for the systems you install?**

INFORMATION MANAGEMENT

9. Which system or method do you use for accessing and keeping information on the advanced systems you install?

- ☐ Carmody Database
- ☐ Spreadsheets and tables
- ☐ Paper filing system
- ☐ Contact county health department when needed
- ☐ Other *[Please Specify.]* ___________

TRAINING AND EDUCATION NEEDS

10. Please tell us about training opportunities related to ATUs and PBTS that you would like to be made available to your company personnel.

GENERAL ASSESSMENT

11. Please tell us about what aspects of the advanced system program in Florida are currently working well as it relates to construction permitting, design, installation, inspection, maintenance, and operating permitting:

12. Please tell us about any changes or improvements you would like to see to the following:

a. ATU regulation, permitting, and management:

b. PBTS regulation, permitting, and management:

c. Innovative System regulation, permitting, and management:

d. Sand or Gravel Filter regulation, permitting, and management:

e. Maintenance entity regulation, permitting, and management:

BACKGROUND INFORMATION

Please give us information for contacting you if we have a question.

Name of Your Business :
Address:
Phone:
Fax:
E-mail:
Contact Name:
Position:

Thank you for taking the time to help us with this study.

Please return this survey in the business reply envelope or fax to:

Fax
FSU Survey Research Laboratory
850.644.0792
Use Business Reply Envelope or Mail to:
FSU Survey Research Laboratory
Florida State University
MC 2221
Tallahassee FL 32306-2221

FLORIDA DEPARTMENT OF HEALTH

Charlie Crist
Governor

Ana M. Viamonte Ros, M.D., M.P.H.
State Surgeon General

March, 2010

Letter to Maintenance Entities

The Florida State University (FSU) Survey Research Lab is under contract with the Florida Department of Health Bureau of Onsite Sewage Programs to conduct a survey of contractors who are maintenance entities for advanced onsite sewage treatment and disposal systems (OSTDS). Advanced treatment systems for the purposes of this study include aerobic treatment units (ATUs), performance-based treatment systems (PBTS), innovative systems, and sand or gravel filters. The purpose of the survey is to learn about the perceptions and practices of system maintenance entities regarding the management of advanced OSTDS.

The FSU Survey Research Lab will also be gathering information on advanced OSTDS from system owners/users, system manufacturers, system installers, system engineers, and County Health Departments. The results of these surveys will provide the Bureau with critical information to assess and improve wastewater management in the state.

Your participation is voluntary, but important and will assist the Department in planning and administering its onsite sewage programs. If you wish to participate, please complete the enclosed survey and return it in the postage paid business reply envelope provided for your convenience.

The Florida Department of Health's Bureau of Onsite Sewage Programs develops and implements statewide rules for permitting the installation, maintenance, and repair of OSTDS within the state, including advanced systems. The Bureau also manages a state funded research program that applies for and receives grants to conduct research on OSTDS in Florida. This project is funded by a grant from the United States Environmental Protection Agency.

Should you have any questions, please feel free to call Ms. Elke Ursin at (850) 245-4070 or contact her by e-mail at Elke_Ursin@doh.state.fl.us.

Thank you for your assistance.

Sincerely,

Gerald R. Briggs
Bureau Chief

NOTE: Florida has a very broad public records law. Most written communications to or from state officials regarding state business are public records available to the public and the media upon request. Therefore your responses to this survey may be subject to public disclosure.

Division of Environmental Health, Bureau of Onsite Sewage Programs
4052 Bald Cypress Way, Bin #A08, Tallahassee, Florida 32399-1713

FLORIDA DEPARTMENT OF HEALTH

Advanced Onsite Systems in Florida:
Survey of Maintenance Entities

The Florida Department of Health, Division of Environmental Health, Bureau of Onsite Sewage Programs is conducting a study to measure the practices and perceptions of maintenance entities about the management of advanced onsite sewage treatment and disposal systems (OSTDS). Advanced treatment systems for the purposes of this study include aerobic treatment units (ATUs), performance-based treatment systems (PBTS), innovative systems, and sand or gravel filters. Your participation in this study will help us identify the strengths of current practices and experiences as well as areas where improvement may be needed. The FSU Survey Research Laboratory is collecting the information for the Bureau.

Your participation is voluntary, but important and will assist the Florida Department of Health in improving wastewater management. If you wish to participate, please complete the enclosed survey and return it in the postage paid business reply envelope provided for your convenience. Thank you for your participation.

The results of this study will be posted on our website: http://myfloridaeh.com/ostds/research

AMOUNT OF MAINTENANCE WORK

1. How many, and what types, of the following advanced onsite systems do you maintain:

a. How many **Aerobic Treatment Units** * does your company MAINTAIN **in Florida** at this time?
**This question pertains to ATU only systems, i.e. units that are NOT a component of a PBTS*

Aerobic Treatment Unit (ATU) _________ units/systems

Please list the TYPES AND MANUFACTURERS of the ATUs your company maintains in Florida.

b. How many **PBTS** * units does your company MAINTAIN **in Florida** at this time?
** This question includes ATU's used as part of a PBTS*

Performance-Based Treatment System (PBTS) ________ units/systems

Please list the TYPES AND MANUFACTURERS of the PBTS your company maintains in Florida.

c. How many **INNOVATIVE SYSTEM** * units does your company MAINTAIN **in Florida** at this time? ** This question includes ATU's used as part of an INNOVATIVE SYSTEM*

Innovative System ________ units/systems

Please list the TYPES AND MANUFACTURERS of the INNOVATIVE SYSTEMS your company maintains in Florida.

