

ASSESSMENT  
OF  
GROUND WATER MONITORING  
FOR  
LAND TREATMENT AND LAGOON SYSTEMS  
AT  
EPA CONSTRUCTION GRANT PROJECTS

Prepared for

U.S. Environmental Protection Agency  
Office of Municipal Pollution Control  
Municipal Construction Division  
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Executive Summary

The appropriate regulatory agencies of each of the fifty states were contacted to determine the status of their ground water monitoring requirements for land treatment systems as required for construction grant projects funded under Title 2 of the Clean Water Act. In addition, eight of the states reported having requirements for ground water monitoring at lagoons, while the majority of the states use seepage limitations as a means of protecting ground water near lagoons.

Thirty-seven states do have requirements for ground water monitoring at land treatment systems. The thirteen states with no requirements for ground water monitoring at land treatment systems gave the following information regarding their requirements. In three of these states (Alaska, Rhode Island, and West Virginia), land treatment is not considered to be either technically or economically feasible by the state agency. Kentucky, Hawaii, and Ohio reported that no land treatment systems have been built under the construction grants program in their states, while Mississippi and North Dakota reported that the current systems were all located in areas where ground water monitoring was not believed to be necessary. Two states, Indiana and Louisiana, are in the process of developing ground water protection regulations which may include monitoring requirements for land treatment systems. Vermont, Texas and Colorado have land treatment systems and consider ground water monitoring on a case-by-case basis, but do not have ground water monitoring programs in place.

Three categories were developed to delineate the type of ground water monitoring requirements at land treatment systems. The first category (Category 1) is composed of states which have no guidelines or do not generally require ground water monitoring. Category 2 includes states which require ground water monitoring and have established certain minimum requirements. Category 3 includes those states which have site-specific requirements, or states with a geology so diverse as to prevent development of uniform requirements for the state. The states falling into each category are summarized in Table 1.

TABLE 1  
SUMMARY OF STATE GROUND WATER  
MONITORING REQUIREMENTS  
FOR LAND TREATMENT AND LAGOON SYSTEMS

Category	EPA REGIONS										Total
	I	II	III	IV	V	VI	VII	VIII	IX	X	
1	RI VT	-	WV	MS KY	IN OH	LA TX	-	CO ND	HI -	AR	13
2	CT MA ME	NY NJ	MD PA VA	AL FL GA NC SC TN	IL WI	AR NM OK	IA KS MO NE	MT SD VT	CA	WA ID	29
3	NH	-	DE	-	MI MN	-	-	WY	AZ NV	OR	8

Category 1 - No guidelines for ground water monitoring or ground water monitoring is not generally required.

Category 2 - Guidelines for ground water monitoring exist.

Category 3 - Monitoring requirements are site-specific or state-wide guidelines cannot be formulated.

Most of the states require some form of ground water monitoring at land treatment sites, as is apparent from Table 1. The monitoring requirements of each state as reported by the contacts listed in Appendix A are summarized in Tables 1 through 10 of the report. Briefly, however, one upgradient and one or two downgradient wells is typical. Analyses for nitrate-nitrogen, ammonia nitrogen, pH and conductivity, or total dissolved solids, either on a quarterly or semi-annual basis, is also typical. Few states have any chain of custody procedures for ground water samples, while approximately half of the states have guidelines for the construction of the monitoring wells.

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Introduction

In recent years, a considerable number of municipal land treatment systems and wastewater lagoons have been constructed and financed with federal funds under EPA's Construction Grants Program. Since both of these processes can have an impact on ground water quality, it is important that they be monitored for such impact. A first step toward determining the adequacy of the present ground water monitoring requirements for municipal land treatment systems and lagoons is to review the present requirements.

Objectives

The objective of this investigation was to gather information on the extent of the states' requirements for ground water monitoring at municipal wastewater land application sites and lagoons. The results of this effort combined with a subsequent investigation of the availability of ground water monitoring data from individual systems, can be used to determine the adequacy of the present requirements. Recommendations for improving the monitoring requirements can then be made.

Scope of Study

In this study, the appropriate regulatory agencies of the fifty states were contacted, primarily by telephone, to determine their ground water monitoring requirements. United States' territories and possessions as well as the District of Columbia were not contacted in this effort.

Summary of State Requirements

The extent of the states' requirements were used as a basis for classifying each state into one of three categories. These categories are defined below and apply primarily to land treatment systems and not to lagoon treatment systems. Most states use seepage limitations as a means of protecting the ground water beneath lagoons. Thus, only a limited number of states require ground water monitoring for wastewater lagoons.

Category 1: No specific requirements - The state has no requirements for, or does not generally require, ground water monitoring at land treatment systems.

Category 2: Specific requirements exist - The state has formal requirements or guidelines for ground water monitoring which generally specify the minimum number of wells, the placement of these wells, the sampling frequency, and the analyses to be performed. States which determine the number and placement of the wells on a case-by-case basis, but which otherwise have general standards for the monitoring frequency and analyses, are included in category 2.

Category 3: Site-specific requirements - The state generally requires ground water monitoring at land treatment sites; however, this category differs from Category 2 in that the number of wells, placement of these wells, the sampling frequency and the analyses to be performed are generally site-specific. To some extent, all states' requirements are site-specific. Category 3 is intended to include those states that require a hydrogeologic or similar study to determine the specific monitoring requirements for a land treatment system. States with a diverse geology that precludes development of a general state-wide policy are also included in category 3.

A summary of the ground water monitoring requirements for each state, using the above classification system, is presented below. Tables 1 through 10 present a summary of the monitoring requirements for each state, listed according to EPA Regions. The information presented in these tables was reported by the state contact identified in Appendix A as being representative of the typical monitoring requirements for a land treatment system in their state. For ease of reference, Tables 1 through 10 are presented at the end of this section. A support document used to develop this report is presented as Appendix B. The information presented in Appendix B provides more detailed description of each state's monitoring requirements.

#### Region I (Table 1, page 11)

No Specific Requirements - Two states: Rhode Island and Vermont have no formal requirements for ground water monitoring at land treatment sites. The Rhode Island Division of Water Supply and Pollution Control, however, has not funded any land treatment projects through the construction grants program. The majority of the land treatment systems in Vermont are leach fields, some of which have monitoring wells to check primarily for mounding. Vermont also has two municipal spray irrigation systems, one of which has monitoring wells. The wells at the monitored system, however, were installed as part of a research project, and the monitoring results are not sent to the state. The other system is underdrained, and the discharge



from the underdrains is monitored under the Vermont Agency of Environmental Conservation's NPDES program. Both states will evaluate the ground water monitoring requirements for future systems on a case-by-case basis.

Specific Requirements Exist - The Connecticut Department of Environmental Protection, Massachusetts Department of Environmental Quality Engineering, and the Maine Department of Environmental Protection require ground water monitoring at land treatment and lagoon sites. Table 1 summarizes the requirements for monitoring reported by each state.

Site-Specific Requirements - The New Hampshire Water Supply and Pollution Control Commission's (NHWSPPC) requirements for ground water monitoring at land treatment sites and lagoons are site-specific. The NHWSPPC does, however, generally require ground water monitoring.

#### Region 2 (Table 2, page 12)

Specific Requirements Exist - The New York State Department of Environmental Conservation (NYSDEC) and New Jersey Department of Environmental Protection (NJDEP) both require ground water monitoring at land treatment systems. The NJDEP also requires ground water monitoring at municipal lagoons. The monitoring requirements of each state are summarized in Table 2.

