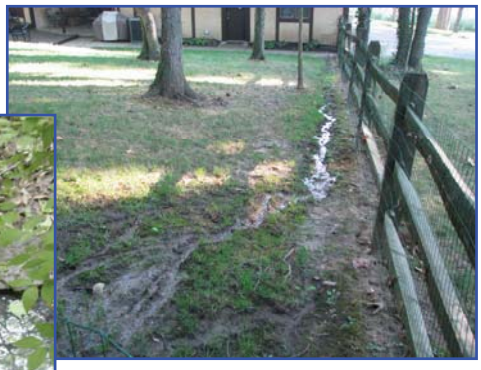
Survey of Household Sewage Treatment Systems Operation and Failure Rates in Ohio



June 1, 2008

Ohio Department of Health

Executive Summary

Am. Sub. H.B. 119 requires the Director of Health to conduct a survey of boards of health in this state concerning household sewage treatment system operations and the failure rates of those systems, and issue a report concerning the survey to the Household Sewage and Small Flow On-Site Sewage Treatment System Study Commission not later than June 1, 2008. The operation and failure rate data collected and presented in this report included a survey of local health district system information, data collected by Ohio EPA for the Clean Water Act Section 303(D) list, the Total Maximum Daily Load (TMDL) reports, Ohio EPA enforcement data, areawide planning agency reports, and state 2000 census data.

Regional meetings were held with local health districts and a survey tool was developed to facilitate collection of the local health district data. Survey data was reported by 73 local health districts. Of the 73 responses, 67 responses were from county health districts and 6 responses were from city health districts. Information on household sewage treatment systems operation and failure rates is also collected by the Ohio EPA as part of their survey of stream quality and impairment and published in the *Ohio 2008 Integrated Water Quality Monitoring and Assessment Report*. Another source of information on operation and failure rates was the Total Maximum Daily Load (TMDL) reports. TMDL reports provide detailed information on sources of pollution for watersheds and stream segments, including the presence of specific groups and numbers of failing systems.

Sewage system failure is typically defined as 1) the inability of the system to accept wastewater at the rate it was designed for which prevents or limits the use of the plumbing fixtures; 2) when the wastewater discharge exceeds the absorptive capacity of the soil, resulting in ponding, seepage, or other discharge of contaminants to surface or ground water, or 3) when wastewater is discharged from a system causing contamination of surface and/or ground water. Failure may also be defined as exceeding state water quality standards. State water quality standards have been established for bathing beach waters, primary contact water, and secondary contact or public health nuisance, and establish limits for fecal coliform, E. coli, odor, and visual manifestations of sewage. The National Pollutant Discharge Elimination System (NPDES) General Permit for household systems sets effluent quality standards for physical and chemical parameters. While specific ground water quality standards are not set for Ohio, ground water quality is generally measured against public and private drinking water standards. Contamination from sewage systems has been documented in some areas of Ohio, especially where ground water is vulnerable to shallow contamination.

Sewage system failure occurs due to a variety of reasons including system age, poor system siting and design, lack of proper operation and maintenance, and system owner abuse or overloading. Authority to require operation permits is present in current rules, however, consistent requirements for inspections and service or maintenance agreements does not exist. A 2002 survey of local health districts showed that only 8%

of the 1 million systems in Ohio are currently under an operation inspection program, with approximately half of the local health districts inspecting at least some system types within their jurisdiction.

Findings

A review of the Clean Water Act, Section 303(d) report prepared by Ohio EPA shows that a total of 37 watersheds, and 116 streams and stream segments have been impacted by urban, unknown and other sources of pollution. Ohio EPA has identified that these source types are often related to failing on-site and discharging sewage systems. Thirty-seven final and draft Total Maximum Daily Load (TMDL) reports for specific watersheds were reviewed, with evaluation of 121 subwatershed units. Of the 121 subwatershed units reviewed, 102 or 84% reported a major source of impairment as bacteria, fecal coliform or pathogens. In addition, of the 121 subwatershed units evaluated, 91 (76%) reported that home sewage systems were a suspected source of impairment. A total numbers of 15,428 failing systems were identified for twenty-three (23) subwatersheds. Surface water is the most frequently identified impact from failing systems in Ohio particularly in areas with large numbers of discharging sewage systems.

The survey questionnaire provided to local health districts requested information for areas in their jurisdiction on 1) the number of systems and systems failures reported by county/area with identification of system type, total existing systems, currently failing systems and systems projected to fail within the next 5 years; 2) principal reasons for failure with identification of failure types observed and the relative percentage of failure type for that county/area; and 3) manifestation of the failure with a check of all ways that failure occurred for that county/area. Local health districts were asked to also provide an indication of the level of accuracy of the data reported. In Ohio, approximately 100 local health jurisdictions implement a sewage program. For this survey, 73 health districts reported survey data.

Based on the survey data reported, 23% of the sewage systems installed today are failing, and 13% are projected to fail within the next 5 years. The southwest region of the state reported the largest number of existing systems (33%) and the southeast region reported the least number of systems (15%). Both the northwest and the southeast regions of the state reported the largest number of failing systems at 26% of each region's totals. The least number of failing systems was reported in the central region. Conversely, the northeast (27%) and southwest (27%) regions reported the largest number of expected future failing systems, and the southeast (10%) region reported the lowest expected number of failing systems.

The largest percentage of discharging systems is located in the northwest and northeast regions of the state. The largest number of on-site systems is located in the southwest region of the state. Of the total systems reported for the categories cited above, 63% were reported as on-site systems and 37% were reported as discharging systems. Assuming a daily discharge of 360 gallons per day for a three bedroom home, then over 61 million gallons of effluent are discharging daily from discharging systems to streams and waterways.

The average percentage of reasons for failure reported shows that soil limitations, substandard or poor designs, space limitations, old system age, no leach lines, and discharges exceeding public health nuisance standards occurred on greater than 40% of the sites reported for all regions of the state. Shallow seasonal water tables and poor operation and maintenance occurred an average of 40% or more in the areas reported in at least three regions of the state. Other reasons for failure such as steep slopes, owner abuse, and unapproved systems were cited less frequently for all regions, but were identified as a more predominant reason for failure in a particular region most likely due to local conditions.

The manifestations of data reported shows that breakout or surfacing of sewage and discharges exceeding public health or NPDES standards are the primary consequences of system failure occurring in Ohio. Some areas of the state, such as southwest Ohio, reported almost twice the number of areas with discharge failures as compared to the rest of the state. The northeast and southwest regions also reported surfacing of sewage as another major consequence of system failure. Impaired or impacted waterways were identified as a major consequence of system failure in the northwest and the southwestern areas of the state. Suspected or known ground water contamination was reported in all areas of the state, but was reported most frequently in the northwest region.

Other sources of failure data were reported including specific surveys and investigations by the Northern Ohio Areawide Coordinating Agency (NOACA) and the Toledo Metropolitan Area Council of Governments (TMACOG). The NOACA study of seven counties and over 700 systems found an on-site sewage system failure rate of 13 to 20% and that 20-33% of off-lot discharging system had poor water quality effluent with 32 to 63% not meeting water quality standards in the original 1977 sewage disposal system rules. In 2001, the Toledo Metropolitan Area Council of Governments (TMACOG) identified 55 critical home sewage disposal areas in 5 counties where system failures were occurring and corrective action was needed. From 1986 through 2007, Ohio EPA has identified 236 communities where failing systems have caused either public health nuisances or environmental degredation and administrative orders to correct have been issued. Sewage permit data reported to the ODH for permits issued in 2007 showed that 30% of the nearly 7,000 permits issued were obtained for system alteration or replacement.

An analysis of 2000 U.S. Census data shows that over 1 million homes in Ohio were constructed prior to 1977 when statewide minimum sewage rules were adopted. Typical design life expectancies for household sewage systems are 30-40 years. Systems constructed prior to 1977 will most likely not have permit records, and the design and construction is unknown. Subsequently, these systems may be more prone to failure in the near future.

Permit data for July 1, 2007 through may 1, 2008 shows new household systems accounted for 65% of all systems installed, household replacement systems were 21%, and household alterations were 13% respectively of all systems installed. Small flow onsite systems accounted for 1% of all new systems installed, and alterations and

replacements to these systems accounted for less than 1% of all systems installed. Permit data for July 1, 2007 through May 1, 2008 shows that septic tank or pretreatment to leach line systems accounted for the majority of systems installed at 67% of the state total. Septic tank/pretreatment to sand mounds accounted for 14%, septic tank/pretreatment to drip distribution accounted for 3%, NPDES systems (replacement of existing discharging systems) accounted for 10%, and other system types accounted for 8% respectively of all systems installed. Permit cost data shows that system costs ranged from $6,450 for septic tank to leach lines to $22,355 for pretreatment to drip distribution. State average system costs were very similar to those reported by ODH in the January 1, 2008 report except that costs for mound systems declined approximately $2,000, and NPDES system costs declined by about $1,000. Several low pressure pipe systems were installed during the reporting period at an average cost ranging from $10,000 to $11,708.

Conclusions and Recommendations

This report concludes that a substantial number of systems in Ohio are failing due to system age, poor siting and design, reported water quality data and observances by state agencies and local health districts. Lack of operation and maintenance has likely also been a significant contributing factor to system failure, and inconsistent operation inspections are conducted across the state.

ODH recommends proper siting, design and installation of sewage treatment systems to help ensure the protection of public health and the environment, and protection of the investment a property owner makes in a sewage treatment system. This will also reduce the need for public dollars to provide sewage treatment through public facilities in the future. System designs need to account for site and soil conditions, site limitations, reasonable expected design flows and waste strength to ensure proper system performance.

Proactive and preventive approaches to managing sewage treatment systems that combines public education, local health district involvement, local planning and management factors, and consideration of area risks to sensitive water or ecological resources are needed. Improved coordination and training for local watershed groups and other grass roots organizations (green and community initiatives) will help promote an understanding of the importance of proper sewage system operation and maintenance to the system owner, and the impact to a community when systems are not maintained. Local health districts need legal and enforcement tools to ensure that service contracts for mechanical systems are maintained, and that routine inspection and maintenance occurs for all systems. Decentralized management of systems should be supported and encouraged as a public and private sector tool that provides assistance and support to system owners, offers a cost structure that is affordable, and helps ensure that systems in a wide range of density configurations are properly managed.

Introduction

Amended Sub. H.B. 119, Section 737.12 (B) enacted on July 1, 2007 states:

(*B) The Director shall conduct a survey of boards of health in this state concerning household sewage treatment system operations and the failure rates of those systems. The Director shall issue a report concerning the survey to the Household Sewage and Small Flow On-Site Sewage Treatment Systems Study Commission not later than June 1, 2008. Boards of health shall provide, in a timely manner, any and all relevant information pertaining to the household sewage treatment system program that is requested by the Director under this division and that the Director determines to be necessary for completion of the survey.*

This report has been prepared by the Ohio Department of Health (ODH) to comply with the requirements of the law.

Types and Sources of Data Collected

The operation and failure rate data collected and presented in this report included a survey of local health district system information, data collected by Ohio EPA for the Clean Water Act Section 303(D) list, the Total Maximum Daily Load (TMDL) reports, Ohio EPA enforcement data, areawide planning agency reports, watershed groups, and state 2000 census data.

During the latter part of 2007 and early 2008, ODH conducted regional training meetings with local health districts and requested comments on the content of this report, the types of data that should be collected for the required survey, and issues or challenges related to the data collection for local health districts and ODH. As a result of those meetings, and consultation with Ohio EPA, a survey for the local health districts to obtain information on operation and failure rates was developed and is included in Appendix A. This survey, and accompanying instructions and examples, was provided to local health districts on March 5, 2008. Completed surveys were requested to be returned to ODH by May 2, 2008. Two conference calls were scheduled (March 6 and 12, 2008) to discuss the survey and the associated requirements, and respond to questions. Information on the survey and forms was also provided at the Midwest Conference for sanitarians sponsored by ODH in March, and at the regional training meetings in April. The forms, examples and instruction were also posted on the ODH website for easy access.

Approximately 100 local health district jurisdictions in Ohio implement a sewage program. A total of 73 local health districts responded to the survey. Of the 73 responses, 67 responses were from county health districts and 6 responses were from city health districts. Not all city health districts conduct a household sewage program depending on the extent of public sewers in their jurisdiction. Table 1 shows the

distribution of responses by region and Table 2 shows the listing of counties that responded to the survey.

Table 1. Distribution of survey responses by region.

Region/Response	*Number responding/total counties in region*	*Percent responded*
Northwest	20/24	83%
Northeast	13/15	87%
Southeast	13/23	56%
Southwest	14/16	87%
Central	8/10	82%

Table 2. Listing of local health districts providing a response to the survey.

Health District	*Survey Response*	*Health District*	*Survey Response*
Adams County	No	Lorain County	Yes
Allen County	No	Elyria City	Yes
Ashland County	Yes	Lucas County	No
Ashtabula County	Yes	Madison County	Yes
Conneaut City	Yes	Mahoning County	Yes
Athens County	Yes*	Marion County	No
Auglaize County	Yes	Medina County	Yes
Belmont County	Yes	Meigs County	Yes
Brown County	No	Mercer County	Yes
Butler County	Yes	Miami County	No
Carroll County	No	Monroe County	No
Champaign County	Yes	Montgomery County	Yes
Clark County	Yes	Morgan County	Yes
Clermont County	Yes	Morrow County	No
Clinton County	Yes	Muskingum County	Yes
Columbiana County	Yes	Noble County	Yes
Coshocton County	No	Ottawa County	Yes
Coshocton City	Yes	Paulding County	No
Crawford County	Yes	Perry County	No
Cuyahoga County	Yes	Pickaway County	Yes
Darke County	Yes	Pike County	No
Defiance County	Yes	Portage County	Yes
Delaware County	Yes	Preble County	Yes
Erie County	Yes	Putnam County	Yes
Fairfield County	Yes	Richland County	Yes
Fayette County	Yes	Shelby City	Yes
Franklin County	Yes	Ross County	Yes
Fulton County	Yes	Sandusky County	Yes
Gallia County	Yes	Scioto County	No
Geauga County	Yes	Seneca County	Yes
Greene County	Yes	Shelby County	Yes

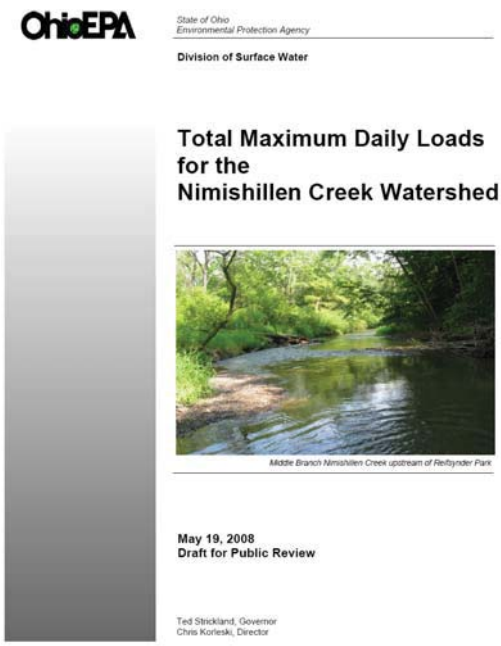
Health District	Survey Response	Health District	Survey Response
Guernsey County	No	Stark County	Yes
Hamilton County	Yes	Summit County	Yes
Cincinnati City	Yes	Akron City	Yes
Hancock County	Yes	Barberton City	Yes
Hardin County	Yes	Trumbull County	Yes
Harrison County	No	Tuscarawas County	Yes
Henry County	Yes*	Union County	Yes
Highland County	Yes	Van Wert County	Yes
Hocking County	Yes	Vinton County	Yes
Holmes County	No	Warren County	Yes
Huron County	Yes	Washington County	No
Jackson County	Yes	Wayne County	Yes
Jefferson County	Yes	Williams County	Yes
Knox County	Yes	Wood County	No
Lake County	Yes	Wyandot County	Yes
Lawrence County	No	Marion City	
Licking County	No		
Logan County	Yes		

*data not included in tables for this report

The results of the local health district survey are described in the Survey Results and Analysis section of this report.

Information on household sewage treatment systems operation and failure rates is also collected by the Ohio EPA as part of their survey of stream quality and impairment and is known as the *Ohio 2008 Integrated Water Quality Monitoring and Assessment Report*. Each State is required by Section 303(d) of the Clean Water Act (33 U.S.C. 1313), to submit a prioritized list of impaired waters to U.S. EPA for approval (the "303(d) list"). The list indicates the waters of Ohio that are currently impaired and may require Total Maximum Daily Load (TMDL) development in order to meet water quality standards. The report indicates the general condition of Ohio's waters and identifies waters that are not meeting water quality goals. Prepared in accordance with federal guidance, the report satisfies the Clean Water Act requirements for both Section 305(b) water quality reports and Section 303(d) lists of impaired waters. The report describes the procedure that Ohio EPA used to develop the list and indicates which areas have been selected for TMDL development during FFY 2009 through 2010. The report may be found at http://www.epa.state.oh.us/dsw/tmdl/2008IntReport/2008OhioIntegratedReport.html#Section%20A. The Section 303(d) list of impaired streams was reviewed to determine areas where failing sewage systems were identified as one of the sources of impairment.