2. What percentage of your company's annual revenue comes from MAINTAINING advanced units/systems (ATUs, PBTS, and Innovative Systems) in Florida?

___________% of annual company revenue

MAINTENANCE CONTRACTS

3. How often do you bill your maintenance contract customers?

- ☐ Yearly
- ☐ Quarterly
- ☐ Every Month
- ☐ Other *[Please Specify.]* ______________________

4. What is the average annual fee you charge your maintenance contract customers?

Average Annual Maintenance Contract $ ______________________________

5. What services are covered by the annual contract fee you charge? *[Please ✓ all that apply.]*

- ☐ Required inspections
- ☐ Replacement of parts
- ☐ Replacement of system
- ☐ Routine maintenance
- ☐ Sampling
- ☐ Other *[Please Specify.]* ______________________

6. How often do you INSPECT a system as part of the maintenance contract?

- ☐ Three or more times a year
- ☐ Twice a year
- ☐ Less than twice a year
- ☐ Depends on type of unit
- ☐ Other *[Please Specify.]* ______________________

7. Please estimate the average number of NON-ROUTINE service and repair visits per year for a typical system:

ATU only ____________

PBTS ____________

Innovative ____________

8. What method does your company use to keep customers informed about their system's performance? *[Please ✓ all that apply.]*

- ☐ Give customer copy of inspection report
- ☐ Leave notice of inspection visit at home
- ☐ Contact customer only if there is a problem with their system that requires corrective action
- ☐ Other *[Please Specify.]* ______________________

MAINTENANCE, MONITORING, AND SAMPLING

9. When you or your staff performs a maintenance inspection, what is usually done?
[Please ✓ all that apply.]

Forms and Checklists

- ☐ Work through a manufacturer's or distributor's check list
- ☐ Work through the engineer's check list if engineered-designed
- ☐ Work through the County Health Department's check list
- ☐ Work through own check list

System Access

- ☐ Open covers to observe aerobic treatment chamber
- ☐ Open covers to observe trash tank/compartment
- ☐ Open covers to observe clarifier/dosing tank
- ☐ Leave surface undisturbed
- ☐ Open observation port

Equipment Checks

- ☐ Trigger alarm
- ☐ Trigger pumps
- ☐ Check that air supply is running

Maintenance Actions

- ☐ Inspect/clean effluent filter
- ☐ Inspect/clean air filter
- ☐ Inspect/clean air diffusers
- ☐ Pump tank(s) every _____ years
- ☐ Replace parts

Assessment of Operating Conditions

- ☐ Check clarity of water in treatment tank/clarifier
- ☐ Check for smell from treatment system
- ☐ Check sounds from treatment system
- ☐ Measure sludge accumulation
- ☐ Check how well solids settle in aerobic treatment chamber
- ☐ Record water meter reading
- ☐ Record number of dosing events or pump runtime (for dosed systems)
- ☐ Record presence, number, or duration of alarms
- ☐ Check and record pressure (drip systems)
- ☐ Check ponding depth in drainfield
- ☐ Check wetness in drainfield area
- ☐ Check presence and supply of chlorination tablets if system includes them
- ☐ Observe and record general appearance of treatment system functioning

Assessment of Effluent Quality

- ☐ Observe clarity of effluent in observation port
- ☐ Use test strips to assess effluent concentrations
- ☐ Use chemistry kits to assess effluent concentrations
- ☐ Take effluent samples for laboratory analysis
- ☐ Take groundwater samples

☐ **Other** *[Please describe.]*

10. Do you take samples from any of the advanced systems you service?

☐ **YES** *[Please answer the following.]*

a. What conditions trigger taking a sample? *[Please ✓ all that apply.]*

- ☐ Permit requirement
- ☐ Standard business practice
- ☐ Odor/ color of effluent
- ☐ Other *[Please Specify.]* ______________

b. Who performs sampling for lab analysis of the advanced systems you maintain?

- ☐ My company does sampling
- ☐ Other entity does sampling *[Please Specify.]* ____________________
- ☐ Sampling is not required/performed on maintained systems

c. How often do samples or observations during maintenance inspections show that the advanced systems are out of compliance?