#### Region 3 (Table 3, page 13)

No Specific Requirements - The West Virginia Department of Natural Resources (WVDNR) does not have any requirements for ground water monitoring at land treatment or lagoon sites. Given West Virginia's mountainous terrain and the requirement for secondary treatment prior to land application, the WVDNR does not believe land treatment is a cost-effective treatment technology in West Virginia.

Specific Requirements Exist - The Maryland Department of Health and Mental Hygiene, the Pennsylvania Department of Environmental Resources, and the Virginia Wastewater Control Board, all require ground water monitoring at land treatment sites. In addition, Virginia also requires ground water monitoring of wastewater lagoons. Table 3 summarizes the requirements of each state.

Site-Specific Requirements - The Delaware Department of Natural Resources and Environmental Control (DNREC) requires a hydrogeologic study on any land treatment site before determining the monitoring requirements.

Region 4 (Table 4, page 14)

No Specific Requirements - The Mississippi Department of Natural Resources (MDNR) and Kentucky Department of Natural Resources and Environmental Protection (KDNREP) have no specific requirements for ground water monitoring at land treatment sites. The hydrogeology of most land treatment sites in Mississippi is such that ground water monitoring is not believed to be necessary. No land treatment projects with a ground water monitoring system are believed to have been constructed in Kentucky.

Specific Requirements Exist - The remaining states in Region 4 (Alabama, Florida, Georgia, North Carolina, South Carolina, and Tennessee) all have requirements for ground water monitoring at land treatment sites, and these requirements are summarized in Table 4.

Region 5 (Table 5, page 15)

No Specific Requirements - Neither the Indiana State Board of Health (ISBH) nor the Ohio Environmental Protection Agency (OEPA) have any specific requirements for ground water monitoring at land treatment sites. Ohio state law does, however, mandate ground water monitoring if a potential health hazard exists. The ISBH is in the process of developing a ground water protection strategy which may include ground water monitoring requirements for land treatment and lagoons.

Specific Requirements Exist - The Illinois Environmental Protection Agency and the Wisconsin Department of Natural Resources have specific monitoring requirements which are summarized in Table 5.

Site-Specific Requirements - The Michigan Department of Natural Resources and the Minnesota Pollution Control Agency generally requires ground water monitoring; however, the monitoring requirements are established on a case-by-case basis.

Region 6 (Table 6, page 16)

No Specific Requirements - The Texas Department of Water Resources (TDWR) does not have any requirements for ground water monitoring at land treatment sites. A review of the site hydrogeology is conducted by the TDWR; however, monitoring wells are not generally required. The TDWR does require that the ground water quality be determined before start-up of a land treatment system. In this manner, the background water quality data will be available should contamination occur after start-up. The Louisiana Department of Natural Resources (LDNR) does not have any requirement for ground water monitoring at either lagoons or land treatment systems. Applicable regulations, however, are currently being drafted.

Specific Requirements Exist - Arkansas, New Mexico, and Oklahoma require ground water monitoring at land treatment sites (Table 6). The Arkansas Department of Pollution Control and Ecology (ADPCE) does not require treatment systems to submit monitoring data to the ADPCE for review. The Oklahoma Department of Health (ODH) requires ground water monitoring and requires the treatment systems to submit the data to the ODH. The ODH, however, does not currently have any data on file.

Region 7 (Table 7, page 17)

Specific Requirements Exist - The Missouri Department of Natural Resources (MDNR) and the Nebraska Department of Environmental Quality (NDEQ) consider ground water monitoring at land treatment sites. The NDEQ requires ground water monitoring at approximately half of the land treatment systems in Nebraska. The MDNR generally only requires ground water monitoring at rapid infiltration systems. The Iowa Department of Environmental Quality (IDEQ) and the Kansas Department of Health and Environment (KDHE) both generally require ground water monitoring at land treatment sites, and these requirements are summarized in Table 7.

Region 8 (Table 8, page 18)

No Specific Requirements - The Colorado Department of Health (CDH) does not have any regulations requiring ground water monitoring at land treatment sites; although, the CDH does encourage treatment systems to install monitoring wells. The North Dakota Division of Water Supply and Pollution Control (NDDWSPC) generally does not require ground water monitoring at land treatment sites. Soil and geologic conditions in

North Dakota are such that ground water monitoring is thus not generally believed to be necessary by the NDDWSPC. At systems where ground water monitoring is believed to be necessary, the ground water monitoring requirements are site-specific.

Specific Requirements Exist - The Montana Department of Health and Environmental Sciences (MDHES), the South Dakota Department of Health and Natural Resources Management (SDDHNRW) and the Utah Bureau of Water Pollution Control (UBWPC) generally require ground water monitoring at land treatment sites. Typical monitoring requirements for these states are presented in Table 8.

Site-Specific Requirements - The Wyoming Department of Environmental Quality's (WDEQ) requirements are site-specific and are dependent upon factors such as the depth and classification of the aquifer.

#### Region 9 (Table 9, page 19)

No Specific Requirements - The Hawaii State Department of Health (HSDH) has no requirements for ground water monitoring at land treatment sites. According to HSDH officials, there are no municipal land treatment systems in Hawaii.

Specific Requirements Exist - The California State Water Resources Control Board (CSWRCB) generally requires ground water monitoring at land treatment systems unless there is no known beneficial use for the ground water. The CSWRCB is composed of nine regional offices, and each regional office establishes the ground water monitoring requirements for the region. Table 9 summarizes the typical requirements for the nine regions.

Site-Specific Requirements - The Arizona Department of Health Services (ADHS) and the Nevada Department of Environmental Protection (NDEP) require ground water monitoring at land treatment sites. The specific requirements, however, are based upon the site conditions.

#### Region 10 (Table 10, page 20)

No Specific Requirements - The Alaska Department of Environmental Conservation (ADEC) does not have any requirements for ground water monitoring at land treatment

sites. Given the climatic conditions, land treatment is not considered by the ADEC to be a feasible treatment technology in Alaska.

Specific Requirements Exist - The Washington Department of Ecology (WDE) and the Idaho Department of Health and Welfare (IDHW) generally require ground water monitoring at land treatment sites, and these requirements are summarized in Table 10.

Site-Specific Requirements - The Oregon Department of Environmental Quality's (ODEQ) requirements for ground water monitoring are based upon the site conditions. Typical monitoring requirements for systems with a ground water monitoring program are summarized in Table 10.

TABLE 1

SUMMARY OF GROUND WATER MONITORING REQUIREMENTS BY STATE\*  
EPA REGION I

	CT	ME	MA	NH	RI	VT
Monitoring wells required for:						
Land treatment	yes	yes	yes	yes	**	no
Lagoons	yes	yes	yes	yes	no	no
Minimum No. of Wells:						
upgradient	1	1-2	1	site-specific	NA	NA
on-site	-	-	-	-	NA	NA
downgradient	2	site-specific	3	-	-	-
Sampling Frequency:						
first year	4-12/year	2-4/year	depends upon	site-specific	NA	NA
thereafter	4-12/year	2-4/year	flow rate	-	-	-
Monitoring Parameters:	NO <sub>3</sub> -N, NH <sub>3</sub> -N, TKN, Cl, Total P, fecal coliform	NH <sub>3</sub> -N, NO <sub>3</sub> -N, Total P, Cl, Total & fecal coliforms	pH, BOD, SS, NO <sub>3</sub> -N, NH <sub>3</sub> -N, TKN	NO <sub>3</sub> -N, pH, Total P, BOD or COD, metals Cond.	NA	NA
Guidelines for Monitoring Well Construction:	formal	None, EPA guidelines used	formal	formal	NA	informal
Disposition of Monitoring Data:	state permit file	state permit file and computer data storage system	state permit file	state permit file	NA	state permit file
Chain of Custody Procedures Routinely Used:	no	yes, by state only	no	yes	NA	no

\*Requirements apply generally to land treatment systems

\*\*Land treatment is not considered a cost-effective technology due to insufficient land availability.