Another source of information on operation and failure rates was the Total Maximum Daily Load (TMDL) reports, also prepared by the Ohio EPA. These reports are established under Section 303(d) of the Clean Water Act (33 U.S.C. 1313), and focus on identifying and restoring polluted rivers, streams, lakes and other surface waterbodies. A TMDL is a written, quantitative assessment of water quality problems in a waterbody and contributing sources of pollution. It specifies the amount a pollutant



needs to be reduced to meet water quality standards (WQS), allocates pollutant load reductions, and provides the basis for taking actions needed to restore a waterbody. While the scope and content of the TMDL reports have evolved over time, they provide detailed information on sources of pollution for watersheds and stream segments, including the presence of specific groups and numbers of failing systems. The TMDL reports can be accessed at the Ohio EPA website at http://www.epa.state.oh.us/dsw/tmdl/index.html#TMDL%20Projects. A summary of the sewage systems failure and operation rates from the TMDL reports is contained in the Survey Results and Analysis Section.

Factors Affecting System Failure

Sewage system failure is typically defined as 1) the inability of the system to accept wastewater at the rate it was designed for which prevents or limits the use of the plumbing fixtures; 2) when the wastewater discharge exceeds the absorptive capacity of the soil, resulting in ponding, seepage, or other discharge of contaminants to surface or ground water, or 3) when wastewater is discharged from a system causing contamination of surface and/or ground water.

Definitions of failure related to State Water Quality Standards

Sewage system failure is also related to the presence of a public health nuisance or having a discharge to surface or ground water that exceeds a water quality standard. Am. Sub. H. B. 119 Section 120.02 (K)(3) provides a definition of public health nuisance which states:

(3) For purposes of this section, a public health nuisance shall be deemed to exist when an inspection conducted by a board of health documents odor, color, or other visual manifestations of raw or poorly treated sewage and either of the following applies:

(a) Water samples exceed five thousand fecal coliform counts per one hundred milliliters (either MPN or MF) in two or more samples when five or fewer samples are collected or in more than twenty per cent of the samples when more than five samples are taken.

(b) Water samples exceed five hundred seventy-six E. Coli counts per one hundred milliliters in two or more samples when five or fewer samples are collected or in more than twenty per cent of the samples when more than five samples are taken.

Water quality standards are defined for recreation, public water supply, and for discharging systems that meet the National Discharge Elimination System (NPDES) General Permit No. OHK000001. Systems that discharge effluent to the ground surface or waterways that exceeds these standards are also an indication of failure. Ohio EPA water quality standards define bathing and primary water contact standards as defined in Ohio Administrative Code Chapter 3745-1-07 (B)(4):

> *(a) "Bathing waters" - these are waters that, during the recreation season, are suitable for swimming where a lifeguard and/or bathhouse facilities are present, and include any additional such areas where the water quality is approved by the director. Water bodies assigned the bathing waters use designation are not necessarily indicated in rules 3745-1-08 to 3745-1-30 of the Administrative Code but include local areas of those water bodies meeting this definition.*
>
> *(b) "Primary contact" - these are waters that, during the recreation season, are suitable for full-body contact recreation such as, but not limited to, swimming,*

canoeing, and scuba diving with minimal threat to public health as a result of water quality. In addition to those water body segments designated in rules 3745-1-08 to 3745-1-32 of the Administrative Code, all lakes and reservoirs, except upground storage reservoirs and those lakes and reservoirs meeting the definition of bathing waters, are designated primary contact recreation.

(c) "Secondary contact" - these are waters that, during the recreation season, are suitable for partial body contact recreation such as, but not limited to, wading with minimal threat to public health as a result of water quality.

These standards are linked to the determination of recreation use impairment status identified in the *Ohio 2008 Integrated Water Quality Monitoring and Assessment Report*. The linkage of the methodology to the Ohio water quality standards is summarized in the following chart and subsequent text (Ohio EPA, 2008).

Bathing Waters		
Indicator	Criterion (Table 7-13, OAC 3745-1-07)	Assessment Method
E. coli	Geometric mean *E. coli* content (either MPN or MF), based on not less than five samples within a thirty-day period, shall not exceed 126 per 100 ml and *E. coli* content (either MPN or MF) shall not exceed 235 per 100 ml in more than ten per cent of the samples taken during any thirty-day period	For the three Lake Erie assessment units, exceedance of the geometric mean bathing water criterion or an exceedance of the single sample maximum for more than 10% of the recreation season is considered impairment of the bathing water use.
Primary Contact		
Indicator	Criterion (Table 7-13, OAC 3745-1-07)	Assessment Method
Fecal coliform	Geometric mean fecal coliform content (either MPN or MF), based on not less than five samples within a thirty-day period, shall not exceed 1,000 per 100 ml and fecal coliform content (either MPN or MF) shall not exceed 2,000 per 100 ml in more than ten per cent of the samples taken during any thirty-day period	Statewide data on rivers and streams were not extensive enough to allow direct comparison of geometric mean to the water quality criterion of 1000; data pooled from all sources over period of record were used; thresholds used for impairment of primary contact use were 75th percentile compared to 1000 and 90th percentile compared to 2000.

These standards are also used to determine bathing beach safety and notification of unsafe swimming conditions at beaches. Water use designations for public water supply are defined in OAC Chapter 3745-1-07 (B)(3) (a) as waters that, with conventional treatment, will be suitable for human intake and meet federal regulations for drinking water. Criteria associated with this use designation apply within five hundred yards of surface water intakes. Effluent quality standards for replacement discharging systems are defined in the NPDES General Permit No. OHK000001 (below).

Table A.1. FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR DISCHARGES FROM HSTS DESIGNED IN ACCORDANCE WITH OAC 3701-29, DISCHARGING TO WATERS OTHER THAN LAKE ERIE.

During the period beginning on the effective date of this permit and lasting until the expiration date, the permittee is authorized to discharge in accordance with the following limitations and monitoring requirements.

EFFLUENT CHARACTERISTICS			DISCHARGE LIMITATIONS		MONITORING REQUIREMENTS (3)	
Reporting Code	Units	Parameter	Concentration 30 Day	Daily	Meas. Frequency	Sample Type
00056	GPD	Flow Rate	-	-	1/year	24HrTot.Est.
00530	mg/l	Total Suspended Solids	-	18	1/year	Grab
00610	mg/l	Nitrogen,Ammonia(NH_3)				
		(summer)	-	2.0	1/year	Grab
		(winter)	-	4.5	1/year	Grab
80082	mg/l	$CBOD_5$	-	15	1/year	Grab
31616	#/100ml	Fecal Coliform (summer)	-	2000	1/year	Grab
00083	-	color, severity (1)	-	-	1/year	Estimate
01330	-	odor, severity (1)	-	-	1/year	Estimate
01335	-	turbidity, severity (1)	-	-	1/year	Estimate
00300	mg/l	Dissolved Oxygen	not less than 6.0 at any time		1/year	Grab
50060	mg/l	Chlorine,total residual (2)	not to exceed 0.038 at any time		1/year	Grab

(1) See Part IV, paragraph E.
(2) See Part IV, paragraph F.
(3) Additional operational monitoring requirements shall comply with those listed in OAC 3701-29 for all system components, including service contracts as applicable.

Table A.2. FINAL EFFLUENT LIMITATIONS AND MONITORING REQUIREMENTS FOR DISCHARGES FROM HSTS DESIGNED IN ACCORDANCE WITH OAC 3701-29, DISCHARGING DIRECTLY TO LAKE ERIE.

During the period beginning on the effective date of this permit and lasting until the expiration date, the permittee is authorized to discharge in accordance with the following limitations and monitoring requirements.

EFFLUENT CHARACTERISTICS			DISCHARGE LIMITATIONS		MONITORING REQUIREMENTS (3)	
Reporting Code	Units	Parameter	Concentration 30 Day	Daily	Meas. Frequency	Sample Type
00056	GPD	Flow Rate	-	-	1/year	24HrTot.Est.
00530	mg/l	Total Suspended Solids	-	18	1/year	Grab
00610	mg/l	Nitrogen,Ammonia(NH_3)				
		(summer)	-	2.0	1/year	Grab
		(winter)	-	4.5	1/year	Grab
80082	mg/l	$CBOD_5$	-	15	1/year	Grab
31648	#/100ml	*E. coli* (summer)	126	-	1/year	Grab
00083	-	color, severity (1)	-	-	1/year	Estimate
01330	-	odor, severity (1)	-	-	1/year	Estimate
01335	-	turbidity, severity (1)	-	-	1/year	Estimate
00300	mg/l	Dissolved Oxygen	not less than 6.0 at any time		1/year	Grab
50060	mg/l	Chlorine,total residual (2)	not to exceed 0.038 at any time		1/year	Grab

(1) See Part IV, paragraph E.
(2) See Part IV, paragraph F.
(3) Additional operational monitoring requirements shall comply with those listed in OAC 3701-29 for all system components, including service contracts units as applicable.

More difficult to identify and quantify is when sewage systems fail and cause contamination of shallow seasonal water or deeper ground water systems (aquifers). The ODH (2008) report to the Household and Small-Flows Onsite Sewage Treatment System Study Commission described seven sites in Ohio where ground water contamination has occurred, and geologic and soils conditions where ground water is

very vulnerable to contamination from on-site or discharging systems. A study conducted by the U.S. Geological Survey (Dumouchelle and Stoeckel, 2005) demonstrated the migration of pathogenic bacteria, nitrates, pharmaceuticals and personal care products to shallow ground water from leach lines, and to curtain drains installed adjacent to leach line systems at several studied sites.

Factors Contributing to System Failure

Many factors contribute to reasons why sewage systems fail including system age, improper siting or design for site conditions or limitations, installation problems, system owner abuse or overloading, lack of operation and maintenance, the presence of broken parts, motors or components, and faulty or improper system repairs or alterations.

System age is a significant cause of sewage system failure. As with any mechanical component or piece of infrastructure for a home, a sewage treatment system has a design life. The expected useful life of a sewage treatment system is dependent on the original system type and design, the suitability of the system type and design for the lot conditions, the level of operation and maintenance, and appropriate system use. Components of systems, such as concrete septic tanks, metal parts, and motors or pumps tend to degrade or corrode over time, leading to collapse or breakage. Typical leach lines or leach beds form biomats with daily use and can become clogged causing ponding and discharge. Sewage treatment systems should be designed to ensure sustainability and may average 30-40 years of operation or perhaps more under ideal conditions.

Improper siting and design also significantly impact system performance and failure that causes sewage effluent ponding, or discharge to surface and/or ground water. The evaluation of the site and soil conditions are critical information needed to determine the proper system type and design for a site to ensure the system will treat sewage and not cause surfacing or contamination. It is important to understand the nature and limitations of the soil when it will be used as the primary or final method of treatment of sewage effluent. Historically, site and soil evaluations were not conducted in Ohio, however, over the last several years; many local health districts have been conducting and now require a site specific soils evaluation as opposed to using more general information from a soil survey. The presence of seasonal saturation in the soil has also not historically been determined for sites in Ohio and has led to increased failure rates in many areas. When the soils are saturated, they are unable to accept or treat sewage effluent resulting in ponding and surfacing or discharge to and subsequent contamination of surface and ground water. The determination of the vertical separation distance to bedrock, ground water and other limiting conditions at sites has not been consistently performed across the state. Historically, these terms were also not clearly or specifically defined in state and local rules leading to the contamination of surface and ground water in Ohio.

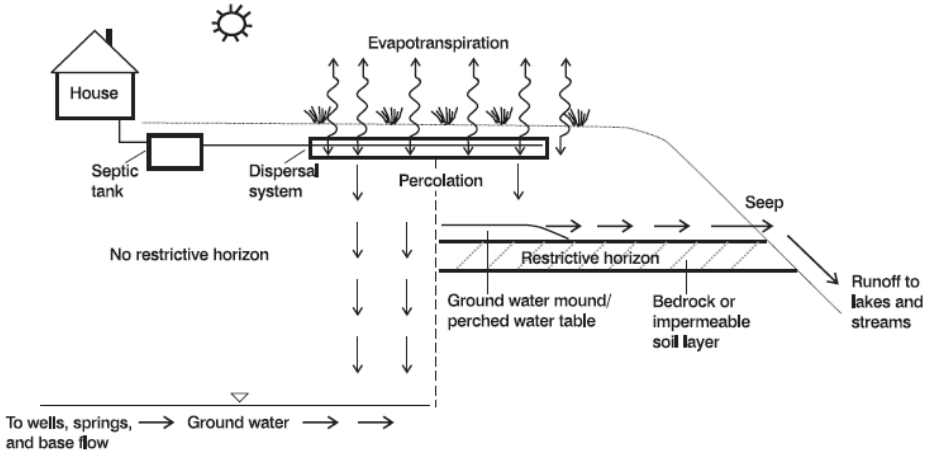


Figure 1. The fate of wastewater discharged into septic systems (U.S. EPA, 2002).

Proper operation and maintenance of systems is the final critical factor affecting system performance and rate of failure. Hydraulic overloading of the system by the homeowner will cause backup into the home, surfacing of effluent, or discharge to the environment of poorly treated wastewater. The discharge of cleaning products, paints or other chemicals into a sewage treatment system will negatively affect the natural biological balance of treatment systems and cause failure.

The lack of proper maintenance of a system often leads to system failure including infrequent pumping of the tank, routine servicing of mechanical units, and replacement of broken parts. System owners may attempt to repair their own systems resulting in system failure or poor performance. The lack of removal of accumulated solids (pumping) can lead to the migration of solids into the soil absorption area clogging and destroying leach lines. Pretreatment components and systems with mechanical valves and distribution lines must be periodically serviced and maintained in order to ensure proper performance and to protect the financial investment the owner has made in the system. System owner education on the specific requirements for maintaining their system is critical, and maintaining service contracts must be enforced and promoted by local health districts where needed.

Current requirements for operation and maintenance of sewage treatment systems in rule and law are variable and incomplete. Local health districts are required under Ohio Administrative Code Rule 3701-29-04 (B) to issue an operation permit for a sewage treatment system, but the rules do not require an *operation inspection*. Am. Sub. H.B. 119 Section 120.02 (C) (2) does require that all replacement discharging systems installed and authorized under the NPDES General Permit for Household Sewage Systems maintain a service contract, and conduct annual sampling and monitoring of the system. All pretreatment components that have been recommended for approval by the Sewage Treatment Systems Technical Advisory Committee and the Director of Health require service contracts for the life of the system as part of system approval and permitting. Maintenance of these service contracts by system owners is overseen and enforced by the local health districts. The level of enforcement of service contracts by local health districts is likely variable. Many local health districts have reported difficulty

with enforcing the service contract requirements due to the legal process required to do so, and there is often community resistance to operation inspection fees. Some local health districts have adopted a real estate point-of-sale inspection program where systems are reviewed for compliance with current construction and public health nuisance standards, and system upgrades may be required. Subsequently, there is substantial variability across Ohio on the level of operation inspection that is conducted and enforcement of requirements for service contracts and maintenance.

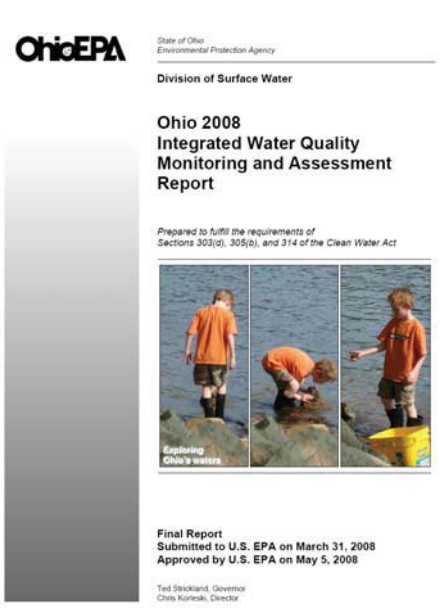
In 2002, ODH conducted a survey of local health districts to identify the scope of current operation inspection programs in Ohio (Caudill, 2002). The survey data included information on program startup year, marketing programs, ongoing education, types of systems inspected, frequency of inspection, personnel, service contracts, service provider registration, fee structure, penalties, program costs, number of systems and expansion plans. Forty-two local health districts responded to the survey, including 36 county or combined departments and 6 city health districts. The survey identified that most operation inspection programs began with inspection of home aeration systems and have expanded into inspection of other systems with mechanical components. Inspection frequency ranged from semi-annual to every 6 years and was often dependent on the complexity and type of sewage treatment system. Only 6 (4 of which were city health districts) inspected all systems within their jurisdiction. Operation inspection fees ranged from $5 to $360, with the most common fee of $30. Most programs reported that the inspection fees did not cover all program costs, and income loss from delinquent fees was reported as an issue. Approximately 80,000 systems were under an operation inspection program at the time of this survey, representing only about 8% of the total number of systems installed in Ohio.