- ☐ Rarely
- ☐ Some of the time
- ☐ Most of the time
- ☐ All of the time

☐ **NO**

11. How often are each of the following a REASON FOR FAILURE OR PROBLEMS with the systems you maintain?

Reason for Failure or Problems	NEVER	SOME OF THE TIME	MOST OF THE TIME	ALL OF THE TIME	DON'T KNOW
a. Homeowner misuse	☐	☐	☐	☐	☐
b. Malfunctioning treatment system parts	☐	☐	☐	☐	☐
c. Engineer design	☐	☐	☐	☐	☐
d. Installation	☐	☐	☐	☐	☐
e. Dosing Pump Failure	☐	☐	☐	☐	☐
f. Drainfield Failure	☐	☐	☐	☐	☐
g. Unit turned off	☐	☐	☐	☐	☐
h. Other [*Please Specify.*] _________	☐	☐	☐	☐	☐

INFORMATION MANAGEMENT

12. What method do you use to TRANSMIT YOUR INSPECTION REPORTS to the county health department? *[Please ✓ all that apply.]*

- ☐ Carmody Database
- ☐ E-mail
- ☐ Fax
- ☐ Mail
- ☐ Deliver in person
- ☐ Other *[Please Specify.]* ____________________

13. Which system or method do you use for accessing and keeping information on the systems you maintain?

- ☐ Carmody Database
- ☐ Spreadsheets and tables
- ☐ Paper filing system
- ☐ Contact county health department when needed
- ☐ Other *[Please Specify.]* ___________

If you do not use the Carmody Database system, please indicate why:

- ☐ Don't know about this free service
- ☐ No access to computers
- ☐ No access to the internet
- ☐ Data security issues
- ☐ Don't want to use more than one record-keeping method
- ☐ Other *[Please Specify.]* ____________________

PERFORMANCE

14. How would you rate the OVERALL TREATMENT PERFORMANCE of the systems you maintain?

Type of System Maintained	EXCELLENT	GOOD	FAIR	POOR	NO BASIS TO JUDGE
a. ATU	☐	☐	☐	☐	☐
b. PBTS	☐	☐	☐	☐	☐
c. Innovative Systems	☐	☐	☐	☐	☐

CONTACT WITH OTHER ENTITIES

15. To what extent do you INTERACT WITH EACH OF THE FOLLOWING ENITITIES CONCERNING THE ADVANCED SYSTEMS YOU MAINTAIN?

Entity	RARELY INTERACT	SOME OF THE TIME	MOST OF THE TIME	ALL OF THE TIME	OTHER [PLEASE SPECIFY.]
a. Manufacturers of systems you maintain	☐	☐	☐	☐	☐ ____________
b. Owners of systems you maintain	☐	☐	☐	☐	☐ ____________
c. County Health Department Staff	☐	☐	☐	☐	☐ ____________
d. Engineers of the systems you maintain	☐	☐	☐	☐	☐ ____________
e. Installers of systems you maintain	☐	☐	☐	☐	WE ARE THE INSTALLER ☐

TRAINING AND EDUCATION NEEDS

16. Please tell us about training opportunities related to ATUs and PBTS that you would like to be made available to your company personnel.

GENERAL ASSESSMENT

17. Please tell us about what aspects of the advanced system program in Florida are currently working well as it relates to construction permitting, design, installation, inspection, maintenance, and operating permitting:

18. Please tell us about any changes or improvements you would like to see in regards to the following:

a. ATU regulation, permitting, and management:

b. PBTS regulation, permitting, and management:

c. Innovative System regulation, permitting, and management:

d. Maintenance entity regulation, permitting, and management:

BACKGROUND INFORMATION

Please give us information for contacting you if we have a question.

Name of Your Business :
Address:
Phone:
Fax:
E-mail:
Contact Name:
Position:

Thank you for taking the time to help us with this study.

Please return this survey in the business reply envelope or fax to:

Fax

FSU Survey Research Laboratory
850.644.0792

Use Business Reply Envelope or Mail to:

FSU Survey Research Laboratory
Florida State University
MC 2221
Tallahassee FL 32306-2221

FLORIDA DEPARTMENT OF HEALTH

Advanced Onsite Systems in Florida:
Survey of Manufacturers

The Florida Department of Health, Division of Environmental Health, Bureau of Onsite Sewage Programs is conducting a study to measure the practices and perceptions of manufacturers about the management of advanced onsite sewage treatment and disposal systems (OSTDS). Advanced treatment systems for the purposes of this study include aerobic treatment units (ATUs), performance-based treatment systems (PBTS), innovative systems, and sand or gravel filters. Your participation in this study will help us identify the strengths of current practices and experiences as well as areas where improvement may be needed. The FSU Survey Research Laboratory is collecting the information for the Bureau.

Your participation is voluntary, but important and will assist the Florida Department of Health in improving wastewater management. If you wish to participate, please complete the enclosed survey and return it in the postage paid business reply envelope provided for your convenience. Thank you for your participation.

The results of this study will be posted on our website: http://myfloridaeh.com/ostds/research

MANUFACTURE AND SALE OF ADVANCED UNITS IN FLORIDA

1. Does your company manufacture advanced treatment systems such as aerobic treatment units (ATUs), performance-based treatment systems (PBTS), and/or innovative systems sold for use in Florida?

☐ **NO** **Please tell us why you do not manufacture advanced systems for use in Florida and skip to Question 10 in the Training and Education Needs Section on page 5.**

☐ **YES** *[Please continue]*

MANUFACTURE AND SALE OF ADVANCED UNITS IN FLORIDA

2. Please list the TYPES of advanced systems your company manufactures for sale/use in Florida:

3. How many of each of the following systems did your company sell for USE IN FLORIDA during the last year?

Type of System	**Number Sold**
Aerobic Treatment Unit *[ATU only, i.e. not part of a PBTS]*	_________ **systems**
Performance-Based Treatment System (PBTS) *[Not counting innovative systems]*	_________ **systems**
Innovative Systems	_________ **systems**
Sand or Gravel Filters	_________ **systems**

4. What percentage of your company's annual revenue comes from the sale of the following TO CUSTOMERS IN FLORIDA?

__________% Advanced System Components

__________% Standard System Components

CONTACT WITH OTHER ENTITIES

5. To what extent does your firm/company INTERACT WITH EACH OF THE FOLLOWING ENITITIES CONCERNING THE ADVANCED SYSTEMS YOUR FIRM MANUFACTURES?