TABLE 2

SUMMARY OF GROUND WATER MONITORING REQUIREMENTS BY STATE  
EPA REGION II

	NJ	NY*
Monitoring wells required for:		
Land treatment	yes	yes
Lagoons	yes	no
Minimum No. of Wells:		
upgradient	1	site-specific
on-site	-	
downgradient	2	
Sampling Frequency:		
first year	4/year	12/year
thereafter	4/year	12/year
Monitoring Parameters:	NH <sub>3</sub> -N, NO <sub>3</sub> -N, TKN, pH, TDS	NO <sub>3</sub> -N, others on a case-by- case basis
Guidelines for Monitoring Well Construction:	formal	none
Disposition of Monitoring Data:	state computer data storage file	state permit file
Chain of Custody Procedures Routinely Used:	yes	no

\*The regional offices of the New York Department of Environmental Conservation develop specific requirements for ground water monitoring.

TABLE 3

SUMMARY OF GROUND WATER MONITORING REQUIREMENTS BY STATE  
EPA REGION III

	DE*	MD	PA	VA	WV*
Monitoring wells required for:					
Land treatment	site-specific	yes	yes	yes	NA
Lagoons	no	no	no	yes	no
Minimum No. of Wells:					
upgradient	site-specific	2	1	1	NA
on-site	-	-	-	-	
downgradient		2	1	2	
Sampling Frequency:					
first year	site-specific	variable	4/year	12/year	NA
thereafter	2/year	4/year	4/year		
Monitoring Parameters:	site-specific	NO <sub>3</sub> -N, Total PO <sub>4</sub> , TDS Cl <sub>2</sub> , fecal coliform; metals & chlorinated organics on an annual basis	NH <sub>3</sub> -N, NO <sub>3</sub> -N, Total PO <sub>3</sub> , MBAS, others on an annual basis.	NO <sub>3</sub> -N, Cl <sub>2</sub> , TOC pH, Total P Hardness, Alk., cond., total coliform, others on a case-by-case basis	NA
Guidelines for Monitoring Well Construction:	formal	formal	formal	none	NA
Disposition of Monitoring Data:	state permit file	state permit file	state permit file	state permit file	NA
Chain of Custody Procedures Routinely Used:	no	no	no	no	NA

\*There are no municipal land treatment systems in West Virginia or Delaware. West Virginia does not consider land treatment to be cost-effective given the mountainous terrain. Delaware requires a hydrogeologic study before setting monitoring requirements.



TABLE 4

SUMMARY OF GROUND WATER MONITORING REQUIREMENTS BY STATE  
EPA REGION IV

	AL	FL	GA	KY	MS	NC	SC	TN
Monitoring wells required for:								
Land treatment Lagoons	yes no	yes yes	yes no	no no	no no	yes yes	yes yes	yes no
Minimum No. of Wells:								
upgradient	0	1	1	NA	NA	1	1	1
on-site	0	1	1			-	-	-
downgradient	2	1	2			1	2	1
Sampling Frequency:								
first year	4/year	4/year	varies	NA	NA	3/year	4/year	4/year
thereafter	4/year	4/year	with influent flow rate	NA	NA	3/year	biannual	4/year
Monitoring Parameters:	drinking water standards	drinking water standards, toxics, others	NO <sub>3</sub> -N, pH, cond., Cl	NA NA	NA NA	NO <sub>3</sub> -N, NH <sub>3</sub> -N TDS, Cl, total coli- form pH, cond. water level	NO <sub>3</sub> -N, NH <sub>3</sub> -N Total P, pH, Cl, Na, TDS, TOC, fecal coliform, alkalinity	pH, NO <sub>3</sub> -N cond., TOC total N, total coliform, water level
Guidelines for Monitoring Well Construction Exist:	informal	formal	formal	NA	NA	formal	formal	informal
Disposition of Monitoring Data:	state permit file	state computerized data storage system	state permit file	NA	NA	state permit file	state computerized data storage system	state permit file
Chain of Custody Procedures Routinely Used:	no	no	yes, by state only	NA	NA	no	no	no

TABLE 5

SUMMARY OF GROUND WATER MONITORING REQUIREMENTS BY STATE  
EPA REGION V

	IL	IN*	MI	MN	OH	WI
Monitoring wells required for:						
Land treatment	yes	no	yes	site-specific	no	yes
Lagoons	no	no	site-specific	site-specific	no	no
Minimum No. of Wells:						
upgradient	1	NA	site-specific	site-specific	NA	1
on-site	-					-
downgradient	1					1
Sampling Frequency:						
first year	2/year	NA	site-specific	site-specific	NA	flow dependent
thereafter	2/year					2/year
Monitoring Parameters:	NO <sub>3</sub> -N, NH <sub>3</sub> -N Cl, SO <sub>4</sub> , pH TDS, PO <sub>4</sub> , fecal coliform	NA	site-specific	NO <sub>3</sub> -N, NH <sub>3</sub> -N TKN, Cl, Cond., pH	NA	(NO <sub>3</sub> +NO <sub>2</sub> )-N, NH <sub>3</sub> -N, BOD, org-N cond., Cl COD, TDS, pH, SO <sub>4</sub> , Alk., hard
Guidelines for Monitoring Well Construction:	formal	NA	formal	formal	NA	formal
Disposition of Monitoring Data:	state permit file	NA	state compliance file	state permit file	NA	state permit file
Chain of Custody Procedures Routinely Used:	no	NA	yes, by state only	no	NA	no

\*Indiana has only recently established a ground water section in the Division of Water Pollution Control.

TABLE 6  
SUMMARY OF GROUND WATER MONITORING REQUIREMENTS BY STATE  
EPA REGION VI

	AR	LA	NM	OK	TX
Monitoring wells required for:					
Land treatment	yes	no	yes	yes	no
Lagoons	no	no	yes	no	no
Minimum No. of Wells:					
upgradient	1	NA	site-	1	NA
on-site	1		specific	1	
downgradient	1			1	
Sampling Frequency:					
first year	4/year	NA	3/year	12/year	NA
thereafter	4/year		3/year	12/year	
Monitoring Parameters:	NO <sub>3</sub> -N, Cl, fecal coliform, others on a case-by-case basis		Total N NO <sub>3</sub> -N, Cl TDS, fecal coliform	NH <sub>3</sub> -N metals(annual)	NA
Guidelines for Monitoring Well Construction:	informal	NA	informal	none	NA
Disposition of Monitoring Data:	kept at facility	NA	state permit file	state permit file	NA
Chain of Custody Procedures Routinely Used:	no	NA	no	no	NA

In general, Texas does not require monitoring wells at land treatment or lagoon systems.