Survey Results and Analysis

Clean Water Act, Section 303(d) Listing

The Ohio 2008 Integrated Water Quality Monitoring and Assessment Report summarizes water quality conditions in the State of Ohio. Available data were compared with water quality goals to determine the suitability of waters for four specific uses—aquatic life (fish and aquatic insects), recreation such as boating and swimming, human health impacts related to fish tissue contamination and public drinking water supplies. The results indicate which waters are meeting goals and which are not. Waters not meeting the goals for one or more of the four types of uses are referred to as impaired. The waters found to be impaired are prioritized and scheduled for further study and restoration. The report also includes the monitoring schedule that Ohio EPA plans to follow for the next several years.

The report describes the methods used to judge impairment of each type of use. Results are reported for the period of 1997-2006 for 268 of 331 watershed units, 16 out of 23 large river units (those draining more than 500 square miles), and 3 Lake Erie nearshore units. Additional information on streams draining between 50 and 500 square miles is presented. General information on Ohio's water quality is also reported in the form of statistics and progress toward Ohio's "80% attainment of the aquatic life use goal." In general, large rivers in Ohio are meeting aquatic life use goals at a much higher percentage than smaller streams. Most water quality impairments are related to modification of the landscape in both urban and agricultural settings. Failing onsite sewage treatment systems have been identified as a source of impairment in each region of the state. Several regions identified issues related to failing system in small, unsewered communities.



Based on consultation with Ohio EPA staff, ODH reviewed the Section 303(d) watershed and large river assessment list (report section M2 and M3) of impaired and impacted streams, and out of all the sources identified, extracted those stream segments that indicated urban runoff, septic systems or unknown sources as the source of impairment. This listing of impaired stream segments from these specific sources is contained in Table 3. Other sources, such as municipal or agricultural discharges may also be affecting these streams. This table identifies the Ohio watersheds by name and hydrologic unit code (HUC) and the affected streams.

A total of 37 watersheds, and 116 streams and stream segments have been impacted by urban, unknown and other sources of pollution. Ohio EPA has identified that

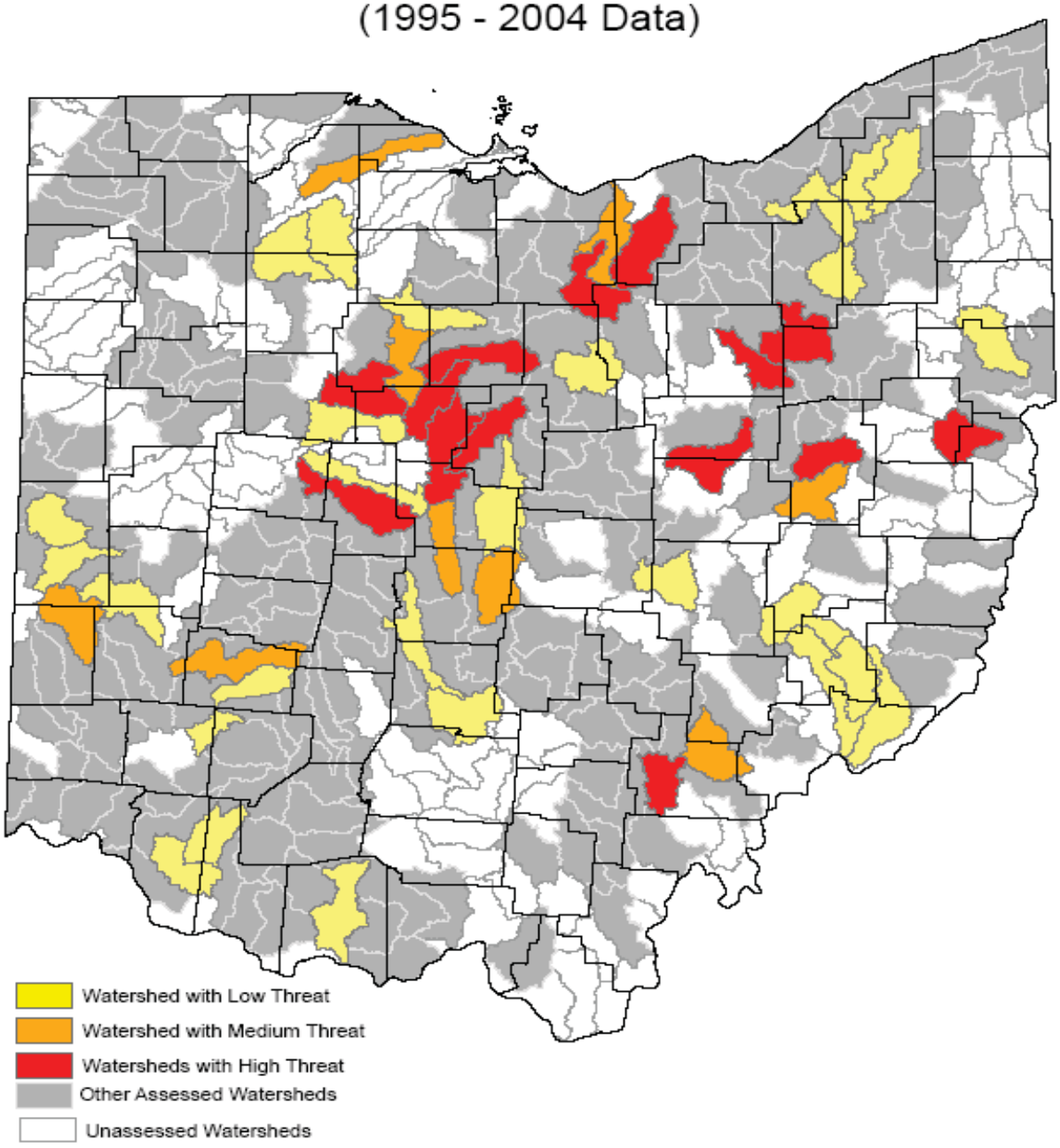
these types of sources are often related to failing on-site and discharging sewage systems.

Table 3. Listing of Impaired Streams from the Section 303 (d) Report			
Watershed (HUC 11)	**Watershed**	**Impaired: Urban, Unknown or other sources**	**Affected Streams**
04100007	Auglaize River (upper)	√	Camp Ck, Quaker Run, Buck run, Sixmile Ck, Blackhoof Ck to Pusheta Ck
05120101	Beaver Creek and Grand St. Lake Mary River	√	Grand Lake St. Marys and Beaver Creek
05060001	Big Darby Creek	√	Upper Little Darby Ck, Hellbranch Run, Milford Center to Flatbranch, Treacle Ck to Proctor Run
05060001	Big Walnut Creek	√	Rattlesnake Ck, Little Walnut, Tributary to Big Walnut, N. Branch French Run, McKenna Ck, Rose Run, Mason Run, Drysar Run, Powell Ditch, Spring Run, W. Spring Run, Kilbourne Run
04110001	Black River	√	Confluence of East and West Branches, West Branch of Black River
04110008	Blanchard River	√	Blanchard River, Ripley Run
05060001	Bokes Creek	√	Bokes Creek to Headwaters to Brush Run, Brush to Scioto Creek
04110003	Chagrin River	√	Rattlesnake Ck, Little Walnut, Tributary to Big Walnut, N. Branch French Run, McKenna Ck, Rose Run, Mason Run, Drysar Run, Powell Ditch, Spring Run, W. Spring Run, Kilbourne Run
05080002	Fourmile Creek	√	Sevenmile Ck
04110002	Cuyahoga River(Lower)	√	Cuyahoga River below Breakneck Creek to below Little Cuyahoga river, Brandywine Ck, Tinkers Ck, Sand Run, Springfield Lake Outlet, Big Ck, Unnamed Tributary to Cuyahoga River, Wingfoot Lake Outlet, Yellow Ck, Wood Ck, Beaver Meadow Ck, Big Ck to Lake Erie, Chippewa Ck, Mill Ck, Ford Branch Big Ck
04110002	Cuyahoga River(Middle)	√	Fish Creek
04110002	Cuyahoga River(Upper)	√	Blackbrook to Breakneck Ck, Tributary to Harper Ditch
05030201	Duck Creek	√	N/A
04110003	Euclid Creek	√	Lake East Tributaries(east of Cuyahoga River to west of Grand River)
04100012	Huron River	√	Marsh Run, Unnamed Tributary to Holiday Lake, W. Branch Rattlesnake Ck, Jacobs Ck, Norwalk Ck
05030202	Leading Creek	N/A	N/A
05030101	Little Beaver Creek	√	Middle Fork Little Beaver, West Fork Little Beaver
05090202	Little Miami River	√	Little Miami River, Caesar Ck, Anderson Fork, Cedarville Reservoir, Tributary to Little Beaver Ck
04110004	Lower Grand River	√	Grand River, Bates Creek
05030103	Mahoning River	N/A	N/A

Table 3. Listing of Impaired Streams from the Section 303 (d) Report			
05090203	Mill Creek (Tributary to Ohio)	√	West Fork Mill Ck, Mill Ck, Sharon Ck
05060001	Mill Creek (Tributary to Scioto)	√	Mill Ck to Otter Ck, Town Run, Crosses Run, Blues Ck
05030204	Monday Creek	N/A	N/A
04100012	Old Woman and Chappel Creek	N/A	N/A
05060001	Olentangy River	√	Lower Olentangy
05090101	Raccoon Creek	√	Rockcamp Ck, Onion Ck, Merritt Run, Elk Fork, Flat Run, Elk Fork to Flatlick, Flatlick Run to Little Raccoon Ck, Strongs Run
04110001	Rocky River	√	Below West Branch to Lake Erie including East Branch and tributaries, Abram Creek,Baldwin Lake, East Branch to Healy Ck to mainstem, Coe Lake, Baldwin Ck, North Royalton "A" tributary, Plum, Ck, Cossett Ck to Plum Ck, Strongsville "A" tributary, Mallett Ck
04100001	Sandusky River	√	Bucyrus, Broken Sword Ck, Upper Sandusky, Upper Tymochtee Ck, Lower Tymochtee Ck, Mexico, Honey Ck, Tiffin, Large Ck
05080001	Stillwater River	√	Mill Ck, Stillwater River(Greenville Ck to Ludlow Ck)
05040001	Sugar Creek	N/A	N/A
05030204	Sunday Creek	√	Indian Run
04100010	Toussaint River	√	Toussaint Creek
05080002	Twin Creek	N/A	N/A
04100012	Vermillion River	N/A	N/A
04100012	Wabash River	√	Wabash River(headwaters of Wabash River to confluence with Beaver Ck), confluence of Beaver Creek to Stateline), Beaver Creek
05040004	Wakatomika Creek	N/A	N/A

Surface water is the most frequently identified impact from failing systems in Ohio particularly in areas with large numbers of discharging sewage systems. Several counties, including Hamilton, Cuyahoga, Lorain and Trumbull have experienced widespread contamination, and subsequent enforcement actions resulting in millions of dollars spent on extending public sewers to many areas or direct replacements of failing systems. Based upon the data collected in the 2008 Integrated Water Quality Monitoring and Assessment Report, Ohio EPA has identified aquatic life use impairments with failing on-site systems identified as a contributing source and as shown in Figure 2. This map lists low, medium and high threat watersheds from failing systems. These water quality impacts limit the ability to use the streams in these watersheds for recreational purposes such as wading and fishing.

Aquatic Life Use Impairments with Failing On-Site Systems Identified as a Contributing Source (1995 - 2004 Data)



Key to Impairment Figure Color Coding (Source: Ohio EPA)

Low Threat: Watershed listed for an aquatic life use impairment with sources including failing on-site systems. Available fecal coliform data from ambient sites indicate few and only sporadic exceedences of WQS criteria. Recreation use is not listed as impaired or not enough data are available to make the determination. Bacteria sources include failing on-site systems but also other potential sources such as combined sewer overflows and those that are livestock or agriculture related.

Medium Threat: Watershed listed for an aquatic life use impairment with sources including failing on-site systems. Available fecal coliform data from ambient sites indicate more widespread bacteria contamination with few to many sites with either 30-day average or individual sample maximum exceedences of WQS criteria. Recreation use is listed as impaired. Bacteria sources include failing on-site systems but also other potential sources such as combined sewer overflows and those that are livestock or agriculture related.

High Threat: Watershed listed for an aquatic life use impairment with sources including failing on-site systems. Available fecal coliform data from ambient sites indicate widespread bacteria contamination with most sites with numerous 30-day average and individual sample maximum exceedences of WQS criteria. Recreation use is listed as impaired. Bacteria sources include failing on-site systems but also other potential sources such as combined sewer overflows and those that are livestock or agriculture related.

Total Maximum Daily Load Reports

Ohio EPA has set forth a schedule for completion of TMDL reports for all Ohio watersheds which can be found on their website at http://www.epa.state.oh.us/dsw/tmdl/OhioTMDLs_InProgress.html. For the purposes of this report, only TMDL reports that were completed or in final draft were reviewed. A TMDL specifies the maximum amount of a pollutant that a waterbody can receive and still meet water quality standards, and allocates pollutant loadings among point and nonpoint pollutant sources. A TMDL is the sum of allocated loads of pollutants set at a level necessary to implement the applicable water quality standards, including wasteload allocations from point sources, and load allocations from nonpoint sources and natural background conditions. The scope and content of the TMDL reports has evolved over time. Some reports provide a more detailed analysis of specific sources of pollution such as failing sewage systems, while others have less detailed information on all source types. The TMDL reports contain information on all pollutant sources identified in a watershed. The review conducted for this report extracted information specifically related to identified failing systems as sources of contaminant loadings in those watersheds.

A complete table listing all reviewed TMDL reports and information related to the documentation of failing sewage systems is located in Appendix B. Please note that not all reports contain the same level of data, and if data was reported, it was included in the table. This table summarizes the following information:

- Watershed – HUC code, watershed name, subwatershed code and name, and county covered by the watershed
- Recreational status (full, partial or non-attainment)
- Cause of impairment (nutrients, bacteria)

- Reported numbers of total and failing systems if identified in the report and related statistics.

Specific TMDL reports that focus on the bacterial total maximum daily load) have been released in 2007 by Ohio EPA for the Chagrin, Grand Lake St. Marys, Sugar Creek, Rocky River, and Olentangy River watersheds. These reports identified failing sewage systems as a contributing source of bacterial contamination in addition to other sources of bacteria such as agriculture or point sources exceeding permit limits. Data on failing sewage systems from these reports has been included in the table in Appendix B.

Thirty-seven final and draft TMDL reports were reviewed, with evaluation of 121 subwatershed units. Of the 121 subwatershed units reviewed, 102 or 84% reported a major source of impairment as bacteria, fecal coliform or pathogens. In addition, of the 121 subwatershed units evaluated, 91 (76%) reported that home sewage systems were a suspected source of impairment. A total number of 15,428 failing systems were identified for twenty-three (23) subwatersheds. The total number of sewage systems for these 23 subwatersheds was not consistently reported to provide a comparison of total present to total failing.

Based on the data collected the watersheds with the highest number of stream segments with failing septic systems included:

- Leading Creek (7)
- Blanchard River (6)
- Sandusky River (6)
- Mill Creek (Tributary to Scioto River) (6)
- Stillwater (6)
- Vermillion River (6)

The region with the most failing septic systems by stream segment was the Northeast region (31); the Central and Northwest region were second with 22 and 24 stream segments with failing systems respectively; 75% of the identified failing septic systems lie within these three regions. The Southwest and Southeast regions had the lowest number of impaired subwatersheds (15 and10).

Survey of Local Health District Operation and Failure Rates

Survey data was collected from local health districts as described in the Types and Sources of Data Collected section of this report. The survey questions and instruction are contained in Appendix A. The survey data provided by local health districts was entered into an Access database and queried to provide summaries and statistics by region. The data is presented by showing the information provided for each section of the survey as follows:

1. Number of systems and system failures reported by county/area with identification of system type, total existing systems, currently failing systems and systems projected to fail within the next 5 years.
2. Principal reasons for failure with identification of failure types observed and the relative percentage of failure type for that county/area
3. Manifestation of the failure with a check of all ways that failure occurred for that county/area.

The following describes the data collected and analyzed from these surveys for each survey section. Table 4 summarizes the data collected from the local health district surveys for each category: 1) number of existing system reported, 2) number of existing failing systems reported, and 3) number of future projected failing systems in the next five years. The percentage of the state totals for each category is also provided. In Ohio, approximately 100 local health jurisdictions implement a sewage program. For this survey, 73 health districts reported survey data.

Table 4. Summary of system data collected from the local health district surveys (73 health districts responding).

Region	Northwest	Northeast	Southeast	Southwest	Central	State Total
Existing Systems	98414 (18%)	126984 (24%)	81061 (15%)	174139 (33%)	51517 (10%)	532115
Failing Systems	32944 (26%)	27206 (22%)	32144 (26%)	19707 (16%)	12164 (10%)	124165 (23%)
Future Failing Systems (5 yrs)	8603 (13%)	17958 (27%)	6818 (10%)	18070 (27%)	15406 (23%)	66855 (13%)

A review of this data shows that based on the survey data reported, 23% of the sewage systems installed today are failing, and 13% are projected to fail within the next 5 years. The southwest region of the state reported the largest number of existing systems (33%) and the southeast region reported the least number of systems (15%). Both the northwest and the southeast regions of the state reported the largest number of failing systems at 26% of each region's totals. The least number of failing systems was reported in the central region. Conversely, the northeast (27%) and southwest (27%) regions reported the largest number of expected future failing systems, and the southeast (10%) region reported the lowest number of expected future failing systems.