Entity	RARELY INTERACT	SOME OF THE TIME	MOST OF THE TIME	ALL OF THE TIME	OTHER [PLEASE SPECIFY.]	
a. Maintenance Contractors for systems	☐	☐	☐	☐	☐	________
b. Owners of systems	☐	☐	☐	☐	☐	________
c. County Health Department Staff	☐	☐	☐	☐	☐	________
d. Engineers of the systems you manufacture	☐	☐	☐	☐	☐	________
e. Installers of systems you manufacture	☐	☐	☐	☐	☐	________

AUTHORIZED MAINTENANCE CONTRACTOR

6. How many maintenance contractors are currently authorized by your company to service your company's advanced systems in Florida?

__________ Number of Authorized Contractors

7. What criteria/qualifications do you require maintenance contractors to meet in order to be authorized by your company to service the advanced systems you manufacture for sale in Florida?

8. Do you specify a region where a maintenance contractor can maintain your advanced systems within Florida?

☐ **YES**
☐ **NO**

9. Which of the following tasks do you usually specify that the maintenance contractor perform during routine inspections of the advanced systems you manufacture for use in Florida?
[Please ✓ All That Apply.]

Forms and Checklists

- ☐ Work through a manufacturer's or distributor's check list
- ☐ Work through the engineer's check list if engineered-designed
- ☐ Work through the County Health Department's check list
- ☐ Work through own check list

System Access

- ☐ Open covers to observe aerobic treatment chamber
- ☐ Open covers to observe trash tank/compartment
- ☐ Open covers to observe clarifier/dosing tank
- ☐ Leave surface undisturbed
- ☐ Open observation port

Equipment Checks

- ☐ Trigger alarm
- ☐ Trigger pumps
- ☐ Check that air supply is running

Assessment of Operating Conditions

- ☐ Check clarity of water in treatment tank/clarifier
- ☐ Check for smell from treatment system
- ☐ Check sounds from treatment system
- ☐ Measure sludge accumulation
- ☐ Check how well solids settle in aerobic treatment chamber
- ☐ Record water meter reading
- ☐ Record number of dosing events or pump runtime (for dosed systems)
- ☐ Record presence, number, or duration of alarms
- ☐ Check and record pressure (drip systems)
- ☐ Check ponding depth in drainfield
- ☐ Check wetness in drainfield area
- ☐ Check presence and supply of chlorination tablets if system includes them
- ☐ Observe and record general appearance of treatment system functioning

Maintenance Actions

- ☐ Inspect/clean effluent filter
- ☐ Inspect/clean air filter
- ☐ Inspect/clean air diffusers
- ☐ Pump tank(s) every _____ years
- ☐ Replace parts

Assessment of Effluent Quality

- ☐ Observe clarity of effluent in observation port
- ☐ Use test strips to assess effluent concentrations
- ☐ Use chemistry kits to assess effluent concentrations
- ☐ Take effluent samples for laboratory analysis
- ☐ Take groundwater samples

☐ **Other** *[Please describe.]*

TRAINING AND EDUCATION NEEDS

10. Please tell us about educational/training opportunities related to advanced systems that you would like to be made available to your customers and maintenance contractors in Florida.

GENERAL ASSESSMENT

11. Please tell us about what aspects of the advanced system program in Florida are currently working well as it relates to construction permitting, design, installation, inspection, maintenance, and operating permitting:

12. Please tell us about any changes or improvements you would like to see to the following:

a. ATU regulation, permitting, and management in Florida:

b. PBTS regulation, permitting, and management in Florida:

c. Innovative System regulation, permitting, and management:

d. Sand or gravel filter regulation, permitting, and management:

e. Maintenance contractor regulation, permitting, and management:

BACKGROUND INFORMATION

Please give us information for contacting you if we have a question

Name of Your Business :
Address:
Phone:
Fax:
E-mail:
Contact Name:
Position:

Thank you for taking the time to help us with this study.

Please return this survey in the business reply envelope or fax to:

Fax

FSU Survey Research Laboratory
850.644.0792

Use Business Reply Envelope or Mail to:

FSU Survey Research Laboratory
Florida State University
MC 2221
Tallahassee FL 32306-2221

Appendix G FDOH Evaluation of Advanced Systems Management Practices Database Description