TABLE 7

SUMMARY OF TYPICAL GROUND WATER MONITORING REQUIREMENTS BY STATE  
EPA REGION VII

	IA	KS	MO	NE
Monitoring wells required for:				
Land treatment Lagoons	yes no	yes site-specific	yes* no	yes no
Minimum No. of Wells:				
upgradient	1	1	1	1
on-site	-	-	-	-
downgradient	2	site-specific	1	2
Sampling Frequency:				
first year	flow	2-4/year	4-12/year	12/year
thereafter	dependent	2-4/year	4-12/year	site- specific
Monitoring Parameters:	Total N,TKN, NH <sub>3</sub> -N,NO <sub>3</sub> -N TOC,TDS,pH,Alk hard., metals, total coliform	NO <sub>3</sub> -N,NH <sub>3</sub> -N Total P or PO <sub>4</sub> , SO <sub>4</sub>	BOD,TSS NO <sub>3</sub> -N	NH <sub>3</sub> -N,NO <sub>3</sub> -N NO <sub>2</sub> -N,Cl, Total P,COD TDS,pH, alk hard.
Guidelines for Monitoring Well Construction:	informal	informal	informal	formal
Disposition of Monitoring Data:	state permit file	state permit file	state permit file	state permit file
Chain of Custody Procedures Routinely Used:	no	yes, by state only	yes, by state only	no

\*Monitoring required usually only at rapid infiltration systems.

TABLE 8

SUMMARY OF GROUND WATER MONITORING REQUIREMENTS BY STATE  
EPA REGION VIII

	CO*	MT	ND	SD	UT	WY
Monitoring wells required for:						
Land treatment	no	yes	site-specific	yes	yes	site-specific
Lagoons	no	no	no	site-specific	no	site-specific
Minimum No. of Wells:						
upgradient	NA	1	site-specific	2	1	1
on-site		-		-	-	-
downgradient		2		2	1	2
Sampling Frequency:						
first year	NA	4/year	12/year	12/year	monthly	1/year
thereafter		2-4/year	site-specific	12/year	during application	1/year
Monitoring Parameters:	NA	(NO <sub>3</sub> +NO <sub>2</sub> )-N cond., Cl water level	NO <sub>3</sub> -N, NH <sub>3</sub> -N BOD, SS, pH fecal coliform	NO <sub>3</sub> -N, NO <sub>2</sub> -N, NH <sub>3</sub> -N, Cl <sub>2</sub> Cond., TDS, fecal coliforms, others	NO <sub>3</sub> -N, total P, total coliform	NH <sub>3</sub> -N, NO <sub>3</sub> -N, pH, Cl, TDS Boron, Selenium
Guidelines for Monitoring Well Construction:	NA	informal	formal	formal	informal	formal
Disposition of Monitoring Data:	NA	state permit file	state permit file	state permit file	state permit file	state permit file
Chain of Custody Procedures Routinely Used:	NA	no	no	no	no	yes

\*Colorado does not have regulations requiring groundwater monitoring at land treatment sites, but wells are encouraged.

TABLE 9  
SUMMARY OF GROUND WATER MONITORING REQUIREMENTS BY STATE  
EPA REGIONS IX

	AZ	CA	NV	HI
Monitoring wells required for:				
Land treatment	site- specific	site- specific	yes	no
Lagoons	site- specific	site- specific	no	no
Minimum No. of Wells:				
upgradient	site- specific	1	site- specific	NA
on-site		-		NA
downgradient		1		
Sampling Frequency:				
first year	site- specific	2-4/year	site- specific	NA
thereafter		2-4/year		
Monitoring Parameters:	site- specific	NO <sub>3</sub> -N, Tot. N, Cl, TDS, Na	NO <sub>3</sub> -N, others case-by-case basis	NA NA
Guidelines for Monitoring Well Construction:	none	none	none	NA
Disposition of Monitoring Data:	state permit file	state permit file	state permit file	NA permit file
Chain of Custody Procedures Normally Used:	no	no	yes	NA

TABLE 10

SUMMARY OF GROUND WATER MONITORING REQUIREMENTS BY STATE  
EPA REGIONS, X

	AK	ID	OR	WA
Monitoring wells required for:				
Land treatment	no	yes	site-specific	yes
Lagoons	no	no	no	yes (if unlined)
Minimum No. of Wells:				
upgradient	NA	1	site-specific	1
on-site	NA	-	specific	-
downgradient		1		1
Sampling Frequency:				
first year	NA	12/year	4/year	flow
thereafter		12/year	4/year	dependent
Monitoring Parameters:	NA	NO <sub>3</sub> -N, Tot. N COD, Total P, and total coliform	NO <sub>3</sub> -N, NH <sub>3</sub> -N, SO <sub>4</sub> , Cl, cond., total & fecal coliform, water level	NP <sub>3</sub> -N, total coliform
Guidelines for Monitoring Well Construction:	NA	none	none	EPA guidelines used
Disposition of Monitoring Data:	NA	state permit file	state permit file	state permit file
Chain of Custody Procedures Normally Used:	NA	no	yes, by state only	no

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## APPENDIX B

### INFORMATION FURNISHED BY INDIVIDUAL STATES

#### Alabama

In the state of Alabama, wastewater treatment systems which discharge into ground water are regulated under the Alabama Department of Environmental Management's (ADEM) NPDES program. All land treatment systems are thus regulated under this system. Specific ground water monitoring requirements at a site are established by state geologists. In general, land treatment systems are required to have a minimum of two downgradient wells (1 deep and 1 shallow). Before a system begins operation, the downgradient wells are used to collect background water quality data for the aquifer. The monitoring data are collected and sent to the state (quarterly), and drinking water standards are used as the monitoring criteria. The treatment systems' monitoring data and operating procedures are examined during periodic inspections at which time the state collects and analyzes samples. The state's results are then compared with the past monitoring data collected by the treatment system. The ADEM does not have ground water monitoring requirements for lagoons. Instead, the lagoons are required to be lined.

#### Alaska

Due to climatic conditions in Alaska, land treatment is not considered a feasible treatment technology. Therefore, the Alaska Department of Environmental Conservation (ADEC) has not developed any requirements for ground water monitoring for land treatment systems.

#### Arkansas

The Arkansas Department of Pollution Control and Ecology (ADPCE) does not require ground water monitoring for lagoons. At land treatment sites, the ADPCE requires that wells be located upgradient, on-site, and downgradient. The exact number of wells at each location, however, will depend upon the site geology. Quarterly analyses for nitrate-nitrogen, chloride and fecal coliform are required, and analyses for BOD or TOC, COD, total Kjeldahl nitrogen, total phosphorus, total coliform, total dissolved solids, alkalinity, temperature, pH, and water level are considered on a case-by-case basis. Most of the treatment systems use contract laboratories to perform their analyses, and the results are kept on file by the treatment plant. Finally, guidelines for the construction of monitoring wells exist.

## Arizona

The Arizona Department of Health Services (ADHS) is in the process of developing regulations for the protection of ground water. These proposed regulations require that any wastewater treatment facility which could impact the ground water must develop a monitoring plan containing a description of a monitoring system adequate to characterize the effects of the facility operation on ground water quality. The plan may be required to specify monitoring location and type, monitoring frequency, and procedures for sample collection and analysis. Thus, the monitoring requirements at lagoon or land treatment systems are site-specific.

## California

The state of California is divided into nine water quality regions, each of which is regulated by a Regional Water Quality Control Board. Each Regional Board can establish independent ground water monitoring requirements. Four of the nine Regional Boards were contacted to determine their monitoring requirements, and the individual regions' requirements were similar. Ground water monitoring at land treatment or lagoon sites is generally not required if there is no known beneficial use of the ground water. Otherwise, ground water monitoring is required. The number of wells required is site-specific, but generally one upgradient well and one downgradient well for each direction of flow is required. Typical ground water monitoring parameters include TDS, sodium, nitrate-nitrogen, total nitrogen, and chlorides. Other parameters may be required depending upon the type of system and the use of the ground water (e.g., boron, if the treated wastewater contains a significant boron concentration and if the aquifer is used for irrigation). The monitoring frequency ranges from semi-annual to quarterly, and the data are sent to the appropriate Regional Water Quality Control Board. At one time, the state did require the use of certified laboratories for performing the analyses. The funding for the laboratory certification program, however, has been eliminated from the state budget.