Survey Section – Number of Systems and System Failures

Table 5 provides a detailed summary of the total number of systems reported for each region for existing, failing and projected system failures for the next five years.

Table 5. Total number of reported existing, failing, and future failing system types by region.

Region System Type	Northwest			Northeast			Southeast			Southwest			Central		
	Existing Systems	Failing	Future Failing	Existing Systems	Failing	Future Failing	Existing Systems	Failing	Future Failing	Existing Systems	Failing	Future Failing	Existing Systems	Failing	Future Failing
Septic tank/leaching lines	48557	7397	3323	26463	2219	4023	33907	7473	3908	123251	5258	12070	20522	1184	8940
Septic tank/mound	211	4	23	744	1	1	23	2	0	995	31	69	76	2	2
Septic tank/sand filter	14765	4749	902	10908	1487	1145	12315	10790	223	9974	699	1840	7019	445	179
Septic tank/storm sewer	1699	1699	28	5908	5721	0	1477	1451	25	249	230	0	0	0	0
Septic tank to ditch/ surface water	3774	3418	241	219	165	46	1729	2	0	776	775	10	129	129	65
Septic tank to unknown	8783	4487	2432	6613	2442	3727	2636	1713	41	1836	956	196	3881	3509	1507
Aeration to leach field	996	298	129	2679	300	260	4429	431	316	2516	118	221	198	3	8
Aeration to mound	1443	52	37	2553	156	83	2209	26	103	175	1	1	131	0	0
Aeration to sand filter	191	50	2	3812	1074	563	3618	1972	277	2198	58	54	44	0	5
Aeration to ditch/ surface water	3439	1019	655	17586	6680	1560	6769	3721	341	12145	7172	220	2595	755	128
Aeration to storm sewer	1227	286	139	3595	971	424	3791	830	548	3875	2563	15	3656	3238	3209
Aeration to unknown	2909	2340	257	1062	422	163	369	106	57	1198	77	57	1456	1190	1265
Privy	19	6	2	191	3	0	213	53	5	143	23	2	417	24	13
Dry wells	1281	1281	0	425	32	200	4834	2335	866	5553	840	1354	629	208	25
Unknown	9093	5846	433	37666	4321	3448	2738	1238	108	8250	888	1961	8605	1334	40
Holding Tank	10	0	0	0	0	0	2	1	0	4	0	0	2012	51	10
Other	17	12	0	6560	1212	2315	2	0	0	1001	18	0	147	92	10
Total	98414	32944	8603	126894	27206	17958	81061	32144	6818	174139	19707	18070	51517	12164	15406

Categories that were reported can be added to provide a total of the number of discharging and on-site systems reported by region (Table 6). The categories summed in this table do not include privies, holding tanks, unknown systems, and others reported. This data shows that the largest percentage of discharging systems is located in the northwest and northeast regions of the state. The largest number of on-site systems is located in the southwest region of the state. Of the total systems reported for the categories cited above, 63% were reported as on-site systems and 37% were reported as discharging systems. The total quantity of effluent from discharging systems can be calculated by assuming a daily discharge of 360 gallons per day for a three bedroom home. With 170,225 discharging systems, this equals over 61 million gallons of effluent discharging daily to streams and waterways.

Table 6. Total of all discharging and on-site systems by region (excludes privies, unknowns, holding tanks and others).

System Type	Northwest	Northeast	Southeast	Southwest	Central	State
Discharging	36787	49703	32704	32251	18780	170225
	(22%)	(29%)	(19%)	(19%)	(11%)	(37%)
On site	51492	32864	45402	132490	21556	283804
	(18%)	(12%)	(16%)	(46%)	(8%)	(63%)

Survey Section – Principal Reasons for Failure

Local health districts were asked to report on the principal reasons why failure occurred in the areas reported based on their knowledge of the area, the types of systems installed, or collected permit or technical data. Multiple reasons for failure may exist for each area. For example, in many small, cross-roads villages, reasons for system failure can include shallow seasonal water table, system age, and space limitations (lot size). Local health districts were asked to estimate the percentage of systems failing due to each reason for the area reported. Table 7 provides the average percentage of the reason for failure for all of the areas reported for a particular region. The number of areas reported for that region is indicated below the percentage.

An examination of the average percentage of reasons for failure reported shows that soil limitations, substandard or poor designs, space limitations, old system age, no leach lines, and discharges exceeding public health nuisance standards occurred on greater than 40% of the sites reported for all regions of the state. Shallow seasonal water tables and poor operation and maintenance occurred an average of 40% or more in the areas reported in at least three regions of the state. Other reasons for failure such as steep slopes, owner abuse, and unapproved systems were cited less frequently for all regions, but were identified as a more predominant reason for failure in a particular region most likely due to local conditions.

Table 7. Average of the percentage failure type reported and the number of records for each category reported.

Region Principal Reasons for Failure	Northwest % failure (no. areas)	Northeast % failure (no. areas)	Southeast % failure (no. areas)	Southwest % failure (no. areas)	Central % failure (no. areas)
Soil limitations	47% (77)	42 % (55)	45% (43)	43% (86)	57% (62)
Substandard or poor design	61% (70)	46% (25)	45% (37)	40% (54)	65% (39)
Shallow seasonal water table	47% (37)	30% (42)	24% (12)	46% (76)	65% (57)
Shallow normal ground water	12% (8)	32% (17)	22% (6)	21% (2)	60% (14)
Damage to soil absorption area	21% (10)	15% (17)	3% (7)	6% (23)	15% (16)
Space limitations	54% (9)	53% (54)	63% (58)	55% (62)	92% (74)
Poor installation	24% (9)	19% (22)	22% (13)	16% (19)	15% (8)
No leach field	53% (111)	59% (37)	47% (29)	18% (15)	58% (27)
Direct discharge exceeding public health nuisance or NPDES standards	53% (132)	58% (113)	58% (49)	67% (189)	76% (72)
Illegal system alteration or repair	23% (25)	14% (28)	24% (9)	15% (23)	15% (11)
System owner abuse	25% (24)	11% (33)	34% (24)	44% (43)	20% (17)
Unapproved system	44% (18)	17% (12)	17% (9)	15% (14)	26% (11)
Steep slopes	67% (6)	17% (6)	38% (7)	10% (5)	43% (2)
Poor operation and maintenance	55% (64)	26% (59)	41% (40)	38% (72)	44% (61)
Old system (age)	56% (156)	76% (131)	58% (55)	56% (161)	84% (103)
Other	20% (4)	53% (3)	0	59% (3)	100% (1)

Survey Section – Manifestations of the Failure

Because failure of a sewage treatment system can occur in several ways, local health districts were asked to report on the manifestations of the system failure. The survey requested that all manifestations of failure be identified for each reported area. Table 8 provides a summary of the total number of counties by region that identified each failure type.

Table 8. Summary of the total number of areas reporting each manifestation of failure type by region.

Region Manifestation of Failure	Northwest	Northeast	Southeast	Southwest	Central
Breakout or surfacing of sewage in yards	55	112	50	153	72
Sewage backup into homes	14	43	12	76	19
Positive dye tests	49	135	11	68	59
Discharges that are public health nuisances/exceed NPDES permit limits	111	139	61	217	78
Suspected or known ground water contamination	40	11	6	20	9
Identified impaired streams or waterways	80	40	17	80	54
Structural failure of system component	78	38	31	57	17
Other	31	7	4	0	21

A review of the manifestations of data reported shows that breakout or surfacing of sewage and discharges exceeding public health or NPDES standards are the primary consequences of system failure occurring in Ohio. Some areas of the state, such as southwest Ohio, reported almost twice the number of areas with discharge failures as compared to the rest of the state. The northeast and southwest regions also reported surfacing of sewage as another major consequence of system failure. Impaired or impacted waterways were identified as a major consequence of system failure in the northwest and the southwestern areas of the state. Suspected or known ground water

contamination was reported in all areas of the state, but was reported most frequently in the northwest region.

Failures such as breakout or surfacing of sewage can be related to improper consideration of site and soil conditions that affect the ability to hydraulically load sewage into the soil, proper system design, space limitations and sizing. Ground water contamination occurs due to improper consideration of vulnerable geologic, site and soil conditions and subsequent designs and installations that do not ensure treatment of sewage before it reaches the ground water.

Discharges that exceed public health nuisance standards can be related to the predominant use of system designs such as direct discharge of aerobic treatment units, or older style septic tank to sand filter designs that discharge effluent exceeding current standards. These systems were commonly installed when soils conditions or site limitations did not permit the use of soil based systems. There was also a period of time when certain technologies were commonly used for discharging systems (i.e. aerobic treatment units and sand filters) for many reasons, and these technologies did not meet water quality or public health nuisance standards for fecal coliform or water quality standards for ammonia and dissolved oxygen. Without proper maintenance, it is very likely that these systems are also exceeding standards (per the NPDES permit) for biochemical oxygen demand (BOD) and total suspended solids (TSS). These technologies definitely require annual maintenance and servicing to meet their original certifications by the National Sanitation Foundation (NSF). As shown in the survey data, routine operation and maintenance by system owners has historically been a substantial problem across the state. For both of these reasons, Ohio has a significant number of discharging systems that produce poor quality effluent, thus resulting in poor quality discharging systems.

Survey Section – Basis of Survey Data

During the development of the survey tool, some local health districts expressed concern over the variability in the accuracy of data that each local health district may have and how the accuracy of that data would be reported for each area. For example, some local health districts may have very detailed engineering studies for small, unsewered villages that shows the exact number of systems types and failures. Within the same county, the local health district may have only estimates of numbers and types of system failures for an unsewered subdivision, or for individual sites within the entire county experiencing failures due to various reasons. Subsequently, this section was added to the survey to allow local health districts to provide an assessment of the accuracy of the data reported for each area. The categories provided to choose from included:

- Estimate based on census data or general county knowledge
- Estimate based on alteration and replacement permit data and/or documented nuisance complaints

- Counts based on surveys and inspections or engineering studies and detailed analyses
- Other sources as specified.

Table 9 provides a count of the number of areas reported with each reporting category for the level of accuracy.

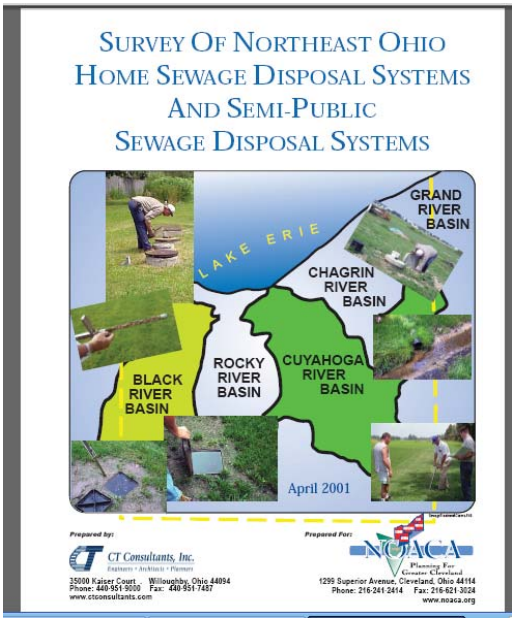
Table 9. Total count by region for each reported level of data accuracy.

Level of Data Accuracy/Region	Northwest	Northeast	Southeast	Southwest	Central
Census data/general knowledge	77	12	30	70	28
Alteration, replacement permit data or nuisances	49	28	9	59	68
Surveys, inspections, engineering studies	47	48	10	147	11
Other	21	64	25	0	10

Other Sources of Failure Data

Several surveys and studies conducted in Ohio have identified approximate failure rates across the state. Mancl (1990) surveyed local health districts who estimated, based on permit and complaint data that 27% of systems were failing. This number was supported by further survey information collected from the public, and local and state agencies during the Ohio Comparative Risk Project conducted by the Ohio EPA in 1995. Many of the areas of failing systems in Ohio are older, small crossroads communities where small lots, old or non-existent systems, and a higher density of housing have caused public health nuisance conditions or environmental impacts. More recent studies have identified, however, impacts to surface and ground water in higher density subdivisions, and lower density housing developments in sensitive ground water areas.

From 1999-2001, the Northeast Ohio Areawide Coordinating Agency (NOACA) conducted a survey of sewage systems in seven northeastern Ohio counties to provide representative data on the performance of systems constructed since 1979 and to determine factors contributing to unsatisfactory performance. Field inspections were conducted on over 700 systems. The survey found that 13 to 20% of household sewage systems in the study area were malfunctioning (surfacing effluent) as defined in the study. Systems installed in soils rated as having severe limitations for sewage disposal were significantly more likely to be malfunctioning than systems installed in soils having low or moderate limitations for sewage disposal.



The survey found that of the off-lot household systems discharging effluent at the time of the inspections (about two-thirds), 20 to 33% of discharging systems were identified as having poor effluent. The survey found operational problems with at least 34 to 47% of the off-lot systems inspected. The survey also found that the percent of systems with aerators had a statistically significant higher number of observations of poor effluent as compared to septic systems. Of the forty-four system effluents sampled for water quality, the survey found that 37 to 68% had fecal coliform concentrations above 5000 Most Probable Number (MPN)/100ml, which is a minimum water quality standard applicable to all surface waters. The survey also found that 32 to 63% of systems sampled did not meet an effluent standard of 20 mg/l BOD_5 and 40 mg/l TSS, as set by the ODH in the 1977 household sewage disposal rules.

Areas of failing systems have been identified by other areawide planning agencies and are documented in their Clean Water Act Section 208 plans. In 2001, the Toledo Metropolitan Area Council of Governments (TMACOG) identified 55 critical home sewage disposal areas in 5 counties where system failures were occurring and corrective action was needed.

From 1986 through 2007, Ohio EPA has identified 236 communities where failing systems have caused either public health nuisances or environmental degredation and administrative orders to correct have been issued. Ohio EPA has proceeded with judicial actions (consent agreements) against 3 communities. From 2004 to the present, Ohio EPA has tracked the number of failing systems identified for each administrative action. Nearly 5,000 failing systems in 30 communities were identified as needing correction due to environmental or public health degradation from failing systems during this time period. Most recently, Ohio EPA's environmental enforcement summary for 2006 lists that 854 failing on-lot sewage systems were corrected with extension of public sewers.

An examination of the number of alteration and replacement permits reported during the July 1, 2007 to May 1, 2008, time period also provides insight to the number of household sewage systems experiencing some type of failure. During this time period, 21% and 13% of all systems installed were replacement or alteration systems respectively, for a combined rate of 34% of all system installations during this time period. While it is recognized that some systems replacements or alterations are due to expansion of homes, etc., this rate is similar to the statewide failure rate of 27% based on prior surveys and studies.

ODH adopted statewide minimum sewage rules in 1977; these rules have now been in place for 31 years. Many local health districts have adopted more stringent rules that permit and require improved site and soil evaluations, and allowed the installation of newer technology systems. Prior to 1977, local health districts had the authority to adopt sewage system rules. System installations prior to 1977 would have been dependent on whether local rules were adopted, and the subsequent rule requirements in effect. Common system designs prior to 1977 include some type of septic tank to leach lines or leach beds, septic tanks to drainage wells where soils were permeable, septic tanks to surface and subsurface sand or gravel filters with direct discharge to surface water, or septic tank to direct discharge. Aerobic treatment system technologies became a popular alternative for system installation in the 1970's and has continued for many years. While many systems installed prior to 1977 are likely functioning to **dispose** of sewage effluent, the unknown question is how many are likely **treating** sewage effluent to a reasonable degree to prevent public health impacts and migration of pathogenic bacteria and pharmaceuticals and other chemicals to surface and ground water.