Table Name	**Description**
CountyStats	Contains the number of systems by various categories (total, unknown, ATU total, Innovative, PBTS non innovative, and PBTS total) by county as well as population estimates and population density estimates.
AverageFractionScoresAllCounties	Contains the average for each county of the calculation % x/(x+o) for various items, where x = the total number of permits that received a full score for that item and o = the total number of permits that received no score for that item (i.e., they failed to complete the item). The items that were scored were: ▪ ATU Inspection 1 by AME (2000 – 2010) ▪ ATU Inspection 2 by AME (2000 – 2010) ▪ ATU Inspection 1 by CHD (2000 – 2010) ▪ ATU Maintenance Contract (2000 – 2010) ▪ ATU Operating Permit (2000 – 2010) ▪ ME Contract Termination Report (2000 – 2010) ▪ ME Inspection Reports (2000 – 2010) ▪ ME Service Permit (2000 – 2010) ▪ PBTS Application (2009 – 2010) ▪ PBTS Inspection1 by CHD (2000 – 2010) ▪ PBTS Inspection 1 by ME (2009 – 2010) ▪ PBTS Inspection 2 by ME (2009 – 2010) ▪ PBTS Maintenance Contract (2009 – 2010) ▪ PBTS Monitoring (2009 – 2010) ▪ PBTS Operating Permit (2000 – 2010) The PBTS items were officially separated out in the evaluation tool starting with the 2009-2011 cycle. The items PBTS Inspection 1 by FDOH county office and PBTS Operating Permit were both items that received a similar score for all years except the pre-2009 scores would also include information from establishments in Industrial/Manufacturing zones and establishments generating commercial strength sewage waste.
ProgEvalScoresAllYears	Contains information on the program evaluation scores from 2000 – 2011 for all counties except the ones that were not completed as of mid-September 2011 (Clay, Escambia, Okaloosa, St. Johns, Sarasota, Volusia, and

<table>
<tr><td></td><td>Washington counties). The overall program score is given, as well as the ATU score, the maintenance entity permit files, and other operating permits (including PBTS). These scores were averaged in several different ways: total average, average over last two evaluations, and average over the last evaluation. The percent difference was calculated between the total average and the average of the last two evaluations, and the total average and the average of the last evaluation for each of the subgroups.</td></tr>
<tr><td>SurveyOwnerAveragesCombined</td><td>Contains information gathered from the user group surveys from homeowners/users for several questions:

▪ Average of users that experienced problems over the past year (question #4 from the owners survey)
▪ Average overall satisfaction with their advanced system (question #9 from the owners survey)
▪ Average number of homeowners that inspect their system and how frequently (question #12 from the owners survey)
▪ Average number of homeowners that are informed of the results of their inspections by the FDOH county office's (question #14 from the owners survey)
▪ Average of how difficult it was to find a maintenance entity (question #17 from the owners survey)
▪ Average of how satisfied users are with the services provided by their maintenance entity (question #19 from the owners survey)
▪ Average of whether homeowners would choose to keep their advanced system if costs were equal (question #11 from the owners survey)</td></tr>
<tr><td>SurveyRegulator</td><td>Contains information gathered from the user group surveys from regulators for several questions:

▪ Number of ATU's (question #1a from the regulator survey)
▪ Number of PBTS (question #1b from the regulator survey)
▪ Number of full time employees assigned to conduct ATU/PBTS inspections (question #2 from the regulator survey)
▪ Total years of experience for those employees inspecting advanced systems (if answer was less than 1 year multiplied by 0.5, if answer was 1 – 2 years multiplied by 1.5, if answer was 3 – 5 years multiplied by 4, if answer was over 5 years multiplied by 6) (combination of results from</td></tr>
</table>

	question 3 from the regulator survey) ▪ Average years of experience for those employees inspecting advanced systems (averaged those that had values, for example Alachua had the total years for less than 1 year at 1 year, none for 1 – 2 or 3 – 5 years, and a total of 12 years for over 5, so the average was 6.5 ((1+12)/2) (combination of results from question 3 from the regulator survey) ▪ Whether turnover is a problem for personnel who conduct inspection on advanced systems (question #4 from the regulator survey) ▪ Number of contractors installing advanced systems (question #5a from the regulator survey) ▪ Are the number of contractors installing advanced systems adequate (question #5b from the regulator survey) ▪ Number of maintenance entities providing maintenance on advanced systems (question #6a from the regulator survey) ▪ Are the number of maintenance entities providing maintenance on advanced systems adequate (question #6b from the regulator survey) ▪ Which counties use Carmody for entering and maintaining information, keeping track of monitoring requirements, and/or keeping track of the monitoring and inspection results for ATUs and PBTS (modified combination from question #s 7, 8, and 9 from the regulator survey) ▪ Which counties have developed a checklist or form to use when conducting inspections of advanced systems (question #12a from the regulator survey) ▪ Which counties have passed ordinances that require standards for advanced systems more stringent than state rules (question #16 from the regulator survey) ▪ Number of advanced systems requiring compliance enforcement action in the past year (question #17a from the regulator survey) ▪ Overall quality of maintenance entity reports submitted (question #21 from the regulator survey) ▪ Overall treatment performance of ATUs (question #26a from the regulator survey) ▪ Overall treatment performance of PBTS (question #26b from the regulator survey)

Appendix H DRAFT FDOH Operating Permit Inspection Report

FLORIDA DEPARTMENT OF HEALTH

STATE OF FLORIDA
DEPARTMENT OF HEALTH
ONSITE SEWAGE TREATMENT AND DISPOSAL SYSTEM
OPERATING PERMIT INSPECTION REPORT
AUTHORITY: 381.0065, FLORIDA STATUTES,
64E-6, FLORIDA ADMINISTRATIVE CODE