## Colorado

The Colorado Department of Health (CDH) does not have any regulations requiring ground water monitoring at land treatment sites; although, the CDH does encourage treatment systems to install monitoring wells. There are also no requirements for ground water monitoring at lagoons. Instead, lagoons are limited to a seepage loss of 1/32-inch per day.

## Connecticut

The Connecticut Department of Environmental Protection (CDEP) generally requires ground water monitoring at both lagoons and land treatment systems. Leach fields and rapid infiltration systems are the predominant form of land treatment in Connecticut. The CDEP uses a pollutant/hydrogeology model to determine the specific monitoring requirements. Typical monitoring requirements specify a minimum of one upgradient and two downgradient monitoring wells. Samples are generally collected monthly to quarterly and analyzed for nitrate- and ammonia-nitrogen, total Kjeldahl nitrogen, chlorides, fecal coliforms, and total phosphorus. The CDEP has formal guidelines for the construction of monitoring wells. Chain of custody procedures for samples, however, are not generally used unless an enforcement action is planned.

## Delaware

The Delaware Department of Natural Resources and Environmental Control (DNREC) requires a hydrogeologic study of a proposed land treatment site (and sometimes at a lagoon site) before a permit is granted. The results of this study are used to determine the potential for and impact of ground water contamination; the number, location, and design of the monitoring wells, and the monitoring parameters and frequency. The DNREC requires that a registered professional geologist supervise the hydrogeologic investigation and sign the hydrogeologic report. Construction of all monitoring wells must be done by a licensed well contractor who must obtain state permits to construct all monitoring wells. The monitoring data is briefly reviewed when received by the DNREC and is reviewed in more detail when the permit is subject to renewal. There are no chain of custody requirements for either the state or facility, nor is there a quality assurance program.

## Florida

Ground water monitoring regulations for municipal wastewater treatment facilities that use land treatment are covered under Section 17-4.245 FAC. Ground water monitoring is only required by the Florida Department of Environmental Regulation (FDER) for those facilities which treat greater than 100,000 gallons per day. Any facility treating less than this amount is not routinely required to monitor the ground water. Any facility with holding ponds or percolation ponds that treat over 100,000 gallons per day, but do not use land treatment methods, are still required by the FDER to develop a ground water monitoring plan.

The ground water monitoring requirements for these facilities have only been in effect since February 1984. At this time, most facilities have only submitted one or two analyses of ground water samples. Data are still being collected on the first year data base to compare with background levels. The data will be stored in the FDER computer system and tracked over several years to determine if more monitoring parameters are needed, if the sampling frequency should be increased, or if more wells may be needed. Some facilities may have the frequency of sampling reduced from the current quarterly sampling interval if no deviations from background are noted for several sampling periods.

Permits are renewed every five years. At each permit renewal, a complete review of the ground water monitoring plan and the water quality data will be required to determine if permit modifications are warranted. EPA standards are used for sample collection, analysis, and quality control. Florida does not have any sample chain of custody procedures. The FDER requires that the ground water be monitored quarterly for the primary and secondary drinking water standards as well as for several volatile organic compounds. A list of these volatile compounds is shown below. Additional monitoring parameters may be required depending upon the wastewater characteristics.

List of Florida Drinking Water Standards  
for Volatile Organic Compounds

<u>Parameter</u>	<u>Standard</u> (ug/L)
Trichloroethylene	3.
Carbon Tetrachloride	3.
Vinyl Chloride	1.
1,1,1-Trichlorethane	200.
1,2-Dichlorethane	3.
Benzene	1.
Ethylene Dibromide	0.02
Tetrachlorethylene	3.

Georgia

The Georgia Environmental Protection Division (GEPD) does not currently have any requirements for ground water monitoring for lagoons, nor are any such standards under development. The current standards for land treatment systems require at least one upgradient or background well, one on-site well (within the application area of the system), and two

downgradient wells. These wells are to extend to a depth sufficient to sample seasonal variations in the unconfined water table. The frequency of sampling varies with the wastewater flow rate of the treatment system, and samples are to be analyzed for nitrate-nitrogen, pH, specific conductivity, and chlorides. Drinking water standards are also generally applicable for the ground water beneath a land treatment system. All systems built after 1978 are required to have a monitoring system as described above.

The above requirements are currently being revised to include specifications for the construction of monitoring wells and to include additional chemical parameters. The revised standards, if implemented in their present form, would require that monitoring wells be screened and the borehole backfilled to prevent seepage from the surface along the casing. Monitoring of the unsaturated zone using lysimeters is also strongly recommended. The additional analyses which would be required under the proposed system include fecal coliform, metals, and priority pollutants.

The monitoring data from existing systems are currently being collected by the GEPD. These data, however, are not routinely reviewed. Within the next year, the GEPD hopes to prepare reporting forms for use by the treatment systems and to implement a review procedure. The GEPD does maintain a chain of custody for samples collected by GEPD compliance inspectors. The treatment systems, however, are only required to show that a contract laboratory (if used) received and analyzed the samples.

### Hawaii

There are currently no municipal land treatment systems in the state of Hawaii; thus, there are no requirements for ground water monitoring. Lagoons are not required to have a ground water monitoring system.

### Idaho

Although the Idaho Department of Health and Welfare's (IDHW) requirements for ground water monitoring at land treatment sites are made on a case-by-case basis, at least one monitoring well is generally required. When ground water monitoring is required, the monitoring parameters are to include biochemical or chemical oxygen demand, nitrate-nitrogen, total nitrogen, total phosphorus, total coliforms, and chemical oxygen demand. Monthly sampling is typical. For routine sampling, the IDHW does not require the use of a chain of custody procedure. The analyses, however,

must be performed by a certified laboratory. Monitoring wells are not generally required at lagoons.

### Illinois

The Illinois Environmental Protection Agency (IEPA) requires ground water monitoring at all land treatment sites except those using overland flow. A minimum of one upgradient well and one downgradient well for each direction of ground water flow is required. Quarterly analyses for nitrate- and ammonia-nitrogen, chlorides, sulfates, pH, total dissolved solids, phosphates, and fecal coliform are generally required.

### Indiana

The Indiana Division of Water Pollution Control (IDWPC) has recently established a ground water section. As of December 1984, this new group had not yet had sufficient time to develop a ground water protection strategy. Currently, there are no requirements for ground water monitoring at either land treatment or lagoon sites.

### Iowa

The Iowa Department of Environment Quality (IDEQ) requires ground water monitoring at land treatment sites. A minimum of one upgradient and one downgradient well is required, and the frequency of sampling varies with the flow rate of the system. An extensive list of parameters is required for monitoring unless a parameter is absent from the influent. These are:

Total Organic Carbon	Beryllium
Total Dissolved Solids	Boron
Sodium Absorption Ratio	Cadmium
Electrical Conductivity	Chromium
Nitrogen	Cobalt
Total	Copper
Organic	Fluoride
Ammonia	Iron
Nitrate	Lead
Chloride	Lithium
Alkalinity	Manganese
Hardness	Molybdenum
Coliform Bacteria	Nickel
Aluminum	Selenium
Arsenic	Zinc

## Kansas

The Kansas Department of Health and Environment (KDHE) generally requires ground water monitoring at land treatment systems. Depending upon the wastewater quality, monitoring wells at lagoons may also be required. The specific requirements for monitoring, however, depend upon the site conditions. For a spray irrigation system, the KDHE uses a "rule-of-thumb" requirement for one well for every twenty acres irrigated. The location of these wells would depend upon the site conditions. For other types of land treatment or for lagoons, at least one upgradient and several downgradient wells would typically be required. The monitoring frequency would range from quarterly to semi-annually, and typical analyses would consist of ammonia and nitrate-nitrogen, total phosphorus or phosphate, sodium, and sulfate. The KDHE does have guidelines for the construction of monitoring wells. The KDHE inspectors do utilize a chain of custody procedure for samples, while the treatment system is not required to use such a system. All analyses, however, must be performed by a certified laboratory.