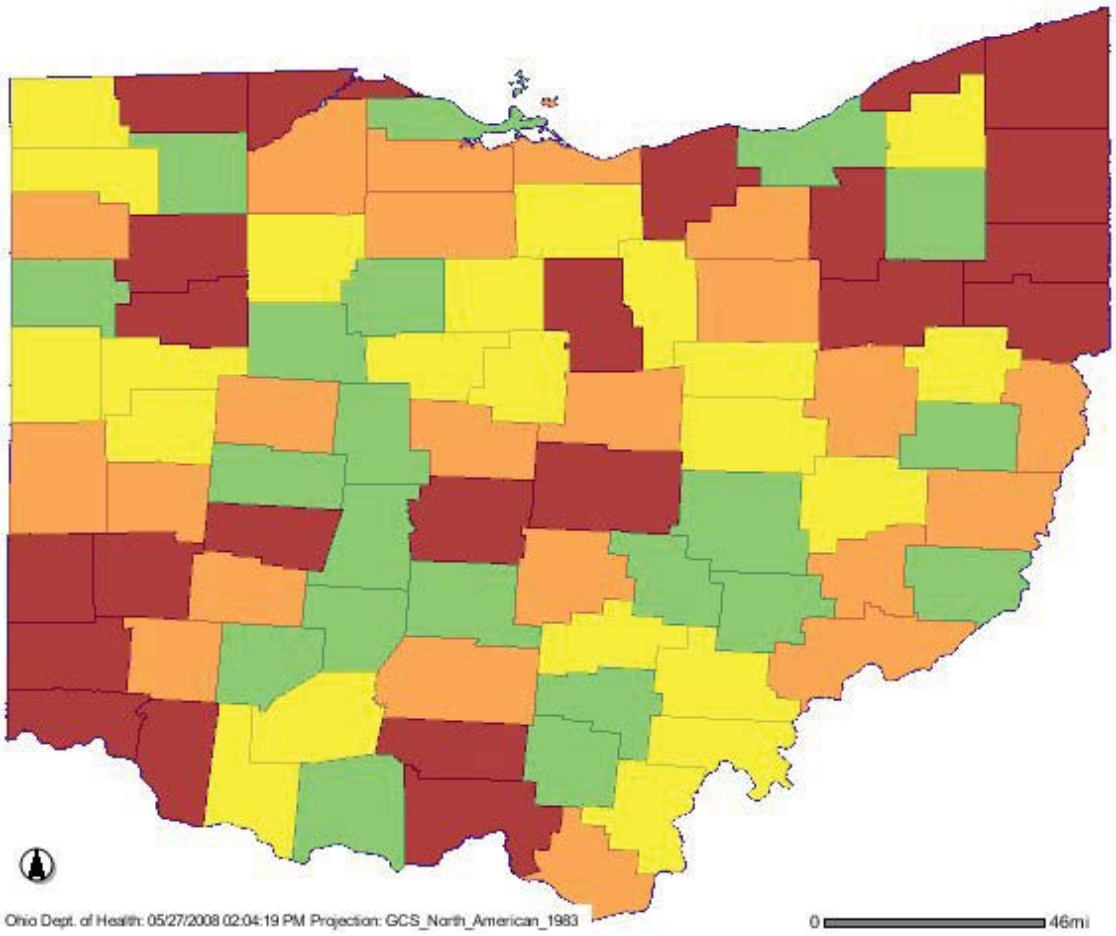
The 2000 U.S. Census data can be analyzed to provide an estimate of the total number of homes located outside of municipal boundaries older than 1977. This date was selected because it is the date that minimum statewide sewage rules became effective, and it also represents homes with systems over 30 years in age. The census data was also analyzed to estimate the number of homes located outside of municipal boundaries constructed between 1979 and 1990. This date range was selected because homes constructed during this time period would mostly reflect systems constructed in accordance with the state minimum rules almost exclusively, i.e. septic tanks to leach lines, aerobic treatment units to leach lines and discharge, septic tanks to sand filters to discharge. Finally the census data was analyzed to show the number of homes by county and region constructed after 1990 which equals the time when some local health districts began using new technology systems for sites with limitations. This analysis of home age using the census data is reflected in the following series of maps and tables.

Table 10. House Age by Region of the State.

	Total	2000 - 1990	2000 - 1990 %	1989-1980	1989-1980 %	1979 and Before	1979 and Before %
Northwest	242546	42716	17.61	29217	12.05	170613	70.34
Northeast	466523	84730	18.16	53143	11.39	328650	70.45
Southeast	244136	49815	20.40	35056	14.36	159265	65.24
Southwest	415355	85791	20.65	60344	14.53	269220	64.82
Central	175118	39733	22.69	19689	11.24	115696	66.07
State Total	1543678	302785	19.61	197449	12.79	1043444	67.59

Table 10 shows that 68% of all houses in Ohio were constructed outside of municipal boundaries prior to 1977. It is reasonable to assume that at least 27-30% of the systems for these houses may be failing based on system age (>30 years), alteration and replacement permit data, and published studies. This would equal a projected number of failing systems (based on age alone) at 313,033. The total number of systems constructed between 1980-1999, reflecting the majority of systems constructed under the 1977 rules, equals 197,449 (13%) of all house ages. The total number of systems constructed between 1990 and 2000, when newer technology systems began to be used by some local health districts, equals 302,785 or 20% of the state total number of houses. The following maps depict the distribution of house age by county for areas outside of municipalities for the time period prior to 1979, houses built between 1980 and 1989, and houses built from 1990 to 2000.

Number of houses by county built prior 1979 – Non Municipalities



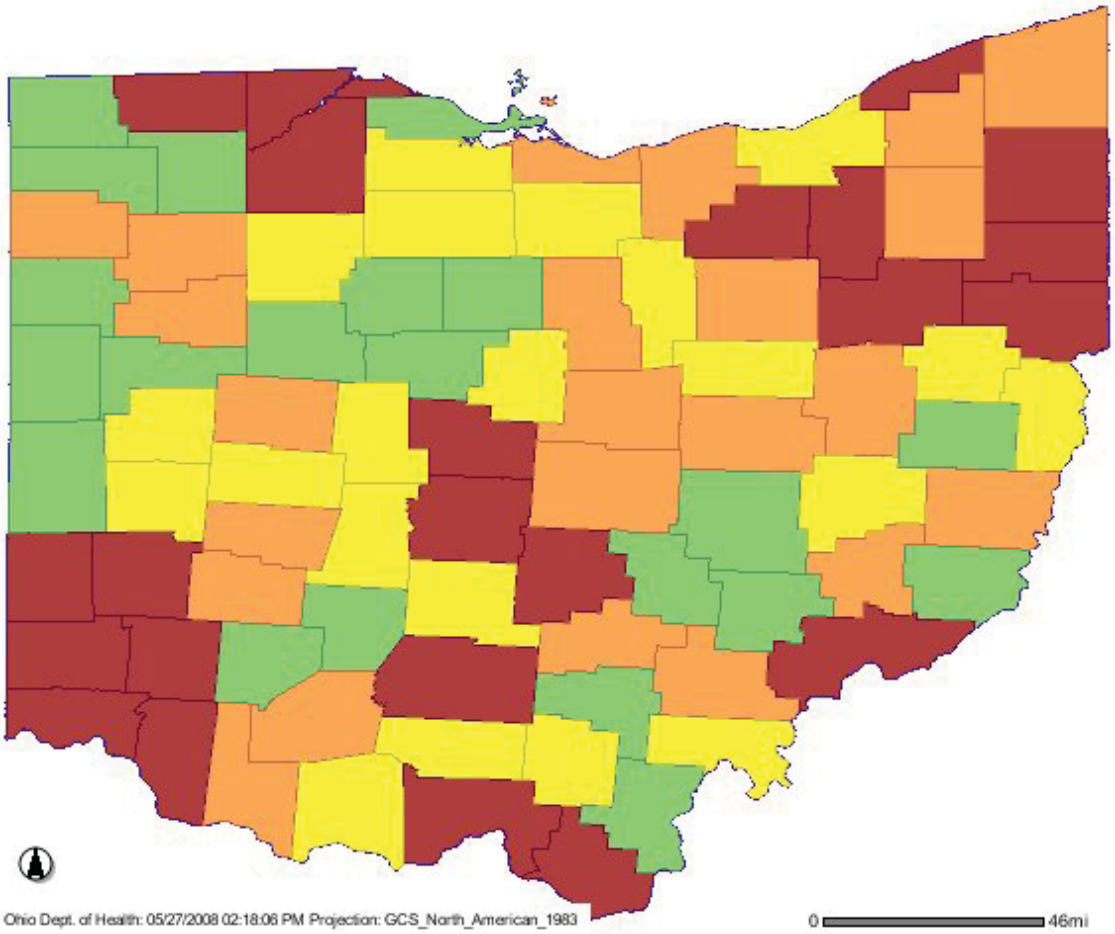
13,636 or more

7,612 – 13,635

4,801 – 7,611

4,800 or less

Number of houses by county built between 1980 and 1989 – Non Municipalities



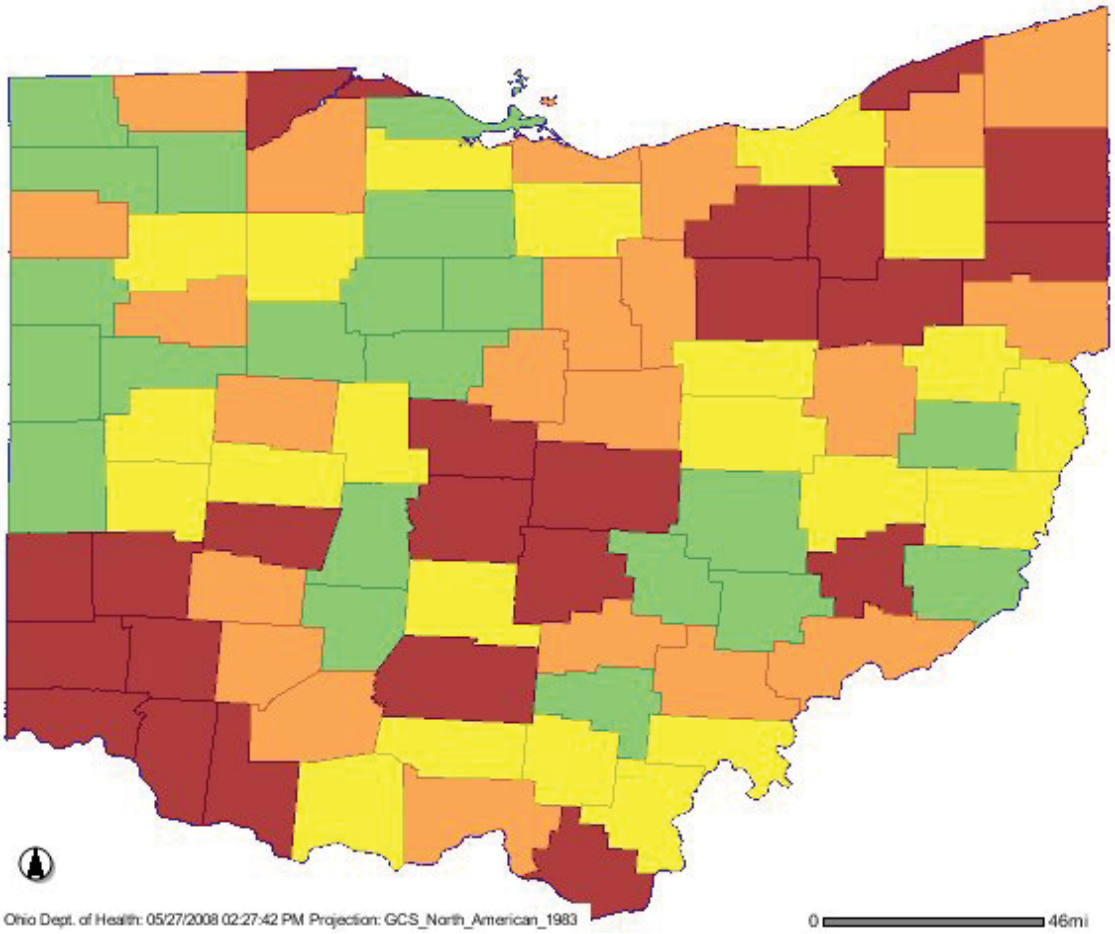
2,600 or more

1,377 – 2,599

906 – 1,376

905 or less

Number of houses by county built 1990 or after – Non Municipalities



- 3,852 or more
- 2,213 – 3,851
- 1,382 – 2,212
- 1,381 or less

Update on Sewage Treatment System Types and Costs – July 2007 through March 2008

The ODH (2008) report to the Household and Small-Flows Onsite Sewage Treatment System Study Commission reported on sewage treatment systems types and costs from July 1, 2007 through November 30, 2007. The purpose of this section is to provide updated information on the sewage treatment system types installed in Ohio from July 1, 2007 through May 1, 2008, and associated system costs.

Table 11. Type, number, and percentage* by region of sewage treatment system installations reported between July 1, 2007 to May 1, 2008**.

Region SystemType/Description Code	Northwest Total reported (%)	Northeast Total reported) (%)	Southeast Total reported (%)	Southwest Total reported (%)	Central Total reported (%)	State Total reported (%)
Septic tank to shallow leach lines	258 (30)	170 (20)	198 (23)	139 (16)	81 (10)	846 (17%)
Pretreatment to shallow leach lines	4 (1)	130 (42)	100 (32)	11 (4)	64 (21)	309 (6%)
Septic tank to 18-30” leach lines	177 (9)	536 (28)	460 (24)	443 (23)	311 (16)	1927 (39%)
Pretreatment to 18-30” leach lines	7 (3)	69 (28)	111 (45)	22 (9)	39 (16)	248 (5%)
Septic tank to sand mound	76 (13)	233 (40)	98 (17)	104 (18)	66 (11)	577 (12%)
Pretreatment to sand mound	16 (24)	13 (20)	1 (2)	29 (44)	7 (11)	66 (2%)
Septic tank to drip distribution	1 (1)	23 (34)	0 (0)	10 (15)	34 (50)	68 (2%)
Pretreatment to drip distribution	2 (5)	18 (45)	0 (0)	4 (10)	16 (40)	40 (1%)
NPDES system	32 (6)	410 (79)	11 (2)	57 (11)	11 (2)	521 (10%)
Septic tank to low pressure pipe	0	0	0	0	1	1 (<1%)
Pretreatment to low pressure pipe	1	4	0	0	1	6 (<1%)
Other	25 (6)	162 (41)	63 (16)	69 (17)	76 (19)	395 (8%)
Total	599 (12%)	1768 (35%)	1042 (21%)	888 (18%)	707 (14%)	5004

*Alterations not included for 796 records
**System type and description not reported for 112 sites

A total of 5004 permit records provided information on system type and description. Alteration permit data was not included in these system type totals. Permit data for July 1, 2007 through May 1, 2008 shows that septic tank or pretreatment to leach line systems accounted for the majority of systems installed at 67% of the state total. Septic

tank/pretreatment to sand mounds accounted for 14%, septic tank/pretreatment to drip distribution accounted for 3%, NPDES systems (replacement of existing discharging systems) accounted for 10%, and other system types accounted for 8% respectively of all systems installed. A total of 7 low pressure pipe systems were installed during this time period.

Table 12. Number and percentage by region of household sewage treatment systems versus small flow onsite sewage treatment systems, and the new, alteration or replacement systems installed from July 1, 2007 through May 1, 2008.

Region	Northwest	Northeast	Southeast	Southwest	Central	State
House-New	416 (11%)	1088 (28%)	1013 (26%)	712 (19%)	614 (16%)	3843 (65%)
House-Replacement	188 (15%)	673 (55%)	78 (6%)	199 (16%)	77 (6%)	1215 (21%)
House - Alteration	140 (18%)	232 (30%)	92 (12%)	177 (23%)	130 (17%)	771 (13%)
SFOSTS - new	8 (13%)	15 (25%)	11 (18%)	5 (8%)	21 (35%)	60 (1%)
SFOSTS - replacement	2 (17%)	7 (58%)	1 (1%)	1 (8%)	1 (8%)	12 (<1%)
SFOSTS - alteration	1 (9%)	6 (55%)	1 (95)	2 (18%)	1 (9%)	11 (<1%)
Totals	755 (13%)	2021 (34%)	1196 (20%)	1096 (19%)	844 (14%)	5912

A total of 5,912 permits were reported from July 1, 2007 through May 1, 2008. Permit data for July 1, 2007 through May 1, 2008 shows new household systems accounted for 65% of all systems installed, household replacement systems were 21%, and household alterations were 13% respectively of all systems installed. Small flow onsite systems accounted for 1% of all new systems installed, and alterations and replacements to these systems accounted for less than 1% of all systems installed.

Table 13. Estimated sewage treatment system costs by type and region as reported from July 1, 2007 to May 1, 2008*.

Region SystemType/ Description Code	Northwest Average $	Northeast Average $	Southeast Average $	Southwest Average $	Central Average	State Average
Septic tank to shallow leach lines	8,292	10,500	4,687	7,500	9,044	8,004
Pretreatment to shallow leach lines	7,000	8,841	6,747	10,857	9,354	8,559
Septic tank to 18-30" leach lines	6,426	7,120	5,363	6,271	7,073	6,450
Pretreatment to 18-30" leach lines	8,278	7,570	6,379	9,928	8,905	8,212
Septic tank to sand mound	8,865	13,455	7,700	17,450	14,369	12,367
Pretreatment to sand mound	14,272	19,181	12,000	22,882	16,875	17,042
Septic tank to drip distribution	16,000	19,666	n/a	29,864	16,270	16,360
Pretreatment to drip distribution	18,000	21,568	n/a	29,697	20,156	22,355
NPDES system	7,971	10,166	7,250	16,516	10,289	10,438
Other	9,275	7,194	3,847	6,206	6,312	6,566
Septic tank to low pressure pipe	n/a	n/a	n/a	n/a	10,000	10,000
Pretreatment to low pressure pipe	12,000	10,625	n/a	n/a	12,500	11,708

*Cost data reported for 4333 sites.