PURPOSE:
- ☐ Routine
- ☐ Re-inspection
- ☐ Complaint
- ☐ Other: ____________

PERMITTED FOR:
- ☐ Industrial/Manufacturing
- ☐ Commercial
- ☐ Aerobic Treatment Unit
- ☐ Performance Based Treatment System

PERMIT NUMBER: ____________

INSPECTION DATE: ____________

Begin: ________ **End:** ________

ESTABLISHMENT NAME: ____________

LOCATION ADDRESS: ____________ CITY: ________ ZIP: ______

PROPERTY OWNER/AGENT ____________ PHONE: ________

BUSINESS OWNER/CONTACT: ____________ PHONE: ________

RESULTS:
- ☐ Satisfactory
- ☐ Incomplete
- ☐ Unsatisfactory

Correct Violations by
- ☐ Next Inspection
- ☐ 8:00 am on:

Date: ________

Items marked below with an "x", are not in compliance with the requirements of Chapter 64E-6, Florida Administrative Code, and require correction within 72 hours unless specified otherwise under Comments and Instructions. Continued operation of this facility without making these corrections is a violation of Chapter 64E-6, Florida Administrative Code, and Chapter 381, Florida Statutes. Violations must be corrected as indicated or an administrative fine, citation or other legal action may be initiated.

GENERAL INFORMATION
- ☐ 1. Application/Business Survey(s)
- ☐ 2. Operating Permit
- ☐ 3. Conditions of Operating Permit
- ☐ 4. Sanitary Nuisance
- ☐ 5. Change In Ownership Or Tenancy
- ☐ 6. Change in Original Permitted Conditions
- ☐ 7. Setbacks to Pertinent Features
- ☐ 8. Single/Multi-Tenant (# of units): ____________
- ☐ 9. Business Activity (I/M and COM): ____________

COMMERCIAL SEWAGE
- ☐ 10. Grease Interceptor
- ☐ 11. Increase In Flow (seating etc.): ____________
- ☐ 12. Menu/Service Type
- ☐ 13. Floor Plan
- ☐ 14. Hours of Operation
- ☐ 15. Other Conditions: ____________

AEROBIC TREATMENT UNIT/PEFORMANCE-BASED TREATMENT SYSTEM
- ☐ 16. Maintenance Contract: ____________
- ☐ 17. Unit Operational
- ☐ 18. Warning Device
- ☐ 19. Bypass(ATU<1500 GPD)
- ☐ 20. Sampling Port(s) (ATU<1500 GPD)
- ☐ 21. Sampling/Monitoring(PBTS): ____________
- ☐ 22. Other Conditions: ____________

INDUSTRIAL/MANUFACTURING or EQUIVALENT
- ☐ 23. Chemical Storage/Disposal
- ☐ 24. Labeling Of Chemicals
- ☐ 25. Contracted Waste Haulers: ____________
- ☐ 26. Sampling Requirements: ____________
- ☐ 27. Floor Drains/Utility Sinks
- ☐ 28. Increase In Flow
- ☐ 29. Other Conditions: ____________

ITEM NUMBERS	COMMENTS AND INSTRUCTIONS

Inspected by: ____________ ____________ CHD

Received by: ____________ Date: ____________

Delivery Method: ☐Mail ☐Hand delivery ☐Fax ☐Email

DH 4145 (04/11)

Instructions/Explanations for Operating Permit Inspection Report

PURPOSE – Indicate whether the inspection was a routine, re-inspection, complaint or other type of inspection. Routine inspections are conducted on an annual basis. 64E-6.003(2)(e).
PERMITTED FOR – Indicate the type(s) of operating permit; Industrial/Manufacturing, Commercial Sewage Waste, Aerobic Treatment Unit (ATU) or Performance Based Treatment System (PBTS). Mark all that apply. Only one operating permit is to be issued for each system.
PERMIT NUMBER – Indicate the Operating Permit Tracking number.
INSPECTION DATE – Indicate the date and the beginning and end times of the inspection.
ESTABLISHMENT NAME – Indicate the name of the business, if a single business or the name of the complex if multiple businesses are present.
LOCATION ADDRESS – Indicate the actual address of the property.
PROPERTY OWNER/AGENT'S NAME – Enter the property owner's full name or the legally authorized representative.
BUSINESS OWNER AND PHONE – Indicate the name and phone number of the business owner. If multiple businesses present, use separate sheets.