## Kentucky

The Kentucky Department of Natural Resources and Environmental Protection has no requirements for ground water monitoring at either lagoon or land treatment systems. To date, no land treatment systems have not been constructed in Kentucky under the construction grants program.

## Louisiana

At present, the Louisiana Department of Natural Resources has no requirements for ground water monitoring at either land treatment or lagoon sites. Regulations for ground water protection which may include requirements for monitoring at land treatment or lagoon systems are currently being drafted.

## Maine

Ground water monitoring is generally required at land treatment sites and at new lagoon systems. The number of wells required by the Maine Department of Environmental Protection (MDEP), however, depends upon the site conditions. Typical monitoring parameters include ammonia- and nitrate-nitrogen, phosphorus, chlorides, total and fecal coliform, and sometimes metals. The MDEP does not have any guidelines for well construction, but instead uses EPA



guidelines. The monitoring wells, however, must be constructed to a depth sufficient to sample the upper three to four feet of the aquifer of concern. The monitoring frequency required depends upon site conditions, but quarterly to semi-annual sampling is typical. The monitoring data is kept both in the permit file and in a computer data storage system. The data is routinely reviewed when received by the MDEP and when the permit is subject to renewal (at five-year intervals). The treatment system is not required to utilize a chain of custody procedure nor is there a requirement to use a certified laboratory for the analysis. The MDEP inspectors, however, do use a chain of custody procedure for their samples.

### Maryland

The Maryland Department of Health and Mental Hygiene (MDHMH) requires monitoring wells at land treatment systems, but not for lagoons. The number of wells required is site-specific; however, two upgradient and two downgradient wells are generally considered the minimum acceptable number. Typical monitoring parameters consist of nitrate- and nitrite-nitrogen, total Kjeldahl nitrogen, total phosphate, total dissolved solids, chloride, and fecal coliform. For the first three months prior to and after start-up, samples are collected monthly for analysis; thereafter, semi-annual sampling is required. Annual analyses for metals and chlorinated organics are also required. The MDHMH also has guidelines for monitoring well construction.

### Massachusetts

The Massachusetts Department of Environmental Quality Engineering (MDEQE) generally requires ground water monitoring at both lagoon and land treatment systems. One upgradient and three downgradient wells are considered the minimum acceptable number of wells. In addition, the MDEQE also encourages the use of multi-level well systems capable of withdrawing samples at several depths within the aquifer of concern. The monitoring frequency depends upon the wastewater flow rate. Samples are analyzed for pH, biochemical oxygen demand, suspended solids, nitrate- and ammonia-nitrogen, and total Kjeldahl nitrogen. Currently, the data goes into the facility's permit file. Eventually, the MDEQE anticipates using a computer for data storage and analysis.

## Michigan

The Michigan Department of Natural Resources' (MDNR) requirements for ground water monitoring at land treatment sites and for lagoons are site-specific. Permits for the construction of monitoring wells over 25 feet deep must be obtained from the Michigan Geologic Survey Division (MGSD). Any monitoring data are currently kept in the facility's compliance file; however, the MDNR is hoping to develop a computer data storage system. The MDNR uses and requires treatment systems to use accepted analytical procedures (i.e. ASTM, EPA, or AWWA/WPCF analytical methods) for ground water samples. MDNR inspectors also use a chain of custody.

## Minnesota

The requirements for ground water monitoring at land treatment systems are site-specific; whereas, ground water monitoring is not required at lagoon treatment systems if the lagoons meet maximum seepage limitations. The number and location of monitoring wells is site-specific; however, when ground water monitoring is required, the Minnesota Pollution Control Agency typically requires one upgradient and two downgradient wells. Typical analyses required are total Kjeldahl nitrogen, ammonia- and nitrate-nitrogen, chloride, conductivity, and pH. The monitoring frequency is also site-specific; but three times per year is typical, and the monitoring data is kept in the facility's permit file. An exception to these typical monitoring requirements would occur if the wastewater were applied to privately-owned land. In such cases, no ground water monitoring is required. The Minnesota Department of Health has developed guidelines for monitoring well construction, while the MPCA has guidelines for ground water monitoring procedures.

## Mississippi

The Mississippi Bureau of Pollution Control (MBPC) currently does not have any requirements for ground water monitoring at land treatment systems, nor are any such standards under development. Currently, none of the land treatment systems in Mississippi have a ground water monitoring system. The ground water flow patterns beneath the existing sites are such that ground water monitoring is not believed to be necessary, but future systems may be required to have a ground water monitoring system. If so, parameters for monitoring would be determined at that time. According to MBPC personnel, fecal coliform and nitrites are the analyses most likely to be required. Any ground water monitoring data collected at future land treatment systems would be required

to be kept by the owner of the treatment system and to be available for inspection upon request.

### Missouri

The Missouri Department of Natural Resources (MDNR) requires ground water monitoring for rapid infiltration systems, but not for other forms of land treatment or for lagoons. Typical monitoring requirements for a rapid infiltration system consist of one downgradient and one upgradient well sampled monthly or quarterly for BOD, TSS, nitrate-nitrogen, and perhaps heavy metals. Monitoring data is kept in the MDNR permit file. MDNR inspectors use a chain of custody procedure; however, the treatment facilities are not required to maintain a chain of custody. Informal guidelines for the construction of monitoring wells are in existence.

### Montana

The Montana Department of Health and Environmental Sciences (MDHES) does require ground water monitoring at land treatment sites. One upgradient and two downgradient wells are generally required. At some systems, however, an on-site well may be substituted for one of the downgradient wells. In addition, existing private wells may also be used instead of installing dedicated monitoring wells. Nitrate- and nitrite-nitrogen, conductivity, and chlorides are the principle monitoring parameters. For the first two years, quarterly monitoring is required. Then, semi-annual sampling is required for two years. If no contamination is found during this four-year period, then annual monitoring is required.

### Nebraska

The requirements for ground water monitoring at land treatment systems or lagoons in Nebraska is site-specific. Currently, the Nebraska Department of Environmental Control (NDEC) requires approximately one-half of the land treatment systems in Nebraska to have a ground water monitoring system. Generally, a minimum of three monitoring wells (one upgradient and two downgradient) are required at land treatment systems. Existing private wells may sometimes be substituted for dedicated monitoring wells. Several samples are required to be collected from the wells prior to system start-up. After start-up, monthly samples are required for a period of two years. The data are then used to determine the frequency of monitoring after two years. The parameters considered for monitoring include: chlorides; total dissolved

solids; pH; total hardness; alkalinity; ammonia-, nitrate-, and nitrite-nitrogen; total phosphorus; biochemical oxygen demand; chemical oxygen demand; heavy metals; and fecal coliform. All or only a portion of these parameters may be required, and the data is kept in the permit file. The NDEC does have guidelines for monitoring well construction.