System cost data was provided for 4,333 permits. It is important to compare the number of system types reported for each category when evaluating average system costs. Some categories had very few cost values reported. Permit cost data shows that system average costs ranged from $6,450 to $8,004 for septic tank to leach lines. Pretreatment to leach line average system costs ranged from $8,212 to $8,559. The average cost for sand mound systems ranged from 12,367 to$17,042, a decline of about $2,000 for the prior reported period (ODH, 2008). Drip distribution system average costs ranged from $16,360 to $22,355, with a decline in the cost of septic tank to drip distribution systems. The average cost of an NPDES system was $10,438, a decline of about $1,000 from the prior reported period. Several low pressure pipe systems were installed during the reporting period at an average cost ranging from $10,000 to $11,708. Table 14 compares the ODH (2008) system costs reported to the data obtained from reporting period of July 1, 2007 through May 1, 2008.

Table 14. Comparison of July to November, 2007 cost data with July 1, 2007 to May 1, 2008 cost data for each system type.

System Type	July 1 – November 30, 2007 State Average Cost Data	July 1, 2007 to May 1, 2008 State Average Cost Data
Septic tank to shallow leach lines	$7,555	$8,004
Pretreatment to shallow leach lines	$8,752	$8,559
Septic tank to 18-30” leach lines	$6,590	$6,450
Pretreatment to 18-30” leach lines	$8,117	$8,212
Septic tank to sand mound	$14, 154	$12,367
Pretreatment to sand mound	$19,051	$17,042
Septic tank to drip distribution	$19764	$16,360
Pretreatment to drip distribution	$19,711	$22,355
NPDES system	$11,612	$10,438
Other	$7,473+	$6,566
Septic tank to low pressure pipe	None reported	$10,000
Pretreatment to low pressure pipe	None reported	$11,708

Conclusions

In summary:

- The Clean Water Act, Section 303(d) listings show that a total of 37 watersheds, and 116 streams and stream segments have been impacted by urban, unknown and other sources of pollution
- Thirty-seven final and draft TMDL reports show that:
    - Out of the 121 subwatershed units reviewed, 102 or 84% reported a major source of impairment as bacteria, fecal coliform or pathogens.
    - Out of 121 subwatershed units evaluated, 91 (76%) reported that home sewage systems were a suspected source of impairment.
    - A total number of 15,428 failing systems were identified for twenty-three (23) subwatersheds
    - The greatest impact to stream segments from failing systems was reported in the northeast, followed by the northwest and central regions of the state, with the least impact reported in the southwest and southeast.

- In Ohio, approximately 100 local health jurisdictions implement a sewage program. For this survey, 73 health districts reported survey data.

- Based on the survey data reported, 23% of the sewage systems installed today are failing, and 13% are projected to fail within the next 5 years. The southwest region of the state reported the largest number of existing systems (33%) and the southeast region reported the least number of systems (15%). Both the northwest and the southeast regions of the state reported the largest number of failing systems at 26% of each region's totals. The least number of failing systems was reported in the central region. Conversely, the northeast (27%) and southwest (27%) regions reported the largest number of expected future failing systems, and the southeast (10%) region reported the lowest expected number of failing systems.

- The largest percentage of discharging systems is located in the northwest and northeast regions of the state. The largest number of on-site systems is located in the southwest region of the state. Of the total systems reported for the categories cited above, 63% were reported as on-site systems and 37% were reported as discharging systems.

- Assuming a daily discharge of 360 gallons per day for a three bedroom home, then over 61 million gallons of effluent are discharging daily from discharging systems to streams and waterways.

- The average percentage of reasons for failure reported shows that soil limitations, substandard or poor designs, space limitations, old system age, no leach lines, and discharges exceeding public health nuisance standards occurred for greater than 40% for sites reported for all regions of the state. Shallow seasonal water tables and poor operation and maintenance occurred an average of 40% or more in the areas reported in at least three regions of the state. Other reasons for failure such as steep slopes, owner abuse, and unapproved systems were cited less frequently for all regions, but were identified as a more predominant reason for failure in a particular region most likely due to local conditions.

- The manifestations of data reported shows that breakout or surfacing of sewage and discharges exceeding public health or NPDES standards are the primary consequences of system failure occurring in Ohio. Some areas of the state, such as southwest Ohio, reported almost twice the number of areas with discharge failures as compared to the rest of the state. The northeast and southwest regions also reported surfacing of sewage as another major consequence of system failure.

- Impaired or impacted waterways were identified as a major consequence of system failure in the northwest and the southwestern areas of the state. Suspected or known ground water contamination was reported in all areas of the state, but was reported most frequently in the northwest region.

- Published studies and collected system permit data for 2007 suggest a statewide failure rate of 27-30% of the existing 1 million total sewage systems (270,000 to 300,000 systems). Permit data for July 1, 2007 through May 1, 2008 shows a combined rate of 34% for system alteration and replacement for the state. Reported survey data shows a state failure rate of 23% with a projected 5-year failure rate of 13% (36% combined).

- System age is a factor related to system failure. Over 1 million homes or 68% of the state total number of homes in Ohio are over 30 years in age and have systems that are just as old that will be approaching the end of their design life.

- System failure has likely occurred due to the lack of adequate site and soil evaluations to determine the presence of conditions that limit or prevent treatment, and allow for the proper hydraulic loading of effluent into the soil to prevent ponding and surfacing. Site evaluations were not routinely conducted in many local health districts prior to 2007. Many local health districts did retain the requirement to conduct detailed site and soil evaluation after the rescission of the 2007 rules.

- The limited use of new technology systems that could provide solutions to challenging site conditions and prevent public health impacts resulting from contamination has likely occurred due to system cost and local health district,

installer and homeowner knowledge. Use of newer technology systems in Ohio has slowly increased over the last 10 years.

- Lack of operation and management of systems has led to system failure. Operation inspection programs are conducted in about half of Ohio health districts but are variable in their scope and level of enforcement. Based on 2002 survey data, only 8% of existing sewage systems are under some type of operation inspection program. Local health districts have reported difficulty in enforcing requirements for maintenance contracts and collecting operation inspection fees.

- The number of discharging systems is estimated at 250,000 and 83% are estimated to not meet public health nuisance standards of 5,000 fecal coliforms/100 ml, and over 98% do not meet the current NPDES General Permit effluent quality standards.
    - Based on the rules in place when most of these systems were constructed, systems would be either septic tanks with direct discharge, septic tanks to sand filters or aeration units with direct discharge.
    - Assuming an equal distribution of system types (83,500 each), and assuming that 0% of septic tanks, 99% of aerobic treatment units, and 50% of the sand filter systems (based on published and reported data) meet public health nuisance standards, then 208,750 (83%) discharging systems are likely exceeding public health nuisance standards of 5,000 fecal coliforms/100 ml.
    - To date, nearly 1,000 discharging replacement systems have been installed that meet the NPDES General Permit for replacement household systems.

- Permit data for July 1, 2007 through May 1, 2008 shows new household systems accounted for 65% of all systems installed, household replacement systems were 21%, and household alterations were 13% respectively of all systems installed. Small flow onsite systems accounted for 1% of all new systems installed, and alterations and replacements to these systems accounted for less than 1% of all systems installed.

- Permit data for July 1, 2007 through May 1, 2008 shows that septic tank or pretreatment to leach line systems accounted for the majority of systems installed at 67% of the state total. Septic tank/pretreatment to sand mounds accounted for 14%, septic tank/pretreatment to drip distribution accounted for 3%, NPDES systems accounted for 10%, and other system types accounted for 8% respectively of all systems installed.

- Permit cost data shows that system costs ranged from $6,450 for septic tank to leach lines to $22,355 for pretreatment to drip distribution. State average system costs were very similar to those reported earlier by ODH (2008) except that costs for mound systems declined approximately $2,000, and NPDES system costs

declined by about $1,000. Several low pressure pipe systems were installed during the reporting period at an average cost ranging from $10,000 to $11,708.

System failure leads to system replacement or extension of sewer lines which is expensive for both the property owner and the community. According to updated permit data, system replacement costs will range on average from $6,450 to $22,355 depending on site, soil and lot conditions. Data collected from Ohio EPA and the Ohio Water Development Authority shows that on average $55 million is spent each year on extending sewer lines to areas of failing systems and constructing or expanding associated wastewater treatment plants (Ohio Department of Health, 2008). The Ohio EPA, Clean Watershed Needs Survey, 2004 data shows a reported need of $874 million dollars to correct areas of failing systems. This cost estimate includes repairs, replacements of existing systems, or extension of sewer lines/construction of new plants. Ohio Department of Health (2008) estimated that $14.6 million was spent on system alteration and repair in 2007. These costs reflect repairs and alterations made to systems installed prior to 2007, under the 1977 rule standards in effect in Ohio.

Recommendations

- Implement the recommendations for sewage treatment system siting, design, and installation, operation and maintenance recommended in the ODH report to the Household Sewage and Small Flows Onsite Study Commission. Proper siting, design and installation will help ensure systems that protect public health and the environment, and also protects the investment the property owner makes in the systems and reduces the need for public dollars to provide sewage treatment through public facilities. System designs need to account for site and soil conditions, site limitations, reasonable expected design flows and waste strength to ensure proper system performance.

- Recommend the use of a proactive and preventive approach to managing sewage treatment systems that combines public education, local health district involvement, local planning and management factors, and consideration of area risks to sensitive water environments or ecological resources.

- Improve coordination with and provide training to local watershed groups and other grass roots organizations (green and community initiatives) to help promote an understanding of the importance of proper sewage system operation and maintenance to the system owner, and the impact to a community when systems are not maintained. Encourage and facilitate solutions and activities that prompt system owners to take an active role in household sewage system management and maintenance.

- Continue the use of operation permits through local health districts with the provision of flexibility to establish local operation and maintenance management programs that recognize priority protection areas, high risk water or ecological resources, or existing unsanitary conditions due to a high incidence of system substandard performance or failure.

- Provide the necessary legal and enforcement tools for local health districts to ensure that service contracts for mechanical systems are maintained, and that routine inspection and maintenance occurs for all systems.

- Recommend the continued option for establishing household sewage treatment management districts to help provide proactive or responsive approaches to resolve sewage treatment problems in an area.

- Encourage and facilitate decentralized wastewater management of systems through public utilities such as county or regional water and sewer districts, local government, and private utilities. Decentralized management offers a public and private sector tool that provides assistance and support to system owners, offers a cost structure that is affordable, and helps ensure that systems in a wide range of density configurations are properly managed.

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APPENDIX A

LOCAL HEALTH DISTRICT OPERATION AND FAILURE RATE SURVEY

Ohio Department of Health
Study Commission Survey 2008
Explanation and Instructions

Amended House Bill 119 was enacted by the General Assembly and signed by Governor Strickland on June 30, 2007. Section 737.12 (B) of the bill states:

> *(B) The Director shall conduct a survey of boards of health in this state concerning household sewage treatment system operations and the failure rates of those systems. The Director shall issue a report concerning the survey to the Household Sewage and Small Flow On-Site Sewage Treatment System Study Commission not later than June 1, 2008. Boards of health shall provide, in a timely manner, any and all relevant information pertaining to the household sewage treatment system program that is requested by the Director under this division and that the Director determines to be necessary for completion of the survey.*

The attached survey tool will be used by the Ohio Department of Health to obtain the information required to satisfy this mandate. The survey is an Excel spreadsheet. **Completed surveys must be returned to ODH no later than May 2, 2008**. ODH appreciates the cooperation of all Local Health Districts (LHD) to meet this deadline in order to allow ODH the appropriate time to compile the information and prepare the report for the Household Sewage and Small Flow On-Site Sewage Treatment Study Commission. ODH will also be collecting data from other sources to identify system operation and failure rates. Ohio EPA water quality surveys, studies by area wide planning agencies, and watershed organizations will be used to prepare the report.

Attached with the survey are instructions for completing each line of the survey. You may also toggle over the red triangle in the corner of the survey cell on the Excel spreadsheet and the instructions will appear. Two example surveys have been attached with the instructions, one for a specific area, and one that represents the rest of the district failure data.

ODH anticipates that each LHD will complete multiple surveys for their district. A separate survey is required for an “area” that has been identified or is known to have sewage system failures. LHD’s may choose to group areas with failing systems where appropriate. LHD may have more complete information for “problem areas” that have received added attention in the form of surveys and nuisance complaints. It is understood that many of the systems in these “problem areas” were constructed at about the same time and are similar in nature; therefore, they may be manifesting similar failures and it seems appropriate to group these systems accordingly. Since ODH recognizes these similarities and that the effects of improper sewage treatment can become evident quicker in areas of dense population, it is requested that these areas are identified, and a separate survey is provided for each. A final survey should be completed for the parts of the district that were not included in the individual area surveys that represents site by site system failures across the rest of the district. After each survey sheet is completed, please save the Excel spreadsheet with a name that represents your district and an identification name for the area.

Actual data, obtained from surveys, inspections, or studies, should be used whenever possible. ODH realizes the information requested in this survey may not be readily available in some districts. It is understood that estimates will be used in these cases. The estimates should be based on the districts permit and nuisance complaint counts whenever possible. Estimates based on the local health departments general knowledge of their district and census data are acceptable when no other information is available. ODH and Ohio EPA are available to assist LHD's with analysis of census data. For example, LHD's could use census data to determine the number of households in a specific area where systems are commonly known to be failing, or census data could be used to estimate the number of failing systems or projected failures based on household age and soil types. Please note that ODH is not asking LHD's to conduct new field surveys for this information, we are simply asking LHD's to report on information they have currently available.

The surveys, or portions of the surveys, will be shared with the Ohio Environmental Protection Agency in order to facilitate the collection of data necessary to complete the 2008 Clean Watersheds Needs Survey (CWNS). The CWNS is conducted by OEPA every four years under the Clean Water Act (1972) Sections 205(a) and 516(b) (1). The CWNS is key in estimating the monetary needs of local municipalities and will influence the dispersal of federal funds allocated to meet the water quality and water-related public health goals of the Clean Water Act. This information will also be used to work with our federal and state legislators to help obtain funds from other sources, for example, to supplement HUD and CHIP programs, and to help develop alternative funding sources and programs for system owners.

If you experience any difficulties with completing the survey, need assistance with survey estimates and numbers, or have any questions about the survey, please do not hesitate to contact Nathan Johnson with the Ohio Department of Health at (614) 644-7181.

Ohio Department of Health
Local Health Department HSTS Survey 2008
Detailed Instructions

1. **Health District**
   Indicate the local health district where the submitted information was collected.
2. **Area Name**:
   Provide a name for the area that will be described within each particular survey. Use the municipality name if the area is incorporated or the subdivision name when appropriate. The name will be used to identify and discuss the data set. The name “the rest of the district” may be used when completing the general survey for the parts of the district that were not included within the individual surveys.
3. **Is the area incorporated or unincorporated?**
   Please respond: currently incorporated or unincorporated.
4. **If the area is unincorporated, provide a narrative description of the location or provide a map that indicates the location of the area.**
   Provide sufficient information in the form of a written narrative (e.g. at the intersection of SR 12 and CR 190) or provide a detailed map identifying the locations orientation within the district.
5. **Number of systems and system failures**
   Provide your best estimate of the numbers and types of HSTS in this area that are (a) existing, (b) currently failing, and (c) anticipated to fail within the next five years. A "failure" is a situation that should result in necessary alteration or replacement of the existing household system, and not simple maintenance items. The survey sheet that is completed for the rest of the district should exclude (subtract) the system counts for the specific area survey sheets.
6. **Principal Reasons for failures**
   Please identify the known or suspected reasons for the failure of sewage systems in this area and estimate the percentage of systems that are failing for each reason checked. It is understood that more than one of the provided reasons could contribute to the failure. Fill in the value for as many as apply - the total can exceed 100%.
7. **Manifestation of the Failures**
   Please identify how the failure(s) that are occurring in this area are being manifested. It is understood that a single failure could be manifested in more than one way. Check as many as apply.
8. **Would either HSTS alterations or replacements be a feasible option for either some or all of the area?**
   Indicate the approximate percentage of failures that could be corrected with alterations to the existing HSTS.
   Indicate the approximate percentage of HSTS that need replaced with a new system.
   If an area has participated in an engineering study, and the study has determined that sewers are the best solution for the area, answer “no” and do not list a technology to be used as an alteration or replacement. If it has not been determined that sewers are the best option for the area, indicate whether alterations or replacements are an option and include a technology to be used as

applicable. It is understood that the only solution for all homes in an area may be NPDES discharging systems. LHD's do not have to determine whether sewers or on-site systems are the best option.

9. **If any HSTS alterations or replacements are feasible, what type(s) of HSTS technologies should be used?**
   Complete this section for systems identified as capable of being altered or replaced. Based on available site and soil information and/or the districts general knowledge, what type of systems would be utilized to alter or replace the failing systems.
10. **Would it be feasible to send the wastewater flow to a nearby existing wastewater treatment plant?**
    Regardless of whether HSTS alterations or replacements are feasible for some or all of the system failures, identify the name or names of nearby wastewater treatment plants. The purpose of this question is to identify whether sewer extensions is a possible solution for the area.
11. **What is the basis for the data provided in this survey for this area?**
    Identify the process by which the submitted data was obtained or estimated. Check the choice that best describes the process. Indicate only **one** choice.
12. **Notes**
    List any additional information about the area you believe may be beneficial, including, but not limited to, the age of the homes, engineering surveys completed and sampling data collected in the area.
    This area may be left blank if you have no other information to provide.