GENERAL INFORMATION
1. Application/Business Survey(s). 64E-6.003(5). The Application for Onsite Sewage Treatment and Disposal System Operating Permit (Form DH 4081, 10/96) should be completed along with the Business Survey (Form DH 4081A, 10/96), for the current operating permit.
2. Operating Permit. 64E-6.003(5)(a) – (c). and sec. 381.0065(4), FS. Annual operating permits are required for systems located in industrial/manufacturing zones or equivalent (IM), or where commercial sewage waste (COM) is generated. Biennial operating permits are required for ATU and PBTS and are obtained by the approved maintenance entity.
3. Conditions Of Operating Permit. 381.0065(4), FS, 64E-6.027(6)(b). The operating permit is issued with specific conditions based on what the system was designed and approved for. For example a specific number of seats for a food establishment, sampling requirement for an IM or PBTS, etc.
4. Sanitary Nuisance. sec. 386.01, FS. An improperly built or maintained onsite sewage disposal and treatment system (OSTDS), or any condition that may threaten or cause disease to an individual. An example would include sewage on the ground surface.
5. Change In Ownership Or Tenancy. 64E-6.003(5)(b). If the tenancy of a business changes, a new business survey form must be completed and submitted to the County Health Department (CHD).
6. Change In Original Permitted Conditions. 64E-6.001(4). If the conditions under which the original prior approved system have changed, this may cause the system to require new permit and be reapproved. This could also affect the conditions of the operating permit.
7. Setbacks to Pertinent Features. 64E.005(1)-(3). This would include setbacks to wells, surface water bodies and other features (that may have been added/altered after system approval or previous inspection). This would also constitute a change in original permitted conditions.
8. Single/Multi-Tenanted – Indicate the number of businesses/tenants that are served by the system.
9. Business Activity. 64E-6.002(13) and DOH/DEP Interagency Agreement. For Commercial and Industrial/Manufacturing permits, the currently-operating business matches the operating permit.

COMMERCIAL SEWAGE
10. Grease Interceptor. 64E-6.013(7). A grease interceptor is normally required for facilities that serve and/or prepare food and where the quantities of grease produced could cause line stoppage or hinder sewage disposal. Check to see if grease interceptor is nuisance free, access ports are sealed and if pumping is necessary.
11. Increase In Sewage Flow (seating, etc.) 64E-6.001(4) and 64E-6.008 Table I. An increase in flow may result in a change in the original permitted conditions that would void the original permit. Flow increases could result from increases/changes in items such as; food service(seats), food outlet with deli/bakery/meat (floor space), daycare(children), group care(residents), schools(students), civic/church(members, meals served), animal grooming/kennels(cages, wash tubs), and/or beauty salon (wash sink).
12. Menu/Service Type. 64E-6.008 Table I. For food establishments that operate with or without single service utensils (disposable cups, plates, and silverware). The type of food served or prepared at a food establishment. e.g. Deli, bakery, meat market, etc.
13. Floor Plan. 64E-6.008 Table I. The floor plans or square footage of the food preparation area in certain businesses that would affect the sewage flow. e.g., food outlets.
14. Hours Of Operation. 64E-6.008 Table I. In food establishments, the operating hours that would affect the sewage flow (16 hours or more or less than 16 hours according to current rule).
15. Other Conditions. Any other condition that is pertinent.

AEROBIC TREATMENT UNIT/PERFORMANCE-BASED TREATMENT SYSTEM
16. Maintenance Contract/Agreement. 64E-6.012(2)(l),(m), 64E-6.009(5)(a)20. and 64E-6.018(3). A maintenance contract/agreement is required for the life of the system and shall be initially for a period of 2 years, renewed at least annually.
17. Unit Operational. 64E-6.012(2). Power to the unit and aeration devices working properly. Access to ports shall be tamper and child resistant.
18. Warning Device. 64E-6.012(2)(c). A visual and audio warning device is required, should be installed in a conspicuous location and functional.
19. Bypass (ATU<1500 GPD). 64E-6.012(2)(f). Bypass that allows sewage to enter drainfield without treatment is not allowed.
20. Sampling Port(s) (ATU<1500 GPD). 64E-6.012(2)(b). Sampling ports should be accessible and installed between the tank outlet and drainfield.
21. Sampling/Monitoring (PBTS). 64E-6.003(5)(b). and 64E-6.029. Monitoring shall be required based on the performance level of the system according to 64E-6.029. See also Informational Memo 08-003.
22. Other Conditions. Any other condition that is pertinent.

INDUSTRIAL/MANUFACTURING or EQUIVALENT
23. Chemical Storage/Disposal. 64E-6.003(5)(a). The storage and disposal methods of the chemical compounds should be checked to ensure there is not a likelihood they will be disposed of into the OSTDS.
24. Labeling Of Chemicals. 64E-6.003(5)(a). The chemical compounds should be labeled to check for compliance with the business survey.
25. Contracted Waste Haulers. Business Survey (DH4081A, 10/96). A waste hauler that has been required by DEP to dispose of any industrial wastes generated at the site.
26. Sampling Requirements. 64E-6.003(5)(a). Sampling of chemical compounds is occurring in compliance with the conditions indicated on the annual operating permit.
27. Floor Drains/Utility Sinks. 64E-6.002(29). Wastewater from floor drains and utility sinks shall not be directed to an OSTDS. If floor drains or utility sinks are present, they shall be addressed by DEP and the method for disposal listed on the operating permit.
28. Increase In Sewage Flow. 64E-6.001(4) and 64E-6.008 Table I. A change in the business activity that would increase the flow for IM or equivalent businesses. For example doctors/medical offices (practitioners), warehouses (loading bays), offices (floor space).
29. Other Conditions. Any other condition that is pertinent.

COMMENTS AND INSTRUCTIONS
Identify any comments, violations, instructions and/or corrective actions.
Inspected By. Name of certified department person conducting inspection. Print name after signature. **CHD.** Name of County Health Department.
Received By. Name of person at the site receiving inspection report or to whom the report is mailed. **Date.** Date inspection report delivered or mailed.
Delivery. Check the delivery method.