#### Nevada

The Nevada Department of Environmental Protection (NDEP) requires ground water monitoring at land treatment sites, but not for lagoons. The number of wells, the monitoring parameters, and the monitoring frequency required are site-specific. The NDEP does not, however, have any guidelines for monitoring well construction.

#### New Hampshire

The New Hampshire Water Supply and Pollution Control Commission (NHWSPPC) requirements for ground water monitoring at land treatment sites and for lagoons are site-specific. The number and location of wells will depend upon the site conditions such as the local geology. Monitoring criteria typically include nitrate-nitrogen, total phosphorus; metals, conductivity and either biochemical or chemical oxygen demand, and the monitoring frequency is site-specific. Monitoring data is kept in the facility's permit file. The NHWSPPC does have final guidelines for well installation. Both the NHWSPPC inspectors and treatment systems use a chain of custody as part of their NHWSPPC quality assurance procedures.

#### New Jersey

Ground water monitoring is required at both lagoon and land treatment systems by the New Jersey Department of Environmental Protection (NJDEP). The monitoring requirements of all facilities, however, are site-specific. The permittee may submit a proposed monitoring plan with the permit application, and this plan may include the location and number of wells, the monitoring parameters and frequency, and the quality assurance/chain of custody procedures to be used. Based upon the past and present discharge activities, the NJDEP will determine if the proposed plan is adequate, or will specify a monitoring plan. A minimum of three wells is required (one upgradient, two downgradient). Effluent monitoring is also used either to replace, or in conjunction with, ground water monitoring. Sampling frequency for both effluent and ground water monitoring varies on a case-by-case

basis, but is usually quarterly for the five year life of the permit. The data is sent to the state for review and is computerized for ease of retrieval.

### New Mexico

The New Mexico Environmental Improvement Division (NMEID) has a very broad ground water protection policy that applies to any waste treatment system which may adversely affect ground water. The monitoring requirements at a land treatment system or a lagoon are determined on a case-by-case basis and depend upon factors such as the site geology and the aquifer(s) potentially affected. Monitoring wells are generally sampled twice a year, usually in April and October; although, treatment systems located above critical aquifers may be required to sample quarterly. Typical analyses required for municipal land treatment systems or lagoons are total nitrogen, nitrate-nitrogen, total dissolved solids, and chlorides.

For routine sampling, the NMEID does not maintain a sample chain of custody. On the other hand, chain of custody procedures are used during compliance inspections or for enforcement actions. The treatment systems are not required to maintain a sample chain of custody.

The data from the monitoring systems are currently sent to the NMEID for review. These monitoring reports are examined to determine if any of the data appear "out-of-the-ordinary." Currently, statistical analysis of the data are not conducted. By 1985, however, the NMEID expects to begin development of a computerized tracking system, and it is anticipated that this system will be used to detect any trends in the data which may be indicative of contamination. Specific requirements for the construction of monitoring wells do not exist; however, the NMEID does have "suggested guidelines" which must be equaled or exceeded.

### New York

For land treatment systems treating more than 30,000 gpd, the New York Department of Environmental Conservation (NYDEC) requires ground water monitoring. The specific monitoring requirements, however, are established by the regional offices of the NYDEC. Monthly analyses for nitrate-nitrogen are typical and the monitoring data are kept in the facility's permit file. There are no state guidelines for monitoring well construction. Monitoring requirements at lagoon systems are site-specific; generally, the NYDEC requires lagoons to be lined. Unless an enforcement action

is planned, the NYDEC does not utilize a chain of custody procedure for samples, nor are the treatment systems required to maintain a chain of custody.

#### North Carolina

The North Carolina Environmental Management Commission (NCEMC) standards requiring ground water monitoring have only recently become effective, and the North Carolina Department of Natural Resources and Community Development (NCDNR) is responsible for implementing these regulations. These standards require monitoring wells for both lagoons and land treatment systems. The number and location of monitoring wells required is site-specific and is determined in conjunction with state ground water specialists. However, two wells (one upgradient and one downgradient) are considered the minimum acceptable number. Monitoring wells are to be sampled three times a year, in March, July, and November; these months are believed to be critical periods for ground water quality. Analyses for nitrate- and ammonia-nitrogen, total dissolved solids, total organic carbon, pH, total coliform, chloride, conductivity, and water levels are required.

For a lined lagoon, analyses for nitrate- and ammonium-nitrogen, chloride, total dissolved solids, pH, specific conductivity, total coliform, total organic carbon, and water level measurements are required. Unlined lagoons are required to monitor for iron and chromium in addition to the parameters for lined lagoons. All analyses must be performed by a certified laboratory. Standards for the construction of the monitoring wells are also in existence. Quarterly monitoring reports are currently sent to the NCDNR regional office for review. In general, neither the NCDNR inspectors nor the treatment system personnel are required to maintain a chain of custody for any ground water samples. If ground water contamination is found and an enforcement action is planned, then the NCDNR would implement a chain of custody procedure.

#### North Dakota

The North Dakota Division of Water Supply and Pollution Control (NDDWSPC) does not generally require ground water monitoring around lagoons, while the requirements for ground water monitoring at land treatment systems are site-specific. Since ground water recharge at many of the land treatment systems in North Dakota is believed to be minimal, ground water monitoring is not generally required. The discharge from the treatment systems is monitored for biochemical

oxygen demand, ammonia- and nitrate-nitrogen, suspended solids, fecal coliforms, and pH under the NPDES program. The monitoring frequency is monthly for the first year, then after the first year, the monitoring frequency is re-evaluated based upon the flow rate and effluent quality.

### Ohio

The Ohio Environmental Protection Agency does not have specific guidelines for ground water monitoring at land treatment sites; however, state law mandates that ground water monitoring is required if a potential health hazard exists. The ground water monitoring requirements for lagoons are made on a case-by-case basis. In general, lagoons are required to be lined and are designed in conformance with "GLUMRB Recommended Standards for Sewage Works."

### Oklahoma

Ground water monitoring is generally required by the Oklahoma Department of Health (ODH) at land treatment sites, but not at municipal lagoons. A minimum of one upgradient, one on-site, and one downgradient well is required at land treatment systems. Monthly analyses for ammonia-nitrogen and annual analyses for metals are required. The monitoring data is submitted to the state; however, the data are not routinely reviewed. There are no chain of custody or quality assurance requirements for ground water samples collected at land treatment systems. The ODH also does not have any guidelines for monitoring well construction.

### Oregon

The Oregon Department of Environmental Quality's (ODEQ) requirements for ground water monitoring at land treatment systems are site-specific. The number of wells, the monitoring frequency, and the monitoring parameters are selected based upon the site conditions. Quarterly monitoring for nitrate-nitrogen, ammonia-nitrogen, sulfates, chloride, conductivity, total and fecal coliforms, and water level are typically required. Any monitoring data collected are sent to the ODEQ for review. There are no guidelines for monitoring well construction. The ODEQ inspectors do utilize a chain of custody procedure for their samples; however, the treatment systems are not required to use a chain of custody procedure. The ODEQ does not, as yet, have a certification requirement for the laboratories which perform the analyses. Lagoons, in general, are not required to have a ground water monitoring system. Instead, lagoons can have a maximum seepage rate of 1/4-inch per day.

## Pennsylvania

The Pennsylvania Department of Environmental Resources (PDER) requires ground water monitoring at land treatment systems. The number of wells required will depend upon the site conditions; however, the PDER requires at least one background well and one well in each direction of ground water flow from the site. Quarterly analyses for total phosphate, ammonia- and nitrate-nitrogen, and methyl blue active substances are required. Annual analyses for the following parameters are also required.