You may also toggle over the red triangle in the corner of the survey cell on the Excel spreadsheet and the instructions will also appear. Two example sheets have been attached with the instructions, one for a specific area, and one that represents an entire county failure data.

Please e-mail* the completed Excel spreadsheets for your district by May 2, 2008 to:
Nathan Johnson
Nathan.johnson@odh.ohio.gov
Phone: 614-644-7181
Fax: 614-466-4556
Ohio Department of Health
246 N. High St.
Columbus, Ohio 43215

* If you have difficulty transmitting the completed spreadsheets via e-mail please contact Nathan for assistance. Other formats for submission can be accepted on a case by case basis.

1. Health District:	
2. Area Name:	

LOCATION OF SYSTEMS

3. Is the area incorporated or unincorporated?	
4. If the area is unincorporated, provide a narrative description of the location (e.g., at the intersection of S.R. 12 and C.R.190) OR provide a map that indicates the location of the area	

NUMBER OF SYSTEMS AND SYSTEM FAILURES

5. Provide your best estimate of the numbers and types of household systems in this area that are (a) existing, (b) currently failing, and (c) anticipated to fail within the next five years. A "failure" is a situation that should result in an alteration or replacement of the existing household system, and not simple maintenance items.

	Total Existing	Currently Failing	Fail within the next 5 years
Septic tank/leaching systems			
Septic tank/mound system			
Septic tank to sand filter			
Septic tank/to storm sewer			
Septic tank/to ditch or surface water			
Septic tank/to unknown			
Aeration/leach field			

Aeration/mound system			
Aeration to sand filter			
Aeration/to storm sewer			
Aeration/to ditch or surface water			
Aeration/to unknown			
Privy (outhouse)			
Unknown			
Dry wells			
Other (specify below)			

PRINCIPAL REASONS FOR FAILURES

6. Please identify the reasons for the failure of sewage systems in this area and estimate the percentage of systems in this area that are failing for each reason checked. Fill in the value for as many as apply - the total can exceed 100%.

	Percentage of each reason for failure (in this area only)
Soil limitations (i.e. permeability, drainage, inadequate thickness)	
Substandard or poor designs	
Shallow seasonal water table	
Shallow normal (or apparent) ground water	

Damage to soil absorption area	
Space limitations	
Poor installation	
No leach field	
Direct discharge exceeding public health nuisance or NPDES standards	
Illegal system alteration or repair	
System owner abuse (overload, disposal of chemicals or bad items into system)	
Unapproved system (e.g., privies)	
Steep slopes	
Poor O and M (no pumping, failure to maintain)	
Old system (age)	
Other (specify below)	

MANIFESTATION OF THE FAILURE(S)	
7. Please identify how the failure(s) that are occurring in this area are being manifested. Check as many as apply.	
Breakout or surfacing of sewage in yards	
Sewage backup into homes	
Positive dye tests	

Discharges that are public health nuisances/exceed NPDES effluent standards	
Suspected/known ground water contamination	
Identified impaired streams or waterways	
Structural failure (i.e., collapse, concrete disintegration, etc.)	
Other (specify below)	

SOLUTIONS FOR THE AREA

8. Would either HSTS alterations or replacements be a feasible option for some or all of the area? If yes, indicate the percentage of each (do not exceed 100%).	Alterations	Replacements

9. If any HSTS alterations or replacements are feasible, what type(s) of HSTS technologies should be used? Indicate the percentage of each type that would be applicable for this area. Fill in the value for as many as apply (do not exceed 100%).	
Septic tank/ pretreatment to leaching trenches	
Septic tank/ pretreatment to sand mound system	
Drip distribution system	
Spray Irrigation	
NPDES approved system	
Other (specify below)	

10. Would it be feasible to send the wastewater flow to a nearby existing wastewater treatment plant (after installing sewers)? Indicate Yes or No.	
Which existing wastewater treatment plant is nearby?	

BASIS OF SURVEY DATA	
11. What is the basis for the data provided in this survey for this area? Indicate only **one** of the following choices:	
Estimated based on census data or general County knowledge	
Estimated based on alteration and replacement permit data and/or nuisance complaints	
Counts based on surveys and inspections or enginerring studies and detailed analyses	
Other (specify below)	
NOTES	
12. Add any additional information about the area that may be beneficial. Optional.	

APPENDIX B

REVIEWED TMDL REPORTS AND INFORMATION RELATED TO THE DOCUMENTATION OF FAILING SEWAGE SYSTEMS

TABLE I - HSTS IMPAIRMENT

Watershed/County	# of Impaired Subwatersheds by HSTS	Other Sources of Impairment	HSTS Recommendations Included in Report
NORTHWEST	**24**		
1. Auglaize River (upper) (Auglaize,Allen,Paulding, Putnam,VanWert)	3	Manufacturing, Agriculture	Replace faulty septic systems, eliminate on-site septic systems; public education
2. Beaver Creek and Grand Lake St. Marys (Mercer and Auglaize)	2	Agriculture, Livestock	Repair or replace faulty systems; connect to main sewer systempublic education
3. Blanchard River (Allen,Hancock,Hardin,Putnam,Wyandot)	**6**	Agriculture, Sedimentation	Better management of septic systems, upgrade septic syste
4. Huron River (Erie, Huron,Richland)	2	Habitat alteration	Replace faulty septic systems, public education
5. Old Woman Creek and Chappel Creek (Erie)	1	Agriculture and livestock	Home sewage treatment system management
6. **Sandusky River(upper)*** (Crawford,Hardin,Marion,Seneca,Wyandot)	**6**	Livestock,Sedimentation	Centralized wastewater collection
7. Toussaint River (Ottawa,Sandusky,Wood)	**4**	Agriculture, Livestock	Eliminate faulty septic systems, public educ.
NORTHEAST	**31**		
8.. Black River (Ashland, Cuyahoga, Huron, Lorain, Medina)	3	Urban runoff, agriculture	Eliminate faulty septic systems, public education
9. Chagrin River (Cuyahoga, Geauga,Lake)	2	Land development	Septic System and storm water mgmt.
10. Lower Cuyahoga River (Summit,Medina,Cuyahoga,Portage)	**4**	Sewer overflow, urban runoff	Inspection and proper maintenance
11. Middle Cuyahoga River (Geauga, Portage,Summit)	0	Municipal discharges	No action
12. Upper Cuyahoga River (Geauga)	2	Municipal discharges	Homeowner education, better management
13. Euclid Creek (Lake,Cuyahoga)	1	Combined sewer overflows	Control of septic discharges, replace septic
14. Little Beaver Creek (Columbiana,Carroll,Mahoning)	3	Agriculture	Better septic system management
15. Lower Grand River (Ashtabula,Geauga,Lake)	1	Agriculture and sedimentation	Better septic system management
16. Mahoning River (Portage,Trumbull,Mahoning)	**4**	Storm runoff, Livestock	Better septic system management
17. Rocky River (Cuyahoga,Lorain,Medina,Summit)	2	Municipal discharges	Septic inspection and maintenance
18. Sugar Creek (Holmes,Stark,Tuscarawas)	3	Agriculture and livestock	Identify and eliminate faulty septic systems
19. **Vermillion River *** (Ashland,Erie,Lorain,Richland)	**6**	Agriculture	Better septic system management

TABLE I - HSTS IMPAIRMENT			
Watershed/County	**# of Impaired Subwatersheds by HSTS**	**Other Sources of Impairment**	**HSTS Recommendations Included in Report**
SOUTHEAST	**10**		
21. Duck Creek (Washington,Noble,Monroe,Guernsey)	2	Acid mine drainage, aluminum	Better septic system management
22. Leading Creek (Meigs,Athens, Gallia)	**7**	Acid Mine Drainage	Improved operations
23. Monday Creek (Athens, Hocking, Perry)	0	Acid Mine Drainage	No action
24. Raccoon Creek(upper) (Athens,Gallia,Hocking,Meigs,Vinton)	0	Metals, pH,Siltation	No action
25. Sunday Creek (Athens, Morgan,Perry)	1	Acid mine drainage	Repairs HSTS or connect to centralized plant
SOUTHWEST	**15**		
26. Fourmile Creek(Butler,Preble)	1	Livestock and agriculture	Better septic system management
27. Indian Creek(Butler)	1	Livestock and agriculture	Better septic system management
28. Little Miami River(upper) (Clark, Greene,Clinton,Montgomery,Vinton,Warren)	3	Phosphorous, Ammonia	Better septic system management
29. Mill Creek (Tributary to Ohio River) (Hamilton,Butler)	1	Municipal discharges	Better watershed management
30. Stillwater River (Darke,Miami)	**6**	Agriculture and Municipal Dis.	Better Septic System Management
31. Twin Creek (Preble,Darke)	2	Agriculture	Better septic system management
32. Wabash River (Darke,Mercer)	1	Livestock and agriculture	Watershed best management practices
CENTRAL	**22**		
33. **Big Darby Creek*** (Champaign, Clark,Logan, Union, Madison, Franklin, Pickaway)	3	Agriculture, Livestock	Stronger regulations, public education
34. **Big Walnut Creek*** (Delaware, Licking,Knox, Fairfield,Franklin,Morrow)	4	Urban runoff, Livestock	No action
34. **Bokes Creek*** (Delaware,Logan,Union,)	3	Agriculture, Storm Runoff	Upgrade failing septic systems
35. **Mill Creek (Tributary to Scioto River)*** (Union, Logan)	**6**	Organic enrichment	Septic system improvement.
36**. Olentangy River*** (Crawford,Delaware,Franklin,Marion, Morrow)	4	Agriculture, land use, livestock	Provide sewers when possible better mgmt.
37. **Wakatomia River*** (Knox,Licking,Coshocton,Muskingum)	2	Livestock and agriculture	Identify and eliminate faulty septic systems
Total	**102**		

***Watersheds may cover more than one region**

TABLE I - HSTS IMPAIRMENT			
Watershed/County	# of Impaired Subwatersheds by HSTS	Other Sources of Impairment	HSTS Recommendations Included in Report

Table II
Number of Failing Systems by Stream Segment

Watershed (HUC11)	Watershed Name	Subwater Number(s)	Subwatershed	County	Recreational Status of Subwatershed (Full or Non-attainment, etc)	Recreational Impaired Waterbodies or Streams	Cause of Impairment(fecal, nitrogen, nutrients, phosphorous)	Is home sewage suspected source of impairment	Reported # of household Sewage Treatment Systems	Reported # of failing home systems	% of failing home systems	Est. ADF of Sewage from failing systems
[04100007]	Auglaize River(Upper)	10	Auglaize River (Headwaters to Downstream Pusheta Creek)	Auglaize, Allen	Non-attainment	Auglaize R Trib II, Dry Run, Owl Ck, Camp Ck, Huffman Ck, Quaker Run	bacteria	yes	DNR	DNR	DNR	DNR
		20	Downstream Pusheta Creek to Upstream Jennings Creek	Allen, Auglaize, Putnam	Non-attainment	Twomile Ck, Sims Run, Sixmile Ck, Buck Run	bacteria	yes	DNR	DNR	DNR	DNR
		60	Upstream Jennings Creek to Upstream Lower Auglaize River	Putnam, Allen, Van Wert, Paulding	Non-attainment	West Jennings, Flat Fork, Big Run, Lap Ditch, Auglaize Trib VI, Prairie Ck	bacteria	yes	DNR	DNR	DNR	DNR
[05120101]	Beaver Creek and Grand St. Lake Mary River	20	Grand Lake St. Marys and Tributaries	Mercer and Auglaize	Non-attainment	Grand Lake St. Mary's and it Tributaries	fecal	yes	DNR	DNR	DNR	DNR
		30	Beaver Creek	Mercer and Auglaize	Non-attainment	Downstream of Grand Lake St. Marys to Mouth	fecal	yes	DNR	DNR	DNR	DNR
[05060001]	Big Darby Creek	190	Upper Big Darby Creek	Logan, Union, Champaign, Madison	Non-attainment	Big Darby Creek, Flat Branch, Buck Run, Robinson Run, Sugar Run	fecal	yes	DNR	DNR	DNR	DNR
		200	Middle Big Darby Creek	Madison, Franklin,Union	Full	none	N/A	no	N/A	N/A	N/A	N/A
		210	Little Darby Creek	Champaign, Union, Madison, Clark	Non-attainment	Lower Little Darby Ck,Proctor Run, Treacle Creek, Hamilton Ditch, Bales Ditch,Barron Creek, Spring Fork,	fecal	yes	DNR	DNR	DNR	DNR
		220	Lower Big Darby Creek	Pickaway, Franklin, Madison	Non-attainment	Hellbranch	fecal	yes	DNR	DNR	DNR	DNR
[05060001]	Big Walnut Creek	130	Upper Big Walnut Creek	Delaware, Morrow, Licking, Knox	Non-attainment	Culver Ck, Rattlesnake Ck, Duncan Run, Reynolds Run	fecal	yes	1419	1109	100%	DNR
		140	Lower Big Walnut Creek	Licking, Delaware, Franklin, Fairfield	Non-attainment	Mason Run,McKenna Ck, Blacklick Ck,	fecal	yes	DNR	DNR	DNR	DNR
		150	Upper Alum Creek	Delaware, Morrow	Non-attainment	Bunker Run, W.Brank Alum Ck, Big Run	bacteria	yes	DNR	DNR	DNR	DNR
		160	Lower Alum Creek	Franklin, Delaware	Non-attainment	Spring Run, W Spring Run, Kilbourne, Bliss Run	bacteria	yes	DNR	DNR	DNR	DNR
[04110001]	Black River	20	West Branch Black River headwaters to mouth	Lorain, Ashland	Non-attainment	Wellington, Creek	bacteria	yes	DNR	DNR	20%	DNR
		30	East Branch Black River headwaters to downstream Cook Creek	Lorain, Medina	full	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		40	East Branch Black River downstream Cook Creek to mouth	Lorain, Cuyahoga	Non-attainment	Willow Creek	bacteria	yes	DNR	DNR	DNR	DNR
		50	Black River confluences of East and West Branch to mouth	Lorain, Cuyahoga	Non-attainment	French Creek	bacteria	yes	DNR	DNR	DNR	DNR
[04110008]	Blanchard River	10	Blanchard Headwater	Hardin and Hancock	Non-attainment	Potato Run, Forest/Simpson Ditch, Shallow Run, The Outlet. Wharton Ditch	bacteria	yes	DNR	DNR	DNR	DNR
		20	Outlet/Lye Creek	Hancock, Wyandot, Seneca	Non-attainment	Lye Ck, Stahl Ditch,						
		30	Eagle Creek	Hancock	Non-attainment	Eagle Ck, Buck Run Ck	bacteria					
		40	Ottawa Creek	Hancock and Putnam	Non-attainment	Ottawa Ck, Duke's Run						
		50	Riley Creek	Hancock, Allen and Putnam	Non-attainment	Riley Creek. Little Riley Ck	bacteria					
		60	Cranberry Creek	Putnam, Allen	Non-attainment	Deer Ck, Pike Ck, Bear Ck						
[05060001]	Bokes Creek	60	Scioto River	Delaware	non-attainment	West Fork West Mansfield, South Branch West Fork, Smith Run	bacteria	yes	DNR	DNR	DNR	DNR
		60	Bokes Creek	Union, Delaware	Non-attainment	North Fork West Mansfield Trib, South Branch West Fork Mansfield Trib, East Fork	bacteria	yes	DNR	DNR	DNR	DNR
		60	Powderlick Run	Union	Non-attainment	Brush Run, Smith Run	bacteria	yes	DNR	DNR	DNR	DNR
[04110003]	Chagrin River	20	Aurora Branch	Geauga	Non-attainment	Aurora Branch, Stoney Brook	fecal	yes	DNR	85	DNR	34,000
		30	Aurora Branch to mouth	Lake, Cuyahoga, Geauga	Non-attainment	Marsh Hawk Run, Dewdale Ck, Pepper Luce Ck	fecal	yes	DNR	DNR	DNR	DNR
[05080002]	Fourmile Creek	60	Sevenmile Creek	Preble, Butler	Full	N/A	N/A	no	no	no	no	no
		70	Fourmile Creek(excluding Sevenmile Creek)	Butler	Non-attainment	Darrs Run, Fleisch Run	bacteria	yes	yes	500	yes	yes
[04110002]	Cuyahoga River(Lower)	30	Below Breakneck Creek to below L. Cuyahoga River	Summit	Non-attainment	Wingfoot Lake Outcreek,Breakneck Ck,Union Oil Trib,Ohio Cana	fecal	yes	DNR	DNR	DNR	DNR
		40	Below L. Cuyahoga River to below Brandywine Creek	Summit, Medina	Non-attainment	Yellow Ck, Brandywine Ck, Powers Bk, Mud Bk	fecal	yes	DNR	DNR	DNR	DNR
		50	Below Brandywine Creek to below Twinkers Creek	Portage, Summit, Cuyahoga	Non-attainment	Tinkers Ck, Pond Bk, Deer Lick Run, Chippewa, Beaver Meadow Run	fecal	yes	DNR	DNR	DNR	DNR
		60	Below Twinkers Creek to Lake Erie	Cuyahoga	Non-attainment	Big Ck, Mill Ck, Ford Branch Big Ck, Kingsbury Run, West Ck	fecal	yes	837	DNR	DNR	DNR
[04110002]	Cuyahoga River(Middle)	10	Breakneck Ck	Geauga	Full	N/A	N/A	no	N/A	N/A	N/A	N/A
		20	Kent	Portage	Full	N/A	N/A	no	N/A	N/A	N/A	N/A
		30	Fishcreek	Summit	Full	N/A	N/A	no	N/A	N/A	N/A	N/A