Appendix I Interview Questions to Assess FDOH County Office Advanced System Management Practices

Person Interviewed: ____

Role(s) in Advanced Program (EH Director, Supervisor, Inspector):

____

Out of the FTEs assigned to conduct ATU/PBTS program activities, how do these generally split between different skill levels between technical, clerical, administrative, management, and legal staff? (we are looking for a general answer)

What are some changes that have occurred recently? (e.g., Charlotte had rapid increase in number of systems, Monroe now has rapid drop, foreclosures due to economic environment throughout state). Please be clear about what time period information is applicable

Workflow Process Matrix (Could also be done as workflow diagram by the county)

Determination	**Who identifies this?**	**Where does the information come from?**	**Where is the information recorded?**	**Who is notified?**	**What is the approximate fraction of advanced systems that have this?**
CHD inspection is due/overdue					
ME-inspection is due/overdue					
OP-renewal is due/overdue					

ME-contract renewal is due/overdue					
System is not operating properly in the field					
Reminder is sent					
Response is received					
Citation is sent					
Follow up on citation					
Compliance is achieved					
Case is closed					

How do you address unoccupied structures?

1. Do you keep track of vacancies?

2. How do you deal with systems that are powered off?

3. How do you find out about changes?

4. How long does it take from finding a problem to abatement (typically, three quarters of cases…)?

5. What is a typical fine in a citation?

6. What do you typically collect?

How frequent are the following problems, and who typically identifies them first? Are there any special trainings that staff have had to identify these issues? Are there many unreported service events?

Problem	How Frequent? (Often, Sometimes, Seldom, Never)	Who Identifies Problem (CHD, Owner/user, ME, Other (e.g., neighbor), Nobody)
Power switched off		
Power failure		
Power on, but blower/aspirator does not work		
Blower/aspirator makes noise but aeration is not effective (e.g., diffuser clogged, tubing kinked or disconnected)		
Alarm on (why is it on generally?)		
Broken/missing cover or lid		
Ponding of drainfield		
Changes to permit condition		
Smell		
Operating permit expired		
Maintenance contract expired		

What is the next step? (Call/reminder letter/citation to ME, owner, etc.)

Who does it?

How do you educate other user groups? Any specialized training opportunities or outreach efforts?

Any best practices that you would consider effective for running the program?

Any suggestions for improvement?

Category	**Best Management Practices**
Recordkeeping	
Inspections & Sampling	
Enforcement	
Funding	
Education	

Recommendations for Maintenance Entities to interview and what sorts of best management practices do you see coming from the MEs?

Appendix JInterview Questions to Assess Maintenance Entity Advanced System Management Practices

Selected Maintenance Entity: ___________________________________

Which counties do you work in?

How many advanced systems do you maintain? Are these mostly ATUs or PBTS? What kind?

Do you also install septic systems? If not, why not?

Approximately what percentage of your work comes from maintaining advanced systems?

Any changes that have occurred recently that effect the installation and/or maintenance of advanced systems?

How do you handle vacant/unoccupied structures?

What is your opinion of the new rule that will require homeowners to go through the CHD to obtain their operating permit?

What is the average fee you charge for maintenance contract customers? What does that include? (inspections, parts, sampling)

Do you notify homeowners of your visit? Before going out / during visit (door hanger) / after visit?

Do you have a lot of non-routine service/repair visits?

What is the reason for failure or problems with the systems you maintain? (homeowner misuse, malfunctioning treatment system parts, dosing pump failure, drainfield failure, unit turned off)

How frequent are the following problems, and who typically identifies them first?

Problem	How Frequent? (Often, Sometimes, Seldom, Never)	Who Identifies Problem (ME, CHD, Owner/user, Other (e.g., neighbor), Nobody)
Power switched off		
Power failure		
Power on, but blower/aspirator does not work		
Blower/aspirator makes noise but aeration is not effective (e.g., diffuser clogged, tubing kinked or disconnected)		
Alarm on (why is it on generally?)		
Broken/missing cover or lid		
Ponding of drainfield		
Changes to permit condition		
Smell		
Operating permit expired		
Maintenance contract expired		

How do you send your inspection reports to the CHD? (Carmody, email, fax, in person)

How do you access and track information on the systems you maintain? (Carmody, spreadsheets, paper files)

If you don't use Carmody, why not?

How would you rate the treatment performance of the systems you maintain? (Excellent, good, fair, poor, no basis to judge) What criteria did you use to determine this rating? (power is on/blower is running, there is no sanitary nuisance, no unscheduled maintenance visits)

How do you receive education and/or educate other user groups (homeowners, CHDs, manufacturers, engineers, installers)? Any specialized training opportunities or outreach efforts?

Would you find it useful for there to be a brochure from the Health Department targeted to homeowners on basic care and information on advanced systems?

Any suggestions for improvement for the program?

What sorts of best management practices do you implement as an ME? (i.e checklist, reminders for inspections, close relationship with homeowner)

Any other best practices that you would consider effective for running the program for advanced systems?

Category	**Best Management Practices**
Recordkeeping	
Inspections & Sampling	
Enforcement	
Funding	
Education	