Alkalinity	pH
Biochemical Oxygen Demand	Sulfates
Chemical Oxygen Demand	Total Solids
Chloride	Settleable Solids
Total Iron	Suspended Solids
Total Kjeldahl Nitrogen	Specific Conductance
	Temperature

The sample results are submitted to the PDER and are kept in the facility's permit file. The PDER does have guidelines for the construction of monitoring wells.

## Rhode Island

The availability of land in Rhode Island is too limited to permit the development of land treatment systems. The need for ground water monitoring requirements at land treatment sites is, thus, not applicable to Rhode Island.

## South Carolina

The South Carolina Department of Health and Environmental Control (SCDHEC) requires a minimum of three monitoring wells at both land treatment sites and lagoons; however, site conditions may require a greater number of wells. Well construction guidelines exist and require that the wells be screened in the aquifer of concern and that the borehole be backfilled to prevent seepage along the casing from the surface. The wells are to be sampled for total phosphorus, chloride, ammonia- and nitrate-nitrogen, alkalinity, pH, sodium, total dissolved solids, and fecal coliform. All of the wells must be sampled before the system begins operation to determine the background water quality. During the first year of operation, the wells must be sampled quarterly, and then bi-annually thereafter.

Most of the existing treatment systems use state certified contract laboratories to perform their analyses. The data



are then sent to the SCDHEC for review and for entry into a computerized tracking system. With this tracking system, the data can be examined statistically. Chain of custody procedures are not used by SCDHEC unless an enforcement action is anticipated. Treatment systems are not required to maintain a sample chain of custody.

### South Dakota

The South Dakota Department of Water and Natural Resources Management (SDDWNR) generally requires ground water monitoring wells at land treatment sites. Although the actual number of wells is site-specific, two upgradient and two downgradient wells is generally the minimum number of wells required. The monitoring requirements for lagoons, if any, are site-specific. The monitoring parameters considered for routine analysis (typically monthly) include: conductivity, chlorides, total dissolved solids, ammonia-, nitrate-, and nitrite-nitrogen, fecal coliform, sulfates, biochemical oxygen demand, phosphorus, suspended solids, and pH. The monitoring data are kept in the facility's permit file.

### Tennessee

The Tennessee Division of Water Quality Control (TDWQC) requires ground water monitoring at land treatment sites, but not at lagoon treatment systems. The number of monitoring wells required depends upon the size of the system, with two monitoring wells considered the minimum acceptable number. Guidelines for the construction of the wells exist, and it is recommended that the wells be constructed similar to the wells used at solid waste disposal sites. For the first year of operation, quarterly analyses for pH, specific conductance, total organic carbon, total nitrogen, nitrate-nitrogen, and water level are required. Thereafter, the nitrate-nitrogen analysis may be omitted. Data from the monitoring wells are kept in the facility's permit file.

### Texas

Before a land treatment system begins operation, the Texas Department of Water Resources (TDWR) requires that the background ground water quality be determined. Existing wells near the site are to be used for this determination. Total dissolved solids, chloride, nitrate-nitrogen, sulfate, pH, and coliform bacteria are to be monitored. Requirements for ground water monitoring after start-up for both lagoons and land treatment systems are made on a case-by-case basis;

however, in general, monitoring wells are not required at either lagoon or land treatment systems. Exceptions to this general policy occur when the treatment system is located near private wells, or in the case of a lagoon, if seepage is suspected. In such cases, parameters which might be monitored could include nitrate-nitrogen, sodium, chloride, or sulfate. Any data collected from a monitoring system are reviewed and placed in the facility's permit file. Standards for the construction of monitoring wells do not currently exist.

### Utah

The Utah Bureau of Water Pollution Control (UBWPC) generally requires monitoring wells at land treatment systems, but not for lagoon treatment systems. Although the monitoring requirements are site-specific, most land treatment systems have two monitoring wells and are required to sample monthly during the period of wastewater application. Total phosphorus, nitrate-nitrogen, and total coliform are the analyses most frequently required, and the monitoring data are kept in the facility's permit file. The UBWPC does have general guidelines for well construction.

### Vermont

The Vermont Agency of Environmental Conservation (VAEC) does not, in general, require monitoring wells for either land treatment systems or lagoons. In general, lagoons are required to be lined. Leach fields comprise the major form of land treatment in Vermont, and any ground water monitoring requirements for these systems would be developed on a case-by-case basis. Guidelines for well construction are in existence should wells be required. Any monitoring data collected would be kept in the facility's permit file.

### Virginia

The Virginia Water Control Board (VWCB) evaluates and approves ground water monitoring systems for land treatment and lagoon systems on a case-by-case basis. In general, however, such systems are required to have one upgradient and two downgradient monitoring well at land treatment sites. Prior to system start-up, the VWCB generally requires that six months to one year of background data be collected. A more extensive list of monitoring parameters is required during this phase of the project. After start-up, several indicator parameters are selected from this list for analysis at a quarterly monitoring frequency. Unless an enforcement

action is anticipated, neither the VWCB inspectors nor the treatment facility are required to utilize a chain of custody.

### Washington

The Washington Department of Ecology (WDE) generally requires a minimum of one upgradient and one downgradient monitoring well at both land treatment and unlined lagoon systems. Total coliform and nitrate-nitrogen are the monitoring parameters most frequently required. While the monitoring frequency depends upon the size of the treatment system, the monitoring frequencies currently required range from bi-weekly to semi-annually, and the monitoring data are placed in the facility's permit file. The WDE uses EPA guidelines for monitoring well construction. There are no chain of custody requirements.

### West Virginia

The West Virginia mountainous terrain combined with the requirement for secondary treatment prior to land treatment has, to date, prevented the use of land treatment in West Virginia. Thus, the West Virginia Department of Natural Resources has not developed requirements for ground water monitoring at land treatment sites.

### Wisconsin

The Wisconsin Department of Natural Resources' (WDNR) requirements for ground water monitoring at land treatment sites are dependent upon the flow rate to the treatment system. In general, the greater the flow rate, the more extensive are the monitoring requirements. Treatment systems receiving less than 50,000 gpd are generally not required to have a ground water monitoring system, while systems treating greater than 50,000 gpd must have a ground water monitoring system. If the wastewater flow rate exceeds 1.0 MGD, the monitoring system must monitor the aquifer at two levels. The location and number of wells required will depend upon the site conditions. For the first three months, monthly samples must be collected. Thereafter, semi-annual sampling is required. Analyses for BOD, specific conductance, COD, organic nitrogen, ammonia-, nitrate-, and nitrite-nitrogen, chloride, sulfate, dissolved solids, alkalinity, hardness, and pH in both filtered and unfiltered samples are required. The WDNR does have guidelines for the construction of monitoring wells.

## Wyoming

The Wyoming Department of Environmental Quality's (WDEQ) requirements for ground water monitoring at either land treatment or lagoon systems are site-specific and depend upon factors such as the depth and uses of the aquifer. One upgradient and two downgradient wells and analyses for ammonia- and nitrate-nitrogen, pH, chloride, and total dissolved solids are typical minimum monitoring requirements. The monitoring frequency is also site-specific and depends upon factors such as the proximity of the system to private wells. Monthly grab samples are typical. General guidelines for well construction do exist. The treatment systems are not required to use a chain of custody procedure for their samples; however, the WDEQ inspectors do utilize a chain of custody procedure for any samples they collect.