Legend: N/A - Not Applicable
DNR: Data Not Reported

Table II
Number of Failing Systems by Stream Segment

Watershed (HUC11)	Watershed Name	Subwater Number(s)	Subwatershed	County	Recreational Status of Subwatershed (Full or Non-attainment, etc)	Recreational Impaired Waterbodies or Streams	Cause of Impairment(fecal, nitrogen, nutrients, phosphorous)	Is home sewage suspected source of impairment	Reported # of household Sewage Treatment Systems	Reported # of failing home systems	% of failing home systems	Est. ADF of Sewage from failing systems
[04110002]	Cuyahoga River(Upper)	10	Headwaters to below Black Brook	Geauga	Non-attainment	Butternut Ck, Sawyer Brook	bacteria	yes	550	DNR	DNR	DNR
		20	below Black Brook to below Breakneck Creek	Geauga	Non-attainment	Harper Ditch	bacteria	yes	DNR	DNR	DNR	DNR
[05030201]	Duck Creek	110	East Fork Duck Creek	Washington, Noble, Monroe	Non-attainment	Whipple Run	bacteria	yes	DNR	DNR	DNR	DNR
		120	Duck Creek and West Fork	Washington, Noble, Guernsey	Non-attainment	Wolf Run	bacteria	yes	DNR	DNR	DNR	DNR
[04110003]	Euclid Creek	10	East of Cuyahoga River to West of Grand River	Lake, Cuyahoga	Non-attainment	East Branch of Euclid River	bacteria	yes	494	80	16.20%	DNR
[04100012]	Huron River	10	Headwatersto upstream Slate Run	Huron, Richland	Non-attainment	Marsh Run, Shiloh Ditch,	bacteria	yes	DNR	47	DNR	DNR
		20	upstream Slate Run to mouth	Huron, Erie	Full	Jacobs Creek, Lower Slate Run, East	habitat alteration	no	N/A	N/A	N/A	N/A
		30	East Branch Huron River	Huron	Non-attainment	Norwalk Ck, West Branch Rattlesnake Ck	bacteria	yes	DNR	DNR	DNR	DNR
[05080002]	Indian Creek	80	Indian Creek	Butler	Non-attainment	Little Indian Ck, Lick Run, Salmon Run, Reverse Run	bacteria	yes	DNR	DNR	DNR	DNR
[5030202090]	Leading Creek	10	Leading Creek to Below Five Mile Run	Meigs, Athens	Non-attainment	Leading Creek to Below Five Mile Run	fecal coliform	yes	213	107	50%	38,000
		20	Leading Creek Below Five Mile Run to Above Mud Fork	Meigs, Athens	Non-attainment	Leading Creek Below Five Mile Run to Above Mud Fork	fecal coliform	yes	359	180	50%	65,000
		30	Mud Fork	Meigs	Non-attainment	Mud Fork	fecal coliform	yes	166	83	50%	29,880
		40	Leading Creek Below Mud Fork to Above Little Leading Creek	Meigs	Non-attainment	Leading Creek Below Mud Fork to Above Little Leading Creek	fecal coliform	yes	562	337	60%	121,320
		50	Little Leading Creek	Meigs	Non-attainment	Little Leading Creek	fecal coliform	yes	497	298	60%	107,280
		60	Leading Creek below Little Leading Creek to the Ohio River	Meigs, Gallia	Non-attainment	Leading Creek below Little Leading Creek to the Ohio River	fecal coliform	yes	126	63	50%	22,680
		70	Thomas Fork	Meigs	Non-attainment	Thomas Fork	fecal coliform	yes	785	471	60%	169,560
[05030101]	Little Beaver Creek	70	Middle Fork	Columbiana	Non-attainment	Honey Ck	bacteria	yes	DNR	DNR	DNR	DNR
		80	West Fork	Columbiana, Carroll	Non-attainment	Leslie Run	bacteria	yes	DNR	DNR	DNR	DNR
		90	Little Beaver Creek	Columbiana	Non-attainment	Brush Creek	bacteria	yes	DNR	DNR	DNR	DNR
[05090202]	Little Miami River	10	headwaters to above Massie Creek	Clark	Non-attainment	Little Miami River North Fork to Caesar Ck	pathogens	yes	DNR	DNR	DNR	DNR
		20	above Massie Creek to below Beaver Creek	Greene	Non-attainment	N/A	N/A	no	N/A	DNR	DNR	DNR
		30	below Beaver Creek to above Caesar Creek	Greene, Warren, Montgomery	Non-attainment	Gladys Run	pathogens	yes	DNR	25	DNR	DNR
		40	Anderson Fork (Caesar Creek Watershed)	Greene, Clinton, Warren	Non-attainment	Ceasar Creek	pathogens	yes	DNR	800	DNR	DNR
		50	Caeser Creek (except Anderson Fork)	Greene, Clinton, Warren	Non-attainment	N/A	N/A	no	DNR	DNR	DNR	DNR
[04110004]	Lower Grand River	50	Mill Creek	Ashtabula	Non-attainment	Cemetery Creek	fecal	yes	DNR	DNR	DNR	DNR
		60	Grand River Below Mill Creek to Lake Erie	Lake, Geauga	Full	N/A	N/A	N/A	N/A	N/A	N/A	N/A
[05030103]	Mahoning River	40	Eagle Creek	Portage	Non-attainment	Eagle Creek	bacteria	yes	DNR	DNR	DNR	DNR
		50	downstream Eagle Creek to upstream Mosquito Creek	Trumbull	Non-attainment	Duck Creek	bacteria	yes	DNR	DNR	DNR	DNR
		70	downstream Mosquito Creek to upstream Mill Creek	Trumbull, Mahoning	Non-attainment	Mosquito, Mud, Meander, Squaw Ck,	bacteria	yes	DNR	DNR	DNR	DNR
		80	Mill Creek to Pennsylvania border	Mahoning	Non-attainment	Mill, Crab and Yellow Ck	bacteria	yes	2406	481	20%	DNR
[05090203]	Mill Creek (tributary to Ohio)	10	Mill Creek	Hamilton, Butler	Non-attainment	Town Run, Crosses Run,East Fork Mill Ck,Lower Mill Ck	bacteria	yes	DNR	DNR	DNR	DNR
[05060001]	Mill Creek (tributary to Scioto)	70	headwaters to Otter Run	Logan	Full	N/A	N/A	no	N/A	N/A	N/A	N/A
		70	Otter Run to Scioto River	Union,Delaware	Non-attainment	Otter Run to Scioto River	fecal coliform	yes	DNR	DNR	DNR	DNR
		70	Town Run	Unior	Non-attainment	Town Rur	fecal coliform	yes	1382	DNR	DNR	DNR
		70	Crosses Run	Unior	Non-attainment	Crosses Run	organic enrichmen	no	no	N/A	N/A	N/A
		70	North Branch Crosses Rur	Unior	Non-attainment	North Branch Crosses Rur	ammonia,pesticides	no	no	N/A	N/A	N/A
		70	Blues Creek	Union,Delaware	Non-attainment	Blues Creek	organic enrichmen	no	no	N/A	N/A	N/A
		70	BMY Tributary	Unior	Non-attainment	BMY Tributary	habitat alteration	no	no	N/A	N/A	N/A
[05030204]	Monday Creek	10	Brush Fork of Snow Fork, Lost Run, Monkey Hollow, Coe Hollow	Athens, Hocking, Perry	Non-attainment	Little Monday Creek and Snow Fork	acid mind drainage	no	no	N/A	N/A	DNR
[04100012]	Old Woman & Chappel Creek	40	Old Woman & Chappel	Erie	Non-attainment	Old Woman Creek	bacteria	yes	yes	DNR	DNR	DNR
[05060001]	Olentangy River	90	Upper Olentangy	Crawford, Marion, Morrow	Non-attainment		bacteria	yes	DNR	2137	DNR	DNR
		100	Whetstone Creek	Morrow	Non-attainment	Shumaker Ditch, Flat Run, Zimmerman Ditch Shaw Ck, Sam's Ck,Mitchell Run, Big Run, Claypool Run	bacteria	yes	DNR	2740	DNR	DNR
		110	Middle Olentangy	Delaware, Marion, Morrow	Non-attainment	Ulsh Ditch, QuaQua Ck,	bacteria	yes	DNR	2077	DNR	DNR
		120	Lower Olentangy	Delaware, Franklin	Non-attainment	Olentangy River, Horseshoe run	bacteria	yes	DNR	2932	DNR	DNR

Legend: N/A - Not Applicable
DNR: Data Not Reported

Table II
Number of Failing Systems by Stream Segment

Watershed (HUC11)	Watershed Name	Subwater Number(s)	Subwatershed	County	Recreational Status of Subwatershed (Full or Non-attainment, etc)	Recreational Impaired Waterbodies or Streams	Cause of Impairment(fecal, nitrogen, nutrients, phosphorous)	Is home sewage suspected source of impairment	Reported # of household Sewage Treatment Systems	Reported # of failing home systems	% of failing home systems	Est. ADF of Sewage from failing systems
[05090101]	Raccoon Creek	20	Headwaters to Hewett	Athens, Hocking, Vinton	Non-attainment	Raccoon Ck, East Raccoon Ck, West Raccoon Ck, Brushy Fork, Sandy Run	ph/metals	no	N/A	N/A	N/A	N/A
		30	Hewett to Elk	Athens, Meigs, Vinton	Non-attainment	Hewett Fork, Carbondale Ck	pH/metals	no	N/A	N/A	N/A	N/A
		40	Elk to Little Racoon	Meigs, Gallia	Non-attainment	Rockcamp Run,Karr Run	pH/metals	no	N/A	N/A	N/A	N/A
[04110001]	Rocky River	60	West Branch Rocky River	Cuyahoga, Lorain	Non-attainment	Mallett Ck, Baker Ck, West Branch Rocky River	fecal	yes	16,800	DNR	35%-60%	DNR
		70	East Branch Rocky River	Medina, Summit	Non-attainment	Baldwin Ck, Abram Ck, East Branch Rocky River	fecal	yes	DNR	DNR	DNR	DNR
[04100011]	Sandusky River	20	Sandusky River - Bucyrus	Crawford, Richland,Wyandot	Non-attainment	Paramour Ck	organic enrichment	no	N/A	N/A	N/A	N/A
		30	Broken Sword Creek	Crawford,Wyandot	Non-attainment	Indian Run	bacteria	yes	DNR	DNR	10%	DNR
		40	Sandusky River - Upper Sandusky	Crawford,Marion,Wyandot	Non-attainment	Little Sandusky River	bacteria	yes	DNR	DNR	48%	DNR
		50	Upper Tymochtee Creek	Hardin,Marion,Wyandot	Non-attainment	Prairie Run, Warpole Ck	bacteria	yes	DNR	DNR	5-10%	DNR
		60	Lower Tymochtee Creek	Seneca,Wyandot	Non-attainment	Little Run, Honey Run, Negro Run	bacteria	yes	DNR	DNR	10-55%	DNR
		70	Sandusky River - Mexico	Seneca,Wyandot	Non-attainment	Lower Little Tymochtee Ck, Unnamed tributary to Sycamore Ck	sedimentation	no	N/A	N/A	N/A	N/A
		80	Honey Creek	Crawford,Huron,Seneca	Non-attainment							
		90	Sandusky Tiffin	Sandusky,Seneca	Non-attainment	Morrison Creek	bacteria	yes	DNR	DNR	10%	DNR
[05080001]	Stillwater River	90	Stillwater River	Darke	Non-attainment	Painter Ck, Ballinger Run, Harris Run	bacteria	yes	DNR	DNR	80-90%	DNR
		100	Stillwater River (Upstream Swamp Creek to upstream Greenville Creek)	Darke, Miami	Non-attainment	Bolton Run, Prairie Outlet, Boyd Ck,	bacteria	yes	DNR	DNR	DNR	DNR
		110	Greenville Creek	Darke	Non-attainment	Pigeye Ck, Brush Ck	bacteria	yes	DNR	DNR	DNR	DNR
		120	Greenville Creek	Darke, Miami	Non-attainment	Greenville Ck, Indian Ck	bacteria	yes	DNR	DNR	DNR	DNR
		130	Sillwater River	Darke, Miami	Non-attainment	Wayne Lakes, Bradford Ck	bacteria	yes	DNR	DNR	DNR	DNR
		140	Stillwater River	Darke, Miami	Non-attainment	Gettysburg Ck, Norcold Ck, Kraut Ck	bacteria	yes	DNR	DNR	DNR	DNR
[05040001]	Sugar Creek	100	Headwaters to above Middle Fork Sugar Creek	Wayne	Non-attainment	Baltic Ck, Sugar Ck, Walnut Ck	bacteria	yes	DNR	DNR	67%	DNR
		110	South Fork	Tuscarawas, Holmes	Non-attainment	South Fork Sugar Ck, Walnut Ck, Indian Trail Ck	bacteria	yes	DNR	DNR	DNR	DNR
		120	From Middle Fork to mouth, excluding South Fork	Tuscarawas, Stark, Holmes	Non-attainment	Middle Fork,Crabapple Ck, Broad Ck	bacteria	yes	DNR	DNR	DNR	DNR
[05030204]	Sunday Creek	70	East and West Branch Sunday Creek	Athens, Perry, Morgan	Non-attainment	Green's Run, Mud Fork, Congress Run,Jackson Run	bacteria	yes	DNR	DNR	10-75%	DNR
[04100010]	Toussaint River	20	Toussaint	Ottawa, Wood, Sandusky	Non-attainment	Toussaint Ck	fecal	yes	1293	517	40%	DNR
		20	Packer	Ottawa, Wood	Non-attainment	Packer Ck	fecal	yes	448	179	40%	DNR
		20	Rusha	Ottawa	Non-attainment	Rusha Ck	fecal	yes	322	129	40%	DNR
		20	Toussaint Lacustuary	Ottawa	Non-attainment	Toussaint Lacustuary	fecal	yes	128	51	40%	DNR
[05080002]	Twin Creek	30	Headwaters to above Bantas Fork	Preble, Darke	Non-attainment	Price Creek	bacteria	yes	DNR	DNR	DNR	DNR
		40	above Bantas Fork to Great Miami River	Preble, Darke	Non-attainment	Reigle Ditch	bacteria	yes	DNR	DNR	DNR	DNR
[04100012]	Vermillion River	10	Vermillion below Clear Creek	Ashland, Richland	Non-attainment	Clear Creek	bacteria	yes	DNR	DNR	DNR	DNR
		20	Vermillion below and above Clear Creek	Ashland,Huron	Non-attainment	Vermillion Creek	bacteria	yes	DNR	DNR	DNR	DNR
		30	Buck Creek	Ashland	Non-attainment	Buck Creek	bacteria	yes	DNR	DNR	DNR	DNR
		40	Buck Creek above SW Branch	Ashland,Huron	Non-attainment	SW Branch Vermillion River	bacteria	yes	DNR	DNR	DNR	DNR
		50	SW Branch to RM 3.8	Huron,Richland	Non-attainment	Indian Creek	bacteria	yes	DNR	DNR	DNR	DNR
		60	SW Branch to above East Fork	Huror	Non-attainment	East Branch	bacteria	yes	DNR	DNR	DNR	DNR
[05120101]	Wabash River	10	Wabash River	Mercer, Darke	Full	N/A	agriculture	no	N/A	N/A	N/A	N/A
		30	Beaver Creek	Mercer	Non-attainment	Celina,Coldwater, Fort Recovery	bacteria	yes	DNR	DNR	10-30%	DNR
		40	Wabash River (Confluence of Beaver Creek to State Line)	Mercer	Full	N/A	agriculture	no	N/A	N/A	N/A	N/A
[05040004]	Wakatomika Creek	20	Upper headwaters to below Brushy Fork	Knox, Licking	Non-attainment	Wakatomika Ck, Harrod Run, Jug Run, Bladensburg	bacteria	yes	DNR	DNR	DNR	DNR
		30	Lower below Brushy Fork to Muskingum River	Mukingum, Coshocton	Non-attainment	Priest Run	bacteria	yes	DNR	DNR	DNR	DNR

Legend: N/A - Not Applicable
DNR: Data Not Reported